People, plants and practice in drylands:

socio-political and ecological dimensions of resource-use by Damara farmers in north-west Namibia.



Sian Sullivan

PhD

University College London

1998

Abstract

Current discourse regarding the use and management of natural resources in the drylands of sub-Saharan Africa is inspired by three issues:

1) the growing emphasis on strengthening 'community-based' management of natural resources as a means of combining resource conservation with improvements in livelihoods;

2) continuing debate concerning the replacement of communal forms of land management with systems of private tenure;

3) and the widespread assumption of environmental 'degradation' and 'desertification' caused by the land-use practices of African livestock farmers.

The way these areas of debate are interpreted affects policy and development intervention relating to the management and conservation of dryland natural resources.

In relation to these issues, this thesis has two primary aims:

1) to analyse patterns and determinants of natural resource-use and management by Khoe-speaking Damara farmers in arid north-west Namibia;

2) to assess the ecological implications of this resource-use in the context of the unpredictable variations in primary productivity characteristic of dryland environments.

A combination of quantitative and qualitative anthropological and ecological techniques are employed to meet these objectives. The use of gathered non-timber products for food and medicine was monitored in 7 repeat-surveys over an 18 month period for a sample of 45 households comprising 2017 individual 'diet-days'. Statistical analysis suggests that food resources are consumed when abundant rather than as dry season supplements, that wealth is a poor predictor of gathered resource-use and that the use of natural resources is remarkably resilient given the disruptive effects of land alienation during this century. The utilisation of timber for fuel and building-poles was quantified at the household level and comparisons with equivalent data from rural societies in more humid environments suggests conservative use of these resources. Qualitative data emphasise the continuing relevance of culturally-informed management practice relating to the use of natural resources.

With regard to the second research objective, woody and herbaceous vegetation datasets were compiled, the former comprising 2760 plant individuals in a stratified sample of 75 transects and the latter consisting of 48 qradrats, half fenced to exclude livestock, in which herbaceous vegetation was monitored over two growing seasons. A number of standard ecological variables, including patterns in community floristics, diversity, cover and population structure, were used to explore the prediction that concentrations of people and livestock cause measurable impacts on vegetation around settlements. Statistical analysis suggests that effects

of settlement are extremely localised and are within the range of variability shown by these measures over larger spatial scales, and that between-year variability in herbaceous vegetation dominates that measured both between- and within-sites.

The research results indicate that current understanding of local resource-use practices in north-west Namibia is constrained by two conceptual influences:

1) a misleading colonial ethnography which continues to inform debate and interventions regarding the use and management of natural resources, operating to deny the present-day validity of local ecological knowledge and practice;

2) a temperate-zone ecology which focuses on density-dependent interactions between the biotic components of ecosystems, and plays-down the role of unpredictable abiotic factors, particularly rainfall, in driving a continuing dynamic of non-equilibrium variability in arid environments.

Keywords: Nambia, Damara farmers, dryland natural resources, non-timber products, policy, tenure, 'community-based' management, 'degradation', colonial ethnography, non-equilibrium variability.











a. Eating stems of *Hoodia* cf. *currori*. b. Herbaceous vegetation sampling exclosure on the outskirts of Khowarib settlement in May 1995 with Suro Ganuses, my interpreter, and the Headman of Khowarib. c. Honey harvesting at Dodo, north-west of Sesfontein. d. Collecting *Stipagrostis* spp. grass seeds from harvester ant nests at |Giribes plains, north-west of Sesfontein. e. Discussing resources, in this case invertebrates, with women at || Gaisoas, Ugab River.

TABLE OF CONTENTS

Page no.

Abstract 2
TABLE OF CONTENTS 5
LIST OF MAPS 9
LIST OF FIGURES 10
LIST OF TABLES 12
LIST OF BOXES 15
Abbreviations 16
Note on orthography 17
Acknowledgements 18

Introduction ***20***

1. 'Community-based' management of natural resources: to institute new practices or build on tradition? 20
2. Private versus communal tenure 21
3. Combating desertification: driven by evidence or politics? 22

Methodological approach 23
Structure of the thesis 23

1. Socio-political and environmental context ***26***

1.1 The 'Damara': deconstruction of some 'ethnographic myths' 26
1.1.1 The Damara in prehistory: some interpretations 28
1.1.2 The Damara in historical times: uprooted from the land 30
1.1.3 Summary 33

1.2 Colonial Namibia: European land appropriation and settlement 34
1.2.1 Land alienation and conquest under German colonial rule 34
1.2.2 Separate Development: the South African 'Homeland' policy 37
1.2.3 The 'Odendaal Commission': its recommendations and implementation 39
1.2.4 Post-independence regional boundaries and power structures 42

1.3 Who lives there? Portraits of contemporary Damara farmers 43
1.3.1 A brief overview of settlement geography 44
1.3.2 Population patterns 45
1.3.3 Livelihoods 48
Livestock ownership and herding 49
Crop cultivation 52
Cash income 53
Food aid and fodder subsidies 54

1.4 Environmental context 54
1.4.1 Abiotic environment 55
Climate 55
Topography 58
Soils 59
1.4.2 Biotic environment 59
Vegetation 59
Animal wildlife 61

Chapter summary 62

2. Assessing plant resource use: background, research questions and methods ***63***

2.1 Background: a focus on the domestic uses of natural resources 63
2.1.1 Gathered products as 'invisible' resources 64
Forest versus drylands 65
A gendered perspective: women as users and managers of natural resources 66

2.2 Arid land plant resource use: an overview 67
Food: 70
Timber use for fuel and construction purposes: 70
2.3 A history of references to gathered resource use by the Damara 71
2.4 Contemporary patterns of gathered resource use: research questions 75
Utilisation of non-timber resources: 75
Utilisation of timber products 76
2.5 Methods 76
The use of non-timber gathered resources: 77
The use of timber resources for fuel and building purposes: 79
Analysis 79
Botany and ethnotaxonomy 79
Chapter summary 81
3. Patterns and determinants of natural resource-use 82
3.1 Utilisation of non-timber resources 82
3.1.1 'These are our Damara foods' 82
Fruit 86
Herb teas 86
Seeds 88
Caterpillars 89
Sâun beer 90
Leaves 90
Corms and bulbs 91
Stems 91
3.1.2 Medicine 92
3.2 Influences on non-timber resource-use 94
3.3 Utilisation of timber resources 101
3.3.1 Firewood 102
3.3.2 Buildings 102
Chapter summary 105
4. Negotiations over land and resources: emergent patterns of management in a continually changing world 106
4.1 Case studies of resource management 107
4.1.1 Seeds, honey and perfume: relationships between folk and formal ecological knowledge 107
Seeds from harvester ant nests 108
Honey 114
Perfume 117
Local knowledge, ecological principles and contemporary resource management practice 119
4.1.2 Water: instituting 'community-based' management of a focal resource 121
4.1.3 Land: communal management on delineated farms 123
Features of migration 126
Features of negotiation 129
The commercial settler and communal farmer economies in southern Damaraland: some comparisons 132
4.2 Discussion: local realities and national policy 133
4.2.1 Community-Based Natural Resource Management (CBNRM) 133
Contemporary use, management and local knowledge of natural resources 135
'Communities': real or spurious? 137
Animal wildlife *versus* the resources people use 139

Policy and resource use 140
4.2.2 Land reform: appropriate legislation for an arid communal area 140
Some options for the redistribution of land 141
Land tenure management within the communal areas and the forthcoming Communal Lands Bill 145
Communal land tenure reform as a development strategy 145
Conclusion and chapter summary 147

5. Vegetation 'degradation' in north-west Namibia: background, research questions and methods 148

5.1 Background 148
5.1.1 Some statements 148
5.1.2 Quantitative ecology regarding effects of vegetation resource use in Namibia 151
The former Damaraland 151
Namibia's other communal areas 153
Commercial farmland 156
Summary 157
5.1.3 Arid land ecology: measured impacts at smaller scales 158
Grazing *versus* abiotic factors 158
Autecological factors 163
Summary 164

5.2 Environmental degradation in north-west Namibia: predictions 164
5.2.1 Floristics and diversity 164
5.2.2 Measures of population 165
Woody vegetation: 165
Herbaceous vegetation 165

5.3 Methods 166
5.3.1 Field methods 166
Woody vegetation 166
Herbaceous vegetation 172
5.3.2 Analysis 176
Floristics and diversity 177
Measures of population 181
Chapter summary 185

6. Floristics and diversity 186

6.1 Woody vegetation 186
6.1.1 Classification 186
Level 1: 187
Levels 2 and 3: 190
6.1.2 Multivariate ordination 193
Detrended Correspondence Analysis (DCA) 193
Canonical Correspondence Analysis (CCA) 201
6.1.3 Diversity 212
6.1.4 Summary: resource-use impacts on community patterns in woody vegetation 215

6.2 Herbaceous vegetation 215
6.2.1 Physical site characteristics 215
6.2.2 Classification 217
Year 1 217
Year 2 221
6.2.3 Multivariate ordination 223
Detrended Correspondence Analysis (DCA) 224
Canonical Correspondence Analysis (CCA) 228
6.2.4 Diversity 233
6.2.5 Summary: resource-use impacts on species composition of herbaceous samples 235

6.3 Conclusions 235

7. Measures of plant productivity and population structure 238

7.1 Woody vegetation: density, cover and population structure 238
7.1.1 Density 239
7.1.2 Cover 242
7.1.3 Dominance 245
7.1.4 Population structure of selected species 249
Acacia tortilis 249
Colophospermum mopane 250
7.1.5 Summary: resource-use impacts on population parameters for woody vegetation 252

7.2 Herbaceous vegetation 253
7.2.1 Cover and dominance 253
Analysis of variance (ANOVA) 254
Multivariate ordination 265
7.2.2 Summary: settlement impacts on herbaceous cover 272

7.3 Conclusions 273

8. Conclusions 279

8.1 Review of the main findings 279
8.1.1 Plant use, local knowledge and resource management practice 279
8.1.2 Effects of land-use practices on measures of vegetation change 281

8.2 Discussion 283
8.2.1 Intervention justified: an ideology of 'traditional communal farming' 284
1. 'Traditional' farming practices = environmental degradation 284
2. 'Traditional communal farming' = a vacuum of resource management institutions 285
3. 'Traditional' = cultural homogeneity 286
8.2.2 Ecological dynamics in arid lands: conceptual considerations 286
The equilibrium model: biotic-biotic interactions and the 'balance of Nature' 287
A non-equilibrium ecology: integrating abiotic-biotic interactions 289
8.3 Beyond 'the lie of the land': some policy approaches 292
1. Promotion of the livestock economy 293
2. Supporting variability rather than imposing stability 293
3. Promoting the poor as well as the wealthy 294
4. Listening to resource-users 296

References 298

Appendices:

Appendix 1. List of Namibian plant species and families referred to in the text. 329

Appendix 2. Species recognised and used as 'sâi' or perfume by Damara women in north-west Namibia. 337

Appendix 3. Additional case study information, including migration histories, for the former commercial farms of southern Damaraland. 343

Appendix 4. Multivariate techniques used in floristic analysis of vegetation datasets 351

Appendix 5. Relative measures for density, basal area and dominance of (at least) the five highest ranked species by topographic category, substrate and distance from a settlement. 353

Appendix 6a and b. Cover abundances by site for above-ground live biomass of each species, plant litter and bare ground for a. the 1995, and b. the 1996, growing seasons respectively. 357

Annexe 1. Database of Damara ethnobotany. 360

LIST OF MAPS

Map 1.1. Reconstructed pre-historical location of Damara 'nations'. 33

Map 1.2. One interpretation of the location of African settlement in 1900. 35

Map 1.3. Namibia in 1963 showing the existing Native Reserves and communal areas (shaded) of the South African Administration at the time of the Odendaal Commission, and the location of the veterinary cordon fence or 'Red Line'. 37

Map 1.4. Boundaries of the communal areas or 'homelands' recommended by the Odendaal Commission in 1964 and implemented in the 1970s. 41

Map 1.5. The post-Independence administrative boundaries, drawn along non-ethnic lines and incorporating both commercial and communal farmland within each region. 44

Map 1.6. Rainfall isohyets. 55

Map 1.7. Main topographic areas. 58

Map 1.8. Vegetation of Namibia following Giess (1971). 60

Map 4.1. Sketch map showing location of honey hives 'owned' by 3 harvesters from Sesfontein and the relationship between these hives and the ancestral lands of these harvesters. 116

Map 4.2.The patchwork of surveyed and fenced farms dominating the land-use geography of Khorixas and Omaruru Districts, southern Kunene and northern Erongo Regions respectively. 125

Map 5.1. Location of sample sites for the woody vegetation dataset. 170

Map 5.2. Location of herbaceous vegetation sample sites. 174

LIST OF FIGURES

Figure 1.1. Registered farmers by language-group recorded for Damaraland in 1991. 47

Figure 1.2a to e. Livestock census figures from December 1987 to July 1994 for the veterinary areas comprising the former Damaraland (Damaraland North and South, Ojhohorongo/Omatjette and Sesfontein) for a. cattle, b. goats, c. sheep, d. donkeys/mules, and e. livestock units (LSUs). 52

Figure 1.3. Rainfall data for Fransfontein from 1899 to 1980 expressed as variability around the mean of 268mm. 56

Figure 1.4a-d. Annual rainfall for successive years plotted against each other (i.e. year 1 and year 2 form an *x-y* coordinate, year 2 and year 3 form an *x-y* coordinate, and so on) for a. Fransfontein, b. Khorixas, c. Sesfontein and d. Uis. 57

Figure 3.1. Proportions of the total number of records (N = 218) of the consumption of gathered foods accounted for by particular types of food. 83

Figure 3.2a and b. Food use by date.. 95

Figure 3.3. Kin relationships between elderly Damara women and their partners in the settlement of Sesfontein. 99

Figure 4.1. Damara classification of some species of edible grass seeds. 109

Figure 4.2. Damara classification of seed-harvesting and other ants. 109

Figure 4.3a and b. Reconstructed patterns of migration for households on a. Malansrust and b. Blaauport Farms. 128

Figure 5.1. Selection of tree individuals using a zig-zag transect. 167

Figure 5.2. Schematic diagram of quadrat lay-out, in this case for site 1. 173

Figure 5.3. Lay-out of each quadrat showing how ground-cover was sampled. 176

Figure 6.1a and b. Dendrograms showing TWINSPAN groups for the woody vegetation dataset. . 189

Figure 6.2a, b and c. DCA ordination diagrams showing the location of a. samples and b. species on ordination axes 1 and 2. 196

Figure 6.3a and b. DCA ordination diagrams showing the location of a. samples and b. species on ordination axes 1 and 3. 199

Figure 6.4a and b. CCA ordination diagrams for the reduced dataset of plains and riverine samples and environmental variables showing the location of a. samples, and b. species on ordination axes 1 and 2. 204

Figure 6.5a and b. CCA ordination diagrams of the mountain samples showing the relationship of the environmental variables with a. samples and b. species on ordination axes 1 and 2. 210

Figure 6.6. Error bars showing 95% confidence intervals for N2 diversity values characterising the following parameters; a. topographic category, b. substrate, and c. distance within topographic category. 214

Figure 6.7a-d. Physical site factors for the herbaceous vegetation dataset; a. plant biomass measured in bioassays, b. soil moisture in 1995, c. rainfall for the wet season of 1995-1996, and d. altitude. 216

Figure 6.8. Rainfall measured at each of the six herbaceous vegetation field sites for the 1995-1996 wet season. 217

Figure 6-9a and b. Dendrograms showing TWINSPAN groups for year 1 of the herbaceous vegetation dataset. 219

Figure 6.10a and b. Dendrograms showing TWINSPAN groups for year 2 of the herbaceous vegetation dataset. 223

Figure 6.11. Graphical representation of DCA axes 1 and 2 for a. samples and b. species, illustrating floristic composition of the herbaceous vegetation dataset. 226

Figure 6.12a and b. Graphical representation of CCA axes 1 and 2 for environmental variables with a. samples and b. species. 230

Figure 6.13a-e. Error bars for diversity indices showing the mean values and 95% confidence intervals for different variables characterising the herbaceous vegetation dataset; a. by year, b. for each site in each year, c. by distance from settlement for 1995 and d. for 1996, and e. by enclosure *versus* non-enclosure of the quadrats. 234

Figure 7.1a and b. The relationship between resource utilisation, as indicated by a. branch lopping and b. browsing by livestock, and distance from settlement. 239

Figure 7.2a-d. 95% confidence intervals for the mean distance between plant individuals for the woody vegetation dataset for a. topographic category, b. substrate, c. topographic category by distance from settlement, and d. substrate by distance from settlement. 242

Figure 7.3a-d. 95% confidence intervals for the mean basal area in cm2 of plant individuals for the woody vegetation dataset for a. topographic category, b. substrate, c. topographic category by distance from settlement, and d. substrate by distance from settlement. 244

Figure 7.4. Scatter graph and regression line demonstrating the relationship between the log-transformed values for plant density (individuals per hectare) and cover (basal area in cm2) calculated by sampling category. 245

Figure 7.5a to e. Relative dominance of (at least) the five highest ranked species for each substrate category by distance from a settlement. 247

Figure 7.6a to d. Population structure of *Acacia tortilis* by distance from settlement; a. 95% confidence intervals for height by distance, b. height class distribution by distance, c. 95% confidence intervals for basal diameter by distance, and d. basal diameter size class distribution by distance 251

Figure 7.7a to d. Population structure of *Colophosopermum mopane* by distance from settlement; a. 95% confidence intervals for height by distance, b. height class distribution by distance, c. 95% confidence intervals for basal diameter by distance, and d. basal diameter size class distribution by distance. 252

Figure 7.8a to f. 95% confidence intervals illustrating the relationship between the cover values recorded for above-ground biomass, plant litter, and bare ground with site by year (Figures 7.8a, c and e) and enclosure by year (Figures 7.8b, d and f). 258

Figure 7.9a to c. Relative cover values by site for the 1995 growing season for a. total live above-ground plant biomass, plant litter and bare ground, b. grasses and c. forbs. 260

Figure 7.10. Fixed point photographs taken during the course of the project at a. site 3, b. site 4, c. site 5, and d. site 6. 261

Figure 7.11a and b. Graphical representation of DCA axes 1 and 2 for a. samples and b. species, illustrating the cover abundances for the herbaceous vegetation dataset. 267

Figure 7.12a and b.Graphical representation of axes 1 and 2 constructed by the CCA of cover values and environmental variables for the herbaceous vegetation dataset for a. samples and b. species. 270

Figure 8.1. A diagrammatic conceptual framework for evaluating ecological hierarchy determinants at various spatial and temporal response scales. 282

LIST OF TABLES

Table 1.1. Population figures and structure for Sesfontein 1947/48 and 1991, and Khowarib 1991. . 46

Table 1.2. Population figures for settlements on the Ugab River, 1956 and 1991. 47

Table 1.3. Means ($\bar{x}$), standard deviations (s) and coefficients of variation (cv) for selected rainfall stations in the former Damaraland, north-west Namibia. 56

Table 2.1. Summary of a range of ethnobotanical information, listed chronologically, derived from literature sources for societies inhabiting dryland environments in sub-Saharan Africa and Australia 68

Table 2.2a and b. Summary of Namibian ethnobotanical literature which is based on field data collected in the country's arid and semi-arid areas and which includes scientific plant names, presented for a. Namibian groups excluding Khoe-speaking groups, and b. Khoe-speaking groups. 73

Table 2.3. Sample structure for households and individuals incorporated in dietary survey conducted to monitor the use of gathered natural resources for food.. 78

Table 2.4. Dates of household survey visits and seasonal conditions during the period February 1995 to July 1996. 78

Table 3.1. Major foods collected by Cornelia ǁGuruses from Gudipos on the Ugab River, during the rain season of 1996. 83

Table 3.2. Species which contributed as gathered natural resources to diets, or which were stored, between February 1995 and July 1996. 84

Table 3.3. Plant parts recorded as used for food by the Damara and by other groups inhabiting dryland environments elsewhere in southern Africa and Australia 85

Table 3.4. Nutritional composition of some fruit species recorded as consumed by households during the course of this study 87

Table 3.5. Nutritional values for the caterpillar *Imbrasia ertli* (Saturniidae) based on Bradley and Dewees (1993: 132). 89

Table 3.6. Gathered medicinal resources in use or stored during household surveys. 93

Table 3.7. Spearman's rank correlation coefficients for the relationship between total wild food use and the use of alternative foods. 96

Table 3.8. Mean number of records of different foods consumed during the diet survey by five households of the Ganuses family in Sesfontein. 97

Table 3.9. Spearman's rank correlation coefficients and probability values for the use of gathered foods, stored foods and medicines by household (N = 45), corrected for numbers of survey visits and diet-days contributing data for each household. 98

Table 3.10. Cochran's Q as a test for mobility by individuals surveyed to the north and south of the veterinary cordon fence respectively 100

Table 3.11. Volumes of wood used as fuel by species and by day per household (N = 26) 102

Table 3.12. Estimated volumes of building poles used by households (N = 15) in the construction of primary dwellings 104

Table 4.1. Grass seeds collected from harvester ant nests: species recorded in this study and literature references 110

Table 5.1. Samples and individuals by site characteristics 169

Table 5.2. Within-site homogeneity for the herbaceous vegetation dataset demonstrated by the mean number of species recorded in each quadrat in 1995 and their standard deviations (s) and coefficients of variation (cv). 176

Table 5.3. Environmental variables used in the multivariate floristic analyses of the woody and herbaceous vegetation datasets 178

Table 5.4. Structure of samples used for the analysis of population structure for *Acacia tortilis* and *Colophospermum mopane*. 184

Table 6.1. Ordered two-way table of the original samples-by species matrix produced by TWINSPAN classification. 188

Table 6.2. Species in the woody vegetation dataset assigned full weights and those downweighted to <.2 for DCA and CCA ordinations. 193

Table 6.3. Ranked scores for samples and species in relation to the axis 1 ordination scores produced by detrended correspondence analysis. 195

Table 6.4. Species assigned full weights and those downweighted to <0.2 for CCA ordinations. Species not listed here have weights ≥0.2 and ≤1. 201

Table 6.5. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed by CCA, and canonical coefficients with t-values ≥4, for the reduced dataset of plains and riverine samples 203

Table 6.6. Monte Carlo permutation tests of significance for each environmental variable in the reduced dataset of plains and riverine samples following forward selection of these variables and after partialling out the effects of all other variables. 207

Table 6.7. Species assigned full weights and those downweighted to <0.3 for CCA ordinations of the reduced dataset of mountain samples. 209

Table 6.8 Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed by CCA, and canonical coefficients with t-values ≥4, for the reduced dataset of samples in the 'mountain' topographic category. 209

Table 6.9. Monte Carlo permutation tests of significance for each environmental variable in the reduced dataset of mountain samples following forward selection of these variables and after partialling out the effects of all other variables. 212

Table 6.10. Physical site characteristics for herbaceous vegetation quadrats 216

Table 6.11. Ordered two-way table of the samples-by-species matrix produced by TWINSPAN classification of the herbaceous dataset for 1995 218

Table 6.12. Ordered two-way table of the samples-by-species matrix produced by TWINSPAN classification of the herbaceous dataset for 1996. 222

Table 6.13. Species in the herbaceous vegetation dataset assigned full weights and those downweighted to <0.3 for DCA and CCA ordinations of sample floristics. 224

Table 6.14. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed for the herbaceous vegetation dataset by CCA, and canonical coefficients with t-values ≥4 and ≤–4 229

Table 6.15. Monte Carlo permutation tests of significance for each of the environmental variables in the herbaceous vegetation dataset, following forward selection of these variables. 232

Table 7.1. F-test statistics and significance levels for general factorial GLM analysis of the effect of distance from a settlement on distance between plant individuals grouped by topographic category and substrate. 240

Table 7.2. Absolute density by hectare (D/ha) by topographic category, substrate and distance from settlement for the woody vegetation dataset (values are averages for transects within each sampling category). 241

Table 7.3. F-test statistics and significance levels for general factorial GLM analysis of the relationship between distance from a settlement and plant basal area grouped by topographic category and substrate. 243

Table 7.4. Absolute basal area in cm^2 for all plant individuals by topographic category, substrate and distance from settlement for the woody vegetation dataset. 245

Table 7.5. Correlation coefficients for measures of branch cutting and browsing with distance from settlement for the two species selected for analysis of population structure. 249

Table 7.6. Results of one-way ANOVA of height and basal diameter measures by distance from settlement for *Acacia tortilis* and *Colophospermum mopane*. 249

Table 7.7. Results of simple factorial ANOVA of cover abundances by treatment of quadrats as enclosed or unenclosed, year and site. 256

Table 7.8. Relative cover abundances by site and year for above-ground live biomass, plant litter and bare ground. 257

Table 7-9. Cover values in the herbaceous vegetation dataset assigned full weights and those downweighted to <0.3 for DCA and CCA ordinations. 265

Table 7.10. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed for the cover values of the herbaceous vegetation dataset by CCA, and canonical coefficients with t-values ≥4 and ≤–4. 269

Table 7-11. Monte Carlo permutation tests of significance for the effect of each of the environmental variables on cover estimates for the herbaceous vegetation dataset, following forward selection of these variables. 272

LIST OF BOXES

Box 1.1. Origin and racial affinities of the Damara. ..... opposite 28

Box 1.2. Historical processes affecting land distribution in north-west Namibia during this century..... opposite 36

Box 1.3. A former commercial farm: Malansrust on the Aba-Huab River in October 1995. ..... opposite 44

Box 1.4. A Damara family from Sesfontein: Elizabet Ge !Nabasen Tauros and her daughters..... opposite 45

Box 1.5. Livestock ownership by household at Malansrust Farm. ..... opposite 49

Box 4.1. Fluidity and heterogeneity at Rietkuil Farm, southern Kunene..... .opposite 122

Box 4.2. The origins of current occupants of Damaraland's former commercial farms..... opposite 123

Box 4.3. Reconstructed migration history for Malansrust Farm. ..... opposite 127

Box 4.4. The changing legislative environment regarding rights held by communal farmers for the management of natural resources..... opposite 140

Box 4.5. The problem of privatisation of communal land in north-central Namibia..... opposite 147

Box 5.1. Simpson's diversity index following Goldsmith *et al* (1986: 461-462) and Ludwig and Reynolds (1988: 90-91). 181

Box 5.2. Calculation of absolute and relative density for distance measures, as used for the woody vegetation dataset. 182

Abbreviations

ANOVA	Analysis of Variance
CANOCO	Canonical Community Ordination
CBNRM	Community-Based Natural Resources Management
CCA	Canonical Correspondence Analysis
CPRM	Common Property Resource Management
DCA	Detrended Correspondence Analysis (also DECORANA)
DRFN	Desert Research Foundation of Namibia
DTA	Democratic Turnhalle Alliance
ENSO	El Niño/Southern Oscillation
FISA	Farmers' Interleague Solidarity Action
FNDC	First National Development Corporation
GLM	Generalised Linear Modelling
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature and Natural Resources
LIFE	Living in a Finite Environment
LSU	Livestock Unit
MAWRD	Ministry of Agriculture, Water and Rural Development
MET	Ministry of Environment and Tourism
MLRR	Ministry of Land, Resettlement and Rehabilitation
MRC (UNAM)	Multidisciplinary Research Centre of the University of Namibia
NAPCOD	Namibian Programme to Combat Desertification
NBRI	National Botanical Research Institute
NCCA	Namibian Community Cooperatives Alliance
NGO	Non-Governmental Organisation
NRSC	National Remote Sensing Centre
NTFPs	Non-Timber Forest Products
SADF	South African Defence Force
SEPASAL	Survey of Economic Plants of Arid and Semi-Arid Lands
SPSS	Statistical Package for the Social Sciences
SWAPO	South West African Peoples' Organisation
TWINSPAN	Two-way Indicator Species Analysis
USAID	United States Agency for International Development
WILD	Wildlife Integration for Livelihood Diversification
WRAU	Welwitschia Regional Agricultural Union
WWF-US	World Wildlife Fund - United States

Note on orthography

Damara is a Khoekhoe or 'click' language closely linked with Nama. In this thesis the standardised orthography is used such that clicks are represented by symbols as follows:

| = dental click

‖ = lateral click

! = palatal click

≠ = alveolar click

Long vowels are represented with a double vowel rather than a macron above a single vowel letter so that ≠h$\bar{a}$ becomes ≠**haa** (see Eiseb *et al*, 1991: 17). Tone is not marked.

Acknowledgements

Thanks go first and foremost to the Damara people who shared their experiences and knowledge with me. You are too numerous to mention all by name but I would like to acknowledge particularly Meda Xamses, Justine Haraës, Nathan ≠Uina Taurob, Elizabet Ge !Nabasen Tauros, Philippine ǁNowaxas, Christophine ǀAwos, Cornelia ǁGuruses, Gideon and Amalia ǁGase.b/s, Hildegard and Manasse ǀNua.s/b, Rachal ǁHoes and Rebecca ǀAwaras. I have tried to represent as fully and accurately as possible the issues and information which emerged from my discussions with Damara farmers and I apologise for any flaws that remain.

Also in Namibia, I am indebted to Linda Baker and John Paterson for friendship, support and homes in Windhoek and Sesfontein, to Rick Rohde for inspiration, and to two brilliant naturalists, Pat Craven and Eugene Marais, whose enthusiasm for what at times seemed irrelevant detail gave me much needed motivation. Andy Botelle and Kelly Kowalski, Margie Jacobsohn, Duncan Gilchrist, Hoffy at Palmwag Lodge, Blythe and Rudi Loutit, Tommy Hall, Colin Nott and Anna Davies, and Phoebe Barnard and Rob Simmons all helped with beer and floor-space when I needed a place to stay or my car broke down.

In London, my supervisors Kathy Homewood at UCL and Phil Stott at SOAS have been untiring in their support, advice and encouragement. I would also like to thank Phil Burnham for taking time to comment on several chapters. At UCL, several people helped create a positive and stimulating environment in which to weather the writing of the thesis: thanks in particular to Dan Brockington, Guy Cowlishaw, Alan Dangour, Hilda Kiwasila and Emmanuel de Merode. Further afield, my friends Bruce Lankford, Shel Hantler, Chris Keesing, Tracey Konstant, Mark Mattson and Mark D'Inverno, as well as my family, helped me keep perspective, and I am also grateful to James Culverwell and Tony Cunningham for encouragement at the outset of my interest in resource-use issues. Thanks too to my Mum and Dad for providing a much needed retreat in the final stages of the thesis.

This project was supported by an ESRC studentship. Additional financial support to cover field expenses was gratefully received from the Parkes Foundation and Boise Fund of the Depts. of Biological Anthropology at Cambridge and Oxford Universities respectively, the Emslie Horniman and Ruggles-Gate Funds of the Royal Anthropological Institute, the UCL Equipment Fund, and the Desert Research Foundation of Namibia. Fieldwork in Namibia was conducted under a Ministry of Environment and Tourism research permit. I am also grateful to the Remote Sensing Unit, Windhoek, who lent a GPS and drew up maps of my vegetation sample sites, to Eugene Marais of the Entomology Centre at the State Museum, who also lent a GPS, and to Werner Kilian and Rudi Loutit of the Ministry of Environment and Tourism who lent rain gauges.

Finally, there are two people without whom this thesis simply would not have happened. They are: Suro Ganuses from Sesfontein, who was my voice and ears, and my companion during fieldwork in Namibia; and Phil Hutchinson, who helped me measure trees in the blazing Namibian heat and taught me songs to make me smile.

Dedicated to my mother and father, my sister Ruth, and to Phil.
Your love and support have carried me through.

"Contrary to popular belief, the desert is bountiful and teeming with life in good seasons. It is like a vast untended communal garden, the closest thing to earthly paradise I can imagine. Mind you, I wouldn't want to have to survive on bush-tucker during the drought".

Davidson, R. 1980 *Tracks*. Pantheon Books, New York. p. 121.

"... it is essentially meaningless to talk about a complex adaptive system being in equilibrium: the system can never get there. It is always unfolding, always in transition. In fact, if the system ever does reach equilibrium, it isn't just stable. It's dead."

Waldrop, M.M. 1994 *Complexity*. Penguin, London. p. 147.

Introduction[1]

This thesis has two primary objectives:

1) to analyse patterns and determinants of natural resource-use and management by Damara farmers in arid north-west Namibia;

2) to assess the ecological implications of this resource-use in the context of the unpredictable variations in primary productivity characteristic of dryland environments.

These objectives are situated within a framework of discussion which incorporates, and challenges, conventional thinking regarding management and conservation policy for dryland natural resources, both within Namibia, and in arid and semi-arid environments throughout sub-Saharan Africa. Three related issues are emphasised in assessing the implications of the research findings: the increasing focus on strengthening so-called 'community-based' management of natural resources as a means of combining resource conservation with improvements in livelihoods; the continuing debate throughout African rangelands concerning the replacement of communal forms of land management with systems of private tenure; and the widespread assumption of environmental degradation and desertification caused by the land-use practices of African livestock farmers. These key issues are summarised in more detail below.

1. 'Community-based' management of natural resources: to institute new practices or build on tradition?

In Namibia there is a growing emphasis on strengthening the management of natural resources at a community level in order to promote both rural development and the conservation of indigenous ecosystems. Many projects run by both NGO and government organisations thus fall under the rubric of 'Community-Based Natural Resources Management' (CBNRM), as formulated by the Directorate of Environmental Affairs (DEA) of the Ministry of Environment and Tourism (MET) and the LIFE (Living In a Finite Environment) project (which is funded by the United States Agency for International Development (USAID) and administered by World Wildlife Fund (WWF-US)). This parallels a general trend in development intervention towards integrating rural development with nature conservation through various ways of encouraging the flow of benefits from resource conservation and/or decision-making power over resources to local communities.

Nowhere in Namibia do 'traditional' systems of natural resource-use and rangeland management exist intact. This is largely related to the historical legacy of an extremely aggressive settlement policy by colonial forces, underlain by genocide at the turn of the century, which resulted in land appropriation on a massive scale, particularly in southern and central

[1] Nb. References to the relevant literature are not included in this introduction except where direct quotes are made; full references are included in the rest of the text.

Namibia. Despite this apparent disintegration, elements of traditional use, management and tenure arrangements relating to land in general, range and individual resources remain extremely important, and attest the resilience of culturally-informed knowledge and resource-use practice.

It is argued in this thesis that the various interventions aimed at instituting 'community-based' resource management within Namibia are in danger of falling into two traps: first, of misrepresenting the social complexity of local resource-users by attaching to them the opaque label 'community'; and second, of overlooking and undervaluing relevant ecological knowledge and resource-use practices which already exist at local levels. In particular, the current focus on animal wildlife undermines both the plant-based resource-use practices which predominate in rural households, and the role of women who are typically (but not exclusively) associated with this domain of resources. Evidence for the depth of ecological knowledge pertaining to selected resources is presented here, in an attempt to emphasise the need for more than superficial understanding of local resource-use practices.

2. *Private* versus *communal tenure*

The development of African pastoral production systems has focused largely on interventions aimed at ensuring a sustainable livestock offtake rate, a management ideal which is thought desirable from both environmental and social perspectives. Any attempt to do this relies on establishing the livestock carrying capacity of the land which, in turn, relies on the ability to define the land area, and therefore range resources, to which livestock have access. Coupled with this economic aim, but less explicitly stated, is the desire by governments to facilitate administration of mobile pastoralist groups by restricting movement through transformations of tenure arrangements which promote attachment of individuals to defined areas of land. Related to this are deeply ingrained perceptions that herd and range management practices by indigenous pastoralists cause environmental degradation through a 'tragedy of the commons' situation which institutes overstocking and consequent overgrazing. These negative perceptions add momentum to an urge to impose constraints on 'traditional' land-use practice.

Development interventions in drylands are thus inextricably bound with changes in land tenure, largely in the direction of promoting the division of land into individual, fenced land-holdings. Recent debate, however, focuses on the detrimental effects of this exercise, which may increase social division between wealthy and poor herders and exacerbate environmental degradation.

Despite these perspectives, and with little regard for the way that the use and management of natural resources is enacted by Namibian farmers in local contexts, Namibia's current plans for communal land tenure reform appear to be firmly committed to the division of land into individual holdings. Material presented in this thesis suggests that ignoring the relevance of local-level management practices in the formulation of a national lands policy will have serious ramifications for the success of this land reform process. Important principles and issues derived

from the analysis of land-use and management presented here are relevant to the land tenure debate in dryland Africa as a whole.

3. *Combating desertification: driven by evidence or politics?*

The perception that environmental degradation is occurring at accelerating rates due to human mismanagement of natural resources is an important force driving development policy and interventions in Namibia and in dryland Africa in general. Over the last few years, this concern has been crystallised in Namibia in the country's 'Programme to Combat Desertification'[2] (NAPCOD). Through its media programme this initiative has considerable influence in moulding a desertification-aware national consciousness, which pervades thinking regarding communal lands policy reform and natural resources management issues alike.

Unfortunately, but as seems to be the norm throughout dryland Africa, assertions of desertification for specified areas of Namibia remain based on opinions by foreign 'experts' which are unsubstantiated by standardised ecological data. In addition, they fail to incorporate current academic debate regarding the significance of abiotic factors, primarily rainfall, in driving productivity in dryland environments. Until recently, the sanctioning of the Apartheid administrations of South Africa and Namibia has further hampered the development of an holistic understanding of degradation issues. Dean *et al* (1995: 258) summarise the situation as follows:

> "South Africa has a rich literature concerned with dryland degradation and the evolution of the concept has mirrored the general evolution of ideas on the problem... As is the case elsewhere, the debate in South Africa has been characterised by a plethora of opinions and a dearth of published and reliable scientific evidence. In addition, South Africa has been subject to an unhelpful degree of research parochialism, especially during the last few decades when a de facto academic boycott isolated rangeland scientists and managers from their African and international colleagues" (Dean et al 1995: 258).

Despite these problems, the primary funders of Namibia's Programme to Combat Desertification, appear disinclined to support a research component to the Programme which would help to elucidate statements asserting the existence of degradation, and highlight issues of real concern and their possible solutions. A large component of this thesis is directed, therefore, towards assessing the measurable impacts of local-level vegetation resource-use using a combination of standard ecological parameters. Interpretation of the results of this part of the study, and assessment of the implications for assumptions of irreversible degradation, are placed firmly within a conceptual framework of arid ecosystems which stresses the dominant role of non-equilibrium dynamics in constraining resource availability in dryland environments.

---

[2] Defined by UNCOD as 'the diminution or destruction of the biological potential of the land' ... leading 'ultimately to desert-like conditions' (UN, 1977).

Methodological approach

This project is explicitly multidisciplinary and drew on a range of methods from both the social and natural sciences. Resource-use issues are multifaceted and can only be fully understood within a framework which takes into account these different dimensions. This perspective is increasingly acknowledged as necessary in the generation of information regarding the use and management of natural resources. As Dahlberg (1994: 36) states, for example, 'Over the last two decades recognition has grown that studies on land degradation must include an understanding of social, economic and political factors ... In spite of this, interdisciplinary studies are not common, and further integration is strongly advocated'.

A picture of the socio-economic and cultural dimensions of resource-use was constructed through employing a mixture of qualitative and quantitative approaches. A degree of tension exists between these two approaches; thus, '... certain interpretations of meaning structures and conceptual categories may be irreducibly qualitative in nature' so that 'The crucial issue is not whether quantification is possible' (Shaffer, 1996: 29) but 'whether problems of social life (and standard of living) can be reduced largely to their quantitative dimensions (and still remain significant)' (Appadurai, 1989: 277)'. Each approach, however, can usefully inform the other. Wherever possible in this thesis, qualitative case studies are presented and interspersed with relevant quantitative information; the intention is to emphasise the 'real people' whose roles in measured patterns of contemporary vegetation resource utilisation and management form the focus of this thesis. In order to minimise disruption to the flow of the thesis, these case studies are printed as Boxes on pages opposite to the main body of the text.

Structure of the thesis

Broadly speaking, the thesis is divided into two halves. The first focuses on defining and analysing local resource-use practices. The second uses a quantitative ecology approach to assess the impacts of this use on vegetation surrounding concentrations of people and livestock. These two halves are sandwiched between an introductory chapter which provides a background to the study area, and a concluding chapter which situates the research findings within current theoretical debate in both resource-use anthropology and arid land ecology. Due to the interdisciplinary nature of this project, and in order to promote coherence in the telling of the story of the thesis, review of the literature is incorporated with the relevant areas of research. A short synopsis of the scope of each chapter is provided below.

Chapter 1 provides the ethnographic, historical, political, socio-economic and environmental backdrop against which the natural resource-use practices enacted by Damara farmers, and the impacts of these on local ecological parameters, are discussed. Misunderstandings arising from an inaccurate colonial and missionary ethnography are identified and shown to influence contemporary perceptions of Damara land-use, as are the historical and political realities affecting current land distribution in north-west Namibia. The chapter concludes with a

description of the main environmental features of the area, focusing on the dominant vegetation communities characterising the region.

Chapter 2 introduces the practical and theoretical issues relevant to an assessment of arid-land natural resource-use practices by reviewing existing literature concerning these practices throughout drylands in sub-Saharan Africa and in Namibia in particular, concluding with a history of references to the use of gathered resources by people identified specifically as Damara. This review of information is used to generate research questions relevant for the analysis and discussion of the contemporary patterns and determinants of gathered resource-use by Damara farmers in north-west Namibia. The chapter concludes with an outline of the methods employed in this study to explore these issues, with a particular focus on the problems associated with arriving at a meaningful definition of the 'household' as a unit of observation in the context of an historically marginalised people inhabiting a variable and unpredictable environment.

Chapter 3 focuses on the presentation and discussion of results concerning the resource-use practices observed and monitored during the course of this project, and the relationship of these to the research questions generated in Chapter 2.

Chapter 4 widens the focus of the thesis from the details and determinants of natural resource-use practices as part of household livelihoods to the relevance of this information for the formulation of national policy related to the management and conservation of these resources. Detailed case studies are presented which explore strands of the deeply-held, culturally-legitimated ecological knowledge regarding appropriate ways of collecting and utilising selected resources, and which highlight current local-level management of water and land as focal and extensive range resources respectively. The implications of a number of principles which emerge from these case studies both for the enacting of so-called 'community-based' resource management initiatives and for the drafting of a national lands policy are discussed.

There is a common perception that local mismanagement of natural resources is causing environmental degradation in drylands. **Chapter 5** introduces these issues as they relate to Namibia and sets the scene for an analysis of local resource-use impacts based on quantitative ecology methods. The chapter begins by providing an overview of perceptions relating to degradation and 'desertification' in both the study area and in Namibia in general, and reviews existing ecological studies from Namibia and elsewhere which focus on the measurable effects of these processes. This is used to derive a number of testable hypotheses concerning the impacts of resource-use by people and livestock on both the woody and herbaceous vegetation surrounding settlements in a selected area of study region. The ecological and analytical methods used to test these hypotheses, and the sampling framework for woody and herbaceous vegetation, are described.

Chapters 6 and **7** present and discuss the results of hypothesis-testing regarding the impacts of people and livestock on vegetation around focal settlements. Chapter 6 focuses on the analysis

of community patterns of floristics and diversity, while chapter 7 concentrates on measures of productivity and population structure.

Chapter 8 is the concluding chapter. Based on the data presented previously, Chapter 8 discusses how and why the findings of this thesis do not match widely-held perceptions of arid-land resource-use practices and the effects of these practices on the landscape. Two areas of culturally-mediated misunderstanding are stressed. First, the discussion shows how the residual influence of misinformation generated under colonial interests continues to pervade current thinking regarding development initiatives based on natural-resources. Second, it reviews the role of assumptions regarding ecological dynamics which are derived from a temperate-zone ecology and are inappropriate for arid-lands. Finally, the chapter stresses the importance of recognising and deconstructing these assumptions for generating appropriate policy affecting the use and management of, and the derivation of benefits from, natural resources.

Chapter 1

Socio-political and environmental context

This chapter constructs a regional background against which issues of contemporary resource-use and management practice and of resource degradation are discussed in Chapters 2 to 4 and 5 to 7 respectively. The chapter is divided into four sections as follows:

1) The chapter begins by introducing the Damara people on whom this study of natural resource-use is based. Questions are raised regarding the picture of Damara identity and land-use practices which emerges from historical sources. These are discussed in the context of recent wider debate concerning the political and economic status over the last two millennia of what have been conventionally considered as isolated hunter-gatherer groups in southern Africa. Pre-historical and historical processes contributing to the disruption of productive activities rooted in maintaining access to land are highlighted.

2) The legacy of a century of land alienation institutionalised by both German colonial rule and the South African administrative mandate is detailed, with particular reference as to how this was translated into widely different land tenure and settlement histories in the north and south of the study area. This emphasises the crucial role of historical political context in shaping the possibilities for contemporary land and resource-use practice.

3) Section 3 focuses on the current socio-economic circumstances of Damara farmers in north-west Namibia. Settlement and demographic patterns are discussed, as are sources of livelihood.

4) Finally, the regional environmental context is described, with particular emphasis on the vegetation of the area.

1.1 The 'Damara': deconstruction of some 'ethnographic myths'

> The Damara are "the oldest inhabitants of the country, had no fixed abode and lived under primitive conditions, hunting game and being hunted like game by every newcomer into the Territory. They were the outlaws of the country. The origin of the Bergdamara is unknown. They inhabited the central and northern parts of the country, but from the earliest times, those who could not hide in the mountains had been subdued and made the slaves of the Namas" (Goldblatt, 1971: 11-12).

The 'Damara' have aroused outside curiosity by virtue of being a negroid but Khoisan-speaking population, whose apparently hunting and gathering lifestyle does not match the herding or cultivating 'mode of subsistence' popularly associated with their racial affinities. These 'problems', however, are an artefact of the emphasis on classificatory schemes in early Namibian anthropology, which, by constructing a rather simplistic picture of separate, stable and coherent tribal groups, has generated deep misunderstandings regarding the country's cultural

diversity and dynamic history (cf. Ranger, 1988: 42; Fuller, 1993: 91-93). In addition, this conservative conception of ethnicity cannot be separated from the political ends it served; the perceived reality of rather uniform and readily classified 'tribes' underpinned and provided justification for the largely repressive Apartheid-policies of the South African Administration from 1918 until independence in 1990.

Importantly for the issues discussed in this thesis, the ahistorical ethnography of the past continues to filter through to perceptions of current land-use practices and tenure arrangements. The aim here, therefore, is to provide a brief disentangling of the ethnographic 'myths' generated by the early literature, against which the contemporary land-use practices by Damara farmers discussed in the following chapters can be offset. Important issues are:

- The pre-colonial observations of early ethnographers, primarily Vedder (1923, 1928, 1938), which were interpreted as gospel by the South African Administration, were often based on dispersed small groups of Damara who had already been impoverished by the historical processes of the 18th and 19th centuries but who were treated as representative of the Damara 'tribe' as a whole ((Lau, 1979; 1988: 92; Jill Kinahan, 1989). As Lau (1979: 66) states, 'Vedder's portrayal of the BergDamara as the pariahs of the country leads him to negate their historical experience totally'.

- The classification of Damara-speaking Namibians as 'culturally hunter-gatherers' who have only acquired livestock in very recent times (cf. Köhler, 1959: 56; Odendaal Report, 1964: 31; Goldblatt, 1971: 11-12; Möller, 1974: 153; Knappert, 1981: 71; Steyn and du Pisani, 1984/1985: 37, 48; Schmidt, 1986: 329; Shaw, 1993: 274), in a way which implies that they have practised an unchanging 'mode of subsistence' for centuries, is flawed. Moreover, it contributes to a misunderstanding of current opportunistic subsistence practices appropriate for survival in a variable and unpredictable environment, and sustains continuing misinterpretations of the dynamic relationships among Namibia's diversity of ethnic groups. This is apparent, for example, in Kambatuku *et al's* (1995: 2) recent statement that 'The Damara people, who were hunter-gatherers, followed the example of Hereros and became cattle and goat farmers' (see also Gurirab, 1988: 315).

  Historical sources reveal considerable variation regarding subsistence practices, and particularly stock ownership, by the Damara, with reports describing groups at one end of the spectrum with apparently no livestock at all, to those with herds of cattle, sheep and goats at the other (cf. Barrow in 1797 (n.d.: 288); Alexander, 1838: 121, 136; Pienaar *in* Vedder, 1938: 38; Galton, 1853: 103; Chapman, 1868: 216; van Reenen 1791 and Wikar *in* Mossop, 1935; McKiernan *in* Serton, 1954: 45; summarised *in* Lau, 1979: 81; Wadley, 1979: 12, and Fuller, 1993: 85-86). Several 18th century observations of the Damara describe them as residing in relatively large groups and engaging in a range of subsistence activities including livestock herding and the specialist production of valued commodities for exchange purposes (cf. Lau, 1979).

- Similarly, the commonly held consideration that the Damara were enslaved by Nama and Herero groups and 'forced' to speak the former's language is erroneous (cf. Fourie, 1926: 62; Hahn, 1928: 223; Vedder, 1928: 39-42; Knappert, 1981: 72; Barnard, 1992: 201, 203)[1]. Lau (1979: 30) instead maintains that the Damara and Nama originate from the same ancestral population and their historical separation led to observed differences between the two (see Box 1.1 for a discussion of comparative studies regarding the biological affinities of the Damara).
- Finally, the notion of a Damara 'tribe' with a coherent cultural identity is inaccurate; they were rather constituted by a number of 'nations' or polities associated with different geographical areas of Namibia (i.e. 'locality-incorporative units' (Barnard, 1992: 203)), which practised a variety of resource-use and productive activities, speaking sometimes mutually unintelligible dialects (Lau, 1979: 30).

Interpretation of archaeological material for the arid central Namib region (Section 1.1.1), and re-interpretation of historical sources in the light of recent debate which highlights the interconnections of groups previously thought to be isolated hunter-gatherers within a dynamic regional economy incorporating agriculturalists and herders (Section 1.1.2), suggests a rather different picture to that outlined above. In combination with an overview of imperialist processes of land dispossession in Namibia (Section 1.2) this context supports a 'political economy' (cf. Adams, 1990: 102) or, more appropriately, a 'political ecology' (Little, 1985: 148; Bryant, 1991: 164) approach to the issues of natural resource-use and 'degradation' discussed in this thesis.

1.1.1 The Damara in prehistory: some interpretations

Like the rest of arid southern Africa, there is archaeological evidence for the existence of nomadic pastoralism by Khoe-speaking herders in the central Namib area for at least 2,000 years (Sandelowsky, 1977: 222; Sandelowsky *et al*, 1979; John Kinahan, 1983, 1991, 1993). Its significance as a subsistence strategy in central and western Namibia over this long period of time is rarely considered, however, due to the bias towards extrapolating the past from the situation of 'disunity and destitution' that, as described below, was encountered by European settlers in the region during the 18th century (John Kinahan, 1991: 7).

Conventional explanations in the archaeological literature of the early adoption of herding and of associated elements of material culture throughout southern Africa were based on the assumption of an immigrant pastoralist society displacing aboriginal hunter-gatherers, of which the San and, in the Namibian case, the Damara, are seen as being remnants (cf. Morris, 1990: 8). As John Kinahan states, there is in this 'paradigm of ethnic succession' (1993: 372) an 'implicit denial of change other than in the form of ethnic or racial migrations' (1991: 18), so that ethnicity, and associated subsistence practices and material culture, are

[1] See Solway and Lee (1992: 191) for a deconstruction of similar historical portrayals of Kweneng San as slaves of the Kgalagadi in the southern Kalahari during the late 19th century.

seen as comprised of a rather static package of attributes which are reflected as different assemblages in archaeology. In the central Namib region of Namibia, for example, Wilton and Brandberg (or Damaraland) artefact assemblages are normally seen as having distinct 'ethnic' signatures such that the former is considered representative of a prepottery (*ca.* 5,000BP) lithic tradition associated with hunting and gathering, and the latter, with its stone-circle huts, pottery and metal tools, is attributed to a recent (*ca.* 2,000-500BP) in-migration of herders (Rudner, 1957: 32-3; Viereck, 1967: 18-9; John Kinahan, 1991: 17, 1993: 375).

Jacobson (1976) asserts, however, that these assemblages may not be as distinct as was once thought. John Kinahan (1991; 1993: 376, 1983: 96), has thus argued for a re-interpretation of the archaeological evidence that allows for more gradual innovation through the diffusion of movable property (particularly livestock) via regional trade networks, accompanied by changing social relations permitting the accumulation of property in domestic livestock[2]. Prehistoric societies in the region are seen as dynamic with transitions occurring between combinations of herding and hunting subsistence strategies, both of which are appropriate for local ecological conditions (Sandelowsky, 1977: 275). Pastoralism develops through the transformation of the social relations of existing hunting and gathering groups, without necessarily diminishing the subsistence importance of the resources on which the latter economy is based. At the same time, the increasingly complex material culture associated with herding can become an integral and functional part of wild resource gathering, as is the case in north-west Namibia where pottery was used by herders for the collection, storage and cooking of gathered grass and *Monsonia* spp. seeds and of !nara (*Acanthosciyos horridus*)[3] in coastal sites (John Kinahan, 1991: 116, 1993: 381-382)[4].

Within this alternative framework, sites in different locations and with different assemblages are attributed to the same group of people exploiting the opportunities presented by a variable environment through extensive mobility, aggregation at focal settlements during rain periods followed by dispersal in response to resource scarcity in dry periods, and the use of stockposts linked to larger settlements several kilometres away (John Kinahan, 1983, 1991, 1993: 379). Wadley (1979), for example, describes a pattern of wet season settlement aggregation followed by dry season dispersal in her analysis of edible food plant remains found in both upland and river valley sites in the inland Erongo mountain area east of the

---

[2] The implications of these processes can be seen as part of a wider debate criticising the portrayal of so-called 'hunter-gatherer' groups as isolated populations who, based on their recently observed subsistence patterns, are considered to have depended completely and unchangingly on 'wild' resources for millennia (see, for example, Schrire, 1984a, 1984b; Wilmsen, 1989;). These criticisms rest largely on the perceived denial in ethnographic studies of both the active involvement in historical processes of such groups and, in particular, of events that may have led to their observed dependence at the turn of the century on hunting and foraging subsistence strategies. As such they build on historical and archaeological evidence for early and long-term involvement by populations currently classified as 'culturally hunter-gatherer' in regional trade networks and other elements of subsistence such as cultivation and herding (for discussion see Marks, 1972: 57; Elphick, 1977: 30-41; Hausman, 1982; Denbow and Wilmsen, 1983; Schrire, 1980, 1984a: xv, 1984b: 1-25, 1984c: 71-2; Alexander, 1984: 19-21; Biesele *et al*, 1984; Denbow and Wilmsen, 1986; Eibl-Eibesfeldt and Wiessner, 1984: viii-ix; Gordon, 1984; Parkington, 1984; Wilmsen, 1989; Morris, 1990; Solway and Lee, 1992).

[3] A full list of Namibian plant species and families referred to in this thesis, together with their nomenclatural authorities, is presented in Appendix 1.

[4] Dunn (1931: 84-85 *in* Rudner, 1979: 9-10) similarly reports the use of pottery by Khoisan peoples in the eastern Cape for making 'a kind of porridge of ground grass seed'.

Namib desert. Archaeological evidence also suggests that the large coastal encampment of ≠Khîsa-‖ubus was connected to several stockposts further inland, allowing a system of stock rotation between relatively fixed points and a well-established regional circulation of livestock and other commodities (Kinahan, 1993: 382-384). Associated with connections within a regional trading network was the possibility of hoarding regionally manufactured non-livestock products with a high exchange value, i.e. beads. Given the variable environment, this was a viable technique of herd management because non-livestock items could be reinvested in livestock at future dates. Unfortunately, however, this practice contributed to an undermining of the regional livestock economy due to the devaluation of these trade items when large quantities of glass beads and other commodities were introduced into the system by European traders (see Section 1.1.2).

While, enormous problems exist with associating modern groups with archaeological assemblages, several strands of evidence indicate continuity between both historical accounts and contemporary observations of the Damara, and the archaeological record. For example, although the Damara do not make pottery today, a fact which could be used to indicate stability of a 'pure' hunter-gatherer population, evidence exists for a long-standing and widespread pottery-making tradition by Damara in various locations. Du Pisani and Jacobson (1985: 109) describe a clay vessel owned by a contemporary inhabitant of Gomatsarab near the Brandberg and reputedly made by his grandfather, which fits both historical descriptions of Damara pottery (Vedder, 1928: 61; Lebzelter, 1934) and pottery found in local archaeological sites. Informants during the current study have also described widespread pottery-making by 'the old-people' from clay known as **sohai** and found at specific sites in the north-west. Similarly, the archaeological evidence concerning pastoro-foraging subsistence patterns in the region also reflects elements of contemporary resource-use by rural Damara, suggesting continuity in local knowledge of the area's natural resource base. The suite of gathered plant food resources documented in this study (detailed in Chapter 3), as well as historical records of such resource use are, for example, reflected in plant remains found in local archaeological sites (cf. Wadley, 1979; Kinahan, 1990).

1.1.2 The Damara in historical times: uprooted from the land

The first recorded European observation of the people now described as the Damara appears to have been in 1791 by Pieter Brand, a companion of the explorer Willem van Reenen (Vedder, 1928: 39). After traversing the country inhabited by the Nama 'Hottentots', Brand found a 'small black people' living in the Auas Mountains and the Swakop River to the south-east of the area demarcated in the 1970s as the Damaraland communal 'homeland'. At this time, their main locations are described as the Auas, Erongo and Otavi mountain ranges and the Brandberg Massif. This resulted in their name the Berg- or **!Hom**-Damara (Vedder, 1928: 39), after the Afrikaans and Nama/Damara words for mountain. These prefixes also served to distinguish them from the OvaHerero who were known as cattle or gomaxa-

Damara (Kamacha-Daman in Hahn, 1928: 220)[5]. In terms of subsistence, they are described in the late 1800s as relying almost exclusively on gathering 'fruits of the veld'[6] (see Section 2.3), although some families were herding goats and inhabiting river valley areas (Vedder, 1928: 42).

It is unlikely, however, that the mountainous areas and the predominantly hunting and gathering mode of subsistence described above were representative of either the wider territory or subsistence practices of the Damara. Rather, habitation of remote and marginal areas can be considered a result of recent historical circumstances. These included initial resource conflicts with the newly arrived cattle-rich OvaHerero who entered Kaokoland *ca.* 1550 (Malan, 1973: 83), some moving further south in the 1700s (Malan, 1974: 114), and the apparently violent and systematic raiding by expanding Nama cattle-herders, the latter using firearms gained through trade with settlers in the Cape (Hahn, 1928: 220; Vedder, 1928: 39; Knappert, 1981: 73, Lau, 1987: 18; Dierks, 1992: 37). Related to this, and with greater locally-disruptive effects, was chronic warfare between various alliances of well-armed Oorlam Afrikaner commandos from the Cape, and Nama and Herero pastoralists throughout southern and central Namibia during the 18th and 19th centuries, as recorded by the early travellers Galton (1852) and Andersson (1856) (cf. Hahn, 1928: 218; Schmidt, 1986: 330; Dierks, 1992: 40). These incursions reached as far as Kaokoland in the north-west; separate migrations of ǁKhau-|gôan- or Swartbooi- and !Gomén- or Topnaar-Nama[7] with firearms, established bases at Sesfontein and Gowareb (Khowarib) between 1850-70 from where they raided livestock from local groups, including the dispersed and nomadic ovaHimba of Kaokoland (Malan, 1973: 83; 1974: 114; Hitzeroth, 1976a: 188). This contributed to widespread regional impoverishment by the turn of the century, which was greatly exacerbated by the rinderpest epidemic in 1896-7 and the German-Herero war in 1904-1907.

The state of inter-tribal dispute described above has been enshrined in the historical literature which asserts that both the Nama and OvaHerero perceived the Bergdamara as social inferiors (Hahn, 1928: 220; Vedder, 1928: 40; Köhler, 1959: 35) and, wherever possible, robbed them of their goat-flocks and subjected captured individuals to labour as herders and menial workers (Vedder, 1928: 39). As pointed out by Lau (1979: 40-45, 1988: 91-93), Saunders (1988: 82) and Fuller (1993: 11), however, interpretations of such 'missionary-ethnography' need to be made with care in view of the motives of colonial agents to amplify existing tensions among indigenous groups. Lau's (1979: 80-85, 1987) reinterpretation of these turbulent centuries places greater emphasis on the role of the infiltration of European mercantile capital in distorting regional voluntary exchange-based relationships; this instituted

---

[5] According to Hahn (1928: 220) the word Damara uses the dual feminine gender and literally means 'two Dama females'. It apparently comes from the word 'Daman' used by the Nama to describe all dark skinned people. The Damara call themselves ≠Nũ-**Khoen (Haukhoin** in Hahn, 1928: 220) meaning 'black or real people'.

[6] 'Veld' is an Afrikaans term literally translated as 'field' but with a widely understood meaning as 'bush' or 'wilderness'. It corresponds with the Damara/Nama term **!garob**.

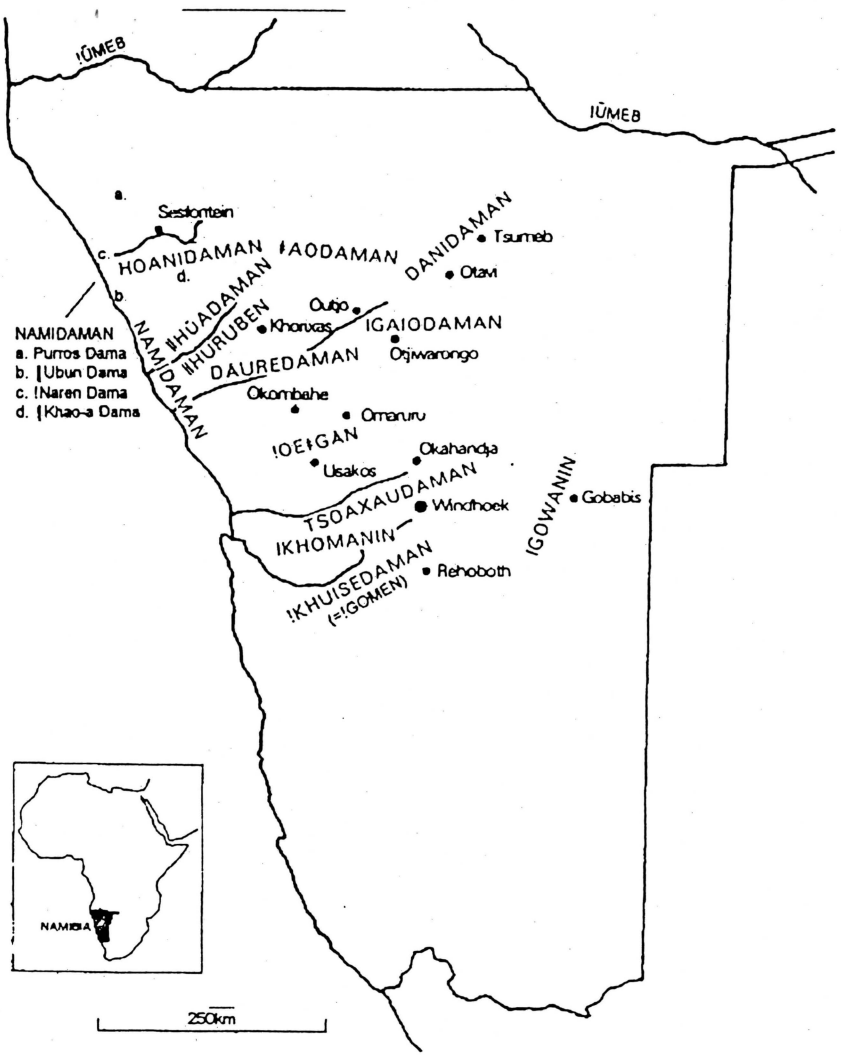
[7] ǁkou-ǥõan and !oman in Van Warmelo (1962: 41).

'coercive clientage' through promoting the value of imported commodities, including firearms, over which Oorlam groups with links to the Cape had the monopoly, at the expense of local economies engaged in the production of both subsistence and trade items.

Prior to their apparent retreat to the region's mountainous areas, it is thought that Damara 'nations' occupied much of Namibia's southern, central and western land territory; Map 1.1 displays one interpretation of these patterns. Hahn (1928: 220) describes them as living in 'large powerful tribes', carrying out over the centuries specialist smelting work in the rich copper areas throughout Namibia. It is likely that they practised herding for subsistence to varying extents; the explorer Andersson, for example, wrote in his diaries in 1851 that 'about the Kuiseb and south of it, a great many Bergdamaras are living. The OvaHereros have not been much in that direction. Before the arrival of the Damaras (Hereros), the Namaquas and Bergdamaras are said to have lived together in the plains and possessed plenty of cattle' (*in* Lau, 1987: 5; see also Irle, 1906: 154-157 *in* Wilmsen, 1989: 94). Jill Kinahan (1990: 25-6, 40) and John Kinahan (1993: 382) also describe observations by a 1786 British Admiralty expedition to the Namib coast that indicate an area inhabited by skilled pastoralists involved in a complex regional exchange network. It is not clear exactly which ethnic group these pastoralists represent but again it is likely that Damara inhabiting the region were incorporated within and affected by such pastoralist and trading networks.

As well as the effects of Nama and Herero incursions into areas thought to have previously been inhabited and utilised by the Damara, and prior to the onset of the country's colonial history, the region has experienced the direct and indirect effects of European influence over a long period of time, culminating in the profound social transformations affecting all Namibians in the post-1915 colonial era (Lau, 1987: 1). European exploration of the Namib coastline occurred from the 15th century on and is documented as tapping into the existing regional livestock exchange network to gain livestock for provisions (Kinahan, 1986: 116). As noted above, these transactions had a profound impact on the regional livestock economy essentially by exchanging productive subsistence resources for unproductive but high-value goods such as beads, tobacco and iron products, thus contributing to the general impoverishment and subsequent decline of regional nomadic pastoralism (Kinahan, 1991: 1). Involvement in the 1800s in the international trade for wildlife products such as ivory and ostrich feathers (Hahn, 1928: 230; Lau, 1987: 45), the parameters of which were set by European markets, also affected much of Namibia and Botswana. As documented elsewhere, this had a deep impact on indigenous populations through distorting existing power differences (cf. Wilmsen, 1989). Finally, missionary activities extended direct European contact on behalf of imperial powers. The Rhenish Mission, for example, acted as the self-proclaimed protectors of the Damara from their subjugation by the Nama and Herero, establishing Damara communities with appointed elders at several centres including Rehoboth, Otjimbingwe, Okombahe, Omaruru and Gaub near Tsumeb (Hahn, 1928: 221; Vedder, 1928: 43; Köhler, 1959: 32).

• Map 1.1. Reconstructed pre-historical location of Damara 'nations'.



Source: Haacke and Boois (1991: 51), supplemented by information in ǁ Garoëb (1991) and oral history collected during the course of this project.

1.1.3 Summary

As a consequence then of persecution and widespread political upheavals, coupled with introduced disease and rinderpest, the Damara at the turn of the century were impoverished in terms of both land and livestock. This state of affairs has had far-reaching implications for the way they have been portrayed and treated throughout this century. As considered at the start of this chapter, they are described as 'culturally hunter-gatherers' (Büttner, 1879: 288-9; Hoernlé, 1923: 22; Köhler, 1959: 33, 56; Knappert, 1981: 71) in a way which implies that they have practised an unchanging mode of subsistence little affected by historical events over the last 3-4 centuries. Historical evidence negates this and begs a reinterpretation of Damara land-use and subsistence practices which emphasises the following:

1) it is apparent that they occupied a much wider territory and have been marginalised in the recent past to less productive areas;

2) there are early historical observations of large herds of livestock (including cattle belonging to the 'Bergdamara' throughout the Namib transition region and, given the existence of wealthy Damara herders today, there is no reason why they could not have been wealthy herders in the past;

3) the material culture described in early observations of the Damara, which includes iron and copper working as well as pottery (Vedder, 1928: 43; Knappert, 1981: 71), does not accord with their portrayal as primitive hunters and foragers.

Given that herding, foraging and hunting are all appropriate subsistence options under semi-arid ecological conditions, and that drastic livestock losses may occur aperiodically in such a dynamic environment, there would seem to be no real reason why these strategies should not be practised in some sort of pastoro-foraging combination (see, for example, Yellen, 1984: 59; Bion Griffen, 1984; 115-7). The Tswana-speaking Bantu of the semi-arid eastern Kalahari in Botswana, for example, have maintained a diverse 'subsistence economy based on a blend of animal husbandry, agriculture-horticulture, and hunting-gathering' which Grivetti (1979: 235, 241) maintains is a significant factor in their greater success in surviving drought periods than that experienced by more specialist agro-pastoral groups of the Sahel. As Grivetti (1979: 252) states, 'dietary and nutritional success are linked with diversification of the food base and ... societies with social-economic institutions sustaining the hunting-gathering component of the food quest will be more successful during periods of climatic-environmental stress or drought than societies without this option'. In other words, retaining the relevant know-how and social relations which allow successful foraging and hunting of natural resources does not necessarily preclude the option of switching to, or incorporating, herding or cultivation, should the opportunity arise. This is particularly true if pre-colonial societies are seen as linked within dynamic regional trade networks allowing both accumulation and loss of movable property.

1.2 Colonial Namibia: European land appropriation and settlement

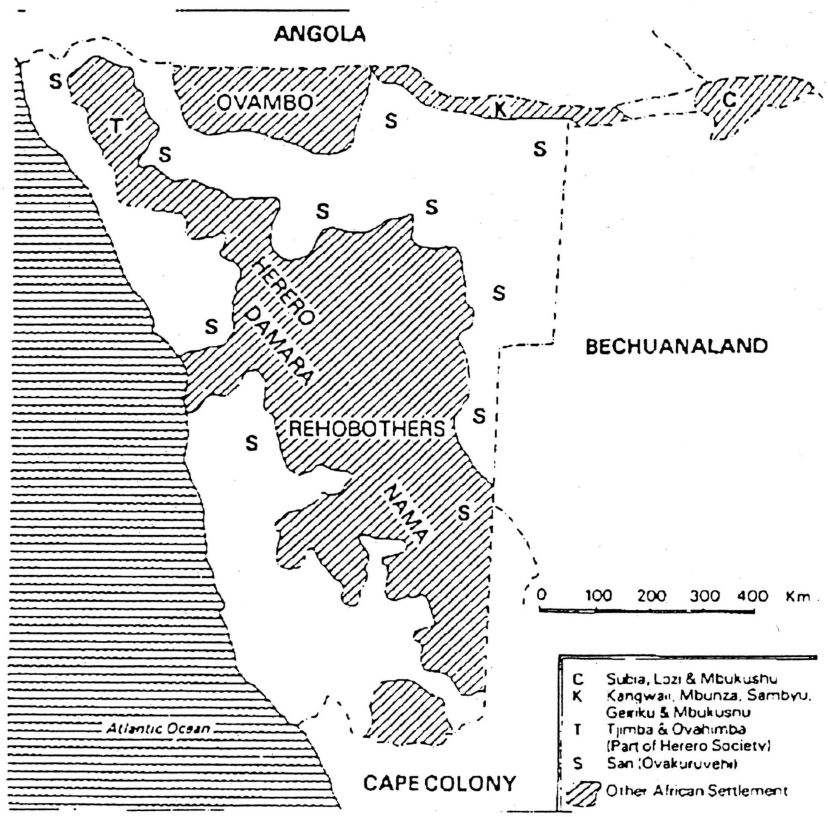
As a result of the processes described above, colonial rule was established and imposed on a situation of disintegration of regional livestock economies and disunity among indigenous groups. Map 1.2 provides one interpretation of the general location of Namibian groups at the turn of the century. Box 1.2 summarises this century's legacy of legislated changes which formally dispossessed indigenous Namibians of their land under both German and South African administrations, and then reallocated land on the basis of a distorted reconstruction of 'traditional' cultures.

1.2.1 Land alienation and conquest under German colonial rule

The end of the 19th century ushered in full-scale German Imperialism in southern and central Namibia, amounting to the alienation of land from indigenous Namibians through brutal means and its enclosure for use as commercial livestock ranches (see analysis in Bley,

1996). Missionary activities were a precursor to German colonial rule in 1884, providing a model for the establishment of protective alliances between the small German administration and various African leaders, such that ethnic groups accepted German rule and protection in return for rights over land and respect for traditional leadership (Dierks, 1992: 49). In reality, these alliances exploited rivalries and facilitated the seizure of productive resources (land and livestock) from groups which did not pledge allegiance to the new administration. The consequent erosion of people's ability to produce for subsistence was exacerbated by the enforcing of game laws coupled with district laws forbidding the collecting of veld foods (Vedder, 1928: 77). With regard to 'the Damara', these policies effectively instituted dependence on the alternative subsistence opportunities offered by the settled reserves established by the Rhenish mission.

- Map 1.2. One interpretation of the location of African settlement in 1900.



Source: Katjavivi, 1988: xvii.

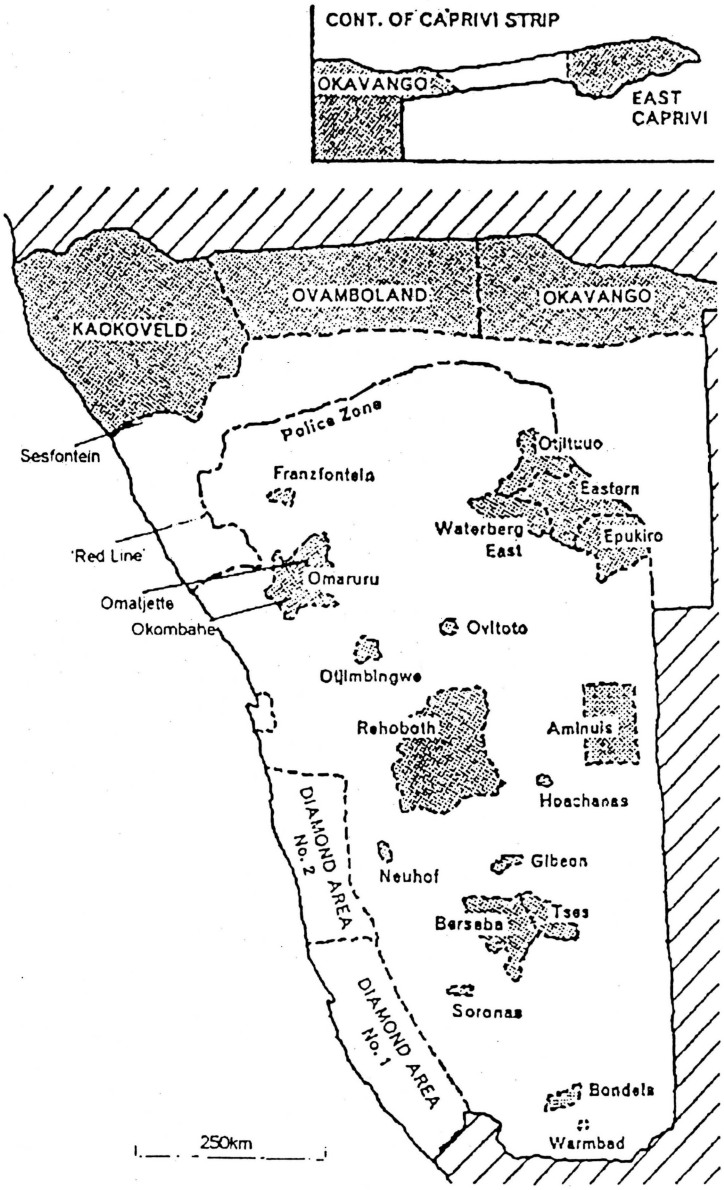
By 1883, concession companies had acquired most of central and southern Namibia (Werner, 1991), settlement of which occurred primarily at the turn of the century (Adams and Devitt, 1992: 3). Escalating resistance to increasingly draconian methods of alienating indigenous Namibians from land and productive resources led ultimately to the so-called German-Herero war in 1904-1907, in which the Herero population was reduced from an estimated 80,000 to approximately 20,000 (Dierks, 1992: 67) through systematic extermination and the fleeing of remaining groups to Ngamiland in Botswana. These events, coupled with the reduction of Nama power (Nama were reduced from 20,000 to less than

10,000), are portrayed as signifying an emphatic end to earlier subjugation of groups of Damara who, it is claimed, chose not to join the Herero against the German authorities who had acted as their protectors (Vedder, 1928: 44; Köhler, 1959: 36-7). In fact, the Damara also experienced substantial losses, from an estimated 30,000 in 1904 to 12,831 recorded by the official 1917 census (Union of South Africa, 1918: 35, *in* Fuller, 1993: 16), and the war begs reinterpretation as a German-Namibian conflict. Linked with the conflict were Ordinances passed by the German Authorities in 1905 and 1907 permitting the 'confiscation of property of the insurgent groups' such that indigenous Namibians 'were practically debarred from the ownership of cattle or sheep' (Walker, 1917: 95); at the same time the area of Okombahe in southern Kunene was allocated to the Damara 'for their loyalty during the rebellion' (Odendaal Report, 1964: 67). Together with the Basters of Rehoboth and the Nama of Berseba, Okombahe constituted one of only three 'home areas' when South West Africa passed into the hands of the South African Administration after the First World War (see Map 1.3).

A significant artefact of Germany's colonial rule was the establishment of the so-called 'Police Zone' which effectively separated southern from northern Namibia. Within the Police Zone, direct administrative control allowed for the settlement of Europeans and the confining of the non-labouring indigenous population to Reserves. To the north, 'indirect rule' relied on customary law through the 'traditional' authorities (Gordon, 1991: 3-4). This division instituted the geo-political roots of the essentially dualistic economy which has been entrenched within Namibia ever since; the communal northern areas and Native Reserves of the Police Zone supplied labour to the southern commercial areas, whose economy was buffered by strict restrictions on the movement of livestock and other agricultural produce from the north. The erecting of the Veterinary Cordon Fence, or 'Red Line', to prevent the spreading of foot and mouth disease and lung sickness into the commercial area, strengthens the geographical reality of this artificial division between the northern and southern areas (as shown on Map 1.3).

By 'separating direct producers from their means of production' (Mbuende, 1986: 51), these processes institutionalised a landless Namibian majority in southern and central Namibia, who invariably wound up either as labourers for settler farmers on land which was historically theirs, or in small home areas which acted largely as a source of labour for white farmers or for industry in the newly established German Colony (see also Hamutenya, 1988: 16-17). Despite their greater independence, areas to the north of the 'Red Line' were economically hamstrung by the inability of farmers to legally export livestock for sale across this boundary, and by the imposition of taxes which forced many into migrant labour for cash wages.

• Map 1.3. Namibia in 1963 showing the existing Native Reserves and communal areas (shaded) of the South African Administration at the time of the Odendaal Commission, and the location of the veterinary cordon fence or 'Red Line'.



Source: First, 1963: 115.

1.2.2 Separate Development: the South African 'Homeland' policy

South Africa's Native Land Act of 1913, in which 13.3% of South Africa's land area was allocated to its majority African population, provided the prototype for 'separate development' within Namibia during its post-First World War history of administration by South Africa under a League of Nations mandate (Fuller, 1993: 25). A 1922 proclamation (no.11) by the Native Administration further allowed the reservation of what amounted to less than 5% of land in southern and central Namibia as Reserves for Africans who comprised over 90% of the region's population (see Map 1.3) (Odendaal Report, 1964: 69; Adams and Werner, 1990: 20-24). In north-west Namibia these 'first schedule' Reserves were the primarily Damara-

Nama inhabited areas of Fransfontein, Okombahe, and Sesfontein. The Herero Reserve of Otjohorongo, later incorporated within the Damaraland 'homeland', was created under the 'second schedule' in 1925. Surrounding the reserves was commercial farmland to which individual settler farmers were given lease- or free-hold title.

Administration of the Native Reserves was by Reserve Boards chaired by the local Superintendent and comprised of a local headman, elected by the South African Administrator as a member of the Bantu Affairs Commission, and up to six locally elected members (Odendaal Report, 1964: 73). In accordance with the projection of a European patriarchal family model (cf. Krieke, 1991: 562), votes for the latter were allocated only to male inhabitants of the Reserves, despite the fact that many men were absent from the Reserves due to migrant labour. The Reserve boards were responsible primarily for managing the Reserve Administration Trust Funds into which all revenues from the reserve were deposited. The 'traditional' leadership of the Reserves were denied the right to allocate land or to hear criminal cases (Gordon, 1991: 5).

As in South Africa, motivation for the establishment of Native Reserves was as much economic and political as ideological: Reserve revenues were largely derived from taxes instituted in a time of labour shortages to prevent a situation of having 'too many serviceable natives in the reserves' (SWA administration, 1928: 32, *in* Fuller, 1993: 32). Similarly, and as Adams and Werner (1990: 7) state, the Reserves 'not only provided cheap labour to the settler economy, but enabled the colonial state to exert political control over the population through co-opting indigenous leaders and appointing local headmen' (see also Gordon, 1991). The establishment and maintenance of these Reserves alongside the growing area of titled commercial farms further instituted the current dichotomy in southern Namibia between communal and commercial land and their associated production systems.

Provision for the settlement of land by European farmers was made by extending to the then South West Africa the 1912 Land Settlement Act of South Africa, which entailed the establishment of a Land Board to oversee the South African Administration's agenda for land settlement and the use of State Land (Fuller, 1923: 27). The success of the ensuing national Land Settlement Program, in terms of farms settled and increases in the white farming population, is quite astonishing; between 1913 and 1962, the number of surveyed and settled farms increased from 1,138 to 5,500, the white population rose from 14,830 to 72,000, and the area thus settled as commercial farms grew from 11,490,000 to 39,812,000 hectares (First, 1963: 248).

These figures are less surprising, however, when interpreted in the light of the lengths to which the Administration went to ensure settlement of the Police Zone by a white farming population, largely composed of landless Afrikaners who formed a political threat within

South Africa as an increasingly hostile white lobby (Moorsom, 1982: 30). These included, for example: extremely generous financial terms offered for the purchase of farms[8], livestock and the development of infrastructure; subsidies and drought assistance which enabled farmers to survive in the face of impending bankruptcy; the instituting of systems of taxation and labour laws which ensured a supply of cheap black labour; and deceptive advertising employed to entice settlers to marginal lands in the west of the country (Moorsom, 1982: 32; Fuller, 1993: 27-30; see also Dean and Macdonald (1994: 291) who summarise the benefits accruing to commercial livestock farmers under the similar process of land settlement in South Africa). Despite such favourable terms, reports to the Administration in the 1920s and 1930s repeatedly express concern regarding the ability of settlers to repay their debts, and there is speculation that many of the commercial farms and debts were never actually paid off (Fuller, 1993: 28-29).

1.2.3 The 'Odendaal Commission': its recommendations and implementation

The process of 'separate development' was taken to its logical conclusion in the early 1970s through the implementation of the 1962 'Commission of Enquiry into South West African Affairs', otherwise known as the 'Odendaal Commission' after the Chairman of the Commission, the Hon. F.H. Odendaal. The Commission's terms of reference were 'to enquire thoroughly into further promoting the material and moral welfare of the inhabitants of South West Africa, and more particularly its non-white inhabitants ... while taking fully into consideration the background, traditions and habits of the Native inhabitants' (Odendaal Report, 1964: 3). Its 'considered conviction' was that 'the continued existence of a home area for each individual group would be in the best interests of the various population groups, and that, ... these homelands should exist as such and become increasingly independent' (Odendaal Report, 1964: 79, 107). The primary objective of the Commission was thus to identify the so-called 'land requirements' of the main racial groups, and delineate an appropriate area of land for each group in the light of these investigations. The resulting recommendations involved the creation of 11 black authorities responsible for the administration of ethnically defined Bantustans, such that these were conceived of as 'separate states' with their own legislative councils (Adams and Werner, 1990: 93). In this way, land distribution was rationalised along racial lines, ensuring that every black person was registered and carried a pass identifying them as an inhabitant of a specific tribal area; in support of the settler economy, this system favoured the movement of cheap black labour out of the 'homelands', while relegating individuals not required by the white economy to their so-called 'home' area.

---

[8] Land was paid for on a lease-purchase basis which involved no payment in the first year, followed by payments in subsequent years with interest levels which remained lower than the going bank rate of 5% (Fuller, 1993: 29).

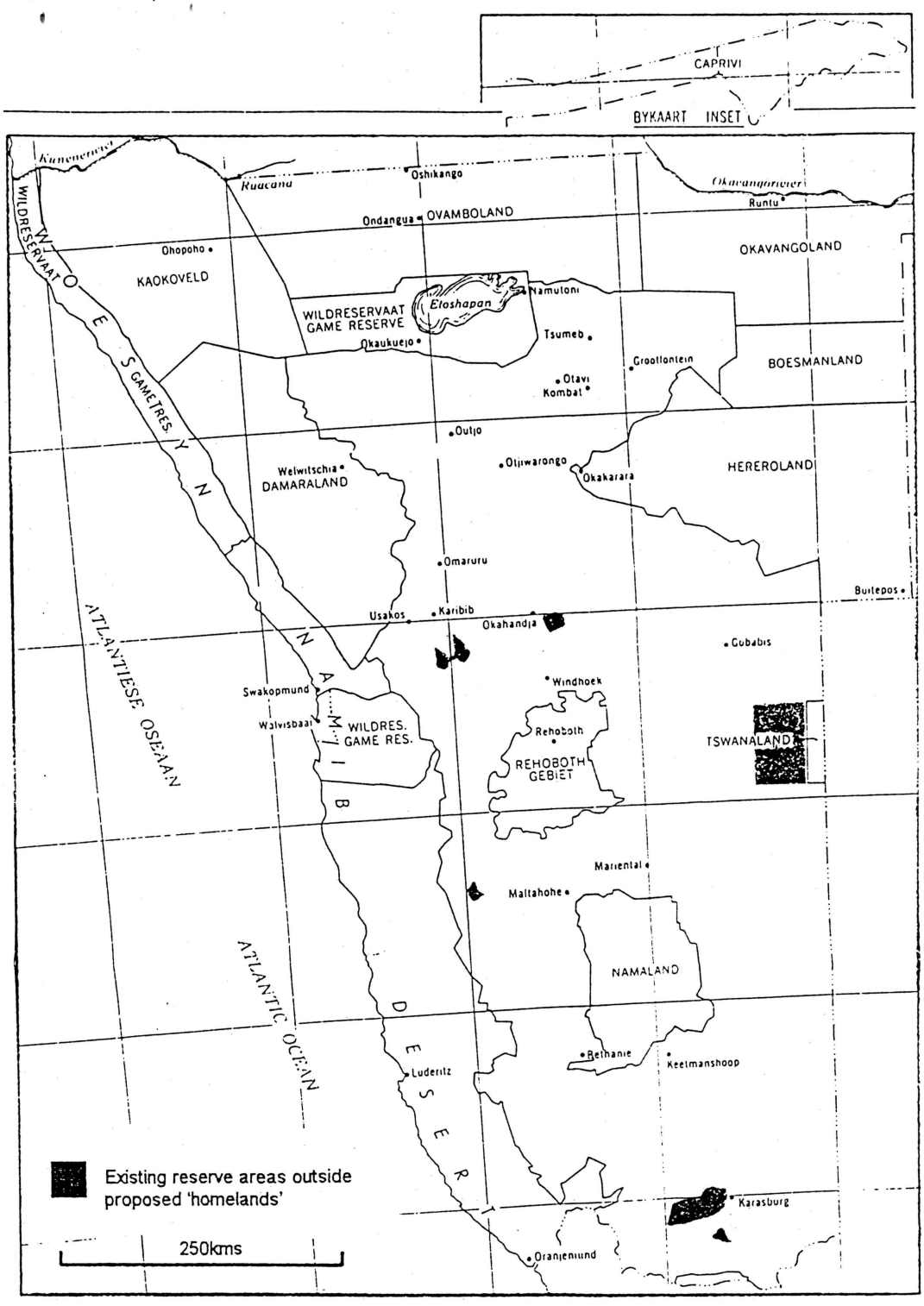
Within the Police Zone, and as demonstrated by Map 1.4, the Odendaal plan to create communal farming areas along ethnic lines essentially involved the expansion of the existing Native Reserves of Damara, Nama and Herero people into the marginal western, southern and eastern parts of the country respectively (Odendaal Report, 1964: 79; Adams and Devitt, 1992: 7). Damaraland was thus created around the Fransfontein, Okombahe and Otjohorongo Reserves, together with Sesfontein to the north of the Red Line, with the addition of over 4 million hectares of surveyed and fenced commercial farms, unsurveyed State land and game reserves (Odendaal Report, 1964: 109-111). A total of 223 previously white-owned farms, covering an area of 1,872,794has, were included within Damaraland, each farm varying from 4,000 to 25,000has in size, with an average of approximately 8,500has (Odendaal Report, 1964: 89-93). These farms were purchased by the administration for the value imposed by an Evaluation Committee, less the amount that farmers owed on their leases and other loans (Kambatuku, 1996: 3). Given that by the mid-1960s, many of the white settler farmers had already vacated these farms (Kambatuku, 1996), partly due to the declining viability of commercial farming in a situation so dependent on the fluctuations of the South African economy (Rohde, 1993: 31), many settler farmers in this region benefited considerably from this process.

The Odendaal Report estimated the Damara population throughout southern Namibia to total some 44,000 in the early 1960s. This amounted to some 250has per 'family' (although it is unclear how 'family' was defined), compared with an average of 8,500has for each white settler family previously farming in this area (Odendaal Report, 1964: 31, 89-93). Movement by communal farmers to the new Damara 'homeland' began in the early 1970s, in the absence of either a 'traditional' land allocation system or any legislated regulation of settlement (Rohde, 1994: 6). It is generally considered that people were forcibly moved to these areas (Adams and Werner, 1990: 93; Adams and Devitt, 1992: 7), although little documentary evidence exists regarding this. Forced removals certainly occurred, as was the case in 1974 when the entire community of Riemvasmakers were moved from Upington in South Africa where an army base was to be created. This movement, to some of the most marginal western farms in Damaraland, was justified on the basis of tenuous links between the Nama spoken by old people within the Riemvasmaker community and Damara in Namibia, which enabled them to be considered 'Damaras born outside South West Africa' and thus with a 'right' to 'citizenship' of Damaraland (Odendaal Report, 1964: 93; Rohde, 1993: 19)[9]. Today it is apparent that the Commission's plan was only partially implemented; in 1981, of a total Damara population of 76,000 most were living in Katatura or working elsewhere as labourers, and only an estimated 24,000 were living within Damaraland (NEPRU, 1992, *in* Rohde, 1993: 31).

---

[9]Despite this, however, they were refused the right to register for the Regional elections in November 1992 on the grounds that they were not Namibian citizens. Following press coverage of this issue, these rights were eventually granted (New Era, 1992, *in* Rohde, 1993: 20).

• Map 1.4. Boundaries of the communal areas or 'homelands' recommended by the Odendaal Commission in 1964 and implemented in the 1970s.



Source: Odendaal Report, 1964: Fig. 27.

The 'homelands' were administered by so-called 'second-tier authorities'; statutory legislative councils consisting of 'present functioning rulers' and members elected by registered voters among the 'citizens' of Damaraland (Odendaal Report, 1964: 93). Below this twelve wards were established within Damaraland, each with a headman and three councillors who, although their powers were not 'legal' as defined by statutory law, had a certain degree of

autonomy in mediating local issues (Rohde, 1994: 6). All legislation remained subject to approval by the President of South Africa. Khorixas (then Welwitschia) was designated the administrative seat of Regional Government. With regard to land, the 'second-tier authority' was essentially considered the 'trustee' of the land which ultimately remained in the ownership of Central Government (Adams and Werner, 1990: 95). Among the powers of the legislative council, with 'permission' from the President of South Africa, was the right to alienate land added to Damaraland to individual citizens or to non-citizens (Odendaal Report, 1964: 95). The regional authorities were also responsible for collecting monthly grazing fees of 5c/small stock and 60c/cattle which supplemented their budget for farming subsidies such as water installation maintenance and drought relief (NEPRU, 1991b: 168).

Local resistance to the imposed system of 'homelands' and second-tier authorities can be illustrated by the fact that the first elections for the Damaraland legislative council, held in 1978, were boycotted by all political groups except the Damara United Front which was linked with the South-African backed Democratic Turnhalle Alliance (DTA) (Fuller, 1993: 78).

In 1981, however, the competing Damara Council led by the new 'Paramount Chief', Justus ǁGaroëb, received a massive majority, heralding the emergence of a strong regional power encompassing an ideology based on promoting Damara ethnic pride and identity, justified in the light of SWAPO (South West African People's Organisation) nation-building rhetoric as a prerequisite for 'national Namibian consciousness' (Fuller, 1993: 101). The Damara Council's continued success prior to Independence was based on positive perceptions regarding its ability to redistribute wealth to the wards (Brown 1991), and its attempts to overcome historically ingrained negative stereotypes of the Damara people without compromising support for the nationalistic ideology of SWAPO (Rohde, 1993: 33).

1.2.4 Post-independence regional boundaries and power structures

One of the first priorities of the post-independence government was to delineate new administrative boundaries along non-ethnic lines such that land from both the communal and commercial areas was included within the new Regions (see Map 1.5). The former communal area of Damaraland is now divided along the Ugab River into the Kunene Region in the north, and the Erongo Region in the south. The 'second-tier' authorities created as a result of the Odendaal Commission are now defunct. All property held by the former Regional Authorities has reverted to the state, and the former regional administration in Khorixas is now largely headed by appointees made by central government, with the position of tribal leaders officially seen as 'increasingly symbolic' (Rohde, 1993: 35, 36). As pointed out by Rohde (1994: 2), however, the current weakness of the new Regional Authorities, which are hampered by the concentration of decision-making power in central government, means that Damaraland retains its social, economical and administrative identity. Tribal leaders and the Agricultural Extension Officers of the previous regional office continue to fulfil important roles with regard to both land allocation and the mediation of conflict (Rohde, 1994: 7; 1997b: 1) so

that, while 'all communal land is *de jure* vested in the State President ... its *de facto* control and allocation ... rest, by delegation, with the competent traditional institutions of the respective communal areas' (Hangula, 1995: 15).

Further complicating the administrative situation, and significantly for the issues of resource-use discussed in this thesis, is the fact that post-independence Namibia is committed to a process of radical land reform, the precise form of which remains unlegislated (discussed in detail in Chapter 4). The implications of the somewhat nebulous current situation are summarised by Adams and Devitt (1992: 17) who point out that the 'local authorities have suspended action pending directions from the centre; the centre, unaccustomed to dealing with the perplexing problems of small farmer and communal area development has itself been waiting for inspiration and direction from elsewhere'.

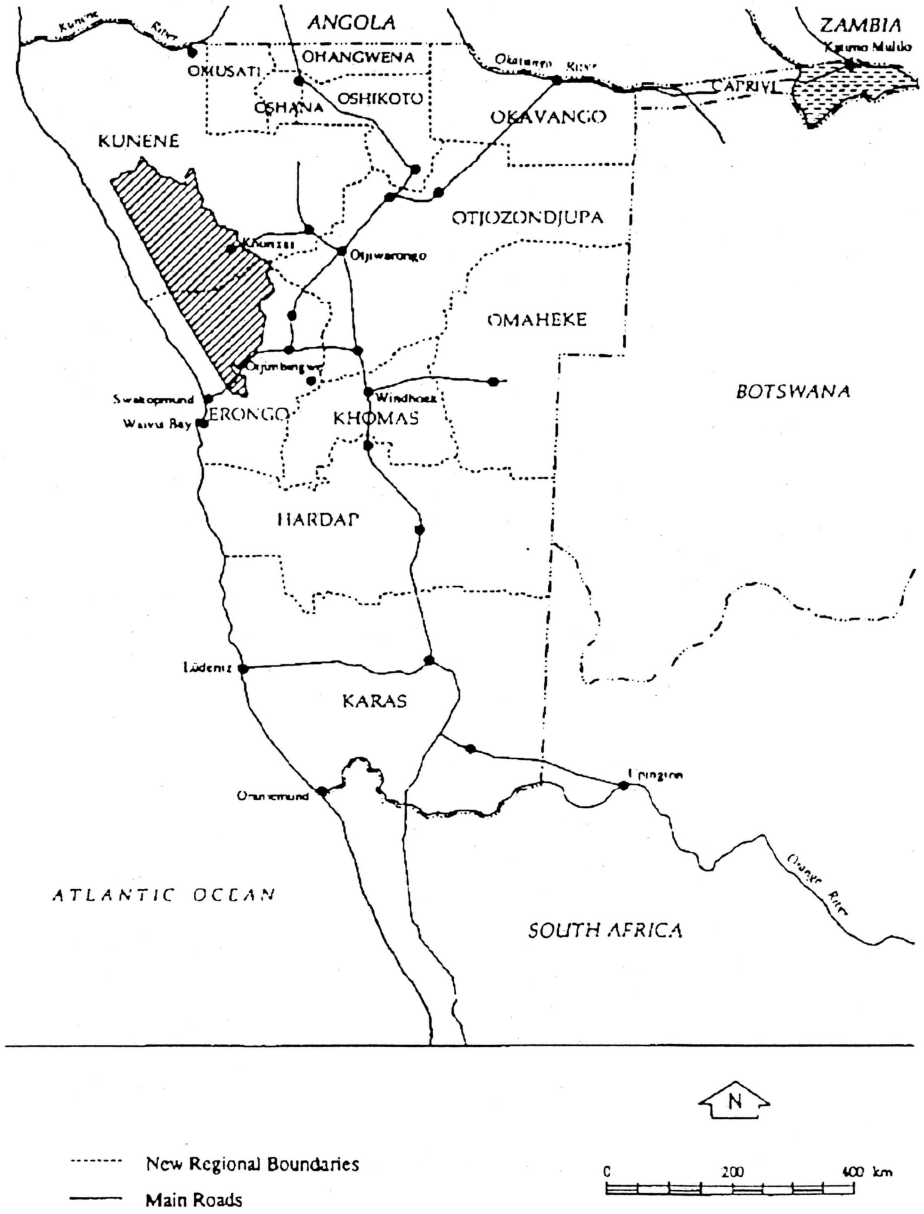
As an emerging regional and local power, the Farmer's Union, in its various forms, is beginning to fill some of the gaps created by the absence of a strong regional administrative organisation. The recently established Welwitschia Regional Agricultural Union initiated by several of the Agricultural Officers of the previous regional administration has, for example, facilitated meetings between wards in Damaraland to mediate resource conflicts and helped organise the recent government subsidised movement of farmers to the Ugab for grazing purposes (Rohde, 1993: 63, 1994: 9). Each ward has its own branch of the Union and thus is able to operate in coordination with the traditional ward leadership. Positive local perception of the Agricultural Unions was indicated in the socioecological survey conducted in the Huab catchment in 1992 by the MET, during which these organisations were cited as the most appropriate bodies through which the MET and local NGOs should work within the region (Jones, 1993a: 54). While the Union has proved effective in facilitating extension work, organising alternative livestock marketing options, and in lobbying government on behalf of regional and local farmers' interests (Rohde, 1993: 63), it is hampered by its inability to attract, and extract subscriptions from, a wide and active membership, and its lack of funding for transport and other necessary resources.

1.3 Who lives there? Portraits of contemporary Damara farmers

As described above, an enduring historical dichotomy which continues to influence land-use and settlement in north-west Namibia, is the geographic and economic reality of the demarcated and recently 'communalized' southern farms *versus* the relatively remote communally-managed livestock economies to the north of the veterinary cordon fence. The following account of the people who live in these areas, their personal histories and livelihood practices, is intended to draw out the ways in which these differences contribute to both diversity and homogeneity in terms of socio-economic factors within the region. Boxes 1.3 and 1.4 provide detailed descriptions of the composition of two clusters of households (‖**gâudi**) from south and north of the Red line respectively. See also Fuller (1993) for an incisive analysis of processes of institutional appropriation based on fieldwork in primarily Otjimbingwe and Sesfontein, and

Rohde (1997) for a contemporary ethnography of communal farmers and their extended families in the settlement of Okombahe, which draws out the 'fortitude, dignity and humour' (p. 19) with which these individuals weather and respond to the political and environmental contingencies of their lives in a former 'homeland'.

- Map 1.5. The post-Independence administrative boundaries, drawn along non-ethnic lines and incorporating both commercial and communal farmland within each region. The shaded area indicates the former Damaraland 'homeland'.



Source: Nærua *et al*, 1993: 4.

1.3.1 A brief overview of settlement geography

Settlement throughout north-west Namibia is determined by water availability. This constraint notwithstanding, a variety of settlement patterns characterise the region, reflecting primarily the different political histories characterising today's communal land on each side of the Red Line.

Settlement within the former Reserves retains a history of concentration along westward-flowing ephemeral rivers where water and livestock fodder, in the form of nutritious pods of leguminous trees, are relatively abundant. This is true, for example, of settlement within the Okombahe Reserve, which utilises the water resources of the Omaruru and Ugab Rivers. In the rugged calcareous mountains to the north of the Red Line, larger settlements are supported by permanent springs emanating from local topographic conditions; this is the case for Sesfontein or **!nani |aus** (i.e. 'six fountains'), Warmquelle ('warm springs') and Khowarib in the Hoanib River catchment, the names of these settlements vividly describing the significance of the water resources on which they depend.

Within the fenced farmland to the south of the veterinary fence, settlement, and the kraaling of livestock, is determined largely by the location of functioning boreholes. When established as commercial farms, boreholes were located at both the site of primary habitation, which was usually as close as possible to communication routes, and at farm-posts in remote areas of the farm. Since these farms were 'communalized' in the 1970s the typical settlement pattern that has emerged is one of the growth of a larger farm settlement around the old commercial farmhouse, with fewer households at the more remote farm-posts[10].

Important cultural factors influence settlement patterns within the ecological constraints posed by the necessity of ensuring a supply of water and important subsistence resources. A feature of the large settlement of Sesfontein on the Hoanib River in the north of the study area, for example, is the orientation of Damara inhabitants towards the land area with which they have ancestral links. The following description by Bell (1993: 8; see also Peterson, 1979) of this same phenomenon among Australian aboriginal groups in the settlement of Warrabri, which is of a size and with a history not dissimilar to Sesfontein, emphasises the enduring cultural relationships with the land which guide these patterns:

> "today people are cramped on settlements ... in daily interactions with whites and other Aborigines who a century ago were scattered across vast tracts of land. ... To ease the tensions of the population-intensive lifestyle of Warrabri and to preserve something of their old identity, Warlpiri and Warumungu oriented their camps to their traditional land west of the settlement, while Alyawarra and Kaytej oriented their camps to the east. Contact between east- and westsiders was minimal and occurred in the service core of the settlement where the whites lived and worked."

1.3.2 Population patterns

Hahn writing in 1871 (1928: 224), and Vedder in the 1920s, both estimated that the population of so-called Berg Damaras was between 25-30,000, mostly distributed throughout

[10] This may not always be the case. At Bankfontein, a study farm in the Aba-Huab catchment, for example, severe problems with water supply at the old farmhouse have limited settlement here to one household and kraal, and a larger settlement has grown at one of the farm's two posts, even though this settlement also periodically experiences problems with water availability.

central and southern Namibia (1928: 39). These figures are subsequent to depopulation caused by the turbulence of the 'German-Herero' war of 1904-7 and the ravages of introduced disease, particularly the rinderpest pandemic of 1897 and TB. In 1978, the Damara were estimated as approximately 80,000 or 8.5% of the total population of Namibia of 931,000 (du Pisani, 1978: 1). Today, only a quarter of this figure are thought to live in the former Damaraland communal area; a recent report which assumed growth rates of 2.5% per annum from the population of 24,000 in 1981, arrived at a total current population of 31,000 (Bayer *et al*, 1991: 60). This is similar to the estimate of 32,986 in Nærua *et al* (1993: 72 following National Planning Commission, 1992), consisting of 19,703 and 13,283 defined as inhabiting rural and urban areas respectively. A further 30% of the Damara population reside at Katatura, the satellite 'township' of Windhoek (van der Merwe, 1983: 48). Unfortunately, deriving more recent comparable aggregate population figures for the former Damaraland using data from the 1991 Population and Housing Census is problematic as the enumeration areas used were based on the new administrative regions and do not directly relate to the former 'homelands'.

Tables 1.1 and 1.2 present some census figures for population sizes and structure for Sesfontein in 1947/8 and 1991, and for settlements on the Ugab in 1956 and 1991. From these several patterns can be discerned. First, while there was a steady increase in both the Omaruru District and the Okombahe Reserve reserve in the first half of this century (the latter the result of the creation of a safe haven for the Damara and not due to natural increase (Köhler, 1959: 43)), there does not appear to be any reason to justify the assumption of a 2.5% population increase over the last decade for these rural Damaraland settlements. It is possible, however, that the very small increases, and even losses, recorded for these rural settlements can be accounted for by rural-urban migration within Damaraland. Even so, it is unlikely that the rural areas of this region are experiencing anything like the average national population growth rate of 3.33% (cf. Dewdney, 1996: 70). Second, there are higher numbers of women compared to men in almost all of the counts for which data on both sexes are available, although the 1991 census indicates the national sex ratio to be almost equal (cf. Nærua *et al*, 1993: 73). This pattern probably reflects the effects of both historical and current male labour migration away from rural areas (Köhler, 1959: 54).

• Table 1.1. Population figures and structure for Sesfontein 1947/48 and 1991, and Khowarib 1991.

	Sesfontein					Khowarib		
	1947/48				1991	1991		
	men	women	children	total	total	men	women	total
Damara	91	111	172	374	±480	82	88	170
Herero	61	73	128	262	±200			
'other'	44	50	55	149	±126			
total	196	234	355	785	806	82	88	170

Source: Van Warmelo (1962: 8, 40); National Planning Commission (1991).

• Table 1.2. Population figures for settlements on the Ugab River, 1956 and 1991.

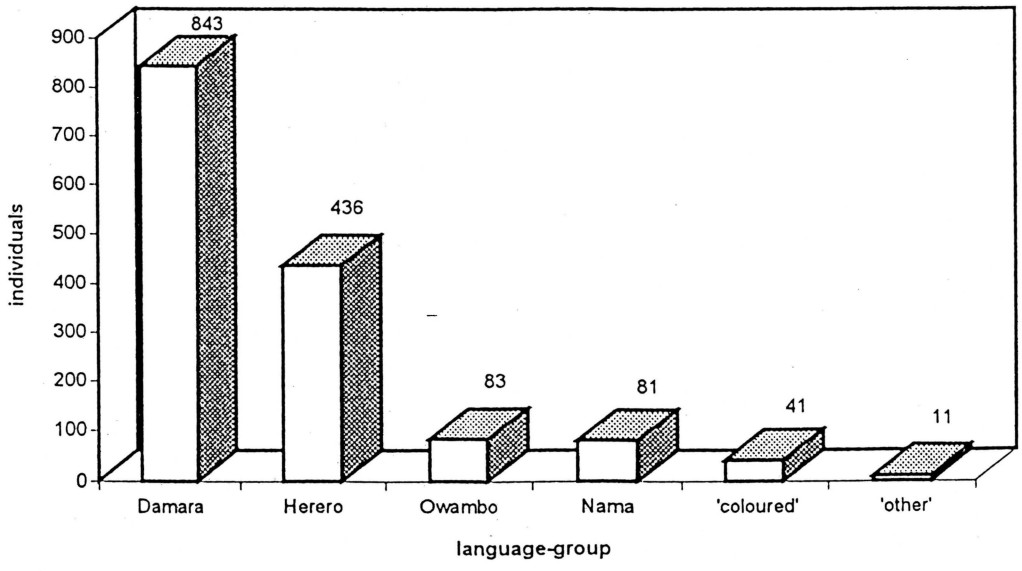
settlement	1956					settlement	1991		
	men	women	boys	girls	total		male	female	total
Ani-≠gab	42	72	33	30	177	Ani≠gab	18	18	36
ǁGai-oas	5	16	13	12	46	Gaes-oas	8	9	17
ǀNai-≠gab	16	21	15	23	75	Nai-gab	16	11	27
Sore-sores	29	28	14	15	86	Sorri-sorris	4	9	13
Daob-!gaos	28	40	28	16	112	no data			

Source: Köhler (1959: 44-47); National Planning Commission (1991).

Secondary data sources corroborated by case-studies indicate the following superficial socioeconomic characteristics for the contemporary human population of the former 'homeland' of Damaraland:

- As Figure 1.1 demonstrates, most farmers identify themselves as **Damara-speaking**, although, as Boxes 1.3 and 1.4 illustrate, a mixture of language-speakers with differing relations to each other may be associated with the same extended family or farm settlement.
- A large proportion of registered farmers receive their **main source of income from skilled or unskilled employment in the formal sector**, usually for the civil service in the regional centre of Khorixas. The government employs some 2,100 people within the former Damaraland (Rohde, 1994: 5), many of whom remain personally involved in the herding economy into which substantial proportions of their salary may be invested. These farmers spend varying amounts of time in the rural areas, forming a continuum between those who seem to be more or less permanently absent, and those who return to their herd during most weekends.

• Figure 1.1. Registered farmers by language-group recorded for Damaraland in 1991.



Source: ǁGaroëb, 1991: 2.

- Following retirement, many wage employees who have maintained herds in rural areas, go to live out their retirement years with their livestock, the collecting of state pensions providing an additional small cash income. At the same time, these farmers may be entrusted with the care of livestock belonging to children or relatives in wage employment elsewhere. A large proportion of relatively permanent inhabitants of rural areas are, therefore, **pensioners**, of which there are approximately 2600 in Damaraland receiving N$135/month (Rohde, 1994: 5).

- Another important group of semi-permanent rural-area inhabitants are **pre-school age children**, many of whom are left in the care of pensioners while their parents are occupied with wage labour elsewhere.

- **Younger adult family members who are not in wage employment** of some description also often spend prolonged periods of time with their older relatives, assisting with herding and household tasks and benefitting in return from having both a place to live and a source of subsistence.

- Finally, **farm labourers** form an extremely important component of the farming population, not least because it is often they who are responsible for the day-to-day management of the herd for farmers who are absent. Many pensioners also employ farm labourers. Most labourers are men in their twenties, often with some family link to the farmers they work for. There is also a considerable number of young men who seek employment for relatively short periods of time (one to two years) from areas such as central Owambo and Opuwo (in Kaokoveld) where unemployment is high. Farm labourers are paid anywhere between N$60-N$150/month, plus food rations. At Namibia's 1991 Land Conference, a great deal of attention was paid to the poor working conditions and wages of farmworkers on commercial farms; as FISA (1991: 4) states, however, the conditions of farmworkers in communal as well as commercial areas need addressing.

1.3.3 Livelihoods

Not withstanding the use of gathered natural resources, analysis of which forms the focus for Chapters 2 and 3, Damara farmers are engaged in a diversity of productive livelihood activities dominated by livestock herding combined with horticulture. Cash incomes are procured from a variety of informal and formal sources, often reinforcing links between rural Damara and urban-based economies. Subsidies in the form of food aid and drought fodder are also important. These sources of subsistence and income are discussed briefly below.

Livestock ownership and herding

The herding of livestock is the primary productive activity in which Damara households are engaged. More than this, it is an all-pervading expression of social and economic life, against which aspirations and achievements are measured, and through which social and kin relations are maintained and negotiated. As discussed below, ownership and involvement in day-to-day management of herds by livestock-owners is extremely varied; this reflects and creates current socio-economic diversity, and is related to the role of historical contingency in structuring the opportunities available to, and the constraints affecting, the families and individuals whose lives are bound up with this region.

Livestock distribution

Throughout the former Damaraland, and as reflected in Box 1.5, there are wide differentials in the livestock wealth identified with different households; this can be a considered a feature of herd-ownership throughout Africa's dryland areas, and the widening of these differentials is a trend in many analyses of pastoralist societies (cf. Homewood and Hurst, 1986: 2). In the former Damaraland, only a small number of farmers own any cattle at all, while most farmers have small-stock, mainly goats. It is usual for farmers to own a few donkeys and several chickens. Less common is ownership of horses, pigs and sheep. In 1992, for example, average herds of 14 cattle, 99 small stock units (goats or sheep) and 3 donkeys were recorded (Rohde, 1993: 35, 1994: 4). These figures mask large differences in ownership, however, illustrated by the fact that the ten wealthiest herders owned approximately 15% of the cattle and 4.6% of registered farmers owned 25% of the total stock numbers. Women, mainly widows or divorcees, comprise approximately a quarter of registered farmers and, on average, tend to have herds of around 65% of the average recorded for male farmers.

Herd-building is inextricably bound with the evolution of the family (see, for example, Du Pisani, 1978: 12; Fuller, 1993; Rohde, 1993: 43). As Rohde (1993: 45-46) points out, the retention of 'entitlements of access' to the extended family network and its productive base, i.e. livestock, is essential for the welfare of many less wealthy family members. Children are allocated livestock which then form the core of independent herds, and livestock are further redistributed as gifts on important family occasions such as weddings. As children establish themselves as independent herders elsewhere, or become drawn into other families through marriage, there is potential for the network of farms to which families have access, to widen. The distribution of livestock through extended kinship relations means that herds often comprise animals belonging to more than one individual. Products from these animals may be utilised by those responsible for their herding but decisions regarding the 'liquidation' of an animal through sale, exchange or slaughter are normally only made by the owner. Due to these patterns of livestock distribution, the number of livestock owners, or of individuals with access to livestock

products, is probably considerably higher than the number of individuals registered as farmers with the Ministry of Agriculture[11], and precise documentation of animal-ownership by individuals is problematic (see also Dahl and Hjort, 1976; Homewood and Hurst, 1986: 5).

Herd structure and management

Many features of herd management by pastoralist societies throughout Africa are related to maintaining rapid reproductive rates, and high milk productivity both for subsistence and for young animals. Herd structure is thus defined primarily by a high ratio of female to male animals within all species of livestock; this facilitates subsistence on a day-to-day basis through the production of milk and, with herd sizes large enough withstand losses in dry years, allows rapid herd recovery following drought by promoting high fertility rates (cf. Oba and Lusigi, 1987: 4-7). As an investment strategy, livestock as a form of currency can also be 'liquidated' as and when the need arises.

Within Damaraland, these features of herd structure are very much apparent, with herds of both cattle and goats commonly having between only one to three males of reproductive age. In cases where herds have no mature males, animals are 'borrowed' from neighbouring farmers for reproductive purposes.

The daily management of the herd largely revolves around watering the livestock; most herds free-range during the day and are kraaled at night, the keeping of young at the kraals ensuring the return of adult animals. In the southern fenced farms the old farm camps may be used as the basis for loose systems of grazing rotation, coordinated between the various farmers with livestock at the farm. North of the 'Red Line' grazing in the wider environs of the larger settlements of Sesfontein, Warmquelle and Khowarib is facilitated by the establishment of stockposts or **‖khaumâidi** (Fuller, 1993: 151) wherever there is water. Although most active animal husbandry occurs within the context of the kraal system close to people's homes, farmers have a substantial knowledge regarding favoured nutritious forage species and plant species used for animal medicinal purposes (refer to Annexe 1). Both men and women are involved in animal husbandry tasks.

A feature of animal husbandry which does not emerge from official livestock records is the keeping of feral doves and pigeons. This practice strongly illustrates that farming animals does not only have a utilitarian function: the primary reasons for keeping doves is an appreciation of their call which is considered calming, and because 'they are beautiful'. These birds are domesticated through regular feeding. The importance attached to them is illustrated by one farmer who moved temporarily to Malansrust in 1994, bringing her 26

[11] In 1993 the number of registered farmers in Damaraland excluding Otjohorongo totalled 1841 (WRAU, 1992, *in* Rohde, 1993: 43).

doves with her and taking them with her on her return the following year to Goedgevind Farm to the south of Malansrust.

Herd population dynamics

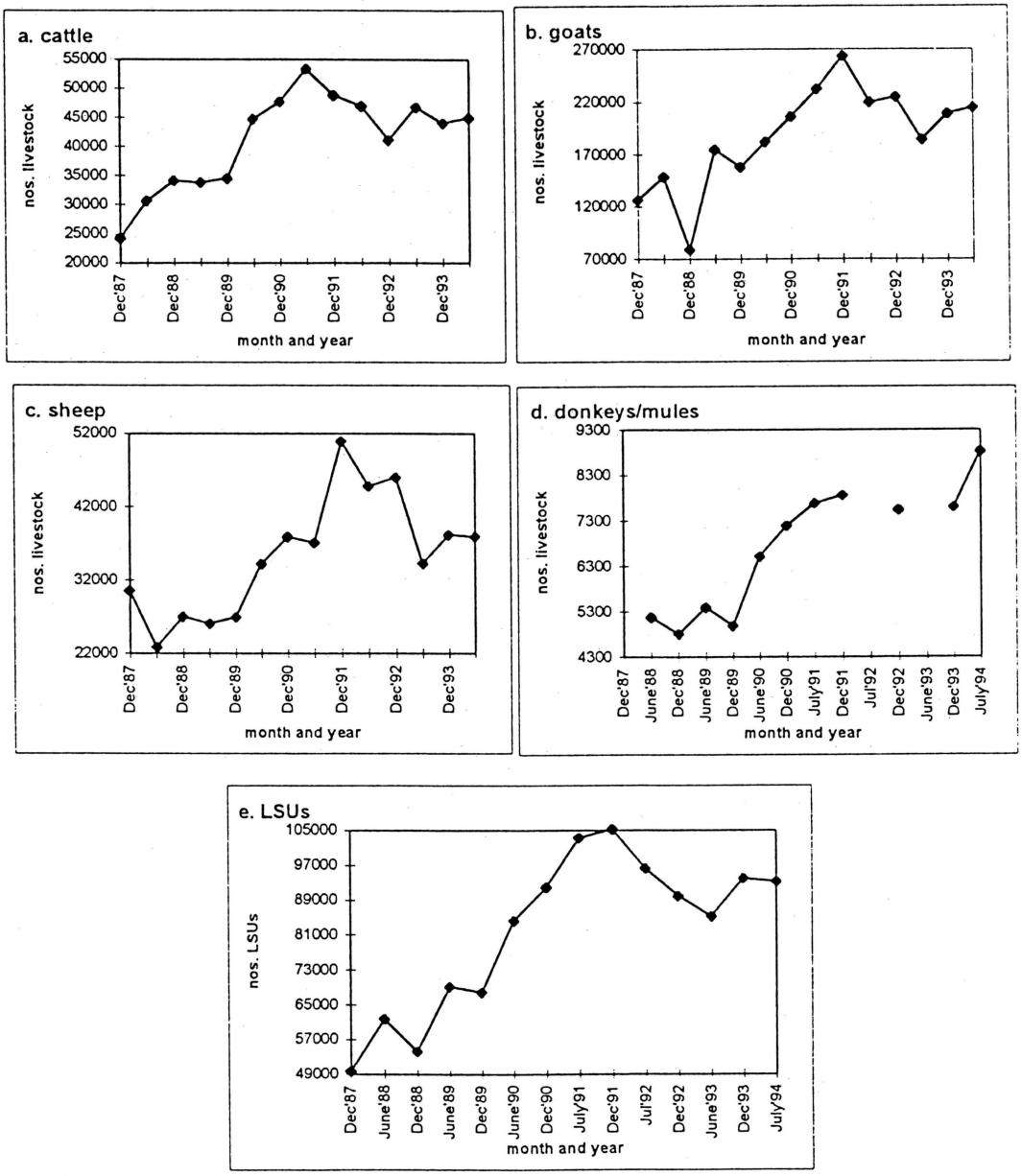
Herd population dynamics, particularly among small-scale subsistence farmers, reflect rainfall-driven variations in primary productivity. This is an integral feature of livestock production systems in dryland Africa (cf. Homewood and Hurst, 1986: 15-22; Homewood and Lewis, 1987). During the prolonged drought of the early 1980s, for example, herds were depleted to an estimated 20% of their pre-drought levels. Similarly in the early 1990s' drought Agricultural Extension Officers in former Damaraland were estimating total stock deaths of 30-35% (NISER, 1992); Devereux *et al* (1993: iii, 14-6) and Devereux and Tapscott (1995: 129-130) indicate that this was the worst affected region in Namibia. Both instances, however, were followed by rapid increases in stock numbers when the drought broke. Livestock fluctuations from 1987 to 1994 are illustrated in Figures 1.2a to e.

Herd offtake

Concern is often expressed regarding low offtake rates by subsistence pastoralists, and the promotion of destocking through such offtake is repeatedly advocated as a means of averting perceived environmental 'degradation' (as discussed in Chapter 5). Figures regarding offtake, however, are usually based on animals sold at formal auctions run by national cooperatives, and fail to take into account those sold or exchanged informally, and slaughtered for home use.

In addition, very real disincentives exist for communal farmers in Namibia to engage in the formal livestock economy by selling livestock through government auctions. Not least of these is the fact that these auctions remain a 'buyer's market'; commercial farmers reportedly organise themselves to bid in tangent and keep prices down (Fuller, 1993: 50; Rohde, 1994: 5). Drought periods are also poor times to destock from the perspective of the farmer as prices fetched are low due both to the bad condition of animals and flooding of the market as animals are sold to provide the cash needed to purchase food. Even with subsidies of N$120 per breeding cow, offered through the government Drought Relief scheme of the early 1990s, prices were considered too low to make up for the fall in prices due to loss of condition (Rohde, 1993: 52; Devereux and Tapscott, 1995: 133). Nevertheless, during these same years, sales at livestock auctions rose by some 40% although, due to the low rate of offtake through official auctions, this represented a reduction in total herd of less than 20% (NISER, 1992).

• Figure 1.2a to e. Livestock census figures from December 1987 to July 1994 for the veterinary areas comprising the former Damaraland (Damaraland North and South, Otjhohorongo/Omatjette and Sesfontein) for a. cattle, b. goats, c. sheep, d. donkeys/mules, and e. livestock units (LSUs). Conversion rates for the latter are: 1 LSU = 1 head of cattle, 6 goats/sheep, or 2 donkeys/mules (cf. Bayer *et al*, 1991: 26). Nb. There are no data for donkeys/mules for December 1987 and figures for Sesfontein from December 1988 to December 1991 appear to be estimates.



Crop cultivation

The Damara have a long history of horticulture in the form of 'kitchen gardens' cultivated in the fertile alluvial silts occurring along the major rivers of the region (Hahn, 1928: 223) and using small-scale gravity-fed irrigation channels. This 'gardening ethic' among Damara and Nama farmers is usually credited to missionary activities on the old Native Reserves (cf. Steyn and du Pisani: 1984/1985: 39). The gardens in Sesfontein, for example, were established at the end of the 19th century with irrigation and cultivation techniques introduced by a Nama evangelist called Nicodemus Kido (Fuller, 1993: 68). Later, a garden using water drawn from a different spring was established by German soldiers garrisoned at the fort in

Sesfontein. This was worked by Damara from the region around Sesfontein (the Namidaman) and their inheritance of these gardens following the withdrawal of German colonists after World War 1, combined with subsequent influxes of Damara groups, increased the ethnic and economic standing of Damara people within the Sesfontein (Fuller, 1993: 69). The former commercial farms of southern Damaraland usually have gardens irrigated with borehole water which are used and managed communally by farm inhabitants.

A wide range of vegetables are grown in these gardens, including maize, carrots, onions, cabbages, beetroots, sweet potatoes, chillies, pomegranates, pumpkins and water melons. Several indigenous species are also cultivated; these are discussed further in Chapter 3. A major problem and disincentive to expanding gardens is the destructive damage to both gardens and water supply caused by animal wildlife, particularly elephants.

Cash income

There are four main sources of cash income: formal employment, payment received by farm labourers, state pension, and a wide range of informal income-generating activities.

Formal employment

The vast majority of those herders who are absent for varying amounts of time due to formal employment work as teachers, hostel matrons, drivers and so on, for the various Government Departments with regional offices in Khorixas. As stated above, these individuals are often the wealthiest livestock owners on the farms, their investment of cash income in livestock being both an expression of a culturally-appropriate way of life and a form of material insurance for the future.

Payment of farm labourers

A form of redistribution of cash income from the formal sector is the informal payment of farm labourers. The maximum wage recorded during this project was N$150/month, although many labourers receive less than N$100 and some as little as N$60. In addition to this cash income, farm labourers also receive rations of foods such as maize-flour, sugar, and oil, and have usufructuary rights to livestock products, primarily milk consumed in various forms. Although farm labourers aspire to possess their own herds, few actually own livestock.

State pension

Farm occupants of over retirement age are entitled to receive a State pension of N$135/month, which provides a degree of economic independence to elderly people. This income tends to be redistributed along kinship lines thereby supporting a wide range of individuals who are related to pensioners, including grand-children and young unemployed adults. For many rural households it is the only source of income for the purchase of maize, on which people are enormously dependent as a staple food, of so-called 'luxury items' such as tea, coffee and sugar, and of clothing. Some old people

experience problems with their application for a pension, and consequently receive no cash income at all.

Informal income-generating activities

Cash and other items are also procured through a range of informal income-generating activities, most of which depend on the extraction of 'free' raw materials from the local environment and their processing into commodities with a higher exchange value. The products may be sold or exchanged locally, or may be directed at tourist traffic through the area. In the south, locally found semi-precious stones are sold, for example, to tourists driving through farms (cf. Nærua *et al*, 1993: 84). This is usually practised by young adult and teenage males, often farm labourers. Inhabitants of the northern settlements are involved in wide informal networks of trade in items such as locally grown tobacco (cf. Fuller, 1993: 67). Indigenous plant materials also form the basis for a variety of informal means of generating income. Again, these are discussed in Chapter 3.

Food aid and fodder subsidies

During drought periods free food and livestock fodder are distributed to communal farmers, primarily from the Red Cross in the case of the former, and from the government via the agricultural cooperative AGRA in the case of the latter (cf. Artivor and Mwazi, 1995). There are some problems in ensuring even distribution of these resources, due primarily to the remote and dispersed nature of most rural settlements in the former Damaraland (cf. Nærua *et al*, 1993: 90-93) and allegations of misappropriation by powerful individuals (Rohde, 1997b: 185). Government subsidies for livestock production, to settler farmers under the South African administration and to communal farmers in post-independence Namibia, have also been criticised on the grounds that they are 'driven by social and political, rather than economic or environmental, objectives' (Dewdney, 1996: 48). Targeted groups for food aid include pregnant and lactating women, children under five and young unemployed adults. Drought fodder is distributed in order to help maintain the breeding stock of small farmers, i.e. those with up to 10 cattle and 50 smallstock, and is valued at N$20/cattle and N$4/goat. The eligibility of farmers with larger herds is individually assessed and based in part on their participation in the government livestock marketing subsidy scheme, introduced to encourage farmers to sell breeding cows to offset drought losses. Subsidies during the 1995/1996 Drought Aid Scheme were available for up to 100 Large Stock Units and 500 Small Stock Units with subsidies for livestock production valued at N$99 million compared with N$50 million spent on food aid (Dewdney, 1996: 49).

1.4 Environmental context

This section presents the regional environmental context for the study, focusing on abiotic and biotic factors respectively. Rainfall, as the most important constraint on primary productivity, receives particular attention as does indigenous vegetation.

1.4.1 Abiotic environment

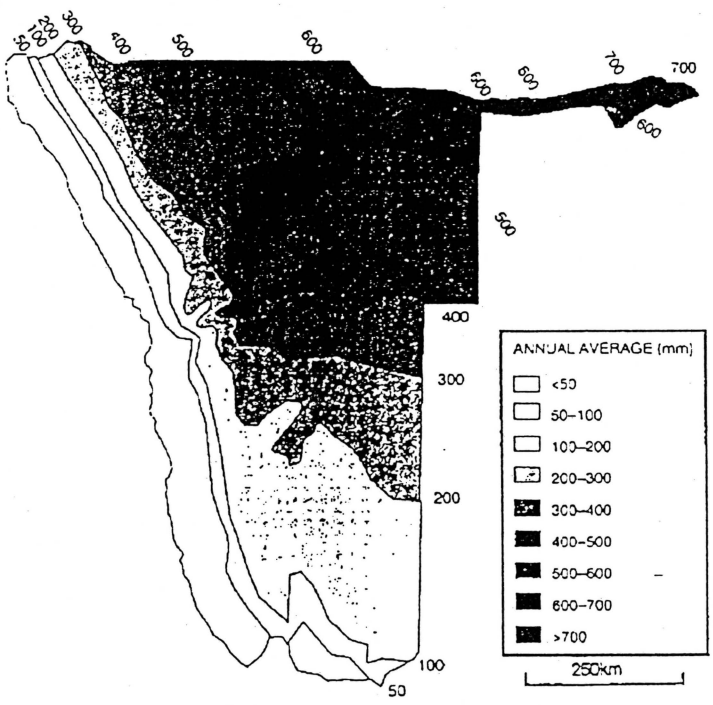
Climate

Relatively detailed information regarding the climatology of Namibia is available in Hutchinson (1995: 17-31). The main features are as follows:

- Rainfall is by far the most constraining influence on primary productivity and, therefore, agricultural potential. In general, rainfall decreases from the north-east to the southwest (see Map 1.6.), is highly seasonal, and is extremely variable between years. With increasing aridity and variability, the proportion of both extreme dry years (<75% of the annual average) and extreme wet years (>125% of the annual average) increases (Tyson, 1986: 11). Most of the country experiences summer rainfall from October to April, although the very south has rainfall in the winter months.

  The single most important climatic feature of north-west Namibia is thus its absolutely low rainfall and the associated variability of this rainfall through time and space. Analysis of time series rainfall data[12] for several rainfall stations in the former Damaraland demonstrates this variability in the high coefficients of variation[13] characterising these data. This is summarised in Table 1.3 and shown graphically in Figure 1.3. Following Noy-Meir (1973), Caughley (1987) and Ellis *et al* (1993), these high coefficients suggest that rainfall in this area, and ecological dynamics related to this, are better described by their variability than by average values.

• Map 1.6. Rainfall isohyets.



Source: du Plessis, 1992: 134.

---

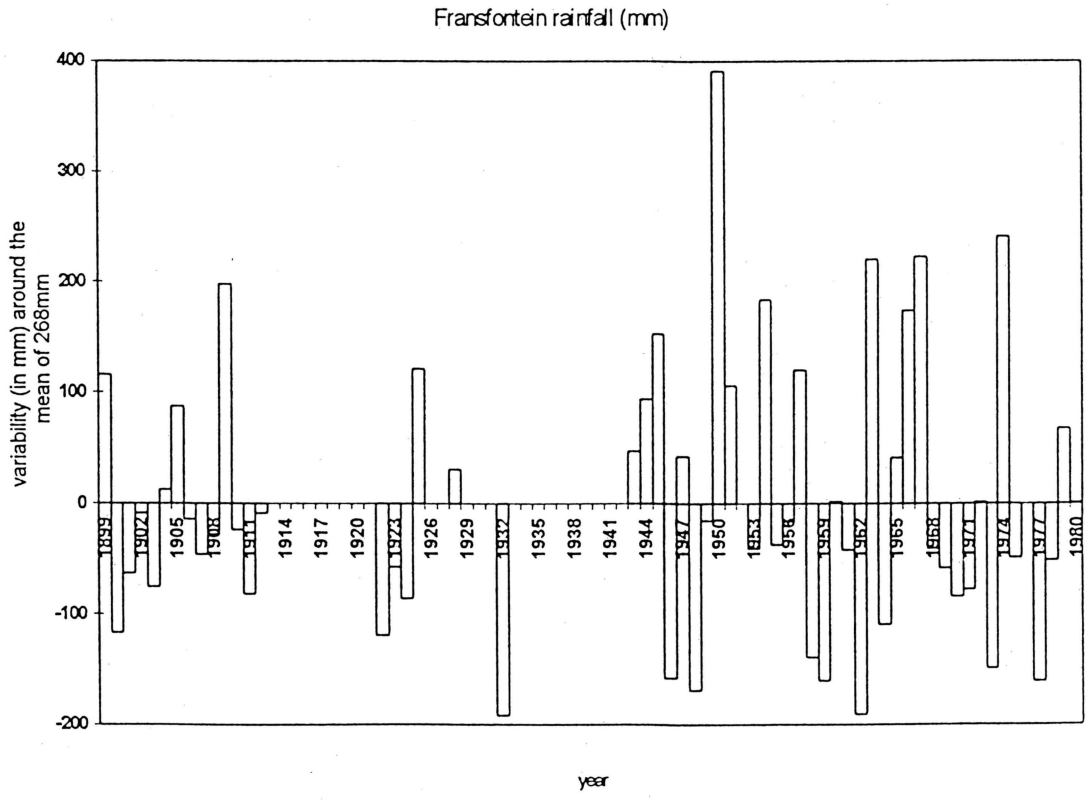
[12] Rainfall data from the Weather Bureau, Windhoek; the Climate Research Unit, University of East Anglia; and the National Meteorological Library, London.

[13] i.e. the standard deviation expressed as a percentage of the mean.

• Table 1.3. Means ($\bar{x}$), standard deviations (s) and coefficients of variation (cv) for selected rainfall stations in the former Damaraland, north-west Namibia.

rainfall station	coordinates	years of data	N	$\bar{x}$ (mm)	s (mm)	cv (%)
Fransfontein	20° 13'S 15° 01'E	1899-1980	56	268.06	123.28	45.99
Khorixas	20° 23'S 14° 58'E	1956/57-1992/93	37	213.90	94.01	43.95
Sesfontein	19° 08'S 13° 39'E	1957/58-1985/86	24	95.35	67.21	70.49
Uis	21° 15'S 14° 45'E	1935/36-1939/40 and 1967/68-1979/80	18	107.08	72.51	67.72

• Figure 1.3. Rainfall data for Fransfontein from 1899 to 1980 expressed as variability around the mean of 268mm. Nb. no data are available for 1913-1921, 1926 and 1927, 1929-1931 and 1933-1942. Fransfontein is located slightly to the east of the main study settlements discussed in this thesis and is therefore somewhat moister; rainfall for this settlement is presented here, however, because it had the longest available time-series of data.



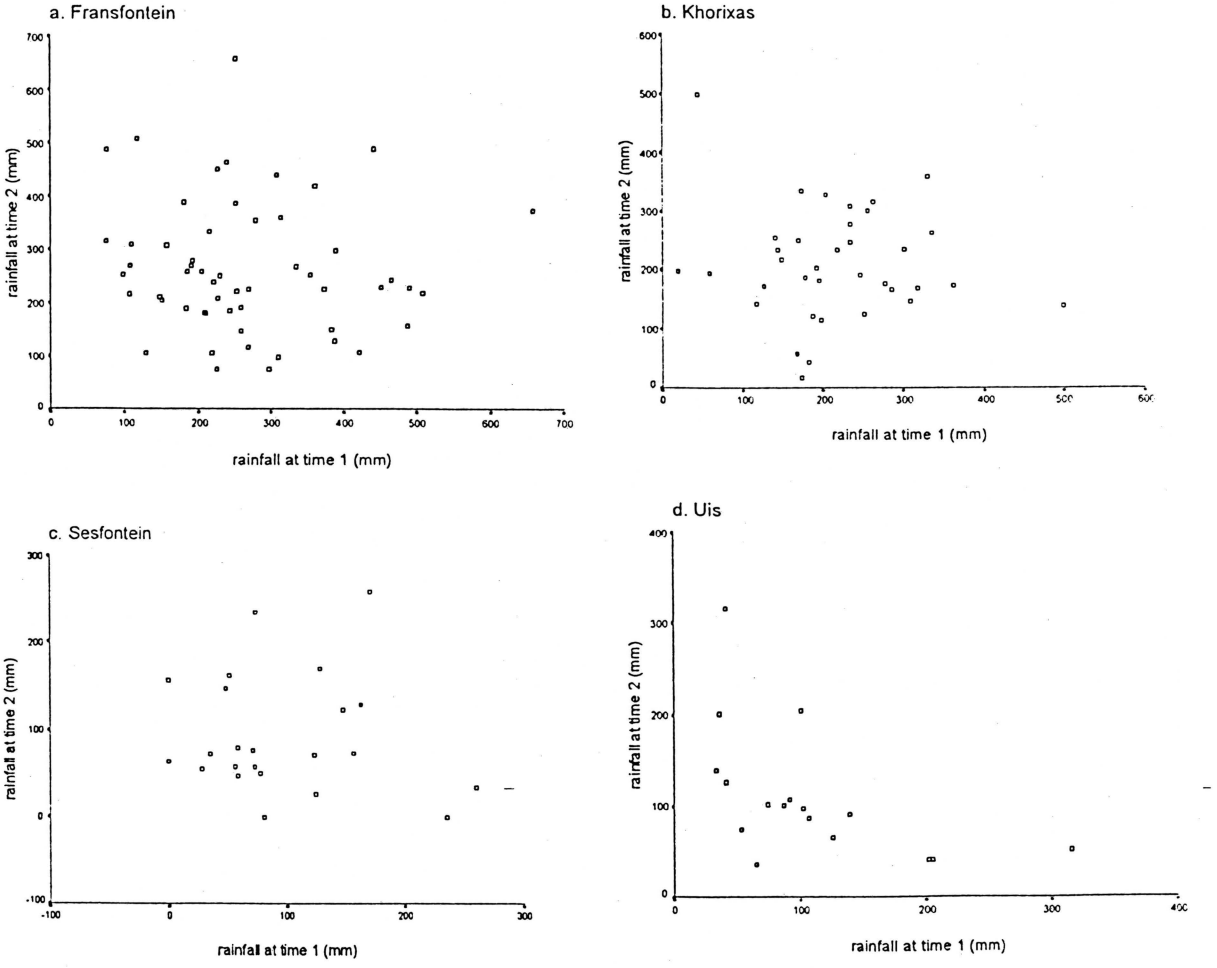
Source: Climate Research Unit, University of East Anglia.

The unpredictable nature of rainfall through time and space is also significant. The temporal dimension of this unpredictability can be illustrated by the lack of correlation between rainfall from one year to the next; as Figures 1.4a to d show, plotting the rainfall at time $t = 2$ against time $t = 1$ generally results in a random distribution with only the data from Uis having a significant, but relatively weak, negative correlation (Pearson correlation coefficient (r) = -0.52, p=0.03 compared with r = -0.08, p=0.58, -0.09, p=0.60 and -0.08, p=0.70 for Fransfontein, Khorixas and Sesfontein respectively; Caughley

(1987: 159) similarly records a serial correlation between successive years of only r = 0.13 for 100 years of rainfall data for Australian sheep rangelands).

Nevertheless, attempts have frequently been made to demonstrate periodicity in rainfall patterns in dryland Africa. Tyson (1986: 12, 68), for example, maintains that a weak 18-year oscillatory cycle of wet and dry periods is displayed by data from this century for east and central southern Africa which he considers 'a systematic non-random component of variation'. At best, however, these cycles only account for some 20-30% of the variance in local rainfall since the turn of the century (Tyson, 1986: 12) and the random variability dominating southern African rainfall patterns, particularly at the drier end of the scale, overshadows any predictive power these oscillatory cycles may possess. Namibia has a tendency for a 6-year cycle (Tyson, 1986: 197) and Rohde (1997b, Chapters 7 and 8) maintains that many rainfall stations for the north-west show an increase in rainfall in the first half of this century followed by a run of relatively dry years since the 1950s.

• Figure 1.4a-d. Annual rainfall for successive years plotted against each other (i.e. year 1 and year 2 form an x-y coordinate, year 2 and year 3 form an x-y coordinate, and so on) for a. Fransfontein, b. Khorixas, c. Sesfontein and d. Uis.

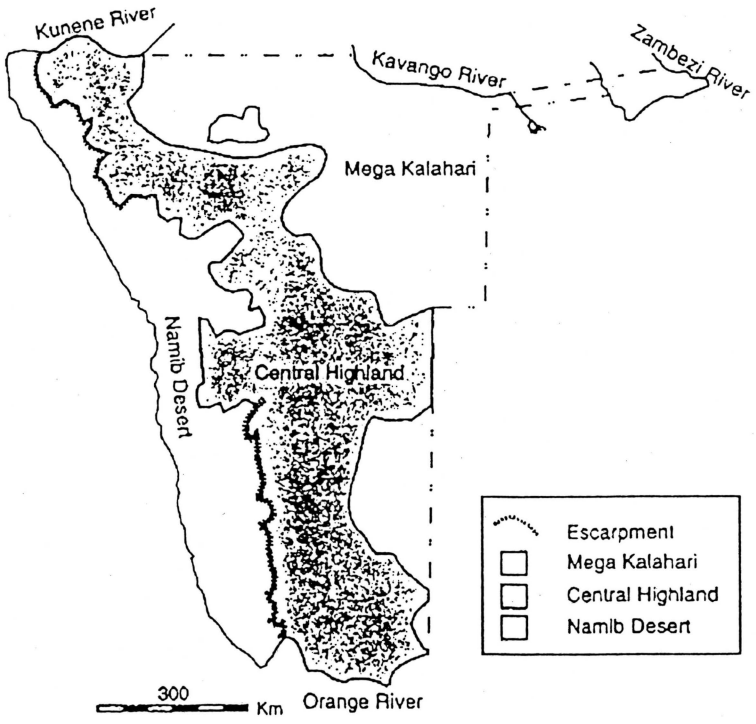


- Accompanying this low and variable rainfall are extremely high evapotranspiration rates, estimated in the region of 2000-3000mm a^{-1} (Infoscience, 1994: 8). This combination of factors means that, as is characteristic for dryland areas, environmental productivity is primarily moisture, as opposed to, nutrient limited.
- Temperatures are characterised by high diurnal and seasonal variations and are generally lowest during the dry months and hottest in the rainy season, especially in the drier areas where average temperatures of 35°C occur.

Topography

The land-surface of Namibia consists broadly of an inland mountainous plateau, which stretches into the north-west where it forms broken mountain ranges of calcretaceous rock, surrounded by the flat desert plains comprising the Namib Desert in the west, the relatively infertile sandveld of the Kalahari Desert in the east, and the Cuvelai flood-plain in the north (cf. Mabbutt, 1952: 335-337; Moorsom, 1982: 11) (see Map 1.7). The so-called Transitional Plains lying to the west of the plateau's escarpment are physically connected with the Namib Coastal Plain, and are broken by geologically youthful granitic inselbergs which support an interesting flora displaying a high incidence of endemics or near-endemics. The largest of these intrusions, and the highest mountain in Namibia, is the Brandberg or **Dâures**. Several westward flowing ephemeral rivers, including the Hoanib, Huab (and its tributary the Aba-Huab) and the Ugab within the study area, traverse these morphological regions, forming deeply incised valleys with many large tributaries and, particularly in the case of the Hoanib and Hoarusib rivers, surrounded by flat floodplains of fertile alluvial sands and silts.

• Map 1.7. Main topographic areas.



Source: Erkkilä and Siiskonen, 1992: 20.

Soils

Soils in Namibia are generally infertile, often with a low water-retention capacity which further limits the potential for dryland agriculture. Topography is the main factor determining soil formation (Erkkilä and Siiskonen, 1992: 22); thus lithosols characterise the central highland area, arenosols are dominant in the eastern Kalahari sandveld, and weakly developed soils, often with no B-horizon, are found in the Namib.

1.4.2 Biotic environment

Vegetation

Within the regions recognised by White (1983) Namibia falls across three main phytochoria, which broadly follow the northern and north-eastern increase in rainfall as illustrated by the pattern of rainfall isohyets across Namibia (see Map 1.6). These are:

1) the Karoo[14]-Namib Region, occurring in the south and west and characterised by two major subdivisions, Kalahari deciduous *Acacia* bushland and wooded grassland, and Namib Desert;

2) the Kalahari-Highveld transition zone in the central and eastern areas of the country;

3) and the Zambesian regional centre of endemism, in the north-central and north-eastern regions.

Giess (1971) has further divided these phytochoria into vegetation zones for Namibia as illustrated by Map 1.8.

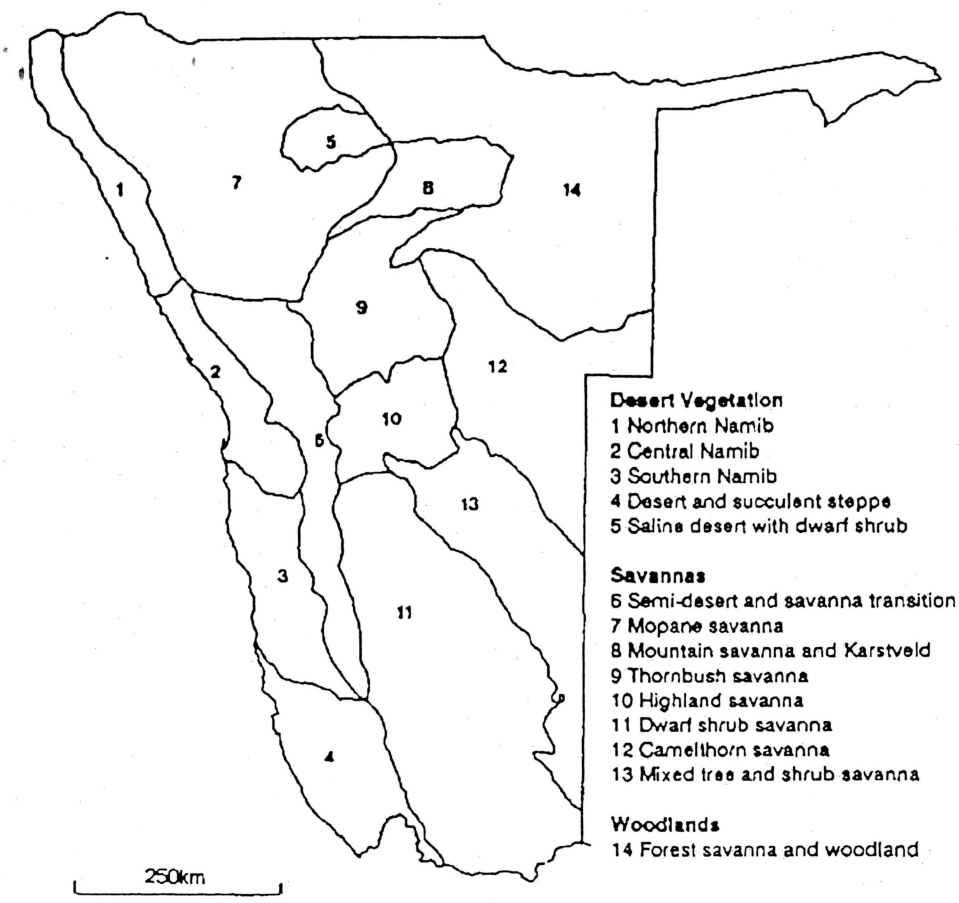
The highest species diversity is found in the Zambezian regional centre of endemism in the north and north-east, and the lowest diversity in the arid Karoo-Namib centre for endemism (Cunningham, 1992: 120). This reflects the effect of a gradient of declining rainfall and increasing evapotranspiration from east to west across southern Africa and its impact on species diversity (see, for example, O'Brien, 1988; Cowling *et al*, 1994).

The vegetation of the former Damaraland can be described as extremely varied in structure, physiognomy and species composition, reflecting diverse topographic factors and related soil and micro-climate characteristics. Floristically the area is normally considered part of the Karoo-Namib biogeographical Region, characterised by a high incidence of succulent life-forms (Werger, 1978a: 145-170; White, 1983), the drier west of the area extending into the northern section of the Namib desert (Walter, 1986).

---

[14] Nb. Karoo is also spelt 'Karroo'; both forms are used here, reflecting the choice of spelling used in the documents drawn on at the relevant parts of the thesis.

• Map 1.8. Vegetation of Namibia following Giess (1971).



source: du Plessis, 1992: 135.

Despite this classification, the north-western area is highly individual having many taxa of the Sudano-Zambezian Region, particularly along wider ephemeral river valleys (Werger, 1978b: 234). These include *Ficus sycomorus* (Moraceae) [15], *Plicosepalus kalachariensis* (Loranthaceae), *Acacia erioloba*, *Faidherbia albida*, and *Mundulea sericea* (Fabaceae), *Ziziphus mucronata* (Rhamnaceae), *Salvadora persica* (Salvadoraceae), *Grewia bicolor* (Tiliaceae), *Cordia sinensis* (= *C. gharaf*) (Boraginaceae), *Sterculia quinqueloba* (Sterculiaceae), *Boscia albitrunca* (Capparaceae), *Combretum apiculatum* and *C. imberbe* (Combretaceae) (Nordenstam, 1974: 57). Jürgens (1991: 21, 30-32) has thus redefined the area as the 'Damaraland-Kaokoland Domain' within his Nama-Karoo phytogeographical Region, using species such as *Maerua schinzii* and *Boscia foetida* (Capparaceae), *Moringa ovalifolia* (Moringaceae), and *Euphorbia virosa* (Euphorbiaceae) as indicators.

The north-west is also a focus for endemism (Maggs *et al*, 1994: 97-98) where endemic or near-endemic elements include *Acacia robynsiana* and *A. montis-usti* (Fabaceae), *Commiphora giessii* and *C. kraeuseliana* (Burseraceae) and *Sesamothamnus guerichii* (Pedaliaceae). Nordenstam (1974: 58) describes the 'Kaoko element' as an interesting

[15] Species family names are included in this initial overview of the vegetation of the study area but not elsewhere in the thesis. See also Appendix 1.

phytogeographical group confined to southern Angola and north-west Namibia, comprised of well-defined species which can be considered as 'epibiotic relic elements'. Taxonomically isolated, monotypic genera include *Welwitschia* (Welwitschiaceae), *Phlyctidocarpa* (Apiaceae), and *Kaokochloa* (Poaceae). Other well-defined species with their phytogeographic centre north of the Brandberg include *Acacia robynsiana* (Fabaceae), *Balanites welwitschii*, and many *Petalidium* species. (Acanthaceae). The Brandberg flora, although occurring to the south of the Kaokoveld phytogeographic centre, contains 28 species belonging to the Kaoko element, comprising more than 8% of its flora (Nordenstam, 1974: 57). More than 25 species recorded for the Brandberg by Nordenstam (1974: 60, 63), are considered the remains of an old Afro-arid flora, and have a markedly disjunct distribution between the arid areas of both the Karroo-Namib region and both the Sahalian-Oriental domain of the Sudano-Zambesian region, and the adjacent Saharo-Sindian region.

According to Giess' Vegetation Map of Namibia the former Damaraland area occupies primarily two broad vegetation categories: the Semi-Desert and Savanna Transition zone in the south, and Mopane Savanna in the north (1971: 9-10). Typical of the former are *Moringa ovalifolia* (Moringaceae), *Adenolobus garipensis* and *A. pechuelii*, and *Acacia montis-usti*, *A. robynsiana*, *A. senegal* var. *rostrata*, and *A. tortilis* subsp. *heteracantha* (Fabaceae), *Euphorbia guerichiana* (Euphorbiaceae), and *Cyphostemma* spp. (Vitaceae). The latter vegetation zone is characterised by *Colophospermum mopane* (Fabaceae), occurring as a tree or shrub depending on local conditions and, with its relatively shallow root system, able to compete in areas where moisture accumulates at shallow depth (cf. Cole, 1986: 116; Giess and Tinley, 1968: 251-252). It also has many representatives of the family Acanthaceae. Both zones have a uniquely high diversity of the genus *Commiphora* (Burseraceae) on rocky substrates (cf. Van der Walt, 1974).

As proposed by Walter (1986: 262) for the central Namib, the diverse geomorphological features of this area thus influence regional vegetation types (see Sullivan, 1993a; Sullivan and Konstant, 1997; Cowlishaw and Davies, 1997; discussed in more detail in Chapter 5) and provide habitats of varying importance for human and livestock subsistence.

Animal wildlife

The area is host to a high diversity of animal wildlife with, for example, some 81, 176, and 101 species of mammals, birds and reptiles respectively recorded for the Huab catchment area alone (Brown, 1993; Griffin *et al.*, 1993a, 1993b). It is well-known for its desert-dwelling populations of elephant (*Loxodonta africana*), black rhino (*Diceros bicornis bicornis*) and the endemic Hartmann's zebra (*Equus zebra hartmannae*). Elephant and chacma baboons (*Papio ursinus*) directly impinge on farmers' lives and production systems, and conflict between animal wildlife and human populations is an important conservation issue in this area. Communal farmers currently have no legal entitlement to these animal resources. As discussed in Chapter 4, The Ministry of Environment and Tourism is, however, engaged in

the process of developing and implementing schemes and legislation which will confer rights to wildlife by local people, in the belief that local income generation from projects related to animal wildlife (i.e. primarily in the tourism sector) will promote the long-term conservation of these natural resources (Jones, 1993: 48).

Chapter summary

The aim of this chapter has been to provide a context for the following analysis and discussion of natural resource-use by Damara farmers in north-west Namibia, and the ecological effects of this use within the region. The following points have been emphasised:

1) Uncritical interpretation of early historical observations and 'missionary ethnography' relating to the Damara has hampered contemporary understanding of the relationship between natural resource-use and other sources of livelihood, particularly livestock.

2) Similarly, currently utilised local knowledge and management practice relating to land and natural resources can only be understood in relation to institutionalised processes of land alienation under the imposed administrations of this century.

3) Damara livelihoods in north-west Namibia today, while structured primarily by the herding of livestock, incorporate diverse sources of income and subsistence.

4) Low and variable rainfall constitutes the most important constraint on primary productivity, and therefore herding and other resource-use activities, within the region. At the same time, a diverse indigenous flora and fauna with a high endemic element raises the conservation value of this semi-arid area and provides important resources utilised by local farmers.

Chapter 2

Assessing plant resource use: background, research questions and methods

The aims of this chapter are to introduce relevant issues regarding the household use of gathered natural resources in dryland areas, and to build a methodology for exploring current patterns of use of these resources by Damara farmers in the arid environment of north-west Namibia. Management practice infusing this use, and its implications for natural resource-based development and conservation intervention and policy reform, is omitted at this stage but is the focus for discussion in Chapter 4.

The chapter is divided into five sections. First, there is a brief background describing some factors guiding increasing interest in gathered resources, and biases constraining an understanding of the contribution of these resources to subsistence in dryland areas. This is followed by a review of existing studies regarding domestic uses of natural resources by both pastoralist and so-called 'hunter-gatherer' societies inhabiting dryland areas in sub-Saharan Africa and Australia. Third is a review of both historical references which emphasise the dependence of the Damara on gathered resources, and of recent ethnobotanical sources which catalogue traditional knowledge and uses of a range of plant species by Namibia's diversity of indigenous cultures. The limitations of these existing studies are discussed, while stressing the potentially valuable role that standardised and in-depth information regarding contemporary natural resource-use can play. This range of background information was used in the development of appropriate research questions which were tested using field data and these form the focus for the fourth section of this chapter. Finally, the field methods employed to generate the information needed to explore these questions with regard to Damara farmers are described.

2.1 Background: a focus on the domestic uses of natural resources

The complementary role of gathered plant resources[1] to rural livelihoods otherwise based on the cultivation of crops and/or livestock herding has received increasing attention in recent years. This is due to the growth of several interrelated areas of interest to academics and professionals implementing development and conservation schemes alike. At the forefront of these are:

1) The growing focus in the 1970s and 1980s on the empirical nature of local 'sociotechnical knowledge' held by rural farmers (cf. Richards, 1985, 1995: 52), and the relationship between 'traditional ecological' and formal scientific knowledge (cf. Baker and Mutitjulu Community, 1992).

---

[1] 'Gathered plant resources' are interpreted here in a general sense as all plant resources used for a variety of purposes which are collected in the environment away from the homestead and brought back to the homestead for consumption. There are a few important exceptions to this general definition which are discussed where appropriate in the text.

2) The recognition that this knowledge may have an extremely important part to play in selecting appropriate species and varieties from indigenous biodiversity for *ex situ* conservation and the development of potentially commercially valuable products (e.g. crop breeds and substances with medicinal value) (cf. Prance, 1991: 209; Bidinger, 1992: 78-80; Cunningham, 1992: 122-123; Richards, 1995: 53).

3) The increasing emphasis on strengthening subsistence and income-generating activities based on the sustainable use of natural resources, as a means of promoting both rural development and nature conservation (cf. the World Conservation Strategy, IUCN, 1980).

Gathered natural resources are now recognised as conferring a wide range of interrelated quantitative and qualitative benefits to their users. These include:

- Contributions to food security through: the direct use of accessible wild foods which, even when utilised in small quantities, may provide essential nutrients and diversify otherwise monotonous diets (cf. Benefice *et al*, 1984: 241-242; Becker, 1986: 61); the sale or exchange of gathered products which increases purchasing power and the ability to obtain alternative foods; and the use of trees as a form of 'savings bank' to be converted into income in response to unexpected contingencies (cf. Chambers and Leach, 1989; Barrow, 1990: 168).
- A source of independence and extra income for women who are often the primary gatherers of uncultivated resources.
- The retention of autonomy through lowering dependence on manufactured goods, imported products and modern medicines.

In addition to these measurable benefits are the less tangible factors of cultural identity and meaning associated with the accepted use of such resources as an integral part of culture and tradition.

2.1.1 Gathered products as 'invisible' resources

One of the main hurdles to the incorporation of natural resources within both academic understanding of subsistence practice, and development and conservation initiatives, is the 'invisible' nature of such resource-use; a quality largely conferred by the perceptions and interests of the outsiders describing, analysing and assessing these systems. For arid areas this 'invisibility' is compounded by two factors, namely, the international focus on forested environments in current debate regarding biodiversity conservation, and the tendency throughout the literature regarding pastoral production systems to construct an understanding of these systems which is essentially patriarchal and overlooks areas of pastoral life typically associated with women. These factors are discussed separately below.

Forest versus *drylands*

Much of the existing literature concerning the role played by gathered plant products in subsistence focuses on communities living in forest and forest-edge ecosystems. A major development in this literature is the recognition that non-timber forest products (NTFPs), rather than the timber, pulp and fuel resources of forests, may represent a major as opposed to a minor contribution to people's livelihoods in these areas, and that ethnobotanical inventory is therefore essential in providing justification for conservation of these environments as well as indicating possible avenues for the commercial development of individual species (see, for example, Prance *et al*, 1987; Longhurst, 1991; Prance, 1991: 210; Falconer, 1990; Falconer and Arnold, 1991; Evers, 1994b; Schreckenberg, 1994). In addition, economic analyses indicate that the harvesting of NTFPs may in fact yield greater long-term monetary value than logging for timber (Peters *et al*, 1989), but these results remain controversial.

A great deal of the work on the importance of NTFPs has arisen in response to international (especially 'First World') interest in the conservation value of tropical forests, and, in particular, rain forest. This emphasises tropical forests as centres of biodiversity and endemism, their perceived functional significance in maintaining the balance of atmospheric carbon dioxide and oxygen, and the possibility that they may contain species which will provide the chemical blueprint for drugs to treat life-threatening disease. Concern regarding the fate of indigenous tropical forests throughout the world, together with a growing recognition that conservation aims will enjoy long-term success only if local people perceive that they will benefit from such projects, has stimulated efforts at community involvement in conservation in these environments. The harvesting of NTFPs in forest reserves by local people is one way in which the conservation of forested areas may be promoted alongside local development. Examples of such an initiative are the 'extractive reserves' of Amazonia, developed as a means of conserving the forest while enhancing the region's economy (Hecht and Cockburn, 1989; Mendes, 1989: 41; Eden, 1990: 211; May, 1991). In many forest reserves, however, access by local people for the purpose of harvesting forest resources remains forbidden. In other areas the vast majority of useful forest products come from secondary forest regrowth and fields rather than the core forest areas of high conservation value, raising the pressure for conversion of such areas into habitats with local use-value (Davies and Richards, 1991; Evers, 1994b; Hartley, 1992; Schreckenberg, 1994).

Many of the concepts and assumptions developed with regard to tropical forests, in terms of the ecology of the resources used, the management systems surrounding their use and the problems regarding their conservation, are not, however, directly transferable to dry savanna and arid environments. Economic models which derive monetary values for gathered resources based on average annual harvesting rates, for example, are inherently inappropriate for arid areas where primary productivity, and therefore resource availability, is driven by rainfall variability and is extremely unpredictable (these issues are discussed further

in Chapter 8). At the same time, the growth of formal ecological knowledge concerning the dynamics of dryland systems has, according to some (cf. Stott, 1994, pers. comm.), been hampered by the focus within the scientific community on forest systems. The effect on dryland resource-use systems has been the imposition over the last three decades of a plethora of multi- and bilateral-aid projects and State interventions, which are based on inappropriate ecological assumptions and have caused dramatic changes in the management of such environments with very few successful outcomes (cf. Swift, 1977: 263; Raikes, 1981; Niamir, 1990: 1; Jowkar *et al*, 1991: vii; Homewood, 1992). Confusion may also arise in the description of open savanna woodlands and rangelands as 'dry forests' (cf. Shepherd, 1992), which subsumes dryland environments within a framework assuming their continuous ecological relationship with tropical forests, implying a status of 'poor relation' to true tropical forest.

A gendered perspective: women as users and managers of natural resources

The growing focus on subsistence and survival strategies which incorporate gathered natural resources necessarily involves a gender dimension because it entails a shift towards domains of productivity typically associated with women. Today it is recognised that women are often the primary producers and distributors of food in subsistence societies and should be involved as such by development initiatives (Talle, 1987: 51; Agarwal, 1989: 46). Unfortunately, many projects, by focusing on men as the main recipients, have acted to reduce women's access to productive resources and, by not utilising women's knowledge of the local environment, may have caused undesirable ecological change (see, for example, Waters-Bayer, 1985: 9, 22; Carney, 1988: 345-347, 345-6; Lane and Swift, 1989: 4; Monimart, 1989: 12; Whitehead, 1990: 54, 62; Joekes and Pointing, 1991: 5-6). The importance of such a focus on women's role in household subsistence, including the productive and consumptive use of natural resources, is enhanced by the overwhelming conclusion during the UN Decade for Women (1980s) that, 'with few exceptions, women's relative access to economic resources, incomes and employment has worsened, their burden of work has increased, and their relative and even absolute health, nutritional and educational status has declined' (DAWN, 1985).

In arid or semi-arid areas, this gender dimension is underscored by the tendency in conventional analyses of livestock-keeping societies to understand productivity and cultural life in terms of their association with men. This has acted to marginalise the role of, and status accruing to, women as producers and decision-makers in all areas of pastoral life, as well as the significance of gathered natural resources, particularly plants, with which women tend to be linked. This is not to say that men do not have a depth of knowledge of the plant and other natural resources derived from their environment. On the contrary, it is to suggest that the value of these resources is overlooked because of an inclination on the part of the (usually western) researcher to conceptualise them as constituents of a female, and thus relatively unimportant, domain of the natural world.

In recent years there has been a (radical) reassessment of the underlying, typically patriarchal, assumptions regarding sub-Saharan pastoralist production systems (see, for example, Hodgson, forthcoming for 1998). Jowkar *et al* (1991: vii), pinpoint the assumption of a 'patriarchal organisation of pastoral life that secludes women and assigns them to economically marginal roles' as one of the fundamental reasons why many dryland development initiatives have failed in sub-Saharan Africa. Particular emphasis has now been extended to the role of women as managers and decision-makers regarding the milking of animals and the distribution of this primary subsistence item, the means by which they have ownership over animals, and the authority over consumption, production and social and biological reproduction conferred on them as 'heads of houses' (some examples include, Broch-Due *et al*, 1981: 252-3; Grandin, 1988: 1; Dahl, 1981: 207; Horowitz, 1981: 85; Talle, 1987: 64, 1990; Joekes and Pointing, 1991: 6, 11-12). There is also an increasing interest in the specific role that women can play in understanding and preventing environmental degradation in drylands (Monimart, 1989; Evers, 1994a).

2.2 Arid land plant resource use: an overview

As stated above, the role of gathered natural resources in the subsistence repertoire of pastoralist groups in drylands has been neglected. An increasing international focus on 'useful plants' from arid and semi-arid areas is suggested, however, in the recent development of a database by Kew's Economic Botany Unit for the 'Survey of Economic Plants of Arid and Semi-arid Lands' (SEPASAL), which emphasises so-called wild species. Table 2.1 indicates that a wide range of indigenous plant species are used by pastoralist groups for a variety of subsistence purposes. Unfortunately, as is the tendency throughout the ethnobotanical literature concerning wild plant use (cf. Williamson, 1956; Gilmore, 1977; Malaisse and Parent, 1985; Hines and Eckman, 1993), few of these studies include any standardised information concerning the degree of current use of these species. Thus, despite the wealth of descriptive information that these studies have procured regarding the potential uses of large numbers of indigenous species, their practical value is limited by the lack of any form of quantitative data regarding the extent, and day-to-day contemporary value, of this resource use (see also Prance *et al*, 1987: 297; Johns *et al*, 1989: 370). This situation is confounded by the relative paucity of research information focusing specifically on the study of gathered plant resources by livestock-keeping peoples in arid areas, and the difficulties associated with accurately assessing levels of use of resources whose availability may be widely dispersed both in time and space.

These problems not withstanding, a number of broad features concerning patterns of arid land plant use can be discerned:

• Table 2.1. Summary of a range of ethnobotanical information, listed chronologically, derived from literature sources for societies inhabiting dryland environments in sub-Saharan Africa and Australia.

ethnic group	geographic location	mean rainfall	subsistence	scope of work					reference
sub-Saharan Africa:						level of identification			
					total	species	genus	family	
Maasai and Kipsigis	Kenya		pastoralists	uses for 234 plant species, many with multiple uses, listed under 13 use-categories					Glover *et al*., 1966
						M K			
				food		84 51			
				beer additives		3 0			
				firemaking		3 1			
				general utility		18 15			
				dye		8 2			
				string/rope		31 21			
				building		41 39			
				furniture		13 15			
				weapons		27 10			
				ornamentation		7 3			
				hypgiene		7 6			
				ceremony/games		8 3			
				problem plants		5 2			
ǀGwi and ǁGana San	≠Kade pan area, central Kalahari	170-700mm	hunter-gatherer-smallstock pastoralists	analysis of contribution of plant foods to diets					Tanaka, 1976
				food:	79	56	11		
				major food	13	11	2		
				minor food	7	5	2		
				supplementary food	15	11	4		
				rare food	28	27	1		
				probable food	16	2	2		
Bantu-speaking Tswana	eastern Kalahari, Botswana	513.4mm	agro-pastoral-hunter-gatherers	collection of species and discussion/observation of food uses					Grivetti, 1979
				food:					
				plants	123	55	18		
				fungi	3	1	2		
				insects	15	5		2	
!Kung San	Dobe area, western Kalahari		hunter-gatherer	analysis of contribution of plant foods to diets					Lee, 1979
				food:	105				
				primary food	1	1			
				major food	13	13			
				minor food	19	12	6		
				supplementary food	30	23	6	1	
				rare food	19	13	6		
				probable food	23	7	8	2	cont'd...

• Table 2.1 cont'd.

ethnic group	geographic location	mean rainfall	subsistence	scope of work	total	species	genus	family	reference
Turkana	north Kenya	250mm	pastoralists	252 of 512 collected plant species or subspecies given vernacular names and uses discussed					Morgan, 1981
				food:	53				
				medicine:	11				
				domestic uses:	65				
				decoration/adornment:	15				
				forage:					
				goats	187				
				cattle	102				
				donkeys	120				
Pokot	north Kenya	semi-arid	pastoralists	of 307 identified plant species:					Tanaka, 1981 *in* Barrow, 1988
				food:	61				
				medicine:	118				
Turkana, Samburu and Ferlo	north Kenya and north Senegal	100-600mm	pastoralists	field interviews focusing on the use of food plants:					Becker, 1986
				Turkana	80				
				Samburu	170				
				Ferlo	20				
				literature survey of wild food use in Sahelian zone revealing nearly 800 food plants					
pastoralist groups	arid and semi-arid areas of Kenya	<200-500mm	pastoralists	names and food uses of edible roots (I e. roots tubers, rhizomes, bulbs) identified from review of published and unpublished sources					Kabuye, 1986
				roots	52	49	3		
various compared	Botswana general	semi-arid	various compared	literature survey of 75 species of wild food utilised by various groups throughout Botswana					Campbell, 1986
Gabra	north Kenya	150-200mm	camel-keeping pastoralist	field interviews and collections of plant specimens for which local names and uses identified, and an indication of their importance for different uses given					Stiles and Kassam, 1991
				livestock fodder:					
				camels		24	1		
				cattle		9			
				goats		23	1		
				sheep		16	2		
				livestock medicines		8	1		
				firewood: 40 Gabra taxa used					
				construction: 18 Gabra taxa used		21			
				objects of material culture		32			
				food		17			
				medicine:		19			
Australia:									
Alyawara	central Australia	300mm	pre-European contact = hunting and gathering	'a descriptive summary of information on traditional and modern uses of native plants' (p. 80), including nutritional information and energy returns per unit time spent collecting and processing for food species					O'Connell *et al*. 1983
				food		92			
				medicines/narcotics		28			
				tools, weapons etc		10			
Martujarra	Little Sandy Desert, Western Australia		pre-European contact = hunting and gathering	discussion of food plants regarding 'those used as staples versus those used opportunistically' discussed in relation to availability and predictability of a food					Veth and Walsh, 1988
				food		89			
Western Aranda			pre-European contact, hunting and gathering	food		77			Latz, 1995

Food

1) The consumption of plant foods has a strongly seasonal dynamic. This is related to both the varying availability of resources (Peters *et al*, 1984: 397), and the changing needs of resource-users.

2) Related to the above, it is generally considered that the majority of gathered foods are consumed during dry periods, either as dry season foods or as famine foods eaten only as a result of extended drought conditions; as such, the contemporary use of gathered food resources is perceived as a response to shortages of more desirable alternatives (cf. Getahun, 1974: 45; Morgan, 1981: 105; Campbell, 1986: 81). During the mid-19th century, for example, the Tswana-speaking Ngwato were observed to disperse into the veld surrounding their villages in order to subsist from wild fruits and animal wildlife during droughts (Mackenzie, 1887: 28-29 *in* Grivetti, 1979: 239). More recently, the nutritious fruits of *Boscia senegaliensis* **(mukheit)** comprised an important famine food due to drought- and war-induced scarcity in Darfur, Sudan (de Waal, 1989: 19). For the West African Sahel, the consumption of wild foods out of necessity has been similarly emphasised by Becker (1986: 61) and Benefice *et al* (1984: 245), who describe the importance of leaves of *Cyphostemma maranguensis* and *Cassia obtusifolia* (= *Senna obtusifolia*), and of *Cassia tora*, among the Peulh and Ferlo Fulani of Senegal respectively. These foods are eaten at the beginning of the wet season which corresponds with the period of lowest staple food supply. In contrast however, Grivetti (1979: 248-251) observes that the majority of gathered plant foods consumed by the Tswana-speaking Tlokwa of the eastern Kalahari are utilised when their availability is greatest, i.e. during the rain season between October and March.

3) The use of gathered plant foods is considered to have a strong socio-economic component in that they are generally considered consumed by the poor in *lieu* of access to preferred animal or other food products. McGregor (1995: 163), for example, observed for a communal area in Zimbabawe that 'Poorer households are more dependent on consumption, sale and other use of woodland and other gathered produce than are wealthy households'. This is related to the general view that gathered plant foods are primarily utilised out of necessity induced by seasonal and inter-annual variations in climate. This perception of gathered produce as a 'poor man's food' has strong historical roots (cf. observations of wild food use by impoverished Tswana-speaking Tlhaping of the eastern Kalahari by Lichtenstein in the early 1800s (Lichtenstein 1970 *in* Grivetti, 1979: 237)).

Timber use for fuel and construction purposes

4) While local vegetation supplies pastoralists with fuelwood and building materials, the use of woody species by pastoralists in arid areas tends to be extremely conservative. It is characterised by the use of dead wood for firewood, over-abundant and low-value

shrubby species for kraal fences, the cutting of species in ways which allow, and may even promote, further growth, and the conservation of species with high use-values and/or cultural significance (cf. Niamir, 1990: 2; Shepherd, 1992: 20-21). As Barrow (1988: 7) describes for the Pokot and Turkana of north Kenya, these groups 'attach great value to trees and will rarely cut a valuable tree. Trees are used on a sustained conserved basis' (see also Barrow, 1990: 167). Concern has been expressed, however, that a trend towards constructing more substantial modern square houses associated with increasing sedentarisation may lead to higher and possibly unsustainable rates of timber harvesting (Brokensha and Riley, 1986: 77; Ensminger *et al*, n.d.: 134).

2.3 A history of references to gathered resource use by the Damara

Abundant references to the use of gathered resources by the Damara can be found in the missionary and colonial ethnography of the late 19th and early 20th centuries. Alexander (1838: 133), for example, on encountering so-called 'Hill Damara' near the Kuiseb River in the west of the Khomas Hochland mountains observed that their diet consisted of 'mice, lizards, roots and sometimes leaves'. Van Reenen (*in* Mossop, 1935: 315) asserts that the 'Damrassen' have 'neither sheep nor cattle and for their sustenance enjoy nothing other than the roots and bulbs and gum from thorn trees. They normally exist on these victuals' (quoted *in* Fuller, 1993: 87). Similarly, Büttner (1879: 288-289) states that 'their proper sustenance they get from the so-called "veldkost"' and that their 'principal nourishment is locusts and uintjies' (i.e. corms and bulbs) as well as honey, seeds and caterpillars. Hahn (1928: 223) also describes how, on arriving at Okombahe in 1871, 'many ("Berg-Damaras") were out in the field seeking "veldkost", namely wild roots, honey ...' and Vedder (1928: 42, 49, 60, 77) wrote copiously about Damara use of bulbs, fruits, seeds, honey, locusts, termites and game, asserting the nutritional value of such foods in preventing conditions such as scurvy. Most plant foods were gathered at the end of the rain season (Vedder, 1928: 60). Von François (1896: 249-250 *in* Steyn and du Pisani, 1984/1985: 39) lists the Damara names of roots, bulbs, berries, fruits, resins and what he describes as a *Euphorbia* sp. consumed by the Damara (probably *Hoodia* spp.), and states that the availability of 'ointjies' was so important that it played a role in determining settlement location. The significance of bulbs is also indicated by their high exchange value (Büttner, 1879: 289), their apparent role in the payment of bridewealth prior to marriage (Alexander, 1838: 137), and the ritual-tasting of this food by men and Headmen at the time of harvesting of bulbous foods (Vedder, 1923: 66 *in* Steyn and du Pisani, 1984/1985: 39-40). With regard to the collection of 'veldfoods', Vedder states that it is primarily the task of women but that men do some collecting. An unusual resource-use practice highlighted by Vedder (cf. 1923: 71-73; 1928: 60) is the collection of grass seeds from harvester ant nests.

While some of these observations are transcribed in considerable detail, their anecdotal nature, and the inescapable fact that the interpretation of resource-use practices reflects the prejudices of their missionary and explorer authors, means that without considerable deconstruction this

type of information has little relevance for an understanding of the contemporary role of gathered resources in household livelihoods. As described in Chapter 1, the implied poverty of both subsistence and cultural life extrapolated from such observations of the 'Damara', needs to be viewed with serious caution. In particular: it overlooks the reality of historical processes during the 18th and 19th centuries which acted to impoverish and marginalise the Damara; it does not accord well with the numerous historical records of widespread livestock-herding attributed to Damara groups; and it ignores the problems associated with extending accounts of isolated groups of Damara to what were in fact a complexity of interrelated 'clans' or polities characterised by socioeconomic differentiation and extending throughout a territory which is now Namibia.

So, for example, while emphasising that the Damara are hunter-gatherers who have only gained meagre herds through contact with other Namibian groups, Vedder (1928: 46) completely denigrates their medical knowledge of plants and other natural resources in the assertion that; 'The medical knowledge of the Berg Damara is extraordinarily small and there is hardly even a moderate knowledge of medical field herbs, excepting in the case of some person, who has grown up amongst the Hottentots, Hereros or Bushmen and derived from them some knowledge of the application of herbs'. Recent uncritical iteration of this statement by the contemporary Namibian scholar Mbuende (1986: 35) emphasises the reality of problems generated by using pre-colonial ethnography to inform understanding of natural resource-use practices. Again, while Vedder continually negates the idea that the Damara manage environmental resources through accepted practices constraining their use of gathered products, he makes frequent reference to such practices. He describes, for example, the way that 'a women will never strip a bush of all its fruit, even if it is plentiful', and how the initial finder of a beehive is respected as the 'owner' of that hive and expected to harvest honey in a restrained manner which ensures the indefinite survival of the hive (1928: 60, 73).

Ethnoecological approaches are currently recognised in Namibia as an important element of a multidisciplinary approach to the conservation of biodiversity (cf. Maggs *et al*, 1994: 101). In recent years, however, interest in gathered resources, particularly plants, has focused on collecting local knowledge regarding identified species in a research effort which amounts to a process of extraction and cataloguing of this knowledge, before it is lost as elder members of the various indigenous Namibian groups die. This reactive type of ethnobotany has the unfortunate, if unintentional, effect of continuing the tradition begun by the 'missionary ethnographers' of collecting what amounts to a memorabilia of interesting past traditions, without situating this information within a context of subsistence and culture which has meaning under current socio-political and ecological circumstances. So, as listed in Tables 2.2a and b, ethnobotanical effort in recent years has resulted in the production of numerous lists of apparently useful and culturally significant resources, without any information concerning current levels of utilisation of these resources or numbers of informants confirming this information.

• Table 2.2a and b. Summary of Namibian ethnobotanical literature which is based on field data collected in the country's arid and semi-arid areas and which includes scientific plant names, presented for a. Namibian groups excluding Khoe-speaking groups, and b. Khoe-speaking groups. The numbers represent the number of species recorded by use-category (see key). References are listed chronologically. Information for vascular plants only is presented; some naturalised species are included but the vast majority are indigenous plants. Use-categories are largely based on those identified by Malan and Owen-Smith (1974: 164-165).

KEY: F = livestock forage; F/B = food/beverages; CSF = curdling, separating and fermentation agents; M = medicine; M-R = magico-religious, symbolic; T/P = toxins/poisons; H/C = hygiene and cosmetics, including perfume, body powder, soap and hair cosmetics; B-O = body ornaments; D/T-A = dye or tanning agents; U = utensils, including containers, digging and walking sticks; W = weaponry, including knobkieries, bows and arrows, and other hunting technology; B = building materials, including poles and fibre; F = firewood; O = other, i.e. miscellaneous items. Nb. occasionally species are used for more than one purpose in a single use category, in which case they are recorded only once in this table.

Language/ethnic group	region	scope of information no. species/use category (see key above): F F/B CSF M M-R T/P H/C B-O /T-A U W B F O	reference
29 identified Namibian languages	national	A preliminary list of approximately 2,000 vernacular plant names for some 300 species.	le Roux, 1971
Herero (Himba)	Kaokoland, north-west Kunene Region	local names and uses identified and described for 192 species, in 58 families. 97 40 12 39 19 6 25 4 6 26 11 23 3 20	Malan and Owen-Smith, 1974
Herero (Himba)	Kaokoland, north-west Kunene Region	Mentions the local names and uses of 10 food plants, 9 identified to species level and 1 identified to genus level. - 10 - - - - - - - - - - - - -	Malan, 1974
names in both Khoisan and Bantu Namiblan languages	national	General ethnobotanical information included for some 312 species.	Von Koenen, *ca* 1977
Nharo, central Kalahari San	former Aminuis Reserve, Omaheke Region	Local names identified and uses described for 115 plants identified to species level, 3 identified to genus level and 14 unidentified plants. This information is amplified by reference to uses for 28 and 30 plants in Bleek (1928) and Story (1958) respectively, not included in the following summary of species by use-category in this publication. - 37 1 38 17 - 2 1 2 9 11 - 1 8	Steyn, 1981
Kwanyama Owambo	former Owamboland, north-central Namibia	Local names and uses identified through both fieldwork and literature review for some 338 plants, 330 indentified to species level and 6 and 2 identified to genus and family levels respectively. Several species included separately here fall into generic categories in Kwanyama classification. 57 96 7 109 37 4 31 12 8 37 23 39 10 11	Rodin, 1985
Kwanyama Owambo	Central Owambo; Oshana and Omusati Regions	Local names and uses tabulated and discussed for a total of 48 species, 39 of which are identified to species level, 2 and 3 to genus and family levels respectively, and 4 are unidentified. Household use of these plant products, and their availability in either palm or mopane savanna, and in wet and dry seasons, are assessed for a total of 40 households. - 43 - - - - - - 1 2 - 1 1 -	Sullivan 1993a (based on analysis of unpublished data collected by Hamata and Cunningham)
Himba and Herero	Former Kaokoland, north-west Kunene Region	Local names tabulated for 106 species, of which 3 and 5 are identified to genus and family (Poaceae) levels respectively. No uses are recorded.	EEAN, 1994
Herero	Okakarara, east Otjozondjupa Region	Local names and uses tabulated or discussed in the text for 25 plants, 4 identified to genus level only, and one unidentified species. An attempt is made to place economic values on useful species and habitats through calculating replacement costs of these resources. - 13 1 19 4 - - - - - - 2 1 -	Kajujaha-Matundu, 1994
Owambo	North-central Namibia	Local names listed for 26 species, 3 indigenous genera and 1 exotic genus. Numbers of species within each use-category are derived from the text as follows. 8 7 1 6 1 - - - 1 11 - 5 5 1	Marsh, 1994
Owambo	North-central Namibia	Local names and some uses derived from a literature review of selected sources as well as original field research for 99 species, of which 2 are identified to genus level only and 1 is exotic. 51 6 - - - - - - - - - 1 1 -	Krieke, 1995

• b. Khoe-speaking groups.

KEY: F = livestock forage; F/B = food/beverages; CSF = curdling, separating and fermentation agents; M = medicine; M-R = magico-religious, symbolic; T/P = toxins/poisons; H/C = hygiene and cosmetics, including perfume, body powder, soap and hair cosmetics; B-O = body ornaments; D/T-A = dye or tanning agents; U = utensils, including containers, digging and walking sticks; W = weaponry, including knobkieries, bows and arrows, and other hunting technology; B = building materials, including poles and fibre; F = firewood; 0 = other, i.e. miscellaneous items.

Language/ethnic group	region	scope of information no. species/use category (see key above): F F/B CSF M M-R T/P H/C B-O D/T- U W B F O	reference
Nama and ≠Aonin or Topnaar	the former Namaland 'homeland and Kuiseb River valley	Local names and uses of 82 plants, 73 identified to species level, listed and discussed. 1 27 6 26 1 - 2 2 4 5 1 12 7 14	du Pisani, 1983
Damara	Ugab River, East of the Brandberg mountain (Dâures)	Uses of 36 identified species discussed; local names only included in 3 instances, one of which is not identified botanically. - 28 - - - - 1 1 2 4 - 5 7 -	Steyn and du Pisani, 1984/1985
Khoekhoe languages, i.e. includes Nama, Damara and Hei‖om	not location specific	Khoekhoe names, marked linguistically for tone, are recorded for some 183 plants, 168 identified to species and 15 to genus level respectively.	Eiseb *et al*, 1991
Topnaar, i.e.≠Aonin	1. Lower Kuiseb River	1. The local names and uses of 42 identified and 8 unidentified plants are listed. Voucher specimens for this project are deposited at the National Herbarium, Windhoek, and the DRFN herbarium at Gobabeb, and the numbers for each species listed for reference purposes in this publication. 7 17 7 28 2 2 12 - - 2 - 6 4 1	Van den Eynden *et al*, 1992
	2. Sesfontein, Kunene Region	2. The local names and uses of 53 identified and 13 unidentified plants are listed. 1 32 1 28 1 - 8 2 - 5 1 4 4 1	
Damara	Khowarib settlement, Kunene Region.	For a survey of 13 households, Damara names and uses of local, predominantly woody, plant species are tabulated and discussed Information for a total of 37 species is presented, comprised of 30 and 4 plants identified to species and genus level respectively, and 2 unidentified plants. Information on the use of plants by people is complemented by an ecological assessment of the impacts of use on woody vegetation in the immediate vicinity of the settlement (see also Sullivan and Konstant, 1997). 13 20 - 12 - - - - 6 10 - - - -	Sullivan 1993a, 1993b (based on fieldwork conducted with T.L. Konstant)

While useful in providing a database of information regarding resources with potential contemporary value, this type of approach is unable to inform ongoing initiatives to strengthen community-based management of natural resources and emphasise the current and potential economic value of Namibia's biodiversity (cf. Barnes, 1995; Central Statistics Office, 1995; LaFranchi, 1996), both of which are restricted by the lack of relevant information regarding actual resource-use practices by rural households. Moreover, it may actually hamper such initiatives. For example, a response among Ministry of Environment and Tourism officials when hearing of the aims of this project was to state that 'these people don't gather resources anymore'. This Ministry is intimately involved with the implementation of projects based on community-based management of natural resources, and in the development of policy relating to conferring rights to these resources to farmers in Namibia's communal areas; given the findings of this research (as presented in Chapters 3 and 4), such statements imply extensive misunderstanding of the local resource-use practices forming the foundation for these initiatives.

2.4 Contemporary patterns of gathered resource use: research questions

From the above review of literature concerning gathered resource use in the dryland environments of sub-Saharan Africa in general, and by the Damara in particular, the following research questions were identified:

Utilisation of non-timber resources

1) **Do the Damara currently utilise gathered resources, other than wood for fuel and building purposes, as part of household subsistence?**
   The objectives of this thesis may seem to pre-empt the need for this question. The lack of any information regarding contemporary use of gathered resources and, as described above, the views of government officials at the outset of this work that Damara farmers in north-west Namibia no longer gather resources, however, necessitated the explicit posing of this question.

2) **If it is established that a range of gathered resources are used by Damara farmers as part of contemporary rural livelihoods, how are patterns of use related to seasonal and inter-annual variations in rainfall?**
   More specifically, are gathered foods utilised predominantly as dry season or drought foods consumed in the absence of alternatives as suggested by review of the literature on livestock-keeping groups from elsewhere in sub-Saharan Africa, or does their use correlate more intimately with periods of resource plenty occurring during and immediately following rain periods, as described for Damara along the Ugab River by Vedder (1928: 60) and du Pisani (1978: 15).

3) **If it is established that a range of resources are used, is the extent of their use related to some definition of household wealth?**
   For example, is their use more frequent among poorer households thereby constituting

a 'poor man's food', or conversely, among wealthier households who can command greater power over labour and other resources and can more effectively organise a range of resource-use activities? Or do other, less tangible, factors appear to play a more important role in guiding patterns of gathered resource-use at a household level?

4) **Is there a relationship between the extent of use of gathered resources by households and the land tenure history influencing areas to the north and south of the veterinary cordon fence or 'Red Line'?**
In particular, is the gathering of resources practised more extensively by households north of the Red Line who have a longer and more continuous history associated with this area, compared with those more recently resettled on the 'communalized' commercial and delineated farms in the south of the former Damaraland?

Utilisation of timber products

5) **As has been observed for pastoralists in arid environments elsewhere, can the use of wood for fuel and building purposes be described as conservative relative to rural 'communities' in moister, more consistently productive, environments?**

6) **Can changes in the type of houses built be expected to lead to a higher, and possibly 'unsustainable', use of timber for building poles as is thought to have occurred elsewhere?** In particular, is there a trend towards the construction of more substantial houses requiring greater amounts of larger building poles than previously used?

2.5 Methods

As described in the introduction to this thesis, a blend of qualitative and quantitative approaches were used to explore the extent of gathered resource-use, and the factors influencing this use. Initial familiarity with the area was attained through a short period of fieldwork in 1992 and a pilot study of 3 months in 1994. This allowed the selection of focal households considered representative of different areas of settlement and prepared to participate over a longer period of fieldwork in more detailed discussions regarding the use of gathered resources, and in the monitoring of specific resources utilised. It is recognised that the definition of a 'household unit' is notoriously problematic. The working definition used throughout this project was of all the individuals consuming food prepared at the same cooking fire. This normally comprised individuals related as kin in some way, but could include unrelated individuals such as adopted children and casually employed herders. Focal households in many cases constituted part of larger family clusters or **‖gâudi**, described by Fuller (1993: 142) as 'the unit which collectively controls ownership of productive resources'. 'Cooking units' and **‖gâudi** are not isolated entities, however, but are part of a wider sphere of kin called **|nîkhoen** (Fuller, 1993: 77) which encourages a continual movement of resources and people between households, usually but not exclusively along points of connection characterised by some form of kinship relatedness.

The implications of this fluidity for the management of natural resources are discussed in more detail where relevant to the understanding of specific resource-use issues in Chapters 3 and 4.

A total of 45 households participated in the multi-round resource-use survey of which 21 lived in the settlement of Sesfontein to the north of the 'Red Line', and 24 lived south of the Red Line on former commercial farms and along the Ugab River. As with Fuller's work (1993), these sites represented different sides 'of the most significant social demarcation' in Namibia, i.e. between indirect and direct colonial rule respectively. A series of repeat visits was made to these households from February 1995 to July 1996 at which a range of resource-use activities were discussed and monitored (as described in full below). Discrepancies in the numbers of households included in each visit occurred due to a number of reasons including the high mobility and consequent unavailability of households during survey periods, and logistical problems associated with reaching geographically dispersed settlements.

The use of non-timber gathered resources

Food

The frequency of use of gathered food resources was monitored throughout the study period for a sample comprising a total of 348 and 2017 household and individual diet-days respectively. At each household visit, dietary surveys were carried out in which all foods consumed on both the day of the visit and the previous day were recorded. This allowed analysis of both the contribution of gathered food products to the household diet in terms of the frequency of consumption of these foods, and the relationship between the extent of this use and access to alternative foods. In order to be completely sure that the full range of food resources was represented by these surveys, additional information was also collected regarding the storage of gathered food items within the household. Table 2.3 summarises the sample structure for households and individuals whose food consumption was monitored as part of this component of the project. As outlined in Table 2.4, the visits to households corresponded with a range of variations in climate, and therefore in resource availability; this allowed exploration of the effects of climatic variability on food resource use by Damara farmers in the study area.

Additional information collected at the household level regarding the dietary use of natural resources included assessment of food preferences through the ranking of samples of different foods.

• Table 2.3. Sample structure for households and individuals incorporated in the dietary survey conducted to monitor the use of gathered natural resources for food. (s = standard deviation).

	Feb-95	Apr/May-9	Jun/Jul-95	Oct-95	Jan-96	Mar/Apr-96	Jul-96					
North of 'Red Line' (Sesfontein and environs): 21 households								total	min	max	mean	s
household survey days	21	70	39	26	32	28	24	240				
individual survey days	167	448	221	150	188	162	132	1468	1	17	6.12	5.08
adults	93	228	131	78	102	90	82	804	1	8	3.35	1.67
children	74	220	90	72	86	72	50	664	0	10	2.76	1.93
South of 'Red Line' (former commercial farms in Aba-Huab catchment and settlements along the Ugab): 24 households												
household survey days		22		12	36	38		108				
individual survey days		102		44	143	260		549	1	31	5.08	4.82
adults		62		26	101	134		323	1	14	2.99	2.09
children		40		18	42	126		226	0	17	2.1	2.96
total: 45 households												
household survey days	21	92	39	38	68	66	24	348				
individual survey days	167	550	221	194	331	422	132	2017	1	31	5.8	3.56
adults	93	290	131	104	203	224	82	1127	1	14	3.24	1.82
children	74	260	90	90	128	198	50	890	0	17	2.5	2.32

• Table 2.4. Dates of household survey visits and seasonal conditions during the period February 1995 to July 1996.

date	seasonal conditions
February 1995	end of early 1990s drought
April/May 1995	towards end of exceptional rain season; 200mm rain in Sesfontein, i.e. twice the annual average
June/July 1995	early dry season
October 1995	late dry season
January 1996	onset of drought due to poor 1996 rain season
February/March 1996	late rain season; drought, i.e. an average of 28.8mm recorded at 3 rain gauges established within 5kms of Sesfontein
July 1996	dry season

Medicine

At each survey visit, householders were asked whether they were using, or had stored, any natural-resource-based remedies. Following Prance *et al* (1987: 298) species included under this use-category were those for which application as a remedy for a specific ailment could, in principle, be tested. Species whose healing power seems to rest purely in the symbolic, magico-religious and supernatural realm (cf. Harvey and Armitage, 1961: 194; Kokwaro, 1983: 237-238) were not included in this analysis. It is recognised, however, that the boundaries between these 'naturalistic' and 'personalistic' categories of illness are often blurred (see discussion in Fratkin, 1996: 64, 81-88), although the latter appear to play a minor role in Damara concepts of disease and ill-health. Information of this nature, however, is documented in Annexe 1, where details of how remedies are prepared, dosages and the diseases treated (following Croom, 1983 and Kokwaro, 1983: 238-239) can also be found.

The use of timber resources for fuel and building purposes

Firewood

Household use of firewood was monitored at 14 households from 6 family groups. This sample was limited to the northern settlement of Sesfontein for logistic reasons. The total sample consisted of 26 cooking days on which 179 pieces of firewood were used, the length and circumference of which were measured (cf. Poschen and Eiche, 1986: 11, 13). These were used to calculate the volume of wood used for firewood by each household using the formula:

$$\text{volume} = \text{basal area} \times \text{length} \qquad \text{Equation 2.1}$$

$$\text{where basal area} = \frac{\text{circumference}^2}{4\pi} \qquad \text{Equation 2.2}$$

Building poles

The use of wood for construction purposes was measured for a total of 33 buildings, of which 21 were bedrooms, and 12 were cooking or storage areas. Again, for logistic reasons, the majority of these were in the more permanent field-base of Sesfontein. For each building the total number of poles was counted. The length, circumference and species were recorded for a subsample of this total, usually 10 poles per building; slightly fewer were measured in some cases due to the concealment of poles by plaster made from moistened earth and livestock dung. Only poles used for the walls of buildings were included. Circumference and length measurements were obtained for a total of 279 building poles, and their volumes were calculated using the above formulae.

Analysis

Where appropriate, field data collected using the methods described above were analysed with non-parametric statistical tests using the statistical package SPSS 7.0 for Windows[2].

Botany and ethnotaxonomy

Underpinning all of the work carried out for this thesis, on both the use of natural resources by people and the impacts of people and livestock on the local ecology, was the necessity of learning about the flora of the region from the perspectives of both formal science and traditional ecological knowledge (cf. Prance, 1991: 210). Achieving this depended on triangulating a number of interdisciplinary methodologies (cf. Martin, 1995), and the process was one of accumulating relevant botanical and ethnobotanical knowledge right until the day of departure from Namibia. The means through which this knowledge was acquired are listed below.

1) Some 468 plant specimens were collected during the course of fieldwork which were

[2]Two-tailed significance tests are used throughout this thesis.

described botanically and prepared for addition as herbarium vouchers to the collection at the National Herbarium, NBRI, Windhoek, where they were formally identified, primarily by Mrs Pat Craven. Species which remain unidentified are referred to in this thesis by their collection number, i.e. SS348.

2) These specimens included a wide range which were collected during field-trips with Damara informants, when any local knowledge concerning a species was noted and included with the botanical documentation accompanying that specimen to aid processing by the Herbarium.

3) Portions of most of these specimens formed the basis for preparation of field-cards, used as an aid to the identification of species while in the field and to provide a basis for discussion about different species during the course of household surveys of resource-use. Every attempt was made to include all the relevant, time-varying above-ground portions of the plant on these field-cards (e.g. flowers and fruits) in order to generate information about these species which was as accurate as possible, despite being removed from the wider ecological setting. Given the impossibility of being in the field with local informants whenever a previously uncollected species was located, this approach was particularly useful in facilitating wider discussion of ephemeral species or those with restricted spatial distributions. 228 of these field-cards were used as the basis for several discussions with a sub-section of the household survey of 12 households, which enabled the ethnobotanical information to be cross-checked and standardised to a reasonable extent, and also allowed areas of variability in the knowledge held by the participants of these discussions to be explored.

4) Samples of useful products of a number of species, such as fruits, seeds, caterpillars and plant parts used in medicines or perfumes, were also used as the basis for ethnobotanical species identification and discussion of the qualities and ecology of these resources.

5) General ethnobotanical and botanical understanding of the region's flora was enhanced by participation on collecting trips with local resource-users, and through field-trips and discussion with Namibian botanists and taxonomists.

6) Review of literature sources regarding the ethnobotanical knowledge of the Damara and closely related and affiliated groups complemented the information generated through fieldwork.

A Damara ethnobotany database was compiled from these many strands of information and is submitted as Annexe 1 to this thesis.

In addition, specimens of insect species with use-value were collected and identified by Dr Eugene Marais, Entomologist at the National Museum of Namibia, Windhoek.

Chapter summary

The background presented in this chapter regarding the domestic use of natural resources, primarily plants, by livestock-keeping peoples in dryland environments including Namibia, has emphasised the following points:

1) The complementary role of gathered resources to household livelihoods in a range of environments has received increasing attention in recent years.

2) Despite this, the understanding of the contribution of these resources to the livelihoods of livestock-keeping groups in arid areas is hampered by two issues: first, the focus on forested environments with a presumed more predictable productivity and high international conservation value; and second, the marginalising effect of a conceptual association of plants with women in the study of societies whose livelihood practices have generally been understood in terms of their control and management by men.

3) In addition, it is argued that as long as the bulk of information regarding local knowledge and uses of natural resources in these environments is presented in the form of ethnobotanical inventory, it will have limited scope for emphasising the potential role that contemporary natural resource-use practices can play in modern land-use initiatives.

This background information was used to formulate relevant research questions for an analysis of contemporary natural resource-use practice by Damara farmers in arid north-west Namibia, and a methodology for investigating these questions was developed. The information generated by fieldwork employing this methodology forms the basis of the following chapter in which observed patterns of resource-use are presented and discussed. This provides a source of practical and factual resource-use information, around which an exploration of qualitative issues of management-practice, and its relationship to recursive, culturally-informed ecological knowledge, is built in Chapter 4.

Chapter 3

Patterns and determinants of natural resource-use

In this chapter, the patterns of natural resource-use suggested by analysis of field data are presented in relation to the research questions developed in Chapter 2.

3.1 Utilisation of non-timber resources

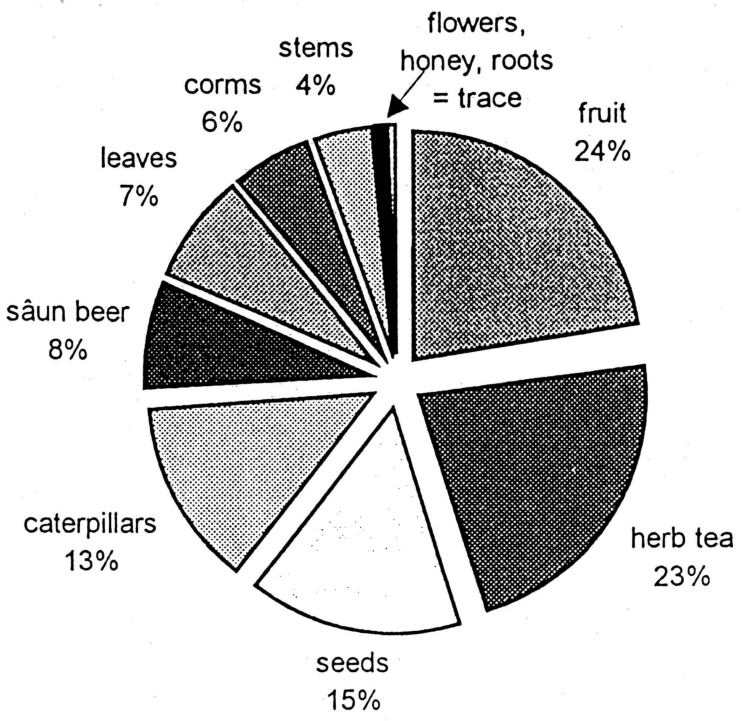
1) Do the Damara currently utilise non-timber gathered resources as part of household subsistence?

3.1.1 'These are our Damara foods'

Of the 348 household diet days in which food consumption was monitored, 125 or 36% included the use of gathered natural resources for nourishment. On these days, between 1 and 4 records of wild foods were recorded, usually of different items but occasionally of the same item contributing to two different meals in a day, leading to a total of 218 records of such resource-use. The percentages of these records accounted for by different types of gathered foods are presented in Figure 3.1 and the species currently utilised and stored at each survey visit are tabulated in Table 3.2. Table 3.3 presents information on the plant parts used by the Damara and by societies subsisting in dryland environments elsewhere in sub-Saharan Africa and in Australia. As recorded for these pastoralist and hunting and gathering groups, the majority of plant foods come from a relatively small number of species, although local ecological knowledge encompasses a much wider variety of edible and inedible species. Only 41 plant species were recorded as actually consumed during the course of the household dietary survey among the Damara, while ethnobotanical fieldwork indicated that some 97 species are recognised as edible (as documented in Annexe 1). The nutritional value of these food types is discussed briefly below together with relevant information concerning their preparation and availability.

The frequencies of gathered food use recorded here for the Damara are considerably higher than those anticipated from existing studies of subsistence among livestock-keeping groups in sub-Saharan Africa. Table 3.1 presents an example of what can be considered a 'typical' range and quantity of resources collected following one rain season. It should also be emphasised that the survey represents only a small proportion of days throughout the study period on which gathered foods may have been consumed, and overlooks both the frequently stated intention to collect these resources by households who were not currently utilising or storing veld foods, and the fact that edible plant parts consumed at home typically represents only a portion of the total consumed (cf. Heinz and Maguire, 1974: 40). In addition, some under-reporting due to 'informant inaccuracy' is to be expected given the retrospective nature of the 24-hour recall data (cf. Bernard *et al*, 1984; Borgerhoff Mulder and Caro, 1985: 324).

• Figure 3.1. Proportions of the total number of records (N = 218) of the consumption of gathered foods accounted for by particular types of food.



• Table 3.1. Major foods collected by Cornelia ǁGuruses from Gudipos on the Ugab River, during the rain season of 1996.

plant part used	species	Damara name	quantity
seeds:			
	Stipagrostis spp.	sâun	200l drum, 1 bucket and 2 ≠goub
	Monsonia umbellata	bosu	collected 3 times, approx 20kgs
fruit:			
	Grewia villosa	sabibes	1 carry-bag full
	Grewia sp.	ǁnais	1 carry-bag full
	Cordia gharaf	ǁkhoos	1 bucket full
caterpillars:			
	Usta wallengrenii	≠nû ǀiru	1 bucket full

- Table 3.2. Species which contributed as gathered natural resources to diets, or which were stored, between February 1995 and July 1996. Records represent the number of times a species was recorded as consumed or stored during the household dietary survey. Data are presented separately for households located in and around Sesfontein to the north of the 'Red Line', and at farm settlements to the south of the 'Red Line'. Naturalised species are marked with an asterix. (Nb. figures for seeds used for beer represent actual consumption of beer by the adult members of a household and do not reflect the extent of beer production for sale. Figures for the storage of seeds include both those intended for direct consumption and those used for the making of beer).

plant parts	species	Damara name	diet-survey records: north of Red Line N=240 consumed	north of Red Line N=240 stored	south of Red Line N=108 consumed	south of Red Line N=108 stored	total N=348 consumed	total N=348 stored
tea: twigs, leaves, flowers:			45	47	7	8	52	54
	Cullen obtusifolia	!honab			2	2	2	2
	Helichrysum sp. (SS468)	!uru			1	1	1	1
	Monsonia umbellata	bosu	3	3			3	3
	Myrothamnus flabellifolius	ǀkhootorotorosen	42	44	3	4	45	47
	Thamnosma africana	≠khanab			1	1	1	1
fruit:			29	37	23	10	52	38
	Berchemia discolor	≠hûis	17	19			17	18
	Boscia albitrunca	ǀhunis			4		4	
	Boscia foetida	xaubes	1				1	
	Cordia cf. *gharaf*	ǀkhos			6	1	6	1
	Cordia cf. *gharaf*	ǀnais	1				1	
	Euclea pseudebenus	tsawib			1		1	
	Ficus sycomorus	ǀnomas	2	3	1	1	3	3
	Grewia cf. *flava*	ǀnarabes	2	4	1	1	3	3
	Grewia villosa	sabibes	1	3	1	1	2	2
	Grewia sp.	ǀnais		1	3	4	3	4
	Grewia sp.	aniǀnais			1		1	
	*Prosopis glandulosa**	≠khen ǀnaras			2	1	2	1
	Salvadora persica	xoris, kaibes	4	7	3	1	7	6
	Ziziphus mucronata	≠aroi	1				1	
seeds:			21	61	14	39	35	88
from harvester ants' nests:	*Kaokochloa nigrirostris*	≠haa		1				
	Monsonia umbellata	≠khari bosu	4	15	9	15	13	26
	Monsonia senegalensis	surube bosu		2		2		3
	Stipagrostis spp.	sâun	12	21	5	16	17	36
	Stipagrostis cf. *hochstetterana*	ǀhoe sâun from ≠habo ǀgâb	3	4	3	6	6	10
	Stipagrostis sp.	!garibe sâun	2	7			2	4
	Stipagrostis sp.	≠habo sâun		2				1
direct from plant	*Setaria verticillata*	≠ares	5	7			5	6
	Trianthema triquetra	≠nurusoâ		2				2
seeds for beer:			12		6		18	
	Monsonia umbellata	bosu			1		1	
	Monsonia senegalensis	surube bosu	1				1	
	Stipagrostis spp.	sâun	11		5		16	
	Stipagrostis cf. *hochstetterana*	ǀhoe sâun from ≠habo ǀgâb	4		2		4	
caterpillars:			27	35	4	8	31	37
	Imbrasia belina	ǀhoobes; tsaurahais ǀgirus	2	3			2	3
	Henicocha marnois	!gobobes; !goboxobe ǀgiru				1		1
	Usta wallengenii	ǀgirus; ≠nû or ≠nûbe ǀgirus	25	32	4	7	29	33
leaves:			17	2			17	1
	Amaranthus sp.	ǀhâubes	14	1			14	1
		ǀhoros	3	1			3	
corms:			13	20			13	13
		ûias	12	19			12	12
		≠gari	1	1			1	1
stems:	*Hoodia* cf. *currori*	!khobas	9				9	
flowers:	*Hoodia* cf. *currori*	!khobas	1				1	
honey:		danib	1	2			1	2
roots:	*Boscia albitrunca*	ǀhunis	1				1	

• Table 3.3. Plant parts recorded as used for food by the Damara and by other groups inhabiting dryland environments elsewhere in southern Africa and Australia. With regard to the Damara, only food uses recorded during fieldwork for this project are included here, i.e. additional literature references to food uses are omitted (but see Annexe 1). This table also does not include plants which act as hosts to edible invertebrate species. Nb. Some plant species provide more than one of the plant parts listed here.

	Damara:		sub-Saharan Africa:						Australia:	
plant part	recorded as consumed during 16 month household dietary survey	recorded as foods during course of fieldwork, listed in Annexe 1	!Kung San #1	!Kung San #2	|Gwi and |Gana San	!Koo San		Tswana-speaking Tlokwa	Alyawara	Martujarra
seeds: total	8	30		4		5		?	36	46
woody species		3							19	20
grasses/herbs	8								17	13
other:										13
roots, tubers, bulbs	3	17	41	24	35	28		31	8	6
fruit/berries/pods	13	27	29	24	14	11		47	26	15
nectar		5								17
gum/resin		9	18	11	9	9				6
leaves	2	4	6	4	7	15		22		
beans			2		3					
melons		2	2	2	2	3				
cucumbers			2		1					
fungi		1	1		1			3		
flower	1	1				1				
stem	1	1				4				
water sources				3						
cone		1								
roots used as curdling or fermenting agents		7								
other:	twigs, stems, leaves used for tea 5	15	palm heart, grass seeds, pods ?		stalk 14		bark, flowers or resins	23	flowers, nectar, leaves, resinous extrusions, insect galls or larvae 32	
total	41	103	>101		86			>126	92	89

References:	
!Kung San #1	Lee, 1979: 159-165
!Kung San #2	Marshall, 1976
|Gwi and |Gana San	Tanaka, 1976: 117-118
!Koo San	Heinz and Maguire, 1974
Tswana-speaking Tlokwa	Grivetti, 1979: 252
Alyawara	O'Connell *et al*, 1983
Martjujarra	Veth and Walsh, 1988: 20

Fruit

Many of the species consumed by the Damara are highly esteemed supplementary foods, often containing greater amounts of vitamin C than domesticated species (Wehmeyer, 1986: 8), and are consumed when available throughout the drier regions of southern Africa. *Grewia flava, Boscia albitrunca* and *Ziziphus mucronata* or closely related species, for example, are relished by San populations throughout the Kalahari, by the Tswana-speaking Tlokwa of south-east Botswana, by Turkana, Gabra, Maasai and Kipsigis pastoralists in Kenya and by Senegalese Ferlo and Malian Tamsheq (Glover *et al*, 1966: 194; Heinz and Maguire, 1974: 41; Marshall, 1976: 113; Tanaka, 1976: 117-118; Grivetti, 1979: 148; Lee, 1979: 160, 162; Morgan, 1981: 101; Steyn, 1981: 12, 20, 27; Becker, 1986: 63; Stiles and Kassam, 1991: 27; Berge and Hveem, 1992: 13). Similarly, the pods of the naturalised legume *Prosopis* sp. are known as a major source of food for indigenous people in the North American deserts (Felger, 1979 *in* Lee and Felker, 1992: 309; Crosswhite, 1981: 51), with a high but variable nutritional content (protein and sugar content range from 9-18% and 6-41% respectively (Oduol *et al*, 1986). Table 3.4 indicates nutritional composition for some fruit species consumed by Damara households surveyed during the course of this study.

Herb teas

Five herbs were recorded as used for tea, the most common being the 'resurrection bush' *Myrothamnus flabellifolius* (‖**khootorotorosen** when green and **!hotorotorosen** when dry). These teas are often added as flavouring to ordinary bought tea but may also be consumed on their own. Although the nutritional contribution of these teas is negligible they are included as part of this section because they are conceived as integral to the pattern of daily food consumption. They may also contain important minerals (for example, values of 609mg/100g, 149mg/100g, 17,9mg/100g, 346mg/100g and 103mg/100g have been recorded for *M. flabellifolius* for calcium, magnesium, iron, potassium and phosphorus respectively (Wehmeyer, 1986: 29)). The addition of milk and sugar when available also adds to their nutritional value. It should be pointed out that as with the consumption of herbal teas worldwide there is some overlap between the use of teas as both beverages and herbal medicines. Table 3.6 indicates that *Thamnosma africana* (≠**khanab**), for example, is one of the most widely used herbal remedies, largely taken as a decoction similar to, but stronger than, tea. Herbs were only recorded as consumed as tea if they were reported under this category by interviewees themselves.

• Table 3.4. Nutritional composition of some fruit species recorded as consumed by households during the course of this study. Values are from: * = Wehmeyer (1986), † = Ministry of Agriculture, Water and Rural Development, Windhoek (1991), ‡ = Maiga (1992). (Ca = calcium, Mg = Magnesium, Fe = iron, Na = sodium, K = potassium, Cu = copper, Zn = zinc, Mn = manganese, P = phosphorus).

		moisture	ash	protein	fat	fibre	carbohydrate	energy	Ca	Mg	Fe	Na	K	Cu	Zn	Mn	P	thiamin	riboflavin	nicotinic acid	vitamin C	carotene
species		g/100g						kj/100g	mg/100g (except where indicated otherwise)													
Berchemia discolor	*	78,8	1	1,1	0,6	2,8	15,7	305	88,6	30,9	2,24	6,04	270	0,2	0,27		40,1	0,03	0,06	0,53	50,3	0,11
	†		3,41	7,1	2,5				474	93	4,2	19	738	0,79	1,06		120					
Boscia senegalensis (mean values for max. 7 samples)	‡	93.3	3	25.5	2	2.9	64	1547.8	0,09g	0,06	72	0,01g	0,64g		44							<50
Euclea pseudebenus	*	68,5	1,3	1,6	0,1	0,7	27,8	498	43,5	28,8	0,28	2,51	358	0,11	0,36	0,12	25,4	0,02	0,003	0,31	105	
	†		10	2																		
Ficus sycomorus	*	82,7	1,1	1,4	0,5	4,3	10	210	72,6	43,1	1,73	5,70	347	0,16	0,38		33,4	0,07	0,03	1,41	7,3	
Grewia bicolor	*	13,2	5,9	10,3	0,1	13,5	67	1302	268	317	5,92	12,4	1707	1,29	2,59		181	0,2	0,25	3,47	9,3	
	‡	95,6	5,5	6,9		39			1,2g	0,3g	16	0,01g	0,9g		1		0,2g					
Grewia flava	*	74,7	1	2,1	0,1	2	21	377	68,1	70,5	1,24	3,11	288	0,33	0,56		67	0,04	0,03	0.62	29,4	
	*	9,6	3	5	0,3	22,1	60	1103	163	169	3,85	3,1	981	0,32	1,26		86,5	0,07	0,2	1,63		
Grewia tenax	*	9,2	2,6	5,5	0,3	19,7	62,7	1157														
	‡	90,4	3,9	7,8	2,5	28,8	78,9	1534	0,4g	0,2g	9	0,01g	1,1g		1,6		0,2g					3700
Grewia villosa	*	70	2	3,3	0,2	1,9	22,6	443		34,6	0,9	3,8	224				41					
	†		2	3,3	0,2	1,9	22,6	443		34,6	1,9	3,8	672				41					
	‡	88,5		8,1	3,2	24,6			0,48g	0,13	12	0,02g	0,98g		1,9		0,2g					1800
Salvadora persica	*	70,8	1,6	1,9	0,6	1,1	24	458													12,1	
	†		18,2	21,9	6,8	12,3	41,8	3007				2095	7095									
	‡	91,7	30,8	14,9	1,7	8	46,6	1093	6,95g	0,41	22	0,01g	1,57g		1,2		0,11g					3400
Ziziphus mucronata	*	50,4	3,2	5,5	0,5	2,1	34,4	659	129	58,3	0,95	5,05	726	0,86	0,52		51,4	0,06	0,05	0,71	42,6	

Seeds

Broadly speaking, seeds utilised for food by Damara farmers are from the grasses *Stipagrostis* spp. (**sâun**) and the Geraniaceae species *Monsonia umbellata* (occasionally *M. senegalensis*) (**bosu**) which are collected from the stores of harvester ants, and the grass *Setaria verticillata* (**≠ares**) collected directly from the plant. This contradicts the general consideration that 'grasses appear not to provide food items for humans' across eastern and southern Africa (Peters *et al*, 1984: 402) and is in contrast to other arid areas where seeds from woody species tend to be as, if not more, important (cf. O'Connell, *et al*, 1983: 86-87 for the Alyawara, north-central Australia; Veth and Walsh, 1988: 20 for the Martujarra of the Great Sandy Desert, Western Australia). Additional grass species whose seeds are recorded as used for food in Annexe 1 include *Setaria finita* (**!gari-ao-oâ**), *Eragrostis* spp. cf. *E annulata* and *E. cylindriflora* (**|homara**), *Danthoniopsis dinteri* (**≠namib**), *Aristida* cf. *effusa* (**!gaebiburu≠gahe**) and the endemic species *Kaokochloa nigrirostris* (**≠haa**). The latter two species are collected from harvester ant nests, either mixed with the more abundant *Stipagrostis* spp., or on their own (as occurs with *K. nigrirostris* in areas of calcretaceous hills where it tends to be the dominant grass species). Seeds are also used as the basis for brewing beer (**!khadi**) and for the distillation of a liquor called **bâuga**; as documented elsewhere, these are important income-generating activities for women (cf. Fox, 1938 for Zulu and Basuto beer production, and Bishop *et al*, 1994, for beer-brewing among Bayei and Hambukushu agriculturalists in Ngamiland, Botswana).

The consumption of grass seeds as cereals is considered to have been a feature of subsistence in semi-arid and arid areas throughout human history and pre-history, despite the apparently low diversity of species used in this manner today. The significance of the intensive use of grass seeds, particularly *Panicum* spp., by the Aboriginal hunting cultures of Australia is noted, for example, by Tindale (1977: 345-347) who links the development of means of grain storage, and of the modification of stream-beds so as to ensure extensive flooding of productive mulga plains, with relatively large population aggregates among the tribes practising this type of resource use. These Aboriginal groups[1] collected seeds direct from the plant but, like the Damara, relied additionally on procuring large quantities of seed from harvester ant nests (Tindale, 1977: 346; O'Connell *et al*, 1983: 89; Latz, 1995: 131, 298-299, Walsh, pers. comm., 1996). The preparation of grass seeds involved 'shallow oval to elongate wooden dishes' in which the seeds were gathered and then cleaned 'by winnowing and rocking in the dishes to separate the grain from the other particles' (Tindale, 1977: 345-346), in a manner akin to that observed with use of the **≠goub** among the Damara. The seeds are then husked, re-winnowed and milled through wet-grinding using highly-valued small upper and large, flat lower millstones. The widespread collection of grass seeds directly

[1] Predominantly the Wiradjuri, Kamilaroi, Kunggari, Iliaura, Walpiri and Wadjari of western and northern Australia, and the Martu of the Great Sandy Desert, Western Australia.

from the plant is also recorded among contemporary Gourma pastoralist groups of Mali, where *Panicum laetum*, *Echinocloa colona*, *E. oryzetorum*, *Cenchrus biflorus* and wild rice (*Oryza* spp.) are the most commonly utilised wild cereals (Maiga, 1992: 1).

As stated in Renvoize *et al* (1992: 7), 'The outstanding value of grasses as a source of food lies in their nutritious seeds' which have both high lipid and protein contents (Carroll and Janzen, 1979: 235). Of further significance in unpredictable arid environments is the fact that cereals lend themselves to storage for later consumption. SEPASAL[2] records the use of seeds for food of 64 species, 22 of which are identified as famine food (Renvoize *et al*, 1992: 8). *Stipagrostis* spp., the most commonly consumed wild cereals among Damara farmers, do not, however, feature in this list at all. *Setaria italica* and *Eragrostis tef* are recognised as 'minor cereals', but *Setaria verticillata* is only recorded as consumed in the form of an alcoholic beverage. The *Eragrostis* and other species recorded as consumed in north-west Namibia are not as yet included in this international database.

Caterpillars

Caterpillars, primarily the larval stages of various emperor moth species (Saturniidae), are 'the most commonly utilized food insects in Southern Africa' and are consumed and traded lucratively[3] throughout Namibia (Marais, 1996: 1-2). Dried caterpillars had a high social and exchange value among the Tswana-speaking Kwena of eastern Kalahari as observed by Livingstone in the mid-1800s (cf. Grivetti, 1979: 237) and are consumed when available by the |Gwi San (Silbauer, 1981: 217). Nutritionally they are good sources of energy and a variety of minerals and vitamins; values for various nutrients are presented for *Imbrasia ertli* in Table 3.5.

- Table 3.5. Nutritional values for the caterpillar *Imbrasia ertli* (Saturniidae) based on Bradley and Dewees (1993: 132).

	fresh, raw per 100g	cooked/dried per 100g
water g	77.7	8.5
energy k/cal	98.7	386.8
protein g	14.8	5
fat g	3.5	12.6
carbohydrate g	2.5	17.3
calcium mg	24	232
phospohorus mg	-	619.5
iron mg	0.9	16
potassium mg	-	2,027?
sodium mg	-	2,616?
vitamin A retinol equivalent	-	37.3
ascorbic acid mg	0?	5.2
thiamin mg	0.3	0.3
riboflavin mg	1.2	1.4
niacin mg	7.4	7.9

Caterpillars are noted as a 'favourite supplementary food' among Damara along the Ugab River by Steyn and du Pisani (1984/1985: 48), an observation supported by this study which

---

[2] Survey of Economic Plants of Arid and Semi-arid Lands, Royal Botanic Gardens, Kew, London.

[3] Analysis of data in Marais (1996: 8) suggest a mean return of N$18.2/kg (N$1.00 = US$0.23 at time of study) for primarily *Imbrasia belina* caterpillars traded in Windhoek in May 1996.

recorded the consumption of caterpillars (**|girus**) on 13% of the diet survey-days on which gathered foods were consumed. As elsewhere, they are generally prepared 'by removing the head and squeezing out ingested leaf material' (Latz, 1995: 131). They are collected in large quantities when available and prepared for storage by sun-drying. The stored caterpillars are consumed dry or reconstituted by boiling into a soup or stew with water.

Imbrasia belina (Saturniidae) (i.e. **|hoobe |giru**), consumed rarely during this survey, is the commonly utilised 'mopane worm' consumed throughout southern Africa where the tree *Colophospermum mopane* predominates (cf. Van Voorthuizen, 1976: 227). Conversely *Usta wallengrenii* (Saturniidae) (i.e. **≠nû |giru**) collected from *Commiphora* spp., which was consumed with high frequency during this survey, is generally considered inedible by taxonomists (Marais, pers. comm.).

Sâun beer

Seeds of *Stipagrostis* spp. grasses, and occasionally *Monsonia* spp., are commonly used in the preparation of beer and, less frequently, in the distillation of a spirit known as **'bâuga'** The latter was only recorded in households to the south of the 'Red Line'. Sugar or honey are added as fermenting agents. Beers based on the fermentation of grains can make a substantial nutritional contribution and, intermittently, may be the sole item consumed during periods of low alternative labour requirements such as after harvests (cf. Fox, 1938: 39). 'Appreciable quantities' of vitamins B_1, B_2 and C have been recorded for local grain beers in South Africa with, for example, a mean of 0.8mg/100ml found for the latter (Fox, 1938: 46-47).

The procedure for brewing **sâun** beer is much simpler than that described elsewhere (cf. Fox, 1938 for the production of Zulu and Basuto beers), requiring only that several kilograms of unground seeds are soaked for two or three days in water sweetened with sugar or honey. The seeds can be reused over periods of one to three years during which time the flavour is improved by topping up with freshly collected seeds. It is common for women to prepare beer in 200l oil drums and to sell beer for around N$1 a pint. The distillation of **bâuga** from beer is much more time-consuming, requiring a complicated apparatus of pipes and containers for heating the beer and collecting the finished product. The returns are much higher, however, with a 250ml bottle fetching upwards of N$5 and higher prices received by women who have the means to transport the liquor for sale in urban areas.

Leaves

Leaves of the wild spinach *Amaranthus* spp. or **‖hâubes** are consumed in varied habitats worldwide as complements to carbohydrate staples (cf. Fleuret (1979) for the Shambaa, Usambara Mountains, Tanzania, Crosswhite (1981: 59) for the Tohono O'odham, Sonoran Desert and Ogle and Grivetti (1985: 14) for Swaziland). These species are known to be high in protein (particularly of lysine and tryptophan which compensates for deficiencies in these in

diets dominated by maize), calcium, magnesium, iron, and vitamin A (sources summarised *in* Fleuret, 1979: 265; Wehmeyer, 1986: 7).

Species utilised as 'wild spinach' generally grow as weeds in cultivated plots and may actually be promoted and planted by farmers thus blurring the boundaries between the categories of 'wild' *versus* 'cultivated' as applied to such resources. Similar management of resources usually perceived by outsiders as 'wild' has been noted for cycads (*Cycas* spp.), which produce large quantities of edible seed, and yams by Australian Aboriginal populations in open-canopy woodland and coastal habitats, Cape York Peninsula, Australia (Harris, 1977: 423-437). In the study area, *Amaranthus* spp. have actively been planted in some plots in the irrigated gardens of Sesfontein primarily through the introduction of seeds from north-central Namibia by Owambo men who have married into Damara families. They are also abundant in the environs around Sesfontein where they are common under the shade of *Acacia tortilis* trees following rains. Both sources of this species are utilised as spinach, and are referred to by the same Damara name (**‖hâubes**). These complications notwithstanding, as indigenous species with high food values *Amaranthus* spp. are included here in the analysis of 'gathered' food-use.

Corms and bulbs

Unlike recorded indigenous food plant consumption by most societies in arid areas, where a diversity of underground portions of plants are important (see Table 3.3), only 2 Damara species were recorded as used during the course of this study. These were used in relatively high quantities, however, particularly after the good rains of 1995, and are likely to have high energy values (for example, 342-633kcal/100g were recorded for the bulbs of three *Cyperus* spp. in Wehmeyer (1986: 24)). Apart from self-collecting, a healthy regional trade exists in **ûias** which are brought south by the Himba of Kaokoveld thus increasing the availability of this resource in the northern study settlements. The species consumed were unsatisfactorily identified and it is likely that **ûias** may be a category covering several different species. Some 16 Damara names for edible roots were recorded (see Annexe 1) which represent species not recorded as consumed during this survey, finer distinctions of species within the category of **ûias** and edible underground plant parts not classified as **ûias**.

Stems

Stems of the succulent near-endemic *Hoodia* spp. are widely consumed following removal of their spines. Again, the use of this resource crosses over two of the conceptual categories used in this analysis: first, as well as being a food it is considered to be an important medicine active in reducing blood pressure and instrumental in preventing being bitten by mosquitos; second, it is commonly planted around people's homesteads and in gardens and is therefore both a 'wild' and cultivated indigenous resource. The latter point is of particular interest given the high conservation value placed within Namibia on the so-called 'spectacular' and

endemic succulents of the north-west, and in view of current concern regarding local uses of *Hoodia* spp. as examples of these succulents.

3.1.2 Medicine

Table 3.6 lists the gathered medicinal resources recorded as either currently in use or stored by households at the time of the survey visits. Unfortunately, the scope of this project did not include field-screening for biological and pharmacological activity of remedies in the form in which they are consumed (cf. Prance, 1991: 211), but information presented here regarding commonly used treatments could provide a starting point for this type of further research. Ailments which these remedies are used to treat and methods of preparation are detailed in Annexe 1. Most natural-resource based treatments discussed here are used for the direct treatment of diseases with recognised physical symptoms. In some contexts, these remedies are incorporated into sympathetic medicinal practices, including the treatment of painful areas of the body with incisions or burns, and the attachment to necklaces of small portions of plant roots considered to have medicinal properties in the treatment of lung, throat and abdominal problems (both of these practices were not infrequently observed during the course of fieldwork for this thesis and are also described in Vedder, 1928: 46-47). The use of massage is incorporated in the treatment of specific ailments.

The overall impression is that local remedies, primarily based on non-timber plant products, play an important role in the self-treatment of common illnesses. Some remedies are particularly widespread which indicates a possibly high degree of effectiveness. For example, the use of leaves from *Colophospermum mopane* (**tsaurahais**) as a general purpose antiseptic and digestive aid (also recorded in Van den Eynden *et al*, 1992: 68) was common, as was the use of a decoction of the herbs *Dicoma tomentosa* (**soreb**) for coughs and *Thamnosma africana* (**≠khanab**) for coughs, colds and flu, nausea and to 'cleanse' the uterus following childbirth (see also du Pisani (1983: 12) and Van den Eynden (1992: 50, 81) who record the use of this latter herb among the southern Nama and ≠Aonin or Topnaar respectively).

Table 3.6 indicates some substantial differences in the use of specific gathered medicines between households located to the north and south of the study area. This can partly be attributed to the geographical distribution of particular species. *D. tomentosa*, for example, is extremely abundant around the southern farm settlements but is sparse in the region around Sesfontein to the north of the 'Red Line', although its medicinal value is also known in this area. *Spirostachys africana* (**âu-haib**), on the other hand, only occurs in the Kaokoveld to the north of Sesfontein, from where it is brought as a trade item into the communal area Hoanib River settlements of Sesfontein, Khowarib and Warmquelle. Cultural factors also play an important part in the choice of collected medicines; *C. mopane* occurs throughout the former Damaraland but its medicinal use was more commonly recorded in the north of the study

area. The relationship between the recorded frequency of use of veld medicines and the location of households to the north and south of the vet fence is discussed further below.

- Table 3.6. Gathered medicinal resources in use or stored during household surveys. Species are listed alphabetically.

		household survey records:		
species	Damara name	north of vet fence N=240	south of vet fence N=108	total N=348
?Acacia erubescens	!uri-haib	3		3
Acrotome sp.	oumahaib	1		1
Adenolobus pechuelii	ai-haib	1	1	2
Aloe spp.	koreb; au-koreb	1	5	6
Antiphiona fragrans	!âusâ; doeba!oa;doeba-oab	1	1	2
Boscia foetida	xaubes	2	1	3
Boscia albitrunca	|hunis		1	1
Caeselpinia rubra	âu-a-uri	1		1
Catophractes alexandri	!gawas	7	1	8
Ceraria longipedunculata	sorab	1		1
Colophospermum mopane	tsaurahais	19	2	21
Combretum imberbe	!haab	7	8	15
Commiphora cf. *glandulosa*	≠gae		1	1
Commiphora virgata	|ânas (N); antob (S)	6	3	9
Croton gratissimus	!abubue	4		4
Dicoma tomentosa	soreb	1	14	15
Euclea pseudebenus	tsawib	1		1
Grewia cf. *bicolor/flava*	≠âub	3		3
Harpagophytum procumbens	‖huribe‖hams	2	5	7
Hoodia currori	!khobas	2	3	5
Laminaria schinzii	‖gam-|hûib	2		2
Maerua schinzii	goradab	3	1	4
Salvadora persica	xori-!nomab	7		7
Spirostachys africana	âu-haib	11		11
Terminalia pruniodes	≠kheeas; ‖gaetahuo	7	1	8
Thamnosma africana	≠khanab	9	7	16
Ximenia americana	≠eros	1	1	2
Ziziphus mucronata	≠aroi-!nomab	3		3
	aore !nara	1		1
	|ao-haib	1		1
	≠habes		2	2
	‖horabe	1		1
	mutikaigo	1		1
	!naui	1		1
	sahetama |aubed	2		2
	simonhaib		1	1
	so-|oa	1		1
kudu skin	xai-khob	7		7
ostrich egg-shell	abu ‖noro	8	1	9
	|ami!ubub	1	-	1
jackal liver	‖a !nai; |giri liver		1	1

3.2 Influences on non-timber resource-use

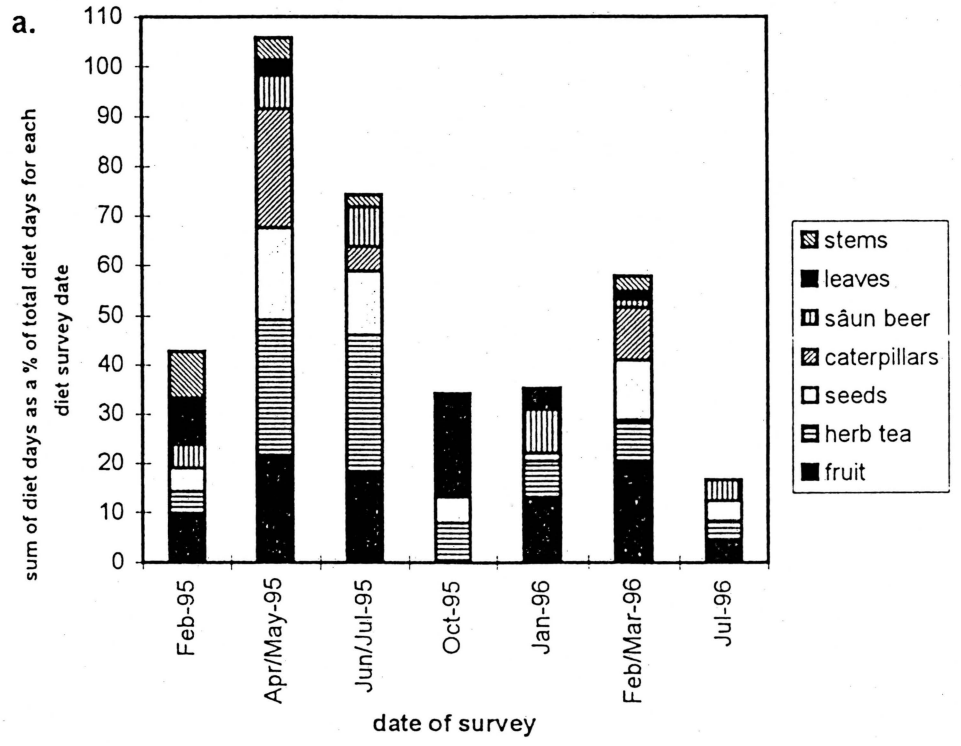
2) How are patterns of gathered resource use related to seasonal and inter-annual variations in rainfall?

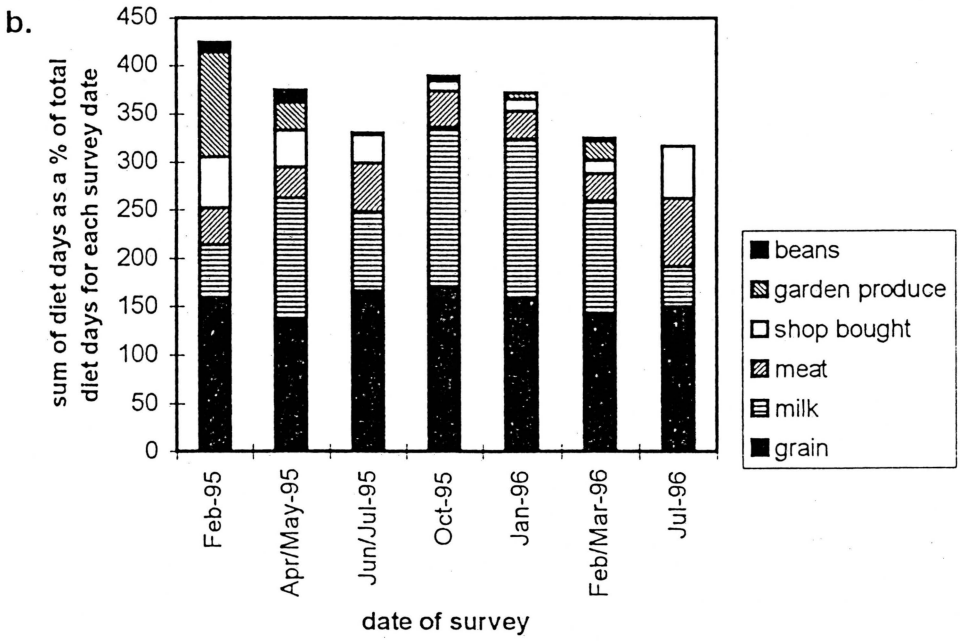
The various categories of wild foods utilised, as described above, were summed for each household diet-survey day, and a Kruskal-Wallis one-way analysis of variance (ANOVA) was used to test for significant differences in the frequency of gathered food use by date of survey. The results of this test were highly significant (Kruskal-Wallis = 32.27, df = 6, p=0.0001). In contrast, the use of foods from all other sources (livestock products, grain, shop bought, garden produce, etc.) was not significantly related to survey date (Kruskal-Wallis = 8.34, df = 6, p=0.214). Figures 3.2a and b indicate the pattern of food use by date for the duration of the household survey. As Figure 3.2a suggests, the use of gathered resources for food is strongly related to rainfall; the highest records for use occurred after the exceptional rain season of 1995, with somewhat lower levels of use occurring in the poorer rain season of 1996. In addition, and not represented by this survey, are the high rates of consumption of gathered food resources associated with periods of mobility coincident with times of high productivity. For example, the members of one household from Sesfontein, who spent at least a week travelling to, and collecting **sâun** (seeds of *Stipagrostis* spp.) from the |Giribes Plains some 40kms north-west of Sesfontein, spoke of how they had eaten 'a lot of **|girus**' (i.e. *Usta wallengrenii* caterpillars) as they travelled through the landscape.

It does not appear that Damara farmers utilise wild foods as a response to dry season or drought conditions; instead, they gather food products as and when they are abundant. This suggests a positive attitude towards these foods in the desire to consume them when they become available, even though the availability of alternative foods remains relatively stable.

As recorded elsewhere (cf. Lee, 1979: 174; Gould, 1980: 66), it is likely that, as well as the absolute contribution of gathered foods to the diet the relative importance of individual species also shifts with inter-annual variations related to rainfall. The yields of the fruit of *Salvadora persica* (**xoris**), for example, were extremely poor in 1995, despite the above-average rains of this season. Recorded incidences of consumption or storage of these fruits were therefore correspondingly low even though this species ranked first in 8 out of 12 household-based small-group interviews regarding fruit preferences for a sample of 16 fruit species, and had the highest mean rank score of 2.75 (n.b. low score = high rank). This non-intuitive, negative relationship between rainfall and fruit yields is similarly described for *Ricinodendron rautanenii*, staple of the !Kung San, following exceptional rains in north-west Botswana in 1973-1974 (Lee, 1979: 189), for 'drought staples' in the Western Desert of Australia, which produce larger yields following prolonged dry weather (Gould, 1980: 66), and for *Prosopis glandulosa* (Lee and Felker, 1992).

• Figure 3.2a and b. Food use by date. In order to correct for the fact that the number of diet-survey days are not the same for each date of the survey, the figures represent the sum of days on which the use of each category of food was recorded, expressed as a percentage of the total number of diet survey days for each survey date.





3) Is the use of gathered resources related to household wealth?

This question was approached by first exploring the relationship between the extent of use of gathered foods and the total number of records for the consumption of alternative foods recorded for each household on each day comprising the diet-survey. The assumption underlying this approach was that the total food consumed by a household would reflect the range of resources to which that household had access. It therefore incorporates the unique set

of wider 'entitlements' a household has to resources, which may otherwise be obscured by a focus on strict definitions of wealth in terms of measures such as size of livestock herds, receipt of remittances or land cultivated (cf. Nærua *et al*, 1993: 21-23; Devereux, 1996; following Sen, 1981, 1984). As Table 3.7 indicates, the use of gathered food resources bears no relation to the use of alternative foods, other than a weak but significant negative correlation with the consumption of grain. This suggests that the use of gathered resources cuts across the range of Damara-speaking households inhabiting north-west Namibia and is an activity practised exclusively neither by the poor with no access to alternatives, nor the wealthy, who can command labour or items for exchange in acquiring wild foods.

- Table 3.7. Spearman's rank correlation coefficients for the relationship between total wild food use and the use of alternative foods.

	gathered foods	
	Spearman's rank	p
total other foods	-0.016	0.759
livestock products:		
meat	0.029	0.584
milk	0.026	0.632
grain	-0.171	0.001
shop bought	0.084	0.12

Given the common emphasis on wealth as an explanatory factor in the household use of natural resources for food, it is perhaps surprising that there does not appear to be a stronger linear relationship in this dataset between the monitored use of gathered foods and wealth in terms of the frequency of consumption of alternative foods. The reason for this can be seen to lie in the complexity of primarily kinship-based social relations which encourage the transfer of resources and thereby blur the boundaries between apparently well-defined households, as well as incorporating individuals, households and families into wider networks of exchange.

These points can be illustrated by analysing the flow of resources between households at the family or **‖gâudi** level. The Ganuses family in Sesfontein, for example, besides cultivating grain and vegetable crops in the settlement's communal gardens, have some 415 goats, 19 sheep, 18 cattle, 78 donkeys and at least 40 chickens herded in the vicinity of the settlement. A proportion of these are kraaled close to people's homes in Sesfontein where they provide milk for regular consumption. The majority of the herd is kept at two farm outposts, Hoanipos and Tsaurob, approximately 10kms outside Sesfontein, where they are looked after by various family members and paid labourers (in early 1995 these were one Herero at Tsaurob and one Angolan responsible for the goats kept in Sesfontein). Ownership by individuals to specific animals may be well-defined but is not exclusively so; members of the family will thus make reference to 'our' livestock when describing the herd, and membership within the family confers entitlement to the products of livestock within this herd. For example, Sara Ganuses, the head of one of the households within this family, has direct access to relatively few animals, namely 10 goats, of which were herded with the larger family herd at Hoanipos and 5 were kraaled at Sesfontein, and 8 donkeys, all kept at Hoanipos. Despite these low herd numbers, Table 3.8 demonstrates

that this apparently poor household consumed meat and grain at a comparable frequency to others within the family group, although the consumption of milk, shop foods and gathered foods is relatively low.

- Table 3.8. Mean number of records of different foods consumed during the diet survey by five households of the Ganuses family in Sesfontein. Household #4 is that of Sara Ganuses (see text).(s = standard deviation).

	meat		milk		grain		shop		wild foods	
household	mean	s	mean	s	mean	s	mean	s	mean	s
1	0.63	0.49	1.25	0.99	1.21	0.83	0.75	0.19	1.46	1.22
2	0.77	0.53	1.14	0.89	1.82	0.73	0.14	0.35	0.45	0.8
3	0.63	0.65	0.92	0.72	1.42	0.93	0.75	1.19	0.54	0.83
4	0.65	0.59	0.45	0.69	1.5	0.51	0.45	0.83	0.05	0.22
5	0.5	0.58	1.25	0.5	2	0.82	0	0	0.25	0.5

Among other households in this family, the consumption of gathered foods is much higher and, as the following accounts of resource procurement from the heads of households #1 and #3 during the rain season of 1995 suggest, is built on a variety of informal exchange arrangements as well the direct collection of resources by members of the household:

Philippine |Hairo ‖Nowaxas

- Given **!garibe sâun** (*Stipagrostis hirtigluma* seeds) by her sister-in-law's son from which she made **sâun** beer to sell.
- Given **≠khari bosu** (*Monsonia umbellata* seeds) by a friend.
- Twice given **≠hûis** (*Berchemia discolor* fruits) from her sister-in-law and bought once from Herero people from Kaokoveld.
- Given **≠ares** (*Setaria verticillata* seeds) by her grand-daughter.
- Twice given **ûias** (corms) by her niece's labourer who herds livestock outside Sesfontein at the farm-post of Tsaurob.
- Bought **|girus** (*Usta wallengrenii* caterpillars) from ovaHimbas when they were selling in Sesfontein.

Alwina Ganuses

- Collected **|nomas** (*Ficus sycomorus* fruits) from trees in the gardens in Sesfontein.
- Collected **|girus** (*Usta wallengrenii* caterpillars).
- Bought **!garibe sâun** (*Stipagrostis hirtigluma* seeds) for **sâun** beer from Josef |Awob, son of a maternal relative of her aunt, who helps with livestock herding at Hoani-pos, east of Sesfontein.
- Given **xoris** (*Salvadora persica* fruits) by an 'uncle' who lives in the nearby settlement of Warmquelle.
- Bought **≠hûis** (*Berchemia discolor* fruits) from Herero people travelling from Kaokoveld.
- Given **ûias** (corms) by the labourer who herds her livestock at Tsaurob.

Links within networks of relatedness, reinforced by the inclusive logic of classificatory kinship[4], usually also extend way beyond the level of the immediate family, creating further implications for both current and potential patterns of resource exchange. For example, as demonstrated by Figure 3.3, fieldwork over the longer term within Sesfontein revealed that all the families in which the household use of natural resources was monitored were ultimately related (cf. Fuller, 1993: 152). The significance of being able to draw on such networks, even if only ephemerally, are discussed in further detail in relation to land and mobility in Chapter 4.

Finally, there is some evidence to suggest that intangible cultural factors operating at the household level, as well as individual preferences, contribute to choices concerning the use of natural resources. As Table 3.9 indicates, there were weak but positive correlations between the frequencies of records for the consumption and storage of gathered foods and medicines by household, although only the correlation between currently consumed and stored foods by household was significant (Spearman's rank = 0.49, p=0.001).

- Table 3.9. Spearman's rank correlation coefficients and probability values for the use of gathered foods, stored foods and medicines by household (N = 45), corrected for numbers of survey visits and diet-days contributing data for each household.

		stored food	medicine
food	Spearman's rank	0.49	0.191
	p	0.001	0.209
stored food	Spearman's rank		0.193
	p		0.204

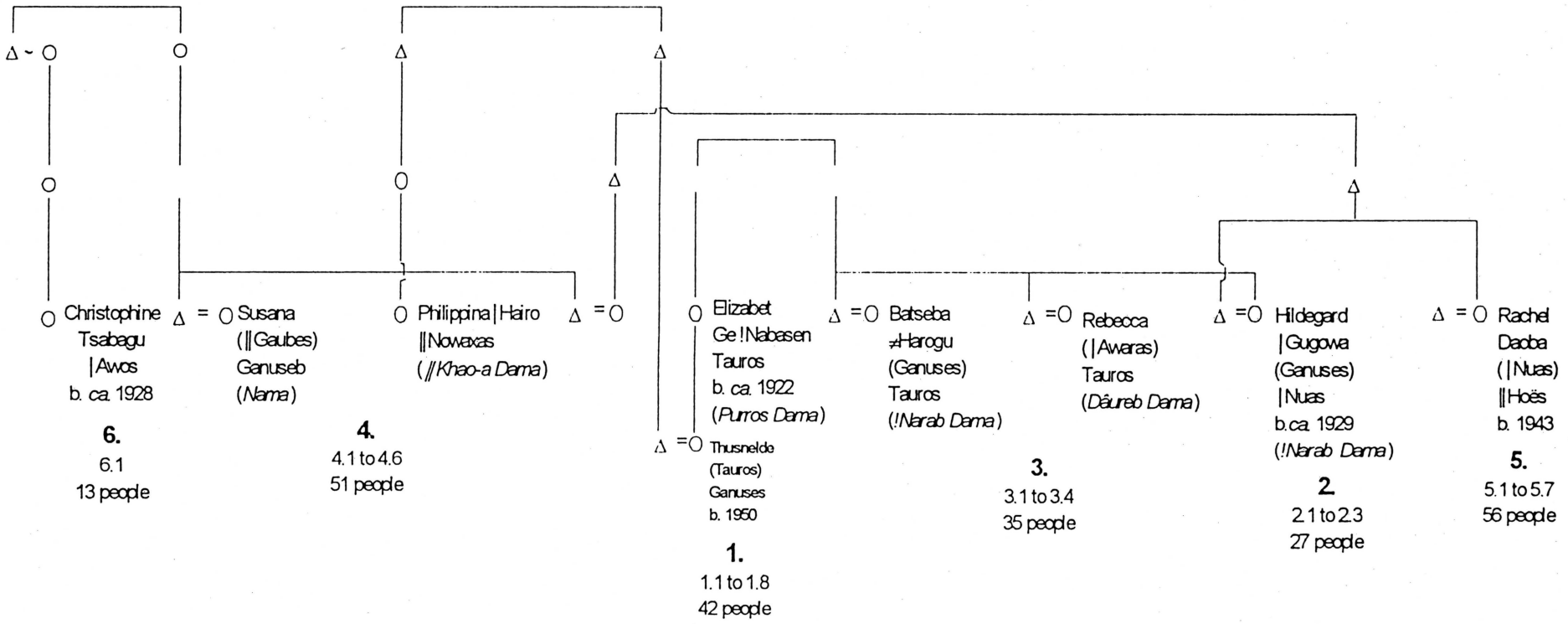
4) Is there a relationship between the extent of household use of gathered resources and the land tenure history influencing areas to the north and south of the veterinary cordon fence or 'Red Line'?

As discussed in Chapter 1, areas of the former Damaraland occurring to the north and south of the veterinary cordon fence have experienced very different settlement and land-use histories. The main difference is the existence of extensive, unfenced rangelands in the north *versus* the delineation of land in the south into private commercial farms settled by European farmers, and the subsequent redistribution of these farms to indigenous Namibian farmers. Despite these different tenure histories, both areas are currently managed as communal land. Accompanying these widely different histories is a general reality of longer-term association by individuals and families with settlements to the north of the 'Red Line' (cf. Fuller, 1993), compared with the rather more intense history of displacement affecting people in the former 'Police Zone' of the south.

---

[4] As Knight (1991: 309, 311), following Radcliffe-Brown (1931) states, 'the essence of classificatory kinship is that siblings occupy similar positions in the total social structure' the implication of which is that 'large-scale coalition relationships have primacy over personal interests or bonds' (see also Fuller, (1993: 142-145) for discussion of the implications of 'cross-descent' for resource exchange).

• Figure 3.3. Kin relationships between elderly Damara women and their partners in the settlement of Sesfontein. The figures below the women included in this figure are the codes used in labelling families and households for analytical purposes, i.e the large bold numbers are family codes and the smaller numbers refer to the households and numbers of individuals identified as part of a family during the course of the study. The names in brackets are a woman's maiden name, and those italicised and in brackets are the 'nation' with which individuals identified themselves.



Current short-term mobility of individuals appears to reflect these differences. For individuals who were part of the household resource-use survey and for whom repeat presence/absence information were available (N=224 over 4 visits for Sesfontein north of the vet fence, and N = 180 over 3 visits for farm settlements south of the vet fence), a Cochran's Q test[5] was carried out which indicated that, while mobility is generally high, it is much higher among individuals located south of the 'Red Line' (see Table 3.10). The reasons for such short-term mobility are many; they include movements by normally absentee herders between jobs in urban areas in the formal economy and farms where they keep their livestock, movements by school-children spending holiday periods with relatives in rural areas, movement due to temporary employment of herd labourers, and a plethora of superficially haphazard movements by individuals between farm settlements and between rural and urban areas. The fluidity of population and land-use in the south arising over the longer-term is discussed more fully in Chapter 4 in relation to the need for mobility as a means of offsetting herd losses due to spatially variable primary productivity.

- Table 3.10. Cochran's Q as a test for mobility by individuals surveyed to the north and south of the veterinary cordon fence respectively.

	north of vet fence	south of vet fence
N	224	180
Cochran's Q	30.973	59.213
df	3	2
p	0.0001	0.0001

A Mann-Whitney U test of the relationship between the extent of gathered resource-use for food and the location of households to the north and south of the 'Red Line' indicated that these areas were indeed significantly different (Z = -2.13, p=0.03). Households in the north used gathered foods more frequently than those in the south; the sum of records of wild food use or storage calculated as a percentage of diet survey days for each area was 71.67% and 53.7% for households in the north and south respectively. Conversely, however, the difference between the total number of records of household use or storage of gathered medicines by location of household, corrected for the total number of survey days on which this use was monitored for each household (i.e. because the diet survey was not able to incorporate each household at each survey date), was not significant (Z = -0.05, p=0.964).

These somewhat conflicting results suggest complex and overlapping processes of both erosion and resilience of culturally-informed knowledge of local resources. On the one hand, while people in both areas use gathered food resources and retain the technical knowledge relevant for this use as part of their subsistence repertoire, the disorienting effects of displacement and the implementation of radical land policies which do not build on local-level experience appear to contribute to a reduction in the use of these resources by households located south of the 'Red Line'. This is recognised by Damara farmers themselves; for example, in instances where

[5] Cochran's Q is a non-parametric test for several related samples with dichotomous nominal data which 'tests the null hypothesis that the proportion of cases in a particular category is the same for several dichotomous variables' (Norusis/SPSS Inc., 1993: 408).

people have recently applied for the right to occupy land at a former commercial farm, so that they may establish themselves as full-time herders following retirement from the formal sector, they often describe how they 'hear about **sâun** and **bosu**' but do not know how to collect these resources because they are 'from the towns' (cf. Martha Tsuses, Malansrust Farm). There are other indications of disrupted links between people and local resources. At the farm Palm, for example, interviewees could recognise and name samples of specific grass seeds used relatively infrequently as food (*Eragrostis* cf. *annulata* and *Kaokochloa nigrirostris*) but could not recognise specimens of the plants from which they came. Similarly, the plants may be poorly known if they occur outside people's normal range of movement, even if they produce resources which are commonly available due to informal trade and exchange networks. This is the case for the commonly used medicinal tuber *Harpagophytum procumbens* (**‖khuripe ‖khams**) which occurs to the south and east of the study area and only reaches households in north-west Namibia through trade and exchange. The frequent lament when discussing a range of plant specimens that names and possible uses were known by the 'old people' also suggests a recognised loss of ecological knowledge (Green (forthcoming: 3) reports a similar response in an ethnoentomology study of the Ju|'hoansi San of Nyae Nyae).

On the other hand, the fact that food resources are used in the south, and that there is no quantitative difference in the frequency of recorded use of veld medicines between areas of such different settlement histories, also suggests a high degree of resilience of knowledge and practice relating to local resources (as has been observed among farm- or Reserve-born San in the Kalahari sandveld of east Namibia (Steyn, 1981: 2)). An interesting adjunct to this, is the observation that in some cases people who were new to farming in the rural areas, and were otherwise employed in the formal sector, were actively pursuing the desire to learn about 'Damara knowledge' in an attempt to reassert Damara culture and identity; thus Michael Doeseb, a teacher in Khorixas who has recently invested his earnings in livestock and is farming at Rietkuil Farm, is currently documenting 'traditional' Damara knowledge and, when at the farm, actively engages with his wife Susan in gathering 'wild' resources. This enthusiasm among some members of the Namibian middle-class for enacting practices seen as part of a traditional cultural identity, can be viewed as analogous to activities such as blackberry-picking in the UK: they are traditional resource-use practices enacted not out of economic necessity, but from a desire to be connected with a past cultural experience of the landscape which is perceived to have meaning when set against a modern urban and capitalist society apparently disconnected from its ecological setting.

3.3 Utilisation of timber resources

5) As has been observed for pastoralists in arid environments elsewhere, is the use of wood for fuel and building purposes relatively conservative compared with rural communities in more humid environments?

3.3.1 Firewood

Table 3.11 indicates that for the Damara households where the use of fuelwood was monitored an average of 1725.56cm^3 or 0.00173m^3 of firewood was used daily. Given an average of 6 people consuming food at each household on the days of these surveys (standard deviation = 2.88) this gives an estimate of 0.105m^3 of wood used for fuel per capita per year. Compared with estimated rates of fuelwood consumption of 0.5m^3 /capita/year for 'arid and sub-arid' areas of Africa (FAO, 1981 *in* deLucia, 1983: 9), and even allowing for a margin of error in the quantities of firewood monitored, the rates recorded for north-west Namibia are extremely low and offset concerns expressed for this region regarding the inefficient use of wood burned in open fires (cf. Jacobson *et al*, 1995: 80).

The preferred fuelwood is *Colophospermum mopane* which is highly valued for its long-burning, hot coals. The high incidence of use of this species suggests that there is little necessity of switching to inferior fuels as occurs when preferred fuels become depleted. Dead wood is preferred although branches are also cut from live trees. Field observations suggested that rural Damara households generally use a maximum of three pieces of wood at any one time, which are placed carefully with only one end alight underneath a cooking pot and fed into the centre of the fire when necessary. When the meal is cooked, the logs are removed from the fire and re-used later. Makeshift windbreaks made of materials such as scrap metal are placed around the fire which helps to reduce the rate at which the wood burns, as does the common use of three stones placed around and under the cooking pot. Similar practices are noted for the Gabra of arid northern Kenya who are described as 'very conservation minded in their use of wood in cooking fires. They use small amounts and usually pull unburned faggots away from the centre of the hearth for re-use later on' (Stiles and Kassam, 1991: 30).

- Table 3.11. Volumes of wood used as fuel by species and by day per household (N = 26). All volume measures are in cm^3 (s = standard deviation).

species	subsample of measured pieces of firewood			total volume	mean volume per day per household
	N	mean volume	s	(total N x mean volume)	(i.e. total volume/26)
total	179	250.64	1355.41	44864.56	1725.56
Colophospermum mopane	105	253.93	1737.55	26662.65	1025.49
Acacia tortilis	56	278.89	476.55	15617.84	600.69
Terminalia prunioides	17	148.37	131.12	2522.29	97.01
Salvadora persica	1	60.19		60.19	2.32

3.3.2 Buildings[6]

Data concerning the estimated volumes of timber by species used in the construction of homesteads are presented in Table 3.12. For the households surveyed (N = 15), the mean volume of wood currently used in the construction of dwelling places was 1781.217cm^3 or

[6] Nb. This section includes an expanded dataset from that subjected to preliminary analysis in LaFranchi (1996: 29-30).

0.0018m^3, while the mean number of poles used per household was 267 (i.e. the mean number of poles used per building multiplied by the mean number of buildings per household). Buildings have variable lifespans depending on the care taken in their construction and the vagaries of climate. They generally survive between 5 and 10 years, with repairs made after each rainy season. When a building is replaced, some of its poles may be re-used while the rest are kept for use as firewood (as Dentlinger (1977: 12) similarly describes for the ≠Aonin or Topnaar of the Kuiseb River). Based on an average lifespan of 7.5 years, households have an annual requirement of wood for building of 237.5cm^3 or 0.000237m^3.

Even if they are revised upwards to account for wood used in the construction of roofs, these figures are extremely low compared with data from semi-arid and more humid savanna areas in Africa. Early travellers to the north-central Namibia expressed concern over the possibly deforesting effects of using some 600 poles for the average homestead (Schinz, 1890: 483). A homestead (**egumbo**) measured in Oshigambo in October 1990 was in fact estimated as utilising a total woody biomass of more than 100m^3 comprised of 21,599 poles or other pieces of wood which, with a lifespan of 6 years for buildings, was calculated as requiring 1.5m^3 of timber/capita/annum (Erkkiliä and Siiskonen, 1992: 155). Similarly, Grundy *et al* (1993 *in* Bradley and Dewees, 1993: 103) report an average annual demand for wood for construction purposes of 2.71m^3/household for the miombo woodland area of Mutanda in Zimbabwe and the Mbeere of Kenya are documented as using '300-600 poles, 350-550 laths and 300-600 rafters' for each homestead (Brokensha and Riley, 1986: 77-78).

6) Can changes in the types of houses constructed be expected to lead to a higher, and possibly 'unsustainable', use of timber for building poles?

Concern has been expressed that changes in the type of constructions built as dwelling places, involving the replacement of traditional low round huts constructed with few small branches with relatively substantial and more permanent square buildings using poles of larger diameter, may have a possibly unsustainable effect on timber resources in the north-west area (cf. Malan and Owen-Smith, 1974: 166; Sullivan, 1993a: 25, 61). The analysis presented above in response to question 5 in fact suggests that timber requirements for these more sturdy structures remain extremely low when compared with settlements in arid environments elsewhere. Two additional points imply that trends in the construction of dwelling places may not have the detrimental effect in this area that has previously been assumed. First, while the construction of relatively permanent buildings requires the use of larger building poles, these structures can also be expected to last longer and require lower rates of replacement. Rapid take-off of a growing trend towards the construction of locally made, sun-dried bricks, as is occurring in Sesfontein, may forestall the occurrence of a huge increase in demand for building poles.

• Table 3.12. Estimated volumes of building poles used by households (N = 15) in the construction of primary dwellings. All volume measures are in cm^3. ($\bar{x}$ = mean and s = standard deviation).

species	subsample of measured poles			total poles	total volume	mean volume per building	volume per household
	N	mean volume	s	total N	(total N x mean volume)	(i.e. total volume/21)	(i.e. mean volume per building x mean buildings per household)
bedroom N = 21:							(mean bedrooms per household = 2.2, s = 1.37)
total	171	6.69	4.19	1969	13172.61	627.27	1379.99
Colophospermum mopane	131	6.59	3.59	1626	10715.34	510.25	1122.56
Acacia tortilis	16	6.66	2.67	101	672.66	32.03	70.47
Euclea pseudebenus	3	11.33	2.83	29	328.57	15.65	34.42
Tamarix usneoides	2	1.89	0.60	152	287.28	13.68	30.10
Ficus sycomorus	4	18.65	7.67	15	279.75	13.32	29.31
Terminalia prunioides	9	4.25	4.89	21	89.25	4.25	9.35
Boscia albitrunca	4	4.22	3.02	21	88.62	4.22	9.28
Combretum imberbe	2	3.44	0.64	4	13.76	0.66	1.44
kitchen/storerooms N = 12						(i.e. total volume/12)	(mean kitchen/store per household = 1.2, s = 0.77)
total	108	6.61	5.33	607	4012.27	334.36	401.227
Colophospermum mopane	67	5.23	3.15	288	1506.24	125.52	150.624
Faidherbia albida	10	8.02	3.15	91	729.82	60.82	72.982
Ficus sycomorus	6	21.89	6.98	32	700.48	58.37	70.048
Tamarix usneoides	3	5.25	2.07	83	435.75	36.31	43.575
Acacia tortilis	13	8.43	5.02	33	278.19	23.18	27.819
Acacia montis-usti	2	3.38	0.73	52	175.76	14.65	17.576
Terminalia prunioides	3	1.67	0.33	21	35.07	2.92	3.507
Boscia albitrunca	1	3.36		2	6.72	0.56	0.672
Combretum imberbe	1	1.99		2	3.98	0.33	0.398
Euclea pseudebenus	1	6.44		1	6.44	0.54	0.644
Maerua schinzii	1	2.86		2	5.72	0.48	0.572

Chapter summary

The analysis of the patterns and possible determinants of household-level natural resource-use presented in this chapter indicates the following:

1) Contrary to popular perceptions regarding the loss of culturally-informed natural resource-use practices by Damara farmers, this study suggests that domestic use of gathered foods and medicines occurs at relatively high frequencies and employs a diversity of species.

2) With regard to gathered foods, the highest records of consumption occur at the times of greatest availability and not as a response to drought-induced shortages of alternative foods as is widely reported for other arid and semi-arid areas. This implies a positive view of these foods, in that they are procured and consumed even as the availability of alternative foods remains relatively stable.

3) Wealth, summarised in terms of access to alternative foods, is an apparently weak explanatory factor in indicating why gathered resources are consumed at the household level. Instead, emphasis is placed on the role of kinship and social networks in blurring the boundaries between households and families, and in contributing to the flow of resources between individual members of these dynamic entities.

4) Again, the relationship between the domestic use of natural resources and land tenure and settlement history is complex and non-deterministic. There is some evidence to suggest that a history of greater displacement exacerbates processes of erosion of natural resource-use practices. In contrast, data for both food and medicine use demonstrate the recursive and resilient nature of these resource-use practices which retain to varying degrees their cultural legitimacy and meaning, and practical value, even in the face of the extremely disrupted histories of households currently located south of the 'Red Line'.

5) Finally, although rural households in north-west Namibia are dependent on indigenous timber resources for firewood and construction materials requirements for these resources are low compared to data presented from elsewhere. The trends identified here do not support frequently expressed concerns about the 'deforesting' effects of timber use in the area.

This chapter has thus provided a baseline of information concerning the role that natural resources play in household livelihoods among Damara farmers in arid north-west Namibia. This will be built on in Chapter 4 which explores areas of culturally-informed management practice surrounding selected resources and assesses the potential implications of such information for the formulation of national-level land and natural resources policy.

Chapter 4

Negotiations over land and resources: emergent patterns of management in a continually changing world

> "not even the tribal area is regarded as the property of the tribe (the Damara). All that is claimed is freedom of hunting and gathering of *veldkos*[1] with which to supply daily wants, ... landed property was unknown to them. In the same manner the water places of their territory were everybody's free property. Without asking anyone's permission the traveller could water his stock and graze his oxen. ... This almost lawless state can only be explained by the fact that he did not yet feel firmly established in his area to have evolved property rights" (Vedder, 1928: 71).

> "Another factor of major importance is the absence of any effective system of land and resource rights resulting from the breakdown of **systems of common property resource management**, the transformation of the role of traditional leaders and headmen under the colonial regime and their subsequent loss of effectiveness and authority under changed circumstances of increasing land pressure and freedom from colonial rule. As a result there is a situation of open access to common lands, under which vulnerable and scarce resources have no effective protection ..." (Quan *et al*, 1994a: 5).

Common perceptions regarding the existence of effective forms of natural resource management in Namibia's communal areas are infused with the sentiments expressed in the above quotes. These voice surprisingly similar concerns given the distance in both time and political environment separating the authors. Some of the misconceptions informing Vedder's statement have already been discussed in Chapters 1 and 2. With regard to Quan *et al*'s statement, it will be argued in this chapter that simply stating that traditional systems of resource management have been transformed by historical factors such that they are now no longer effective, fundamentally undermines any recognition of either the ability of resource-users to respond creatively to new situations, or the resilience of both cultural knowledge and the discourse of vernacular law in contemporary contexts. This is not to negate the history of marginalisation which many Namibians have experienced this century; the intention is instead to focus on both the relevance of culturally-informed resource-use practice and the reality of extensive and dynamic networks of alliance and communication which, *even with* a history of institutionalised repression, lie at the root of decisions relating to land and natural resource management.

An understanding of these issues is crucial for the success of rural development and conservation processes within Namibia. In particular, there are two interrelated arenas of change which would be usefully informed by in-depth appreciation of the ways in which farmers

---

[1] An Afrikaans expression, literally translated as 'field-food'.

negotiate and understand issues of land and natural resource access, and practise resource management. These are:

1) the community-based natural resources management (CBNRM) initiative of the Ministry of Environment and Tourism and the USAID- and WWF(US)-funded LIFE project as part of the mandate of the MET to promote 'environmental policy, and cross-sectoral planning, to enhance sustainable development' (Ashley *et al*, 1997: 2);

2) and the evolution of legislation constraining Namibia's post-independence land reform process, particularly as it relates to the widespread belief that 'The introduction of secure, exclusive *tenure* at the *community level* is the single most important policy reform needed to prevent degradation' (Dewdney, 1996: iv).

Given this situation, the focus of this chapter will be an analysis of contemporary management practices related to the use of specific natural resources by Damara farmers in north-west Namibia. The emphasis throughout will be on drawing general principles from these examples and assessing their implications for both the strengthening of 'community-based' approaches to resource management and the development of appropriate policy related to land reform in an arid communal area. The resources discussed are:

1) grass seeds, honey and perfume, as examples of possibly ancient resource-use practices, guided by enduring cultural knowledge which has potential relevance to contemporary resource-management initiatives;

2) water, access to which is the ultimate constraint on land-use practices in the region, and is therefore a focal resource whose management may be infused with tension;

3) land, and its management as an extensive grazing resource.

The chapter concludes with a discussion of current directions in both the CBNRM initiative and the land reform process relating to Namibia's communal areas, emphasising the apparent discontinuities which exist between local-level practice, as described by the case studies, and national-level policy formulation. The aim is to stress possible ways in which an understanding of land and resource-use practices by rural farmers can guide the development of appropriate policy by national government.

4.1 Case studies of resource management

4.1.1 Seeds, honey and perfume: relationships between folk and formal ecological knowledge

This section emphasises the value of using an ethnoecology approach (cf. Fowler, 1977) to derive a more than superficial understanding of local ecological knowledge related to specific, culturally-valued resources, and the potential for building on this knowledge in contemporary land and resource management interventions. Field-notes written during participation in resource collecting trips throughout the study period constitute the main body of information on which this section is based.

Seeds from harvester ant nests

"//Gaises ai ge sâu-e ra //garahe.
!Oaxaseb ge /nanuba ra /awi, /nanub gera /awi.
Khoetoma daibas ta aba?
Xoa ≠ga tara hîa tao danaba da !gau
!nara tara hîa tao !nuriba da !gau.
!Naidadama //naisore! Ho-ai!"

*"At //Gaises we winnow **sâu-i** (grass-seeds).*
The rain that we've been longing for is falling, the rain is falling.
Khoetoma, why are you crying?
*Collecting (the **sâun**) and putting it in (the **≠goub**)*
is making my head break (in the sun)
moving from place to place (nest to nest) is making my back break.
The giraffe nation are singing
*(because they are successful in collecting **sâun**).*
Ouch! (The ants bite my hand when I reach into the nest)."

(!Narab and Purros Damara 'Arus' or rhythmic song recorded in Sesfontein).

As mentioned in Chapter 2, harvester ant nests (i.e. '**≠goburun oms**' or 'ants' house') provide an important source of seeds for both food and the production of beer and liquor or **bâuga** which constitute important income-generating activities for the women of many rural households. Knappert (1981: 71) records the naming of an ancestral leader of the Damara as '**saub**', i.e. the term used to describe grass seeds of primarily *Stipagrostis* spp., which emphasises the value placed on this food resource, and songs such as that transcribed above affirm shared experience of the hard work required in enacting this resource-use practice, and highlight the excitement generated by successful collecting in seasons of plenty. It is likely that seeds from this source were extremely important in sustaining the Damara in the precolonial past; the seeds can be stored for up to three years and, as recorded among seed-collecting groups elsewhere, could have been stored in convenient natural caches such as rock crevasses, as well as in dwelling places (cf. O'Connell *et al* (1983: 93) for the Alyawara of north-central Australia and Veth and Walsh (1988: 20) for the Martujarra of the Sandy Deserts, Western Australia).

Together with honey-harvesting, this resource-use practice is guided by essential knowledge regarding the links between two completely different orders of the natural world, in this case ants and plants. Harvesting practice is thus informed by pragmatic understanding of both ecological diversity and the dynamics of seed availability, and is coupled with constraints linked to ensuring future productivity as well as considerations of access concerning who has rights to harvest from specific nests. These areas of folk ecology and customary practice surrounding seed-collecting are discussed separately below.

1. Ecological diversity and classification

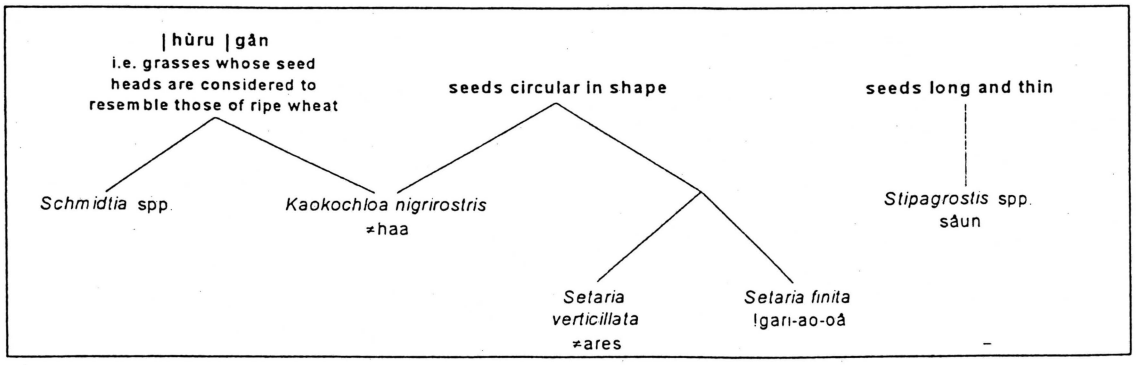
As Table 4.1 indicates, a range of seed-harvesting ant nests yield a diversity of edible seeds, primarily from grasses. This is in contrast to a recent phytochorological[2] analysis of

[2]i.e. focusing on floristic regions where species are naturally distributed.

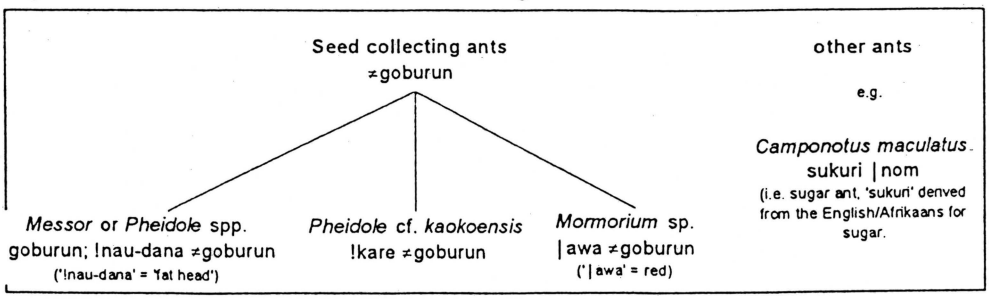
'useful' grass species which recorded only 8 useful grass species for the Karoo-Namib region as a whole, none of which were recognised as human food (5 were important as livestock forage, 1 for building materials, and 5 recognised as important for 'land use' i.e. soil erosion control, salt tolerance, etc) (Renvoize *et al*, 1992: 5-7).

Differentiation in Damara names of seeds to species level is the norm, despite both the separation of seeds from their parent plant once collected at a nest, and the extreme similarity of seeds from different species once assembled together in a nest. Figure 4.1 provides a preliminary indication of Damara seed taxonomy (cf. Fowler, 1977: 220-223), both those collected from harvester ant nests and those collected directly from the plant. From this it can be seen that classification is based pragmatically on physical similarities of the seeds (cf. Heinz and Maguire, 1974: 12; Posey, 1984: 123; Povinelli, 1990) translated into considerations of relatedness between species (as in 'this species is family w5ith that one'). Figure 4.2 shows names and classification of different ant species which indicates that all of the three genera occurring in Namibia are recognised, i.e. *Messor*, *Pheidole* and *Mormorium* spp. (Myrmicinae, sub-family Myrmicininae) (Marais pers. comm. 1996), which are considered to constitute some 95% of the total forager biomass in the Namib Desert (Wilson and Hölldobler, 1990: 610). Seeds are generally collected from the nests of 'ordinary' ≠**goburun**, sometimes referred to as **!nau-dana** (or 'fat-head') ≠**goburun** and identified as *Messor* or *Pheidole* species. *Pheidole* cf. *kaokoensis* nests also yield smaller quantities of seeds from which the outer seed coat has been removed or 'cleaned' by the ants. The nests of *Mormorium* sp. (**|awa**' or 'red' ≠**goburun**) are not raided, again because this species stores such small amounts of seed. Different castes within the same species of ant are recognised by the distinguishing terms **kai** or ≠**khariro**, i.e. large or small.

• Figure 4.1. Damara classification of some species of edible grass seeds.



• Figure 4.2. Damara classification of seed-harvesting and other ants.



• Table 4.1. Grass seeds collected from harvester ant nests: species recorded in this study and literature references.

species	Damara name and ethnoecological information	additional literature references
Grass seeds:		
Aristida cf. *effusa*	Both the seeds and the plant are called '!gaebiburu≠gahe'. This species is one of a generic class of grasses or '| gân' called 'tInki' which has awns which are not hairy or feathery like those of *Stipagrostis* spp. (classed as '!haburo | gân', see below). The name '!gaebiburu≠gahe' describes the difficulty of preparing these seeds before cooking; 'buru' refers to the process of winnowing and '≠gahe' refers to putting the seeds into the ≠goub or winnowing bowl.	Schultze (1907 *in* du Pisani, 1978: 14) states that seeds from *Aristida* spp. are collected from ants' nests and usually consumed with milk.
Chloris virgata	This species is called 'nanube' and its seeds are mixed with sâun in harvester ant nests and consumed with sâun as a consequence. This species has a terminal raceme and is therefore recogised as a '≠hara ≠gai' type of grass, literally translated as 'foot at the end'.	
Danthoniopsis ramosa (= *Loudetia ramosa*)	The similar species *Danthoniopsis dinteri* is called '≠namib' from which the edible seeds are collected directly from the plant. When 'cleaned', these are reportedly white like '≠u sâun'.	*Loudetia ramosa* is referred to as '≠u-saû', collected from harvester ant nests, by State Museum (n.d.).
Enneapogon desvauxii	The seeds and plant are referred to as '≠khari !nabise', i.e. 'small' !nabise. This distinguishes it from the larger '!nabise', i.e *Monelytrum leuderitzianum*, to which it is considered similar. Also referred to as '≠khari	hùru' (see notes for *Kaokochloa nigrirostris*). Like *Chloris virgata*, the seeds are mixed with sâun in harvester ant nests and consumed with sâun as a consequence.	Eiseb *et al* (1991: 21) record the name '	gâri.-i' for this species.
Kaokochloa nigrirostris	The seeds are referred to as '≠haa in and around Sesfontein and as '≠narabe' by informants further south e.g. Dâureb Damara. The plant as a whole is called '| hùru	gân', '| hurube' or '≠narabe'. '| Hùru' means 'ripe' as in ripe ears of wheat, e.g. '!horo ge go	hùru' means 'the wheat is ripe'. This name refers to the perceived similarity of this and other grasses (e.g. *Schmidtia* spp.) when ripe to ears of wheat. The open, empty seed heads of this and other	hurube grasses can make sâun and bosu 'dirty' and difficult to 'clean' or winnow. The seeds of this species are collected either on their own in areas of calcrete hills where *Kaokochloa* dominates or are found in a mixture with other species.	
Stipagrostis spp.	The seeds are referred to as 'sâun' while the plant as a whole is called '!gaburogu	gân'. 	Gân' is a generic term for grass and '!gaburogu' describes the feathery awns characteristic of this genus, which, when the wind blows, carry the sâun to the ground for the harvester ants (≠goburun) to collect so that they 'do not stand in one place'. 	Naa-i' is the term used to describe the empty seed head, i.e. the lemma with no seed inside.	Referred to, but unidentified, by du Pisani (1978: 14); referred to as 'saawi' by Steyn and du Pisani (1984/1985: 45) and as 'sâu-i' in a State Museum leaflet (n.d.). Used in Sesfontein (Van den Eynden *et al*, 1992: 86).
Stipagrostis cf. *damarensis*	Identified as a 'sâun	gâb' i.e. which produces edible seeds. Dâureb Damara respondents towards the south of Kunene consider that this species produces edible seeds known as '≠uu'.	
Stipagrostis cf. *hirtigluma* subsp. *patula* and subsp. *hirtigluma*	Both the seeds and the plant are referred to as '!garibe', a name describing the hardness of the seed ('!gari' means 'hard').	Referred to as 'saawi' by Steyn and du Pisani (1984/1985: 45).
Stipagrostis hochstetterana var. *secalina*	Both the seeds (which are sâun) and the plant are referred to as '| hoe'. Distinguishing features of the seeds are their small size and sharpness.	Referred to as 'saawi' by Steyn and du Pisani (1984/1985: 45).
Stipagrostis cf. *obtusa*	Called '≠habo	gâb' and described as a 'tsaura' or 'soft' grass which sways and lies on the ground when the wind blows.	*Stipagrostis obtusa* referred to as 'saui' collected from 'ant-hills' or ≠gui-adi' by du Pisani (1978: 14) and called '≠habob' by State Museum (n.d.).
Stipagrostis cf. *uniplumis*	As with *Stipagrostis* cf. *hirtigluma*, both the seeds and the plant are referred to as '!garibe', a name describing the hardness of the seed ('!gari' means 'hard').	Referred to as 'saawi' by Steyn and du Pisani (1984/1985: 45). **cont'd...**

• Table 4.1 cont'd.

species	Damara name and ethnoecological information	additional literature references
other seeds:		
Fabaceae *Indigofera* sp.	The small orange seeds are called '!ganikie' and are collected and consumed in small quantities when found with more abundant seeds in harvester ant nests.	
Geraniaceae *Monsonia umbellata*	Commonly called 'bosu' or '≠khari bosu', i.e. 'small' bosu to distinguish it from the larger seeds of *M. senegalensis*. Also called 'raba'.	Rust (1969: 255 *in* du Pisani, 1983) states that the Nama refer to the seeds as 'raba', the orange seed from which the husk has been removed as 'tsaman', the harvester ants nests as '|kunib' and the act of gathering seeds as '|kunire'. Du Pisani (1978: 14) refers to the consumption by Damara settled on the Ugab River of an unidentified 'red seed' called 'bosui'. Steyn and du Pisani (1984/1985: 45) also refer to the consumption of these seeds in the same area. Dentlinger (1977) refers to the use of *Monsonia* seeds by the ≠Aonin or Topnaar of the Kuiseb River. Van den Eynden *et al* (1992: 74) refer to *Monsonia* sp. as 'harapab' or 'rapab', the seeds as 'bosui' and unripe seeds as 'surube'.
Monsonia senegalensis	The seeds of this species are also called 'bosu' with the addition of a preceding term describing their large size relative to those of *M. umbellata*, i.e. 'surube', '|nurabe' or 'gai' bosu.	
Seeds collected from harvester ant nests by Central and Western Australia Aborigines (from Latz, 1995 and Walsh, pers. comm. 1996)		
Poaceae *Aristida inaequiglumis* *Brachiaria* spp. particularly *Brachiaria subquadripara* *Yakirra australiensis* Fabaceae *Acacia ancistrocarpa* *Acacia dictyophleba* *Dactyloctenium radulans* Malvaceae *Abutilon otocarpum* *Sida* spp. x 2		

2. Dynamics of availability

Damara understanding of the availability of seeds for collection from harvester ant nests is rooted in observation of the effects of unpredictable and rainfall-driven variations in primary productivity. This is apparent, for example, in the existence of the specific term **|uubi** or **!gûibes**[3] to describe nests which are small and where the harvester ants are inactive as a result of periods of drought. It is thought that the ant population falls as a result of the lack of available grass seeds during these conditions and that it needs time to recover following rain; the consideration that a run of good rain seasons enables the harvester ants to store increasing quantities of seeds further suggests observation and understanding of time-lags associated with the recovery of seed stores in ants' nests following drought. Collecting occurs towards the end of the rain season when the ripe seeds begin to be blown to the ground and are carried by the harvester ants to their nests. Depending on rainfall, seeds can be collected from these nests throughout the year such that good rain years lend themselves to more frequent harvesting.

These considerations mirror formal ecological understanding of foraging and population dynamics among seed-harvesting ants in desert ecosystems, although it is worth mentioning that not a single one of the references reviewed demonstrated an awareness of the practice of raiding the granaries of these ants by people. Ludwig and Whitford (1981: 288) state that the scanty and unpredictable availability of seed (cf. Brown *et al*, 1979: 203-204), together with the type of colony, regulates foraging activity in Chihuahuan Desert species and Whitford (1978 *in* Ludwig and Whitford, 1981: 288) describes how the large colony-size group-forager *Pogonomyrex rugosus* 'harvested intensively in a year with high annual production following drought' (see also Brown *et al*, 1979: 210-211). Under laboratory conditions, increased exit rates of foragers from nests are stimulated by the return to the nest by an ant with exceptional food (Carroll and Janzen, 1973: 240). Conversely, reduced energy expenditure through ectothermy and dormancy, coupled with seed storage, allows periods of foraging inactivity corresponding with low availability of seed (Brown *et al*, 1979: 208). A suggestion by Wilson (1971 *in* Brown *et al*, 1979: 208) 'that individual colonies may sustain dramatic reductions in populations of workers and brood while retaining the capacity to respond quickly when conditions become more favourable' remains possible but has not been confirmed empirically. The ability to capitalise on good years and store food throughout periods of low seed productivity enables established colonies to survive for many years (Brown *et al*, 1979: 204, 206; Wilson and Hölldobler, 1990: 610).

---

[3]The latter is from the dialect of the Sesfontein Purros Damara, i.e. Damara who, prior to settling in Sesfontein, inhabited and used land and resources to the north-west of Sesfontein, as far as and beyond the current settlement of Purros.

3. Harvesting practice and constraints

Related to the observations of inter-annual variations in seed availability described above are various harvesting practices which are understood and explained as means of ensuring productivity into the future. It is widely stated, for example, that harvesters must leave enough seed within the nest for the ants to survive the process of nest-raiding and be able to continue to store seeds in future seasons. Similarly, only seeds from the surface layers of the nest are collected so as not to damage the nest through digging too deep, and seeds located deep in the nest during drought should not be collected as these are necessary to enable the ants to survive the drought so that they can collect in abundance following rain. The practice of remaining silent while collecting is intended to minimise disturbance to the ants, although Vedder (1928: 50), in characteristic dismissive fashion, describes how women are expected to gather in silence so as not to behave as 'chatterboxes'. Stones are placed over the entrances to the nests for various reasons; to 'prevent the ants from leaving the nest', to mark the nest as the property of a harvester (see below), and possibly to facilitate collection of seeds by encouraging the concentration of seeds in surface chambers formed by these stones and preventing, to some extent, the mixing of these seeds with soil and other debris in the nest.

4. Nests as property

Harvester ant nests may be considered the property of the individuals, normally women, who first collected from them, and as such can be passed on to their daughters. This is particularly true of nests located in close proximity to settlements where the ratio of nests to people is relatively low. This agreement is informally understood and enacted; the harvester makes it known throughout the settlement that she has begun collecting from a specific nest and appropriate social behaviour requires that noone else should collect from it.

This treatment of nests as essentially private property does not constrain collection from nests located further afield. Ancestral claims to land do, however, play an important role in influencing where people will go to collect seeds, as well as other resources. When collecting seeds or honey in Sesfontein and environs, for example, people tend to travel in the direction of the land area with which they have ancestral links. So, Damara from the area north-west of Sesfontein towards Purros travel in that direction and collect from nests in the |Giribes plains, while so-called Namidaman from the Hoanib River and Namib Desert to the west of Sesfontein tend to return to known concentrations of ant nests in the direction of these areas. In this sense, food-gathering constitutes an affirmation of relationship with the land; as Bell (1993: 52) describes for Warlpiri aborigines of central Australia, resource gathering constitutes 'time away from the settlement, time with close kin, time in one's country', all of which are as important as the economic dimensions associated with exploitation of local resources.

Honey

Honey is a sought-after and highly valued commodity throughout sub-Saharan Africa and elsewhere, particularly as an additive to beer, and its collection is universally an activity carried out by men[4]. Both the collection of wild honey and the harvesting of that from managed hives is usually surrounded by a 'rich honey culture' including myth, ritual and song (cf. Brokensha *et al*, 1972: 117, 121 and Brokensha and Riley, 1986: 79, for the Mbeere, Kenya; Strickland, 1982: 157-158 for the Nepalese hill tribe the Gurungs; Ntenga and Mugongo, 1991: 32-34, for the Gorowa, Iraqw and Barbaig of Babati District, north-central Tanzania). Honey collectors tend to be widely respected for their 'bravery and experience, and in their knowledge of the ways of bees' (Brokensha *et al*, 1972: 116).

Similarly, and despite the aridity of north-west Namibia, honey-harvesting is a time-honoured tradition among the Damara requiring skill, patience and relevant environmental know-how, and surrounded by celebratory myth and praise songs. Knappert (1981: 73) states that 'Their ability to find honey and collect it for trading purposes has further earned them the name "Danidaman"', i.e. **danib** = honey. Its importance can also be illustrated by the emphasis on honey in the following account by Köhler (1959: 35) of conflict between the Herero and Damara in which he states that 'Under the leadership of one Josef Toke they (the Herero) made a raid on the Bockberg area, burnt down the Bergdama huts and plundered the people. They seized their livestock and their honey'.

The honey bee ('**!habub/s**') represents valued qualities of industriousness, discipline and respect for the wisdom of elders, as the following account of the origins of honey-making indicates:

> *'!Gâimû-es ge ǁnamahebas ge !habu sa ge ǁnâu.'*
>
> !Gâimû-es was scolded; !habu listened.
>
> i.e. **!Gâimû-es'** (*Xylocopa caffra*, the carpenter bee) mother and father taught her how to make honey one day and the orphaned honey bee ('**!habus**') (*Apis mellifera scutellata*) sat and listened. **!Gâimû-es'** parents said that you must collect ≠**habo** |**gâs** (i.e. *Stipagrostis* spp. grasses, see Table 4.1) and weave the stems together, and then take nectar from |**gom**|**gom** plants (such as *Ruellia* spp. i.e. with flowers from which you can suck nectar) and place the nectar in the holes between the woven strands of grass. **!Gâimû-es** didn't follow this advice because she had her parents to look after her; **!habus**, on the other hand, listened very carefully and from that day has been able to support herself by producing honey in the same hive, year after year. **!Gâimû-es** meanwhile is destined to live alone, moving aimlessly from place to place (**!gâi-!gâi-!gâi** = from place to place to place), and all her attempts to make honey end in failure. (Story recorded in Sesfontein)

---

[4] cf. Grivetti (1979: 247) for the Tswana-speaking Tlokwa, eastern Kalahari; Brokensha *et al* (1972) for the Mbeere of Embu District, Kenya; Ntenga and Mugongo (1991) for the Gorowa, Iraqw and Barbaig of Babati District, north-central Tanzania; Jennings (1994: 12-13) for predominantly Hehe and Wagogo, central Tanzania; Cunningham (1996: 17-19) for beekeeping and honey hunting by Bakiga agriculturalists and Batwa hunter-gatherers around Bwindi Impenetrable Forest, Uganda.

Interestingly, formal descriptions of the reproductive cycle of Carpenter bees (Xylocopidae) mirror the sense of this story almost exactly, as in the following statement regarding nest establishment that 'This can be regarded as a primitive stage in the development of true social life and energy-conserving division of labour, as exhibited by honeybees' (Braack, 1996: 141).

As well as the widely harvested honey from the honey bee *Apis mellifera scutellata,* the very palatable small quantities of honey of so-called 'mopane bees' or '**nani**' is also consumed opportunistically when found.

As described above for the collecting of seeds from harvester ant nests, a wealth of technical knowledge is employed in order to harvest honey in ways which prevent destruction of the hive, and harvesting is further constrained by property rules amounting to individual ownership of particular hives. Unfortunately, these constraints are becoming overshadowed by processes rooted outside control by local resource-users and threats to sustainability are apparent. These issues are discussed separately below.

1. Harvesting honey: technical aspects

Locating a new hive relies on keen observation of swarms of bees in flight, aided by following the trail of minute secretions dropped by honey bees when in flight and sometimes by attaching a fine thread to the leg of a bee in order to more easily follow its flight direction. These practices are also reported in Guy (1972: 163-164). As is common among honey harvesters throughout the world, the technique of harvesting requires the use of smoke to subdue the bees following which the harvester can reach into the hive and break off pieces of comb dripping with honey. Ladders are sometimes constructed to aid access to hives, a long regional history of which is indicated by the wealth of rock art depicting this practice among honey harvesters in southern Africa (Guy, 1972: 162; Pager, 1973: 61-63, 66).

Du Pisani (1978: 15) has described the practice of locating hives and harvesting honey by Damara living along the Ugab River as follows:

> "To locate a hive can take two or three days. In order to establish the exact spot, men not only pay attention to the flight of bees, but also observe their secretion which can be seen clearly on dark stones. Before the honey is removed, the hive is fumigated. Normally only half the combs are taken. This prevents the bees from deserting the hive alltogether (*sic*), and thus secures its future utilization. Honeycombs are eaten, while honey also constitutes an ingredient of an intoxicating honey beer (**dani-!kari**)".

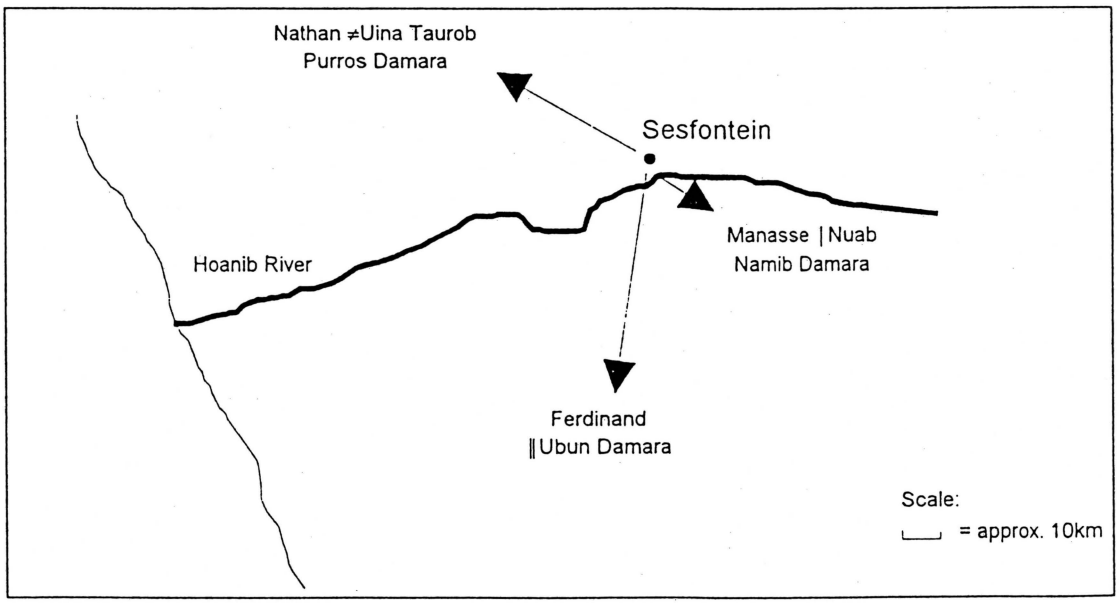
2. Honey hives as property

A hive is considered to be the property of the first Damara man who found it, who asserts ownership by placing a stone in the opening of the hive. This practice was noted by Wandres (1909: 676) and Vedder (1928: 60, 73) and is similar to that described for

southern African San populations in Guy (1972: 163). Among the Damara it continues to be carried out today by now elderly honey-harvesters, particularly from the northern settlements of the former Damaraland. During fieldwork for this project stones marking rights to hives in use were observed in rock crevasses and large trees such as *Sterculia africana* and *Moringa ovalifolia*; similarly, nests in *Moringa ovalifolia* trees which had been marked and closed off with stones were found in the course of archaeological work at the Brandberg by Kinahan (1991: 64). Access to hives may be facilitated by building loose ladders as also observed at the Brandberg by Kinahan (1991: 63). The practice of marking ownership of nests is in contrast to other areas where bee-hives are more abundant as a result of higher rainfall; among the Hehe of central Tanzania, for example, more than one honey-hunter could harvest from the same hive (Jennings, 1994: 12, 55).

In the north of the former Damaraland area where people have a more continuous history associated with the landscape, and as described for the collection of seeds from harvester ant nests, honey-harvesters maintain hives in the areas with which they have ancestral links. Map 4.1 demonstrates this pattern of harvesting for three harvesters from Sesfontein.

Map 4.1. Sketch map showing location of honey hives 'owned' by 3 harvesters from Sesfontein and the relationship between these hives and the ancestral lands of these harvesters.



3. Constraints on harvesting

The departure of a swarm from a hive due to overharvesting was noted as an offence in Wandres (1907: 676) and a number of practices are observed today among traditional harvesters to ensure the sustainable production of honey. Only a portion of the honey is removed, for example, and the harvesting of honey from young hives is avoided. The practice of placing a stone over the entrance to the hive is also considered to encourage the swarm to remain in the hive.

Ensuring the long-term sustainable production of honey seems to be a principle which informs harvesting practices wherever there is a long tradition of honey-harvesting (cf. Guy, 1972: 163; Strickland, 1982, 157; Ntenga and Mugongo, 1991: 22). Among the Hehe of central Tanzania, for example, the bees are similarly subdued with smoke and the honey removed by boring a small hole into the comb, taking care not to disturb parts of the comb containing grubs, and the hole is resealed after collection thereby minimising damage to the hive (Jennings, 1994: 12, 55).

4. Current threats to sustainability

Wherever areas are subject to changes in land-use, often accompanied by conflicting land claims, traditional forms of honey-harvesting appear to be compromised and vulnerable. Brokensha *et al* (1972: 122), for example, identify two threats to honey-harvesting among the Mbeere of Embu District, Kenya; first, the process of land adjudication which, through granting individual title to land, restricts the movement of honey-collectors to their hives, and second, the fact that, without an emotional commitment to the harvesting process, younger men are unlikely to 'be prepared to spend as much time and effort in getting honey'. Similarly, around Ruaha National Park in Tanzania, where Hehe honey-hunters have been forbidden to harvest honey from within the park, an increase in practices which damage the hive has been observed (Jennings, 1994: 13). In addition, the movement of people into lands with which they have a less intimate ancestral claim is also responsible for an increase in unsustainable raiding of marked hives in this area (cf. Jennings, 1994: 29, 56).

Likewise, in north-west Namibia two processes underlie breakdowns in the sustainability of the traditional process of honey-harvesting as it is enacted by Damara harvesters. First, is the increasing movement into the area by non-Damara livestock herders who, without either a long history associated with the land or an awareness of the locally-acceptable harvesting practices described above, are known to destructively raid hives for honey as they encounter them during the course of herding away from settlements. Movement of people into the area is made possible by Namibia's constitution which, in reaction to the constraints imposed by the Apartheid-style South African administration, allows Namibian citizens to move anywhere on communal land. Second, is a breakdown in understanding between successive generations of Damara, with the skills surrounding honey-harvesting losing value among young Damara men, even while they relish consumption of honey when it is available.

Perfume

Sâi, loosely translated as 'perfume' and also referred to as 'buchu' in historical sources, is a powder made of various combinations of aromatic plants. It is widely used to perfume body, garments and bed clothes, and is considered to impart female beauty and attractiveness. As a substance it is deeply associated with femaleness, and all aspects of its procurement,

preparation and use are conducted and controlled by women. Its cosmetic use is underpinned by deep symbolic significance. Vedder (1928: 48), for example, relates how during the seclusion of their first menstruation girls were instructed how to prepare and grind this perfume, and were given their first perfume or 'buchu' container, made out of a tortoise shell and kept afterwards on their girdles. For each girl 'this powder box was the symbol of her femininity, and buchu the symbol of her feminine potencies, of fertility and giving life' (Schmidt, 1986: 334-335). Demonstrating this power is a myth related by Vedder (1923: 1, 7) in which a heroine killed by an 'ogre' is revived by her children by placing her heart in the ash of a fire and sprinkling buchu over it[5]. As well as the ability to confer strength and revival, buchu is also described as having calming and taming properties (Vedder, 1923: 1, 7).

An intimate symbolic relationship existed between **sâi** and the hunting of animal wildlife. For example, the grinding and use of **sâi** was prohibited when a woman's husband was hunting due to the opposition which was understood to exist between the life-giving potency of **sâi** and the ability to kill required by the hunter (Schmidt, 1986: 334-335)[6]. This is similar to the statement by Biesele (1975: 281 *in* Schmidt, 1986: 341) that prior to a hunt a good hunter in !Kung society was 'fearful of eating or sleeping with his wife lest his poison got cold because she smelt of milk and sâ'. The symbolic connections between menstrual blood and the blood of hunted animals, and the ability of women to enhance the female power associated with menstruation with ritualised substances such as ochre or body perfume, are widespread in the ethnographic record (see Knight, 1991, especially chapters 10 to 13).

Species which are currently used in the making of **sâi** and are considered as **sâ-hain** or perfume-plants are detailed in Appendix 2. Species recorded in Malan and Owen-Smith (1974) as used as perfume by the Himba of Kaokoveld are also indicated. As can be seen, a diversity of species are used and recognised by Damara women as ingredients of **sâi**. Particular mixes of these species are preferred. For example, Justine Haraës, a long-standing inhabitiant of Rietkuil Farm in the southern part of former Damaraland (see Box 4.1), prepares **sâi** made from a combination of the leaves and stems of *Hemizygia flocossa* (**|hai hais**), the bark of *Commiphora virgata* (**soba**), the dry rotten wood or **≠gae** of *Terminalia prunioides* (**≠kheas**) and *Colophospermum mopane* (**tsaurahais**) and the pods and seeds of *C. mopane* and *Zanthoxylum ovatifoliatum* (**|noboheda**). **Sâi** which she had purchased in Otjiwarongo she considered to be of low quality due to the addition of plants not recognised as 'Damara **sâi**', in this case the leaves of *Eucalyptus* sp. (known as **calipto**).

Many of the species used for perfume have additional uses, particularly as medicines. *Commiphora virgata*, of the genus whose resiniferous wood is famous for the production of

---

[5] Schmidt (1990: 310) asserts that the resuscitation of a person killed by an ogre is a standard final episode in Nama/Dama 'magic tales'.

[6] For further descriptions of the 'weakening influence' of women, particularly when menstruating, on the prowess of the hunter see also Fourie (1926: 56, 58) and Marshall (1976: 96-97).

myrrh (cf. Miller *et al*, 1988: 82-87, 304-307) is, for example, used for a variety of medicinal purposes throughout the former 'homeland' of Damaraland, many of which relate to maternal health at or after childbirth. A decoction of the leaves, bark and stem is taken for coughs and colds, general strength and good health, restoring maternal health after child-birth, stomach disorders and for heart and chest pain (see also Van den Eynden *et al*, 1992: 67). This species is also host to an edible caterpillar called ≠**nû** (black) |**girus** (*Usta wallengrenii*, Saturniidae), which, as noted in Chapter 3, is eaten with relish and traded throughout the north-west. The perennial herb *Thamnosma africana* or ≠**khanab** is similarly used as a medicine for common ailments: a decoction from whole plant is an all-purpose medicine valued throughout former Damaraland and used to treat coughs, colds, chest pain and flu, to relieve stomach pains, to 'cleanse' the uterus after giving birth, for menstrual problems, to increase the likelihood of conceiving and as a 'multivitamin' drink (see also medicinal uses among the Nama in du Pisani, 1983: 12, and the Kuiseb Topnaar in Van den Eynden, 1992: 50).

Finally, extensive trade in plant perfumes in the wider region connects women of different groups in informal networks of exchange incorporating these and other locally produced commodities. Several aromatic species found to the north of the former Damaraland, for example, are gained through trade with Himba women at centres such as Sesfontein, where they are often exchanged for the highly-valued local tobacco and other garden produce grown by both Damara women and men.

Local knowledge, ecological principles and contemporary resource management practice

The above case studies demonstrate several areas of convergence between local culturally-informed knowledge and scientifically-derived ecological principles. These include:

1) **Biological diversity.**

All of the case studies demonstrate a deep recognition of regional biological diversity classified largely in parallel with formal taxonomy. Even when a generic term is used in Damara 'ethnotaxonomy' for several species which are considered related (often borne out by scientific taxonomy), individual species are recognised by physical characteristics and/or habitat preferences (see also Baker and Mutijulu Community, 1992: 178 for an analysis of Anangu classification of reptiles, north-central Australia).

Conversely, two species may also be recognised which formal taxonomy defines as a single taxa. Usually this arises when either an aspect of the wider ecology of the species or a variable quality which is meaningful only in the context of its local use-value is overlooked by taxonomists working in locations far from the environment of the species in question. An example of this is the Damara classification of *Cordia gharaf*. All informants adamantly maintained that this encompassed two completely different, although closely related, plants referred to as ‖**khoos** and |**ais** respectively and

recognised from their habitat preferences, different physical characteristics and qualities of their edible fruits. The former, for example, are found on relatively rocky substrates, have small, rounded leaves, are generally less spreading in growth habit, and have smaller fruits which are the preferred of the two. The latter occupy alluvial soils in better watered areas, have elongated leaves, a more spreading habit and the fruits are bigger but filled with a sticky pulp which makes them rather less pleasant to eat. The pulp, in fact, is used additionally as a substitute for paper-glue by school-children! It is likely that all of these differences can be attributed to different habitats; however, the possibility that these two forms may represent either different species or two subspecies of *C. gharaf* is an interesting taxonomic question warranting exploration.

2) Species interactions and interdependence

To a very great extent, ecology is concerned with the complexity of interrelationships between species, and the dynamics of these at population, community and ecosystem levels. Similarly, the case studies of seed-collecting and honey-harvesting demonstrate local empirically-tested observations regarding the relationships between two completely different orders of the natural world, i.e. insects and plants. This includes an understanding of the different plant species producing seeds appropriate for a variety of seed-harvesting ants, the importance of the availability of these seeds in maintaining populations of ants, and an awareness of the links between the harvesting of plant-nectar by bees and the production of honey.

3) Ecological dynamics

As has already been emphasised, the most important constraint facing inhabitants of the north-west Namibian landscape is its low and variable primary productivity. Baker and Mutijulu Community (1992: 174, 186) maintain that, a 'true appreciation of the dynamics of the ecosystem' rests with a long ancestral connection with the land. This observation is borne out by the above case studies on plant-harvester ant ecology and honey production in which the relationship between seed or honey availability is conceived as intimately related to, and driven by, temporal and spatial patterns of rainfall. In contrast, one of the contentions of this thesis is that the implications of an unpredictably varying abiotic element for ecosystem and resource management are poorly understood; both by development professionals and policy-makers in dryland areas such as Namibia, and within the academic discipline of ecology which conventionally emphasises the equilibrating interactions between the biotic components of ecosystems (these issues are fully discussed in Chapters 5 to 8).

4) 'Sustainability' as a harvesting principle

Finally, the case studies demonstrate that the harvesting of resources in ways which will ensure their continuing productivity is firmly entrenched within culturally-informed harvesting practice. So, for example, when collecting seeds from harvester ant nests it

is accepted that enough should be left for the ants, while non-destructive harvesting practice associated with the procurement of honey is explicitly linked with facilitating the maintenance of bee hives into the future.

4.1.2 Water: instituting 'community-based' management of a focal resource

In an arid environment such as western Namibia, water is the primary limiting factor for both human settlement and livestock herding. Land reform in communal areas is thus inextricably tied up with issues of how this valuable focal resource is managed and who shoulders responsibility for the costs of maintaining the infrastructure (i.e. boreholes and pumps) necessary to ensure its continued availability.

The provision of water is currently the official responsibility of the Dept. of Agriculture, Water and Rural Development, but the practical aspects of this are primarily implemented by the Dept. of Water Affairs (Africare, 1993: 7). State-controlled and subsidised water provision within the 'homelands' created by the South African administration was a necessary condition for the implementation of the Odendaal plan and the associated resettlement of communal farmers. This long-term situation of State-ownership over water and the infrastructure necessary for its supply has encouraged a strong tendency to perceive communal area farmers as 'dependants' of the government in terms of water supply. While they technically lack ownership rights over basic water-related infrastructure, however, farmers are actively involved with its day-to-day management and maintenance, and invest considerable amounts of time, energy and resources on maintaining infrastructure during their occupancy of a farm. Moreover, they are engaged in continual processes of negotiation relating to who has rights of use to these key resources.

With annual operating costs of over US $1 million for maintaining water provision in the Kunene and Erongo Regions alone (Africare, 1993: 8), the government is understandably anxious to find ways of dispersing some or all of these costs away from central coffers[7]. In an attempt to make the transition between institutionalised dependence on government for water provision and user-accountability, the NGO Africare, following a request for assistance by the Ministry of Agriculture, Water and Rural Development, is currently implementing a program 'to provide technical assistance and training to establish a maintenance system and capacity' for water provision in drought-prone communal areas (Africare, 1993: 7). The primary aim of this programme is to empower communal farmers by instituting the participation of rural populations in the rehabilitation and maintenance of boreholes, through the establishment and training of water-point management committees at 'village' level (cf. Fry, 1995: 170-171); i.e. to promote 'community-based' management of water resources. The establishment of these committees involves the identification of one or two individuals as 'water caretakers'

[7] This is in fact less than US $10/person/year; given the stated socialist aims of the government, this, perhaps, could be reasonably assumed the responsibility of the government in its commitment to the provision of basic welfare to its rural population.

responsible for simple repairs, routine maintenance checks, and the management of a fund comprised of cash or in kind payments by consumers to cover the costs of water-point maintenance (Africare, 1993: 10). With regard to the latter, Boxes 4.1 and 4.2 provide data which illustrate the complexities of the 'real world' situations on which currently popular 'community-based' approaches to development by donor and implementing organisations are being imposed. Box 4.1 describes a farm where the institution of a community-run 'water-point committee' was being piloted, starting with participation by one of the farmers in a workshop designed for the training of treasurers for these committees. Box 4.2 demonstrates the range of origins of current farmers in the 'communalized' farms of southern Damaraland. In particular, these examples highlight the variability in background and socio-economic factors characterising the households which constitute so-called farm 'communities' in this area. The following features bear crucial significance for the management of focal resources such as water:

1) The heterogeneity expressed by farm occupants on many different levels cannot be overemphasised. Superficially, farm settlements give the appearance of being coherent groupings of households, an impression which is emphasised for the demarcated farms of southern Damaraland by the relatively permanent nature of the buildings and infrastructure on these farms. This, however, is largely a function of the importance of water in focusing the location of households, and not because of strong underlying relationships binding all of these households. There are many examples of such heterogeneity in the case study of Rietkuil farm in Box 4.1, corroborated by the case studies presented throughout this thesis. For example:

   - while many of the farm's current occupiers are related by kinship in some way, this is certainly not the basis for the settlement of all households on this farm. Family ties are extremely important in facilitating the movement of livestock between farms, and often affect decisions related to choosing a farm for more permanent settlement; but as both Boxes 4.1 and 4.2 emphasise, it is equally true that people who have no prior experience of each other are often settled together on a farm. Reciprocal relationships may or may not develop between these individuals over time;

   - wide disparities in wealth, both in terms of livestock and access to alternative sources of income, exist between farm occupiers. This raises a plethora of issues fundamental to instituting ideals of 'community-based' management of focal resources, related in particular to the real danger of promoting systems in which the less wealthy shoulder the costs of more wealthy, but often absentee, farmers. For example, should contributions towards the maintenance of farm water supply be related in some way to the income or wealth of farmers and their households, perhaps based on numbers of livestock herded at the farm? Given that many farmers have significant alternative sources of income, should this be taken into consideration when deciding their share

of the costs? With so many of the more wealthy farmers spending varying and sometimes prolonged periods of time away from the farm, how can their contribution to the costs of watering their herd be elicited? In fact, follow-up visits to Rietkuil Farm demonstrated that these are precisely the problems being experienced in the establishment of a water-point committee on this farm (and also observed in Okongo, Ohangwena Region, north-central Namibia in Dewdney, 1996: 103); despite informing the other farmers that they would have to set-up their own fund to carry the costs of maintaining infrastructure related to water, the household of Justine, the 'treasurer', remains the only one to have contributed any money. The household with the largest herds utilising grazing resources on the farm has yet to contribute to the fund (household 2 in Box 4.1), and inhabitants of the farm remain convinced that the Government will continue to take responsibility for water provision.

2) The case study of Rietkuil farm in Box 4.1 indicates the reality of such factors as the largely drought-driven movement of livestock and people between farms, varying periods of farm occupancy by different households and individuals, absentee herding of different degrees, and the retention of claims to farms by individuals over sometimes prolonged periods of absence from the farm (see Section 4.1.3 for further discussion of these factors). All of these are expressions of the fluidity and flexibility which overlays the apparently static geography of the surveyed commercial farms, and through which people in Damaraland manage the land and its resources to maintain and increase the movable property (i.e. livestock) which comprise household wealth. The success of 'community-based' approaches to the management of focal resources will thus depend on their ability to respond creatively and flexibly to variable farm communities; this requires departing from conceptions of communities as stable and easily defined entities in time and space.

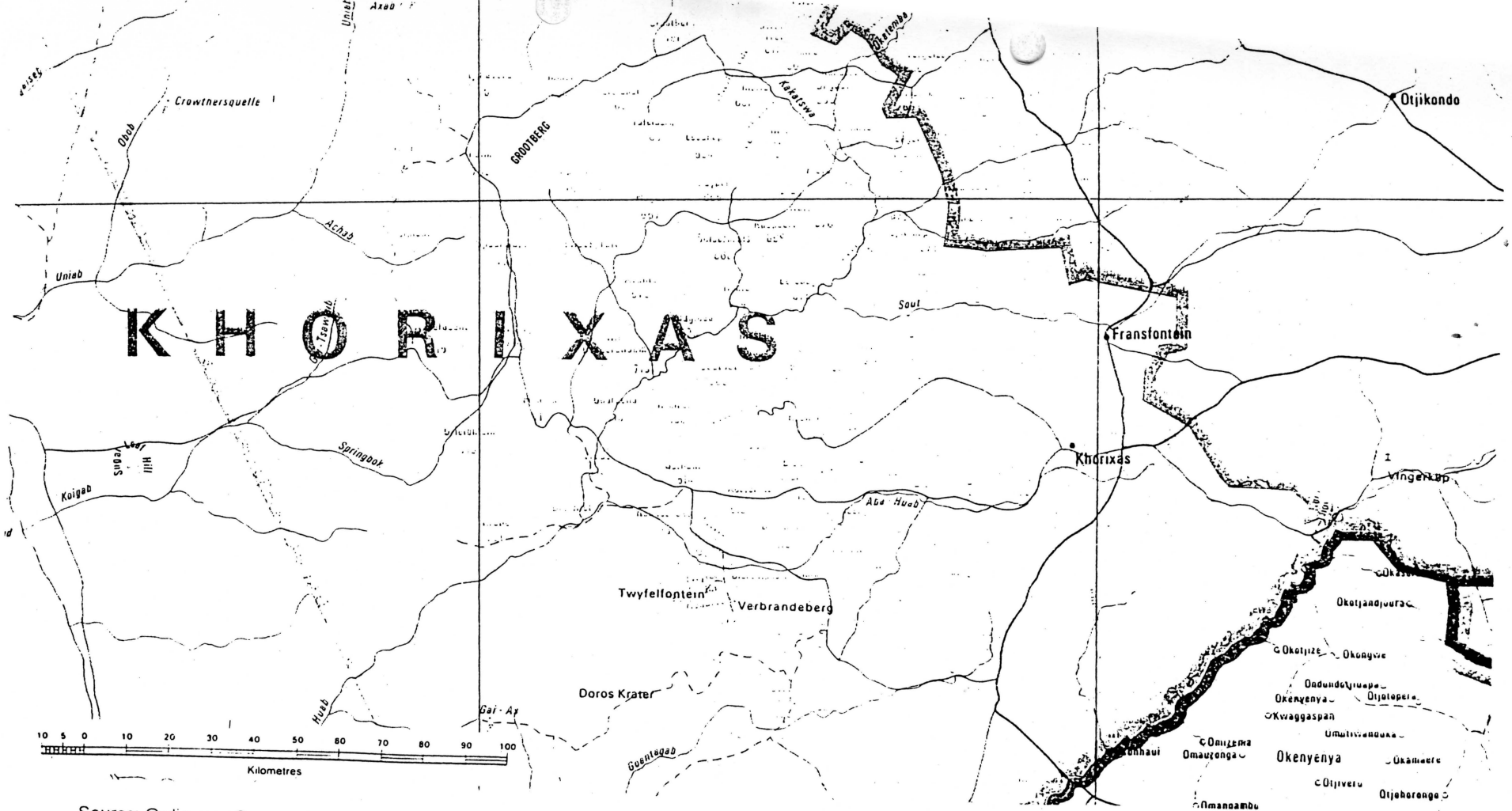
4.1.3 Land: communal management on delineated farms

As described in Chapter 1, delineated farms to the west of the commercial farming district of Outjo south of the 'Red Line' were incorporated within the communal homeland of Damaraland in the 1970s following recommendations by the Odendaal Commission. These 'communalized' commercial farms form the basis for the following discussion of how land and grazing resources are managed for the purposes of livestock production (cf. Sullivan, 1996). This area was selected because its multi-layered land use and settlement history would logically make it susceptible to a breakdown of customary forms of management, thus conforming to Quan *et al*'s statement at the start of this Chapter. In fact, this case study demonstrates the reality of on-going processes of negotiation related to the use of land for livestock-herding, and the emergence of a dynamic coherence in informal understanding of rights to land and grazing, even in the face of extreme uncertainty in both the lack of formal tenure rights and the vagaries of environmental productivity.

At first glance, the farm geography established by the surveying and delineation of commercial farms, and represented by their fences, water points and farmhouses, appears extremely static. The stable demarcation of these farms on maps of the area from both before and after the delineation of the new Regions and Administrative Districts, adds to their perceived concrete reality (see Map 4.2).

Overlying and tangled up with this farm geography, however, are complex movements of both people and livestock (not to mention other traded commodities). In 1992, for example, a large-scale movement of livestock away from the western and southern Odendaal farms took place towards better grazing in the east and north and along the Ugab, Huab and Omaruru Rivers (Rohde, 1993: 50, 1997: 266-267). At the same time the Aukeigas (!Ao-‖Aexas) community, who had been forcibly moved to the farm Sorris-Sorris in 1956, expressed their disgust at the marginal and drought-affected conditions under which they were constrained to live by moving to and squatting outside their ancestral lands near Windhoek (now Daan Viljoen Game Reserve) (cf. Nærua *et al*, 1993: 107-110; Devereux, 1996: 16-17). In 1994, the north-east pattern of movement was to some extent reversed, with farmers from the drought-stricken Khorixas and Kamanjab areas moving south towards the Ugab River (pers. obs.). Even before the establishment of the communal area of Damaraland, Köhler (1959: 48-49) reports the regular migration of livestock to the Namib when surface water is available following good rain seasons, and the movement of whole communities to the forage resources of the Omaruru River following drought in the early 1950s. Populations elsewhere in Namibia are similarly mobile (cf. Dentlinger (1977: 14-15) for descriptions of mobility among the ≠Aonin or Topnaar of the Kuiseb River).

Many of these movements demonstrate the importance of the pods of leguminous plants, particularly *Acacia tortilis* and *Faidherbia albida*, which occur in high concentrations along ephemeral watercourses and which form a particularly nutritious source of livestock forage during the dry season (cf. Scholte, 1992). Ensuring access to this resource is often crucial; among the Turkana of north Kenya it has led to the recognised family ownership over an **ekwar**, or discrete area of riparian vegetation, which occurs within the family **ere** or place of permanent settlement where young and old livestock remain throughout the year (Barrow, 1988: 4, 8, 1990). The importance of pods for the sustenance of livestock in Namibia's arid areas was described by early European observers. For example, Walker (1917: 60), describing Riet on the Swakop River, states that 'The trees are quite a feature, and are a species of acacia known locally as the "anna". It grows large as an oak, and the pods, ... are used as food for animals' (see also Hahn, 1928: 225).



Source: Ordinance Survey Map of the Republic of Namibia, 1994.

Detailed recent migration histories were constructed for individual communal farmers since the settling of these former commercial farms in the 1970s, for all households on five former commercial farms in the Aba-Huab catchment. A full account of the migration histories for all households currently inhabiting Malansrust Farm is presented in Box 4.3 and further migration histories can be found in Appendix 3. Figures 4.3a and b map patterns of migration; apart from demonstrating visually the spatial and temporal fluidity in farm occupancy by people and livestock, the extent of movement enacted by different households also provides some indication of the size of networks with which farmers have connections. These case studies highlight the astonishing fluidity through time and across space which characterises communal management of this otherwise bounded and enclosed area. Given descriptions of former commercial farms elsewhere in Damaraland (cf. Rohde, 1993, 1997), these are considered broadly representative of the former commercial farming area of south-east Damaraland as a whole; the general features of management and decision-making which they exemplify, therefore, can reasonably be extrapolated across a wider area. In addition, they are likely to have relevance to the 'communalized' commercial farming areas of the former Namibian 'homelands' of Namaland and Hereroland.

Features of migration

Analysis of case study material draws out the reality of several features of migration:

- The ability to move in response to drought-induced shortages of grazing is probably the most important herd management strategy employed throughout the world by pastoral societies inhabiting variable environments (cf. Benefice *et al*, 1984: 231; Homewood and Lewis, 1987; Oba and Lusigi, 1987; De Leeuw and Tothill, 1990: 5; Oba, 1992: 4). As Box 4.3 and Appendix 3 suggest, this remains so in the former commercial farms of Damaraland, in spite of the division of this area into demarcated and fenced land-holdings and the relatively recent allocation of land to communal farmers, many of whom had no prior knowledge of the region. The continual movement of people and productive resources means that the population of a farm at any one time represents only a proportion of the individuals who can claim rights to occupy that farm (see also Nærua *et al*, 1993: 14; Rohde, 1993: 40, 42). This poses complex problems for the strengthening of 'community-based' approaches to the management of focal farm resources, as is discussed above in the context of borehole maintenance and the provision of water to farmers and their herds.
- Similarly, access to livestock and livestock products is not a matter of simple ownership of animals, and the relationship between people as owners of herds and the livestock on a farm at any given time is rarely straightforward. For example, a farmer may be responsible for herding animals belonging to individuals currently elsewhere, while conversely the herds being tended by farmers at a particular farm may not represent the total number of animals to which he or she may lay claim.

mother's sisters with assistance from two boys from the family. When these boys went to school, the old women could no longer cope with all the herding and household tasks and so Simon had to move his livestock even though the grazing remained good at Granietkop;

i. **1976**
Due to the effective shortage of labour for herding at Granietkop, Simon transferred his livestock to an adjacent farm, Bankfontein, where his brother, Martin Tsuseb, was farming. The livestock remained in Martin's care until 1987 when Simon moved to Malansrust;

ii. **1981**
In response to the early 1980s' drought, Simon's livestock were moved with his brother's herd east to farms in Gobabis District such as Blouperd and Vergenoeg. This move was orchestrated by the Regional Agricultural Authorities to try and prevent livestock losses in the west. It is reported that the livestock were distributed between different farms to spread the risk of loss;

iii. ***ca.* 1984**
Simon and Martin Tsuseb's livestock returned to Bankfontein;

iv. **1987**
Simon and Martha moved to Malansrust where Simon's cousin Albert was already farming. As Simon was still working at Okahandja, Martha would look after the livestock during the week with assistance from a male labourer already inhabiting Malansrust;

v. **1988**
Simon and Martha decided that their livestock should move with Gottlieb's and Albert's to Potgietersrust due to drought-induced local grazing shortages. The livestock remained there until the end of 1990;

vi. **January 1991**
They returned with their livestock to farm at Malansrust;

vii. **1993**
Due to drought in the early 1990s, they moved their livestock to |Haraxam-pos[8] between Fransfontein and Gainatseb Farm. Before this move they actively went to look for places with good grazing (Simon owns a Datsun 1300 pick-up truck which he uses when looking for grazing in drought years). After negotiating with the people already at |Haraxam-pos, they applied to the Ministry of Agriculture at Khorixas for a permit to move their livestock. It seems that the inhabitants of |Haraxam-pos, with whom they had had no prior contact, were at first reluctant to have more livestock on their farm and agreed to this move on condition that it didn't involve 'too many' animals. A labourer was employed to go with and herd the livestock.

viii. **March-April 1994**
The livestock were returned to Malansrust;

ix. **January 1995**
Due to the lack of good grazing at Malansrust, and after negotiating with farmers at Goedgevind Farm to the south, Simon and Martha took their livestock to this farm. While here they stayed away from the existing farm settlement, going into the settlement only for their and their herd's water needs;

x. **March 1995**
Following the good rains of early 1995, Martha and Simon returned to Malansrust. At present they are not planning to move again because the grazing remains plentiful at Malansrust. If and when this area enters another drought period, however, they will certainly endeavour to move with their livestock to farms with better grazing resources.

6) Johannes ‖Gaseb

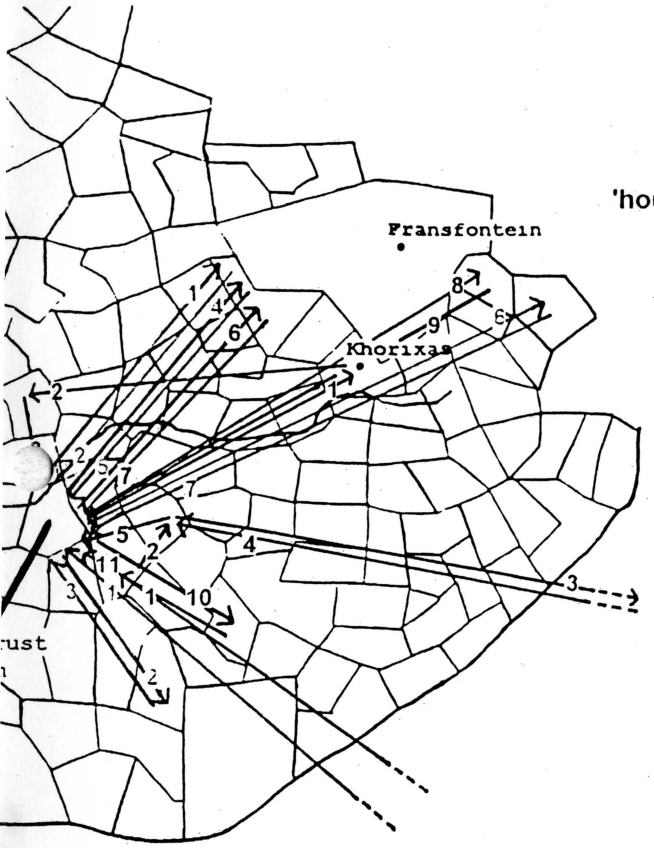
i. **early 1970s**
From being in paid employment as a lorry driver for Mr Malan, the commercial farmer at Malansrust; Johannes moved to Khorixas where he worked as a labourer for the Dept. of Water Affairs;

ii. **1987**
Johannes moved with his dependants to Bloukrans Farm east of Khorixas where his cousin (his father's brother's son) was farming;

Cont'd...

[8]Judging by the description of its location, this is probably on Naacham Farm to the east of Fransfontein, although there is also a farming post called Narachaampos in the west of the old Fransfontein Reserve.

ure 4.3a and b Reconstructed patterns of migration for households on a. Malansrust and b Blaauport
ms. The numbering of 'households' or 'herding units' follows the numbering used for the case-studies
sented in the main text for these farms (Boxes 1.3, 1.5 and 4.3 in Chapters 1 and 4) and in Appendix 3
ration routes marked with a question mark indicate that the exact location to which the household
ved is unknown.



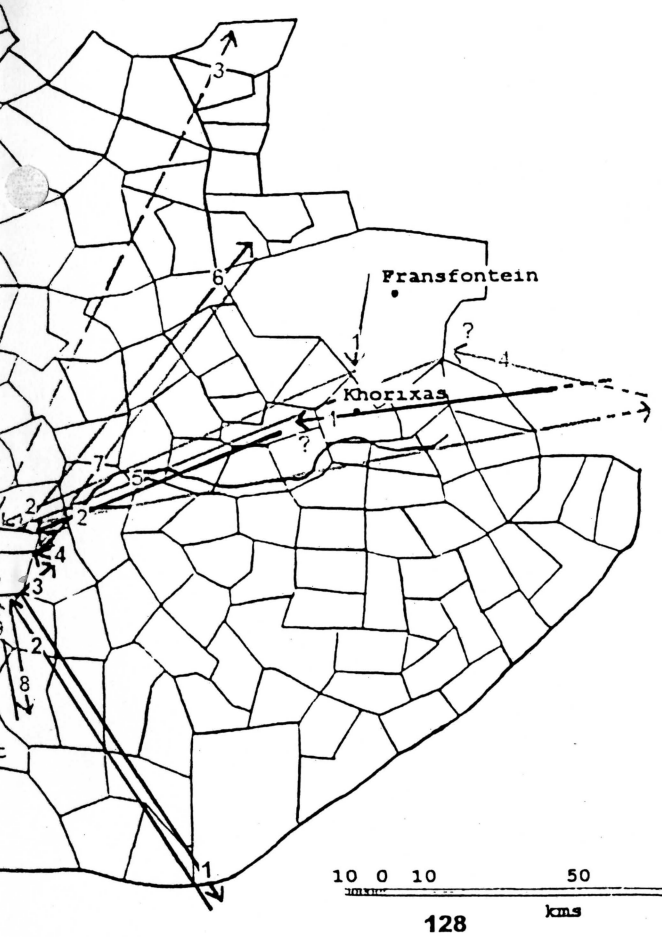
'household': year of migration:

1.
1 = pre-1989
2 = 1994

2
1 = 1975
2 = 1983
3 = 1984
4 = 1988
5 = 1991
6 = 1992
7 = March 1994

5.
1 = 1972
2 = 1976
3 = 1981
4 = *ca.* 1984
5 = 1987
6 = 1988
7 = January 1991
8 = 1993
9 = March-April 1994
10 = January 1995
11 = March 1995

6.
1 = early 1970s
2 = 1987
3 = 1994



1
1 = 1971
2 = November 1972
3 = 1980
4 = 1982
5 = 1984
6 = *ca.* 1987
7 = *ca.* 1990
8 = November-December 1994
9 = March 1985

1a — — 3 = 1992

1b - - - - 3 = 1995

2
1 = pre-1972
2 = 1972

3.
1 = *ca.* 1940s (?)
2 = 1980
3 = 1992
4 = May 1995

- Although migration may last several years it is usually temporary in that most farmers appear to return to what may be considered as their farm 'base'. This farm tends to be the one that a farmer or his or her family were originally allocated following implementation of the Odendaal plan.

- Farmers who own cattle often choose to move only their cattle in response to drought. Even when both large and small stock are moved, cattle are usually moved first due to their greater need for quality fodder and their large water requirements. For absentee farmers, wealthy and otherwise, leaving their goats in the care of a labourer at their 'base' farm also acts to maintain their claim to that farm while their main source of livestock wealth is being tended elsewhere.

- Migration by wealthier farmers during drought, usually with cattle rather than small-stock, tends to be over larger distances than those traversed by small-scale farmers. This is related to a number of factors which act to buoy up the wealth of farmers, including their access to geographically dispersed farms through widely spread kinship networks and the greater amount of resources they can divert to the process of moving. This is borne out by Rohde (1993: 49) who observes that wealthier herders tend to display the highest degree of flexibility regarding mobility and destocking, strategies which are related to herd ownership as a form of capital investment.

- Most movement is organised informally between farmers but the choice of areas to which people move their livestock may be influenced by information released by government-employed Agricultural Extension Officers, particularly if the distribution of drought fodder is involved. Movement may or may not be sanctioned by the appropriate government permits. In some instances of extreme emergency the government has in the past organised the movement of livestock to alternative grazing. This occurred in the drought of the early 1980s when the Regional Authorities bought farms in other regions to which cattle were moved from the former Damaraland.

- In some cases, particularly where the livestock owner is in employment elsewhere, the movement of livestock may be prompted by labour shortages. This may cause the amalgamation of herds belonging to related individuals and their redivision when labour becomes available or the owners themselves takes up full-time farming.

- Not surprisingly, not all migration can be fully explained with reference to decisions made in relation to herd-building; personal reasons, for example, may also prompt movement, as is illustrated by the citing of family differences as the reason for Alwina's move from Blaauport-pos to Malansrust-pos.

Features of negotiation

Complex processes of negotiation surround and infuse the act of migration. These generally involve some or all of the following features:

- Most migration is first informally negotiated between farmers, and only then sanctioned by the appropriate government authorities, if at all. A great deal of migration occurs without notification of the relevant authorities.

- Negotiations regarding the use of grazing and water usually take place between people who are in some way related to each other, i.e. at the 'point of least resistance' (Rohde, 1993: 34). This emphasises the continuing importance of social and kinship networks, which in many instances spread over wide geographical areas. As Gordon (1972: 77-78 *in* Fuller, 1993: 113) states with regard to Okombahe in the south of former Damaraland, kin are 'a form of security for an uncertain future, and minimal ties are kept alive in view of the norm of reciprocity'. While it is true to say that it is comparatively rare for negotiation to take place between farmers who are not related or known to each other in some form, it is also important to recognise that these networks are continually modified on the strength of new interactions between individuals. In the words of Ingold (1992: 208), they are 'constituted by relations of incorporation rather than exclusion, by virtue of which others are "drawn in" and not "parcelled out"'. Similarly, and as described by Fuller (1993: 114, 128) 'The intimate connection between kin and the social imperatives of economic survival leads to an imprecision in the definitions of who and who is not kin because the imperatives of economic survival are themselves constantly changing. ... A wide net of kin increases the area over which one could utilize resources thus counterbalancing the periodic localized droughts that occur'. It is this in-built flexibility which confers buoyancy to any network; in this instance it means that the potential inherent within the social network for future linkages and reciprocity is not limited to the links between individuals which are activated at any one time.

  Viewed in this way, it is easy to conceptualise the multilayering of social and kin networks, and the 'contractual alliances' on which they are based (Knight, 1990: 14), as literally providing a 'safety net' for the individuals and families constituting its 'members'. The other side of this is, however, is that 'extended family relationships are fraught with conflicting demands and opportunities' (Rohde, 1997: 177; see also Fuller, 1993: 147-150). Nevertheless, while at any one time the majority of farmers own very small herds it remains possible for farmers who are part of a strong and coherent, or growing, family network to become relatively wealthy in terms of livestock (see also Fuller, 1993: 77-78). For example, the largest livestock herds recorded this study area were those of a farmer at Blaauport Farm on the Aba-Huab River, and consisted of approximately 100 cattle and over 200 goats. This same farmer had access to a strong network of close family members at farms elsewhere, including Moria to the east of the Grootberg, Spitzkop-pos near Fransfontein, and Blydskap Farm south of Kamanjab. In other words, he had considerable options, should the need arise, for negotiating arrangements for the movement of his livestock between places where he already had a strong family link, and *vice versa*. Similarly, herding responsibilities can be shared between family members in

times when drought conditions precipitate movement. In early 1995, for example, this farmer's niece's cattle from Moria Farm were herded with his, first at Goedgenoeg Farm to the south of Blaauport, and then at Blaauport itself, before hers were returned to Moria by the labourer in her employ (see Figure 4.3b).

- Agreements do not involve any form of 'up front' payment or compensation for the use of grazing, and surprise was repeatedly expressed at the suggestion of payments of this kind, particularly if the agreement was between family members. There are two main reasons for this. First, the moral power of reciprocity infusing the social and kinship institutions with which livestock herding is intimately bound, and rooted deeply in social anthropological theory as Mauss' (1954) 'spirit of the gift', means that the farmers allowing the use of grazing on 'their' farm are protecting their own future options for grazing should their farming area experience drought-induced shortages. Second, the knowledge that the land and its resources technically belong to the State means that even the most commercially oriented of communal area farmers has no legal support whatsoever for the charging of 'rents' to incoming farmers.
- Perhaps surprisingly, given the persistent varying of herding patterns within the area, there are few reported instances of conflict over access to land and grazing. Only two incidents involving a degree of dispute were documented during the course of constructing migration histories for farmers in this area; in both cases, the farmers were previously unknown to each other and disagreement was due to concern by the recipient farmers over the sizes of herds to be moved.
- Because most situations are negotiated successfully and conflict is minimal, the role that government institutions play in interceding over potential conflict is correspondingly small.

This analysis of features of migration and negotiation by farmers in southern Damaraland serves to emphasise three things:

1) Despite assertions of 'the lack of systematic livestock management in this communal area' (Jobst, 1995: 19), farmers are actively involved in making decisions regarding the use of grazing in order to sustain their herds, in ways which creatively exploit the options available to them in a tenure and land distribution system not of their choosing.
2) Mobility is an important component of herd management, even in a system of land allocation based on delineated and fenced farms and in contradiction to statements that 'the principal land use ... is sedentary livestock rearing under a communal tenure system' resulting 'in intense uncontrolled grazing' (Kambatuku, 1995: 40).
3) On-going processes of informal (and 'invisible') negotiation mediate access to land for grazing purposes, form the basis of a system of 'informal social security' based on

transfers of resources, including labour, between households (Nærua *et al*, 1993: viii, 26-31) and shape understanding of appropriate, or customary, land and resource management behaviour.

The commercial settler and communal farmer economies in southern Damaraland: some comparisons

Given the extreme disparities in government subsidies, size of land-holding per farmer, and tenure rights between the commercial settler farming system in this area of the 1950s and 1960s and its management as part of a designated communal area from the 1970s on, one could be forgiven for assuming that the land management practices described above would be rather different from those of the European settlers. Recent research by Kambatuku (1995) into the archival records for the commercial farms of this region in fact indicate that the converse is true. For example, movement of livestock between farms was common and the archival records are replete with requests to the Administrator, through the Land Board of the Department of Lands, to move to pastures elsewhere. Farmers would also often apply for per5mission to sublease their farms in order to assist family and friends with regard to grazing and water; informal negotiation would precede notification of the relevant authorities and, again, the reciprocal links activated by farmers tended to be among existing kinship or social contacts. Variations in herd size recorded in the archives were often related to the addition and removal of these 'visitor herds' rather than to real increases and losses. Thus, despite the leasehold and freehold tenure to which European farmers had access, they are recorded as moving repeatedly when local drought conditions made this necessary, with individual farms accommodating sub-lessees for periods of varying lengths while other farms remained completely vacant when affected by adverse conditions.

As occurs today, herd numbers (generally of karakul sheep and goats) during this period were characterised by wide fluctuations, following a broad pattern of increase in the late 1950s, dramatic drought-induced losses in the early 1960s, and herd recovery in the mid-1960s. Commercial productivity by European farmers was largely dependent on the employment of cheap black labour and bolstered by a contract labour system devised by the Labour Commission in 1938 which acted to lower local wages through the easy recruitment of labourers from areas north of the Police Zone (Fuller, 1993: 32). Within the socio-economic diversity embodied by the current communal system, the availability of cheap labour remains extremely important. Significantly, cheap labour is essential for farmers with a more commercial orientation within the communal area of Damaraland, and is the basis on which farmers employed within the cash economy elsewhere can continue farming. Finally, the survival of both commercial and communal systems has been facilitated by the distribution of subsidised fodder supplements during drought periods, and the State-funded facilitation of livestock movement to better pastures. This belies assertions of greater efficiency characterising commercial production systems; they too experienced the periodic need for the injection of resources providing relief during drought, the current communal

areas of north-west Namibia support far greater numbers of people than the former commercial farms, and a substantial body of evidence has been accumulated from elsewhere demonstrating that productivity in terms of total output per hectare is actually greater for land under communal as opposed to commercial systems of production (cf. Behnke, 1985; de Ridder and Wagenaar, 1986; Abel, 1993).

The data presented above provide a strong case to suggest that the underlying ecological constraints of this area mean that *even when farmers have secure tenure to generous land-holdings they have to migrate with their livestock to take advantage of, and avoid losses due to, variable environmental conditions*. In other words, *security of tenure to units of land, whether on a lease- or a free-hold basis, will not ensure security of livelihood*, unless options for near continual movement between these units are retained. As discussed towards the end of this chapter, this principle is the diametric opposite to the legislative framework being constructed to facilitate land reform which is based on promoting the demarcation of land into smaller, individual holdings. It can be argued that security of tenure is a necessary prerequisite for farmers to be able to negotiate reciprocal grazing arrangements and thereby facilitate mobility of herds; the stringent restrictions indicated by Namibia's draft Communal Lands Bill regarding who will be eligible for land-holdings, however, indicate that the poorest farmers will be alienated from land through the land reform process, while the bargaining power of farmers with medium to large herds is promoted.

4.2 Discussion: local realities and national policy

The case studies of resource management practice detailed above illustrate a number of areas of local-level complexity with important implications for the success of national-level policy development and project implementation. In post-independence Namibia there are two major domains of change which have the potential to greatly affect the use and management of land and natural resources by communal farmers. As stated at the outset of this chapter, these are first, the emphasis on strengthening community-based management of natural resources as a means of promoting rural development while ensuring resource conservation, and second, the process of communal land tenure reform which potentially constrains all issues of resource and land access. These will be discussed separately below, emphasising throughout the ways in which an awareness and understanding of local resource-use and management practice can inform national-level change.

4.2.1 Community-Based Natural Resource Management (CBNRM)

A theme running through much of the post-independence literature in Namibia, is the need to transfer decision-making and management power over natural resources, both biological and physical, to local communities. In this sense it mirrors the global trend to reassess the value of common property resource management (CPRM) practices (cf. Arnold, n.d, 1993; Cousins, 1993; Turner, 1996: 2), and to use so-called 'community-based management' as the basis for resource conservation and rural development (see, for example, Bishop *et al*,

1994: 47; Leader-Williams *et al*, 1995; Metcalfe, 1995; Wild and Mutebi, 1996; Hartley and Hunter, 1997). This is seen as the most socially acceptable and long-term strategy for natural resources conservation, including biodiversity, and is based on the premise that resources will be harvested and utilised non-destructively **only** if their benefits and management are harnessed effectively by the users themselves.

At a deeper and often inexplicit level, a participatory, 'community-based' approach to conservation and development can be viewed as an attempt to recognise the significance of culture as a 'determinant of social interaction', where these interactions pertain to the use and management of culturally and economically valued biological resources. As Botelle and Rohde assert (1995: 25-26) regarding land-use planning in Eastern Otjozondjupa;

> "in the context of land use planning it is necessary to recognise existing (cultural) rules governing rights to land and natural resources, and to understand the connections between these rights and kinship networks, modes of exchange and strategies for subsistence survival. Such rules and common practices, while subject to constant revision and adaptation, have an enduring essence which structures individual attitudes towards and perceptions of the material and social environment. These common cultural practices or 'traditions' underpin strategies of survival which continue to evolve in response to a changing physical, economic and social environment.' thus 'it is vital that the cultural practices that shape ... societies are taken into account within the conceptual framework of land use planning".

This type of more liberal conservation-thinking has led to the establishment of several 'community-conservation' initiatives in Namibia, under the umbrella concept of community-based natural resources management (CBNRM). Similarly, the Directorate of Lands of the MLRR, through an inter-ministerial advisory committee (IMSCLUP) to the Cabinet[9] (Botelle and Rohde, 1995: 4), supports the integration of different sectors, i.e. animal wildlife, trees, water and soils, with the aim of maintaining and promoting the diversity of existing Namibian farming economies.

Projects which fall under the CBNRM rubric include those by the NGOs LIFE (Living in a Finite Environment) and IRDNC (Integrated Rural Development and Nature Conservation), of which the latter has been operating in Kaokoveld since 1982, the conservancy initiative of the MET and a new project plan for Wildlife Integration for Livelihood Diversification (WILD) (drawn-up by Ashley, 1997). Related research agendas include the resource economics programme of the Directorate of Environmental Affairs, MET (cf. Ashley *et al*, 1997), and the natural resources component of the research programme of the Social Sciences Division, MRC, University of Namibia. Particular attention has been paid to creating pathways,

---

[9]This was an interim non-statutory body and as such has been relatively ineffective (Corbett and Daniels, 1996: 40-41). Policy was approved by Cabinet in 1995, however, for the establishment of a Land Use and Environmental Board (LUEB) to promote integrated land-use planning and as an advisory body to the National Planning Committee and Cabinet.

primarily in the form of conservancies[10], whereby benefits from Namibia's fast-growing tourism industry, especially those aspects based on non-consumptive and consumptive uses of animal wildlife, can devolve to communities at the local level (cf. Ashley *et al*, 1994; Ashley and Garland, 1994; Jones, 1995; Turner, 1996; Ashley and LaFranchi, 1997; Jones, 1997). It has been formalised as a recognised approach to conservation by the MET in the writing of a policy document on the 'promotion of community based tourism' in 1995.

The actual implementation of these initiatives, however, is hampered by four interrelated areas of complexity. These feature in critiques of community-based initiatives worldwide and highlight the relevance of analysis of detailed case material, such as that presented in this thesis, to wider debate regarding the contemporary relevance of forms of common property resource management. These areas of complexity are:

1) a lack of focus on the details of how people currently use and manage resources, and the value of accumulated local knowledge regarding the ecology of these resources;

2) the rather cavalier use of the label 'community' to describe heterogenous groups of rural farmers;

3) the emphasis on animal wildlife, which obscures wider dependence on, and local knowledge of, other natural resources, and, in the conventional association of men with animal resources (both domestic livestock and wildlife), may act to further marginalise women who as gatherers and cultivators are typically linked with plant resources;

4) the uncertain policy framework defining and supporting access and use rights to natural resources on communal land.

These are discussed separately below.

Contemporary use, management and local knowledge of natural resources

CBNRM aims to create management institutions where such institutions do not, or no longer exist. The danger is that existing resource management practice and knowledge may be overlooked in the assumption that common property regimes have disintegrated; an assumption which in fact reveals more about both the lack of detailed information regarding these issues and a tendency to perceive indigenous Namibians as passive victims of historical process, than about the 'on-the-ground' reality of contemporary natural resource-use practice.

---

[10]The 'conservancy' concept emerged from commercial farmland where individual farmers who have had legal rights since 1968 to use animal wildlife on their farms consumptively, 'realised that it is advantageous to pool their land and financial resources to make available a larger unit on which integrated management practices can be carried out' (Jones, 1995: 4; see also Barnes and de Jager, 1995). This concept has been taken by the MET and developed as a 'conservancy policy' (see MET, 1992 *in* Jones, 1995). It is currently being debated and transformed to increase its relevance for the conservation of natural resources, primarily animal wildlife, by farmers on communal land.

Chapter 3 demonstrated that a diversity of plant and invertebrate resources are used and appreciated by rural Damara households in north-west Namibia, and the case study material presented in Section 4.1.1 above indicated for specific resources that their use is guided and constrained by a 'logic of practice' (cf. Bourdieu, 1990) related to a culturally-mediated understanding of their ecology. These can be considered loosely as etic and emic dimensions of resource-use respectively. Given the general perception that a loss of ecological knowledge is associated with the onset of environmental problems (asserted by Brokensha and Riley, 1986: 80, for the Mbeere of Kenya; Campbell, 1986: 88-89, for most populations in Botswana; Getahun, 1974: 48 for Ethiopia; and Barrow, 1988: 16, for the Pokot and Turkana of north Kenya), these dimensions of natural resource-use would appear to have a large potential role to play in land-use planning in north-west Namibia. Moreover, building on relevant existing connections between people and landscape in the form of the practical application of knowledge regarding natural resources (cf. Biesele, 1984: 8), and emphasising its value in areas outside conservation such as nutrition, preventative medicine and self-treatment, can be an effective path to empowering a wider 'community' of people with regard to natural resources.

This is not to advocate a romantic view of 'indigenous technical knowledge' as a panacea for all the ills of the development process (cf. Adams, 1996: 155), or to uncritically assume that rural farmers 'abound in agro-ecological wisdom' (Richards, 1995: 61). The following quotes from arid environments elsewhere, however, indicate the potential value that external intervention can have in both strengthening existing customary forms of resource management, and rejuvenating the value of local ecological knowledge in pursuit of these aims. Barrow (1988: 9-10), describing the role of social forestry among Pokot and Turkana pastoralists of north Kenya, states that;

> "... an aspect of any arid lands forest project should include finding out what the traditional knowledge base is concerning trees, what the people perceive as the problems and what the solutions might be. This can then form a rational base for social forestry interventions in the arid lands and help to ensure the long term success of any such venture. However this does demand a sensitive understanding of the area and its people, a long term involvement and the development of an extension approach based on awareness of values and solution finding."

Similarly, Little and Brokensha (1987: 207), with reference to Maasai, Il Chamus and Mbeere range and forest resources of Kenya state that,

> "many remnants of the indigenous management systems still exist ... and producers of these regions maintain a sophisticated knowledge of the environment. As was the case with many colonial programmes, however, many donor-funded natural resource programmes fail to build upon, or even to acknowledge, local practices and knowledge. Yet these projects usually require producers to invest their own labour ... in conservation activities that may

> be less viable than existing practices and that may be implemented with no real local participation in decision-making".

Emphasising the role of formally trained ecologists in supporting the technical value of local ecological knowledge among Aboriginal populations of north-central Australia, Baker and Mutijulu Community (1992: 187) assert that;

> "A primary area of concern is the pace at which indigenous knowledge is being lost. Many Aboriginal people are trying to pass on their knowledge, but are at times confounded by young people who have embraced the European view that such knowledge is no longer relevant or valued ... There are also many instances where young Aboriginal people no longer have the opportunity to interact with their land and their elders. Ecologists have an opportunity to assist Aboriginal people to maintain their knowledge by promoting its validity."

The opinions expressed in these statements apply vividly to the natural resources situation in north-west Namibia. The rootedness of identified ecological principles within traditional knowledge held by Damara farmers in this area, strongly suggests that, as long-term inhabitants and users of the landscape, they should be the starting points for discussion regarding ways of maintaining and achieving the conservation and sustained use of environmental resources. At the very least, an awareness of these practices could provide an *entrée* into ways of broaching resource-use issues which are both culturally-meaningful and ecologically relevant. This is in contradiction to current emphases on the breakdown of local resource management practices, as exemplified by Quan *et al*'s (1994a: 5) statement quoted at the beginning of this chapter. Notwithstanding the well-meaning intentions in such perspectives to acknowledge distortions caused by politically unjust historical processes, these amount to a complete negation of the contemporary existence of culturally-informed resource-use practice. As such, they pave the way for intervention which is potentially non-participatory, overlooks the existence of relevant local ecological knowledge and, by being understandably drawn to those who are politically vocal within a 'community', may marginalise individuals who have maintained the deepest connections to land and local resources.

'Communities': real or spurious?

Many problems are raised by the easy use of the word 'community' and the lack of definition of the actual 'social unit' to which this refers (cf. Turner, 1996: 31). These have implications for how to define the most appropriate 'level' or 'unit' within a population to target for CBNRM-related projects, or whether it is appropriate to attempt such a definition at all. Perhaps even more importantly, and as emphasised by the discussion of water management in Section 4.1.3 above, it acts to mask the reality of local heterogeneity and fluidity, and their influence on both how such initiatives are enacted and who stands to benefit from them. As Hartley and Hunter (1997: 3) point out, these issues imply that 'the skills required for

implementation (of community conservation projects) are much broader than the traditional skill set of the wildlife manager or conservationist' who nevertheless tend to be the professionals responsible for management and implementation of these projects.

Explicit recognition of the heterogenity masked by the label 'community' is essential if diverse user-groups with different resource management knowledge are to be represented, and the process of devolving rights to communities is to be truly participatory. 'As Sections 4.1.2 and 4.1.3 indicate 'communities' are comprised of individuals 'with projects and agendas of their own' (Leach and Mearns, 1996: 7). Communication with only leaders or politically active members of a 'community', for example, may exclude the sectors of the population to which an initiative is directed, perhaps those with the greatest reliance on certain resources. As Devereux (1996: 8) states, 'it should not be presumed that the allocation of rights by community leaders ... is any more equitable, or any less patriachal, than any other institution which wields this power'.

Several examples from Namibia demonstrate that is unclear as to how effective communication actually is between the 'traditional' or elected local leadership, for example, a 'conservancy committee', and the rest of the 'community'. In a rather extreme example under the pre-independence administration, members of the Bushman Council were informed in 1980 about the pending proclamation of a nature reserve in Eastern Bushmanland and, despite the constraints it would impose on Ju'|hoansi lifestyles, approved the proclamation **but 'did not discuss the issue with members of their groups'** (Adams and Werner, 1990: 160, emphasis added). Research conducted subsequently by Marshall and Ritchie (1984: 107-108 *in* Adams and Werner, 1990: 158) among the Ju'|hoansi to assess opinions about the reserve indicated that,

> "most people had not heard of the plan for the reserve, did not know if their territory was included in it, and had no idea that they would be forbidden to practise subsistence farming in the reserve. Of the 60 people in our sample who had heard of the plan for the nature reservation, one approved. 100 people rejected the plan vehemently."

There is evidence for similar problems in communication between local leadership structures and other community members within the study area in post-independence Namibia. For example, following a 'socioecological' survey conducted by the MET in north-west Kunene in 1994, which included presentation of the concept of natural resource management under a locally-controlled conservancy, an interview-based survey was conducted among a small (n = 28) but broadly representative sample of Damara-speaking members of the Sesfontein 'community'. This indicated that, of the people interviewed, none attended the discussion meeting in Sesfontein, and the vast majority had not been informed of the meeting nor that they had a right to be present (Sullivan, 1995: 2). Continuing in the same vein, a similar survey was conducted by the MET in 1992 with the ≠Aonin or Topnaar 'community' inhabiting part of what is now the Namib-Naukluft National Park, with the aim of promoting a CBNRM

approach in the lower Kuiseb valley by producing 'management proposals ... which integrates the needs and aspirations of the Topnaar people with the needs and objectives of conservation' (Jones, 1992: 1). Today, as a result of misunderstanding and growing mistrust, the situation is one of a 'stalemate' between the MET and the ≠Aonin; both sides are expecting the other to initiate change with the result that few, if any, of the recommendations discussed during the course of the 1992 survey have in fact been implemented (Botelle and Kowalski, 1995: 5, 13), and the Topnaar remain 'in perpetual uncertainty and a land tenure and human rights limbo' (Jones, 1997: 4).

Animal wildlife versus *the resources people use*

CBNRM projects focusing on the conservation of animal wildlife have to find ways of ameliorating the contradictions raised by the following simple fact: while animal wildlife, particularly large mammals, has the greatest commercial and international conservation value, it carries the heaviest costs for communal farmers, who conversely enjoy subsistence benefits from a wide range of alternative natural resources, primarily plants and invertebrates.

In Namibia, the dichotomy between animal wildlife conservation and human welfare has a strong historical reality; draconian measures were imposed by the various pre-independence administrations to prevent hunting of animal wildlife on communal lands, which additionally caused damage to farms and individuals for which compensation was difficult to claim. Negative perceptions of elephant focus on their effects on valued subsistence resources as in statements by interviewees during the course of this study that they 'break' the important riparian fruit-bearing trees *Ficus sycomorus* and *Prosopis glandulosa** and make people afraid to range far from their homestead in order to collect resources from this habitat. On top of this they cause damage to water installations, fences and gardens. At the same time, the impetus to enlist the support of local people for the conservation process began in north-west Namibia as an explicit response to the large-scale losses of these same animal wildlife species, due to their high international conservation values (Owen-Smith, 1995: 138)[11]. The current emphasis on community-based conservation in this area retains an emphasis on large mammal species and continues to support the employment of male 'community game guards'.

In other words, existing efforts to support wildlife conservation in communal areas under the rubric of CBNRM, focus on resources which are extremely contentious and highly politicised. Expectations concerning the flow of financial benefits from these resources have been raised, and the situation can potentially be abused by individuals confident in negotiations

[11] In this case, successful poaching activities during a period of devastating drought was enhanced by the distribution of firearms by the SADF to the DTA-supporting Herero-speaking herders of Kaokoveld with the intent of creating a 'civilian force strong enough to keep SWAPO from infiltrating through the region and reaching the white farming areas' (Fuller, 1993: 81)

with the primarily white-male, and frequently paramilitary-style government and NGO officials typically involved with animal wildlife conservation.

It is the contention here that a positive effort to refocus CBNRM initiatives, so that they explicitly incorporate the full range of resources used and valued by people, will shift the emphasis to areas viewed more positively and confidently by a broader spectrum of individuals. This includes women who tend to be associated with plant resources and are excluded from discussion regarding the conservation of, and flow of benefits from, animal wildlife (for example, at the final meeting of the MET-initiated 1994 socioecological survey of southern Kunene, all Damara and Herero women who attended the meeting were constrained to sit outside the shelter in which the meeting was held). Translating such a shift in focus into project implementation would require increased intra- and inter-sectoral linkages and communication at a policy-level (cf. Hartley and Hunter, 1997: 5), as recommended for the Namibian context by Dewdney (1996: 88).

Policy and resource use

Finally, community-based, as opposed to benefit-sharing, approaches to conservation can only develop in areas where local people have control over land and resources because, when correctly defined, these approaches depend on empowering people through devolving decision-making power over wildlife resources on land formally acknowledged as theirs (Hartley and Hunter, 1997: 8-9). The legal framework surrounding and supporting the use of natural resources therefore has an important bearing on the extent to which resource management practices guided by customary or 'community' law can be strengthened or initiated. The current situation in Namibia is one in which 'all natural resources in the communal areas are ... owned by the state, and rights to these resources are not clearly defined' (Botelle and Rohde, 1995: 2). The long and complex process of decentralising these rights within an appropriate legal framework is underway, however, and the legislative environment allowing the devolving of decision-making rights over, and the flow of benefits from, natural resources to communal farmers is currently rather dynamic. Existing legislation, and proposals for relevant legislative and policy change are listed in Box 4.4 and will not be discussed further here. Surrounding and constraining all of these areas of legislative change regarding rights to natural resources is the process of land reform, particularly as it relates to the allocation and management of communal land. This is the focus of discussion in Section 4.2.2.

4.2.2 Land reform: appropriate legislation for an arid communal area

Land reform in Namibia, involving the redistribution of commercial farmland to communal farmers, is motivated by the context of existing inequity of land ownership; at independence, 44% of the land area was delineated as roughly 6,292 freehold farms, of which 6,123 were white-owned supporting some 4,200 commercial farmers, while 43% was designated communal land and home to an estimated 120,000 rural black households (President of

Namibia, 1991: 4; Adams and Devitt, 1992: 1). The remaining land area includes proclaimed conservation areas, the Diamond Area of the Namib, and other State land. A further important feature of this pattern of land distribution is the fact that communal land is located in areas with the poorest agricultural potential; for example, of the roughly 4.5 million hectares constituting the former Damaraland, 2.4 million hectares are considered agriculturally unusable due to aridity (NEPRU, 1991b: 147).

This extreme inequity in land distribution, the outcome of a colonial history tarnished by repression and dispossession, formed a powerful symbol motivating Namibia's long struggle for independence. It is not surprising then that, in an atmosphere of post-independence optimism, the government embarked almost immediately on a process of 'national consultation' regarding the land issue, which culminated in the National Conference on Land Reform and the Land Question (Republic of Namibia, 1991a). A number of resolutions were drafted at the Land Conference for consideration by Parliament as part of a Land Reform Bill which would provide an enabling legislative environment for affirmative action regarding land redistribution (cf. Republic of Namibia, 1991: 23-34). Some of these resolutions have now been enshrined in Namibia's Agricultural (Commercial) Land Reform Act which aims

> "To provide for the acquisition of agricultural land by the State for the purposes of land reform and for the allocation of such land to Namibian citizens who do not own or otherwise have the use of any or of adequate agricultural land ...; to vest in the State a preferent right to purchase agricultural land for the purposes of the Act; to provide for the compulsory acquisition of certain agricultural land by the State for the purposes of the Act; to regulate the acquisition of agricultural land by foreign nationals; to establish a Lands Tribunal and determine its jurisdiction" (Agricultural (Commercial) Land Reform Act, 1995: 2).

The potential effects on communal farmers of land reform will be discussed below in relation to two related aspects of the land reform process; first, the manner in which commercial land is redistributed, and second, the way in which new and existing communal area land is allocated to communal farmers.

Some options for the redistribution of land

Given the commitment to redistribute land from commercial settler farmers to indigenous communal farmers there are, as discussed at the Land Conference, a number of possible scenarios which this process can actually follow. Importantly, and as is clear from the options summarised below, these target a range of beneficiaries and constrain the forms of land management available to communal farmers.

1) **Freehold farms could be purchased by the government and made available to larger herd owners in communal areas**, through offering financially favourable terms as an incentive to participate in this scheme. As Rohde states (1993: 61), this is reminiscent of the incentives offered earlier this century to European farmers during the

Resettlement Program of the South African administration. A variety of interest groups, reflecting complex aspirations and constraints, favoured this proposal at the Land Conference:

- white politicians from the opposition who, as farm-owners, consider the introduction of rich black farmers into their community as an optimal solution to the 'unfortunate necessity' of land redistribution;
- African business men and politicians who perceive the scheme as an opportunity for themselves to own farms;
- small-scale farmers who are affected by the impact of large-scale farmers on local resources;
- conservationists who view the control of livestock herds on fenced farms as a solution to perceived environmental degradation on communal land.

Two major problems were recognised as being likely to affect the success of this scheme. First, is the issue of how to ensure that wealthy communal farmers, and not business men or officials from elsewhere, are targeted such that it does actually have a positive effect in terms of reducing pressure on either poorer farmers remaining in the communal areas, or the environmental resources in these areas. Second, in view of the fact that communal farmers currently enjoy free grazing and other services, and are not taxed on their farming activities, there will need to be extremely good incentives for them to enter this scheme. Related to this is the possibility that such farmers will continue to graze their livestock in communal areas, conserving grazing on their farms to which they can move their herds when necessitated by shortages on communal land.

Partial implementation of this option has occurred and the Agricultural Development Bank of Namibia has been established as the most appropriate channel through which loans are administered. By 1994, however, only two such loans had been taken up by communal farmers in Damaraland, who apparently continued to use communal grazing, thereby negating a primary reason for instituting this scheme (Rohde, 1994: 10-11). This has also proved a problem in southern Namibia where, as the Farmers' Interleague Solidarity Action (FISA) group of the Namibian Community Cooperatives' Alliance (NCCA) complain, 'large farmers from communal areas who obtained loans and bought commercial farms under the previous administration still receive our leaders' permission to graze their herds in the communal areas' (FISA, 1991: 1). Since 1992, so-called 'middle farmers' have also been targeted for loans of N$10,000 for the purchase of livestock, although by 1994 only 20 from 95 applications had been approved (Rohde, 1994: 10-11).

2) The second option discussed at the Land Conference is almost the opposite of the first, i.e. **the relocation of the poorest households to commercial farms** purchased by

the government, through using the existing division of farms into several fenced camps as the basis for the settlement of individual 'family units'. This is essentially the model on which the redistribution of commercial land to communal farmers following Odendaal was based (discussed in Chapter 1). From a government perspective, the main problem with this scheme is the high cost that is associated with establishing poor families in new areas and then maintaining services to these farmers. This is illustrated by current rhetoric surrounding widely perceived problems of dependency by communal farmers on government, and accompanying development initiatives which attempt to increase accountability for state services among these farmers (cf. Africare, 1993). Concern regarding this option is also expressed by the environmentalist lobby who fear the effects of continuous grazing pressure on farm-camps, the possibility of initially high herd growth-rates following movement to a new area, and perceived low herd off-take rates by communal farmers. Unfortunately, these negative perceptions exist in a near vacuum of empirical evidence from the existing experience of the communalization of commercial land, regarding both the use and management of local resources, and environmental resilience under these production systems.

3) It is possible that the **existing communal areas could** simply **be expanded through the acquisition of farms adjacent to communal area boundaries**. Similarly, commercial farmland could be purchased for use by communal farmers on a cyclical basis, for example during drought years. This approach was in fact implemented in drought periods by the pre-independence government, during which the movement of cattle from communal areas was organised by the relevant Regional Authorities. It is easy to see that the benefits of this approach are directly proportional to the numbers of livestock, primarily cattle, owned by communal farmers; if not complemented by alternative schemes it may therefore act to promote the wealthy while neglecting inhabitants of communal areas who own few or no livestock.

4) Various forms of **group or cooperative ranching** were also suggested, based primarily on models from Kenya and Botswana (cf. Perkins and Thomas, 1993). Group ranching involves the joint management of one or more delineated farms by a group of communal area stock owners. Problems experienced by this approach are associated with making 'corporate management decisions', as exemplified by the Maasai Group Ranches of Kenya, where patterns of herding continue to be based along long-standing lines of alliance enabling extensive movement of livestock between different ranches (Galaty, 1981; Barrow, 1988: 20; Grandin, 1988). The latter approach is based on the translation of livestock into shares within a cooperative from which owners receive dividends, and the management of this cooperative as a single corporate unit by a paid manager. This could be conceived as appropriate for stock owners in formal employment who do not herd their animals themselves but wish to continue investing in livestock. It is likely to remain theoretical for a number of reasons, however, including the

importance of the non-cash value of livestock ownership, and the fact that a considerable number of family members and employees may derive daily sustenance from a herd in the absence of its primary owner.

The Agricultural (Commercial) Land Reform Act of 1995: its provisions for the enactment of land redistribution

Since these options were discussed, the Agricultural (Commercial) Land Reform Act has been passed by parliament and provides legislated mechanisms to enable the Minister of Lands, Resettlement and Rehabilitation (MLRR) to acquire, with appropriate compensation, agricultural land under free- or leasehold tenure, and to reallocate this land to Namibian citizens with 'inadequate' agricultural land. An important focus of the Act in terms of constraining potential forms of communal land and resource management is Section 38 which makes provision for the subdivision of land acquired under this Act into surveyed holdings for small-scale farming purposes (Commercial (Agricultural) Land Reform Act, 1995: 37). These holdings will usually be offered for lease with the option to purchase the farming unit after five years from the commencement of the lease. Notification of the availability of this land is to be made in the area in which the land is situated, including information regarding the delineation of farming units, the terms and conditions attached to allotment, and the minimum qualifications required of applicants, as stated in the 'allotment plan' prepared for the land in question by the Land Reform Advisory Commission[12]. Under the conditions attached to the allotment of agricultural land as laid out in the Act, lessees are required to use the land for farming purposes only, except with permission from the Minister to embark on other ventures, and are expected to maintain certain standards with regard to farming practices and maintenance of farm improvements (Commercial (Agricultural) Land Act, 1995: 42-3). An interesting caveat is that these restrictions echo, almost to the smallest detail, the conditions laid down for European settler farmers by the South African administration.

When viewed in the context of the possibilities for land redistribution discussed at the Land Reform Conference of 1991, this Act can be seen to be following a path somewhere in the middle of the first two options described above. For example, while not specifying the level of 'wealth' necessary to qualify for land holdings in this scheme, the term 'minimum qualifications' indicates possible exclusion of the poorest communal farmers, particularly if allotments are available under leasehold tenure only. The emphasis on individual land holdings also precludes the option of simply enlarging the existing

---

[12] Under the Act, a Land Reform Advisory Commission is to be established for the purposes of advising the Minister in all matters related to land acquisition and allotment. This Commission is comprised of two officers from both the MLRR and the Ministry of Agriculture, Water and Rural Development (MAWRD), nominated members of designated organisations 'involved in agricultural affairs', one person nominated by the Agricultural Bank of Namibia, and five 'suitably qualified' persons, including at least two women, who are not employed in the public sector (Agricultural (Commercial) Land Reform Act, 1995: 8-9). Each member shall be appointed by the Minister with approval of the National Assembly to hold office for three years, and may be re-appointed on the expiry of this term of office. A Lands Tribunal is also established under the Act to mediate conflict between recommendations made by the Minister in consultation with the Advisory Commission, and the owners and lessees of agricultural land.

communal areas, and may possibly hamper the development of group or cooperative ranching efforts as a means of effecting appropriate livestock management strategies and incorporating absentee herders within the communal pastoral system.

Land tenure management within the communal areas and the forthcoming Communal Lands Bill

Since the passing of the Commercial (Agricultural) Land Act, the form which land allocation and management within existing communal areas will take place has been the subject of intense speculation; this is not least because the initiatives of other government ministries depend on the legislative context for tenure in communal areas (as discussed above with regard to the instituting of community-based development and conservation schemes). More recently, an internal draft of the long-awaited Communal Lands Bill by the Ministry of Lands, Resettlement and Rehabilitation again places emphasis on the subdivision of communal land into alienated land-holdings. For example, any person or group of persons holding recognised rights to communal land is 'entitled to convert such holding into a leasehold tenure of one hundred years', providing this takes 'into consideration local customary law' (Draft Communal Lands Bill, 1995: 30). Similarly, vacant communal land may be delineated and allotted as economic land units, subject to approval of the Minister. Approved allotments would then be publicised and allocated in a procedure similar to that described above for commercial land acquired by the State.

According to the Bill the allocation and management of land in the communal areas will ultimately rest with Regional Boards, modelled on the Land Boards of Botswana and comprised of representatives of the MLRR, local authorities and traditional leaders, community members and government extension workers (Draft Communal Lands Bill, 1995: 4). These Regional Boards will have the power to allocate land rights under customary law in Communal Land falling under its jurisdiction, to cancel these rights, to allot land, and to demarcate land into economic holdings (Draft Communal Lands Bill, 1995: 6). Also set out in the Communal Lands Bill is the establishment of a Lands Adjudication Commission for the purpose of mediating any dispute arising with regard to Communal Land. A land tax will be imposed on all communal land to be paid annually to the Government, at least part of which will be allocated to the Land Development Fund, established for the purpose of development and improvement of communal lands (Draft Communal Lands Bill, 1995: 42-4, 50).

Communal land tenure reform as a development strategy

As can be seen from the above analysis of the options considered for land redistribution and the legislation concerning land reform in relation to both commercial and communal land, the focus throughout is on facilitating the demarcation of land into individual holdings. Interestingly, the proposed form that this will take, in terms of the conditions attached to the leasing of land by farmers, is surprisingly similar to that specified for settler farmers under the South African administration and described in Chapter 1. This 'politics of straight lines'

(Scoones, 1996: 44) is intimately related to conventional perceptions of what development means in the context of communal livestock farmers, and to the lack of alternative models for land tenure reform in arid environments.

As stated for the Namibian context by Adams and Devitt (1992: 14), and as has been the case throughout dryland Africa, official thinking on the development of communal areas managed for livestock production remains fixed firmly on one path; that of 'transforming traditional stock keepers into commercial farmers and replacing customary forms of land tenure with freehold or leasehold title' through 'the subdivision of communal land into fenced holdings'. The basis for this perception is the belief that 'traditional' livestock production systems and their accompanying tenure arrangements are mutually exclusive with improvements in productivity and the commercialisation of activities. In addition, and as Queroz (1993: 1) states with regard to policy development in Botswana, 'the theoretical link that exists between range degradation and communal land ownership as proposed by Hardin (1968)' provides further motivation for an emphasis on transferring control over land to individuals. This view is held despite evidence from pastoral societies throughout Africa that the privatisation of communal land increases poverty and landlessness, widens the gap between rich and poor livestock owners, and contributes to environmental degradation (cf. Brokensha and Riley (1986: 76), Barrow (1990: 164) and Oba (1992: 11-14) for descriptions of the profoundly negative social and ecological effects of land privatisation and controlled grazing schemes in different regions of Kenya, and Dean *et al* (1995: 251) for examples of increased degradation due to confining livestock in patches in the Karoo).

More recently, and associated with an emerging and politically right-wing African middle-class in southern Africa as a whole (cf. Abel, 1992, for Botswana), these perceptions are being translated into a political ideology which understandably promotes policy initiatives supportive of the aspirations of this class, including the commercialisation of the livestock industry through instituting stocking rates on demarcated and individually owned land. At Namibia's 1991 Land Conference the Democratic Turnhalle Alliance (DTA, 1991: 3-4), for example, stated that 'peasant farmers must be encouraged to become commercial farmers' and favoured 'the enclosure of land and the allocation of land to individuals, families and cooperatives', while the Herero Chief Riruako (1991: 5), representing wealthy farmers on communal land anxious to establish rights to land (cf. Rohde, 1994: 12), called for 'the immediate surveying, ... and fencing of eastern and southern Kaokoland into economic farm units'.

Within the Namibian context, the view that considers titled farms a necessity for development is extremely important because it automatically sets the agenda and tone of possibilities for communal land reform, perhaps prior to the adequate exploration of alternatives. Interestingly enough, the focus on instituting tenure to delineated land-holdings exists in the face of vigorous opposition to the informal privatisation of land in north-central Namibia (see Box

4.5). While the existing emphasis on the subdivision of land for indigenous Namibian farmers may be appropriate in wetter environmental conditions where crop cultivation forms the primary source of subsistence, evidence from the material presented in the case study of land management above (Section 4.1.2), as well as from elsewhere in Africa, strongly suggests that it may be grossly misapplied in the context of extensive livestock production systems based on mobility in arid or semi-arid conditions.

Conclusion and chapter summary

This chapter relates case study material regarding the local-level management of specific natural resources to the formulation of relevant policy at the national level. It is argued that two related areas of change in post-independence Namibia, i.e. the strengthening of 'community-based' management of natural resources and the land reform process, are constrained by a lack of awareness and understanding of contemporary resource-use and management practice by communal area farmers. Analysis of the resource-use case studies demonstrate weaknesses in post-independence policy initiatives in terms of their ability to reflect local realities and complexities. The following issues are highlighted:

1) A wealth of culturally-mediated local ecological knowledge exists, despite assertions of the widespread disintegration of 'traditional' systems of resource-use and management, which could inform attempts to reinforce 'community-based' resource management practices.

2) Attachment of the word 'community' to initiatives associated with natural resources does not necessarily translate into representation of all targeted community members; appreciation of local heterogeneity, and both temporal and spatial fluidity in terms of individuals constituting so-called communities, is essential for the meaningful success of these initiatives.

3) A broader approach to such initiatives, so that they include discussion of resources such as plants and invertebrates which make important contributions to the livelihoods of a wide range of people, may promote the involvement of individuals otherwise alienated by the focus on large mammals.

4) The importance of mobility as a fundamental component of herd management in arid and unpredictable environments, even when people have access to delineated areas of land, implies that the current policy emphasis on sub-division of land into individual land-holdings may be inappropriate in north-west Namibia.

As Biesele *et al* (1991: 2) state, 'the real challenge is to balance Namibia's new democratic ideology with ethno-economic realities'. While national policy is clearly needed, as the Prime Minister asserted at the 1991 Land Conference, 'many of the solutions to these highly specific land issues can be generated only at the local level' (1991: 16). The fulfilment of these aims is only possible, however, in a policy environment which incorporates the implications of systematic and detailed information regarding contemporary resource management practice among farmers coping within, and modifying, the differing constraints and opportunities presented by the existing Namibian communal areas.

Chapter 5

Vegetation 'degradation' in north-west Namibia: background, research questions and methods

In Chapter 4 it was argued that the flavour of current policy changes regarding land and natural resources reflects perceptions of a lack of local-level constraints on the use of these resources. Related to this is a general consensus among policy-makers, development practitioners and conservationists that Namibia's communal areas are experiencing environmental degradation due to the mismanagement of natural resources. Chapters 5 to 7, therefore, shift the focus of the thesis away from how Damara farmers actually use and manage vegetation resources to the ways in which this use is manifested within the resource base.

This chapter begins by introducing perspectives regarding the existence of environmental 'degradation' in Namibia, and in the north-west in particular. This is followed by summaries of the findings of quantitative ecology studies regarding vegetation resource-use in Namibia. The focus is then opened out to introduce some complexities regarding the relative roles of density-dependent interactions between species *versus* abiotic factors in driving ecological patterns, as observed in small-scale ecology studies from dryland environments elsewhere. This review of literature is used for the generation of hypotheses concerning the form that environmental degradation might take within the study area, and the ways in which the existence of degradation might therefore be measured. These predictions are listed, followed by a description of the field and analytical methods used in their testing. The results produced by this part of the project are discussed in Chapters 6 and 7.

5.1 Background

5.1.1 Some statements

> "...the whole surrounding area has been overgrazed so thoroughly that only the large trees remain in a level plain of bare sand. There are no young trees nor can any raise its head owing to the intensive browsing of the numerous cattle, goats and donkeys ... as the large trees die off one by one and no others take their place it seems that all vegetation must eventually disappear ..." (Van Warmelo, 1962: 39).
>
> "Abuse of natural resources in the past has aggravated the problems of the livestock industry in the Homeland ... severe degradation has occurred" (Loxton *et al*, 1974: 22).
>
> "... environmental catastrophe (is) imminent in most of the communal areas ..." (UDF (1991: 5).
>
> "... the Hoanib river is now a desert landscape; grass, or for that matter any growth other than huge acacias is nowhere to be seen. All and all, it is an ecological system put off balance and in danger of collapsing altogether. The only way that something can be done about this, is to have fewer ... livestock" (Dr. M. Lindeque, then head of the Etosha

Ecological Institute, quoted in Menges, 1992, *in* Rohde, 1997: 368).

"... rural economy in the arid western parts of Namibia has steadily declined over the last few decades, its reserves of pasture depleted to critical levels." (John Kinahan, 1993: 385).

"The ravaged landscape is testimony to mass overgrazing ..." (Næraa *et al*, 1993: 82).

"... eventually the whole ecosystem will suffer severely and collapse" (Infoscience, 1994: 22).

"Reduction in vegetation cover and subsequent soil denudation following overgrazing ... can be found in all regions, in particular, Erongo, Kunene and Oshana" (Seely and Jacobson, 1994: 31; see also Seely *et al*, 1995: 53).

"In Damaraland, overgrazing has resulted in the virtual disappearance of perennial grass leading to continuous soil erosion" (Giorgis, 1995: 232).

The above statements describe the perceived existence of widespread and devastating environmental degradation through human misuse of resources in the former Damaraland 'homeland' of Namibia. The dates of the references demonstrate how little perspectives regarding the effects of land-use have changed, despite the radical transformations of political context experienced during this time[1]. They form a continuum with the generally dismal views of the area made by early explorers. As long ago as 1786, the explorer Thompson wrote that 'some people who have visited a part of Caffraria[2] have said that it appeared to them to have been a country worn out by time, and had once been fruitful' (*in* John Kinahan, 1990: 44). Similarly, Hahn in 1928 (p. 222) stated that 'There can scarcely be a doubt that this barren coast-girdle gradually increases in breadth and encroaches gradually upon the more fertile parts of the country, which in time will become as barren as the coast-land now is ...'.

Statements echoing these sentiments can be found for communal areas throughout the country. For example, Malan and Owen-Smith (1974: 140) assert for the Kaokoveld (north Kunene) that severe overgrazing is a problem, particularly in valley areas dominated by woodland savanna, where it is thought to have 'virtually exterminated most perennial grass species' so that 'for much of the year the ground ... is bare and trampled into a fine dust'. For the Kalahari sandveld of Hereroland it is considered that an increase in livestock numbers, particularly cattle, throughout this century has caused 'overgrazing, soil erosion, and trampling of the rangeland', perceived to 'drastically decrease the grassland productivity' (Kakujaha-Matundu, 1994: 6, 22). Similarly, widespread concern has been expressed regarding vegetation degradation through overgrazing and deforestation in the former

---

[1] Van Warmelo's observations on behalf of the South African government in fact were made in 1951 but were only published in 1962.
[2] An early name describing the region known today as north-west Namibia and south-west Angola.

Owambo region of north-central Namibia, particularly the central Cuvelai floodplain, leading to the assertion that central Owambo is approaching the limits of its human and livestock carrying capacity under present subsistence strategies (cf. Loxton *et al.*, 1983: 87, 114; Jensen, 1990: 15; Erkkiliä and Siiskonen, 1992: 152-155; Marsh and Seely, 1992: 17, 25; NISER, 1992: ix; Marsh, 1994: 44-50; Soroses *et al*, 1994: 6-14; Mubita, 1995: 68-70).

With regard to Namibia's southern communal areas, Karani (1991) summarises general perceptions in his reference to the 'destruction of pastures in communal Namaland' stating that,

> "the communally owned land is suffering from all the usual problems of common property, used by all, but none is prepared to invest in improvement remedies ... the result is .. serious overgrazing where pastures have been denuded of most of (the) palatable shrubs, trees and perennial grasses. Some old and isolated trees like *Acacia erioloba* are still found along river banks. There are (*sic*) no more young regeneration and when the present ones are cut for fuel or blown down by the wind there would (*sic*) be no replacement ... The original perennial grasses, shrubs and trees have disappeared through selective grazing by livestock and have been replaced by more hardy succulent shrubs such as *Calicorema capitata* ... and *Catophractes alexandri*".

These confident assertions, however, are supported by no empirical evidence. Nevertheless, the concerns they voice are reflected in the current fear of 'desertification' in Namibia, perceived as caused largely by the negative impacts of people and livestock on the country's environmental resources, particularly in communal areas (cf. Marsh, n.d.; Adams and Devitt: 1992: 7; Nærua *et al*, 1993: 1; Quan *et al*, 1994a, 1994b, 1994c; Seely and Jacobson, 1994; Wolters, 1994; Bester, 1995: 96; Seely *et al*, 1995: 57-61; Aharoni and Ward, in press). They find additional justification in statements which abound asserting that worldwide 'desert or arid regions ... are increasing at an alarming rate as a result of both natural causes (prolonged drought) and man's activities (overgrazing, overcultivation)' (Hadley and Szarek, 1981: 747; see also Herskovitz, 1926; Stebbings, 1935; West, 1968; Russell, 1977: vii; Pratt and Gwynne, 1977; Lamprey, 1983; Barrett, 1989 1, 3; references in Adams, 1990: 88-101; Burley, 1990: 199-200: Grainger, 1990, 1992; Chapman, 1992; references regarding the Sahel in Swift, 1996: 74-81; van Rooyen, 1996)[3].

Namibia's Programme to Combat Desertification (NAPCOD) can be seen as both a response to, and, through its influence on people's perceptions of the environment, a cause of, this fear of desertification. It is not helped by the UNCOD (1977) negative consideration, despite the natural aridity of the country, that 'the whole of Namibia is rated as potential

[3]Dahlberg (1994: 17-23) summarises the perceived situation of rangeland degradation in Botswana, Zimbabwe, Swaziland, Lesotho and South Africa.

desert' (Tyson, 1986: 86), i.e. the apparent antithesis of international 'green' environmental ideals which increasingly frame conditions attached to the 'greening of aid' process (cf. Davies, 1992 *in* Leach and Mearns, 1996: 25-26). The Programme's position is summarised in its recent policy review which states, 'that land degradation has, and is continuing to, take place at an alarming rate is an undisputed fact' (Dewdney, 1996: iii). The lack of data presented in support of this view, however, suggest that it may alternatively be understood as an 'institutional fact' (cf. Thompson *et al,* 1986 *in* Warren and Agnew, 1988: 10) which supports both the purposes of the programme and the validity of intervention by institutions and 'experts' (Roe, 1995: 1066). Similarly, economic assessment of the impacts of desertification in Namibia are acknowledged to be based on 'assumed and reported, rather than scientifically documented, change' (Foreword in Quan *et al*, 1994) and have considered it as given that desertification is occurring.

5.1.2 Quantitative ecology regarding effects of vegetation resource use in Namibia

The few small-scale quantitative studies that do exist regarding the ecological effects of resource- and land-use practices in Namibia have produced somewhat equivocal results. These are discussed below in relation to first, the former Damaraland 'homeland', second, other communal areas in Namibia and finally, to Namibia's commercial farming areas.

The former Damaraland

1) The 1994-1995 Summer Desertification Student Project of the DRFN conducted in southern Kunene and northern Erongo Regions had as its starting point the consideration that 'farmers of this area are experiencing difficulties with an ever-deteriorating rangeland that makes livestock farming only marginally productive' (Kambatuku *et al*, 1995: 3). A primary objective of this study was thus to 'gather vital information on desertification' (Kambatuku *et al*, 1995: 4); for this reason two of the eight study sites were located in an area selected for its appearance as obviously severely degraded, so much so that the area was given the working name of the 'Moonlandscape', to describe its desolate nature and lack of vegetation.

The project found a number of correlates with grazing pressure leading to assertions that the area was vulnerable to 'desertification' processes. These included:

- The toxic invasive plant *Geigaria ornativa*, interpreted as a sign of heavy grazing pressure, was common at all study sites with sandy soils and intense grazing, although it occurred in its highest proportion at the site with the greatest grass cover (Jobst, 1995: 32). Similarly, associated with heavy utilisation by livestock close to boreholes was the reduced incidence of perennial grass species and the encroachment of *Acacia mellifera* and *Acacia tortilis*. These factors were interpreted

as the possible beginning of piosphere[4] development and perhaps of 'desertification' (Jobst, 1995: 32-36). Little emphasis however was given to the high recorded levels of between-site variability in both species composition and biomass which indicated instead that factors other than proximity to boreholes were affecting these variables.

- Soil parameters showed a nonlinear relationship with distance from boreholes, with higher nutrient levels occurring in the immediate vicinity of waterpoints due to manuring by livestock (Mouton, 1995: 16). No significant differences were found in these parameters between sites under different grazing pressures on sandy soils, while differences between sites on silts were attributed to factors other than grazing (Mouton, 1995: 17);
- High germination rates for planted seeds in soil samples taken from the study sites indicated that plant growth potential was high in all but the two sites considered to have experienced the most intense grazing history (Kambatuku, 1995: 41). Similarly, biomass production was lower in sites categorised as heavily utilised but proximity to a waterpoint had no significant effect on germination or productivity (Kambatuku, 1995: 45);
- Soil samples from sites classified as heavily grazed had lower numbers of both seeds and nematodes, the former representing seed bank status and the latter indicating presence of soil biota required for organic matter decomposition and nutrient cycling (Nghitila, 1995: 55-60).

The overall conclusion arising from these biophysical studies was that reductions in primary productivity and changes in plant species assemblages were occurring as a result of unsustainable grazing pressure, particularly around boreholes, and that at sites considered severely overgrazed these changes may be irreversible.

What was not fully appreciated when these conclusions were drawn, however, was the effects on the area of several years of below-average rainfall and the residual potential for ecosystem productivity given appropriate environmental conditions, i.e. alternative potential explanations for the research findings were not considered. The complex ecological dynamics of this arid area were forcefully illustrated by the late rains of 1995, occurring only a couple of months after the completion of the DRFN project, which transformed the study area into a landscape reminiscent of prairie grasslands. Even the 'Moonlandscape' became an unrecognisable sea of *Stipagrostis* spp. grasses (Jacobson and Jacobson, pers. comm.), a state which certainly was not predicted within the constraints of the conceptual framework within which the above results were interpreted.

---

[4] i.e. the growth of degraded areas of land in a circular pattern around waterpoints or settlements, due to 'the radial nature of a point-centred livestock system' in which ' the available grazing resource increases exponentially with distance from a borehole ... creating annuli of different herbivore use intensities' (Perkins and Thomas, 1993: 184).

Analysis of matched photographs comparing archival with recent material in fact illustrate 'that dry periods in the past resulted in denuded landscapes' similar to those observed recently without apparently hampering the potential for ephemeral grass growth in years with above-average rainfall (Rohde, 1997b: 309).

2) A study of the effects of human and livestock utilisation around Khowarib settlement in the north of the former Damaraland was conducted by Sullivan and Konstant (1997), and forms a starting point for the vegetation analysis presented in this thesis. This small-scale study focused on patterns of woody vegetation species composition and its relationship to settlement impact, and was based on the assumption that this variable can be considered a relatively long-term and robust indicator of vegetation change.

The results of this study indicated that Khowarib settlement was influencing local woody vegetation communities, primarily by reducing species richness and increasing dominance by a handful of tolerant species. This relationship was significant for all three of the environmental variables used as measures of settlement impact, i.e. browsing, branch removal and distance from the settlement. Extreme caution was advocated in the interpretation of these results, however, for the following reasons:

- Use impacts were extremely small-scale in an area which is otherwise sparsely populated, i.e. the dataset comprised a vegetation survey which only covered an area up to a maximum distance of 5kms away from Khowarib settlement. This calls into question the issue of scale in vegetation analysis generally and, more importantly, it highlights the danger of drawing broad conclusions regarding human impacts on vegetation from a survey which essentially only confirms the use of woody vegetation resources at a small, local scale.
- Many woody species have the ability to coppice vigorously following branch removal. Branch removal in itself, therefore, can not be assumed as indicative of the unsustainable use of resources, and is more accurately interpreted as merely reflecting the existence and level of resource-use.
- Finally, it was observed that abiotic driving parameters of primary productivity may have an influence which overrides the significance of small-scale utilisation effects. In particular, rather than being subject to constant driving parameters and processes of change which are gradual and cumulative, it may be more appropriate to think of woody species as dependent on intermittent and environmentally-driven establishment events which would override the significance of small-scale utilisation activities.

Namibia's other communal areas

1) The DRFN's 1996 Summer Desertification Project had as part of its objectives to determine for the pro-Namib whether a communal area suffers greater degradation than

an adjacent commercial farm, and whether degradation increases with proximity to settlement in a communal area. These aims were tested using comparisons of a variety of vegetation and soil parameters at the communal area of Otjimbingwe and two commercial farms in Erongo Region. The overall conclusion of the project was that 'communal farming ... is not more destructive to the natural environment than commercial farming' (Apollus *et al*, 1997: 7); nevertheless land degradation through overgrazing is considered as given throughout the study area (Kisco *et al* 1997: 1; Munukayumbwa *et al*, 1997: 1; Ward, 1997: 2;). Results of this study include the following:

- Distance from the settlement of Otjimbingwe had significant negative and positive effects on the height of browse line and distance measured between woody individuals respectively, but had no statistical effect on tree size distribution (Apollus *et al*, 1997: 4). These results were interpreted as indicating that 'local overgrazing is occurring', exacerbated by higher wood removal closer to the town (Apollus *et al*, 1997: 6). Given that distances of only up to 1200m from the town were measured, however, the results may also indicate that these effects were extremely small-scale, and might be considered low in relation to the expected demand for natural resources in a relatively densely populated settlement.

- No significant differences were observed in grass height either at different distances from Otjimbingwe, or between Otjimbingwe and the neighbouring commercial farm of Tsaobis (Apollus *et al*, 1997: 4). This was considered as 'due to the fact that the whole area has been equally overgrazed' (Apollus *et al*, 1997: 7). The different stocking rates for the areas studied, however, suggest that a more parsimonious explanation lies in the role of low rainfall in constraining herbaceous productivity in both areas, particularly in view of the fact that this study was conducted towards the end of the dry season.

- With regard to soil factors, organic carbon content was higher in Otjimbingwe than in the commercial farms, while a range of bioassay measures used to assess fertility displayed no significant differences between the two (Apollus *et al*, 1997: 4-5). This was considered due to depositions of organic carbon at Otjimbingwe through the flooding of the Swakop River (Apollus *et al*, 1997: 7). The role of manuring by livestock in raising soil fertility is overlooked, and the results are interpreted as follows:

> "This is a good indication that the soil in the Otjimbingwe area is not totally exhausted of its nutrients. If the people of the area could be convinced to reduce their livestock numbers, land degradation could be greatly reduced and even reversed. That is, through better land management in the area the vegetation in the area can once again flourish". Similarly, "Even though the communal area has 20 times more stock than the commercial farms the soil quality is basically the same. Once the stock numbers are reduced,

the communal area has great potential to recover". (Apollus *et al*, 1997: 7).

An alternative explanation might be that both soil fertility indices and the high recorded stocking levels indicate that land-use practices in the Otjimbingwe area are in fact 'sustainable' and that land degradation, in terms of reduced soil fertility and secondary productivity, is not occurring.

2) A quantitative ecology study regarding resource-use in a communal area was conducted in the former Owambo in 1992 (Konstant *et al*, 1995; Sullivan *et al*, 1995) and focuses specifically on the plant resources used in basketry production, an industry which has had increasingly detrimental effects on its resource base in Botswana (Terry, 1984, 1987a, 1987b; Cunningham and Milton, 1987; Cunningham 1988a; Terry and Cunningham, 1993: 42-43), South Africa (Cunningham, 1988b), Zimbabwe (Terry and Cunningham, 1993: 45) and the Sudan (Babiker, 1982). The results of this work demonstrate that the relationship between the ecological status of a resource and the sources of pressure are complex and may be unexpected in the light of findings from elsewhere. For example:

- Unlike other centres of basket production in southern Africa, the level of *Hyphaene* leaf utilization and of the dye-plant *Berchemia discolor* was low due to the small commercial market for baskets from this area, and there is potential for greater use of these resources.

- In terms of anticipated future impacts on these resources, there are two major causes for concern: first, a potential increase in basket production related to increases in both commercial outlets and local demands, possibly unaccompanied by appropriate management of the natural resources on which this industry relies; and second, the measured intensity of browsing by domestic livestock on young palms (for which 89% of all opened leaves were recorded as damaged by browsing relative to only 10% recorded as cut or spoiled by harvesters of leaves for basketry or fibre (Konstant *et al*, 1995: 350)). It was considered that this may negatively affect the future structure and viability of the *Hyphaene* palm population by reducing recruitment of juvenile palms into the mature, sexually reproductive size classes, and thus possibly promoting destructive uses of remaining mature palms.

- Evidence of reduced plant vigour and production was indicated by lower rates of leaf emergence at the more heavily utilised study site.

- The population structure of *Hyphaene*, as measured by parameters such as height and basal diameter, was strongly skewed such that there were extremely high numbers of juvenile unstemmed plants relative to mature stemmed plants, with very few individuals in the replacement size classes. This is possibly related to the stimulation of vegetative reproduction of single-stemmed palm suckers due to defoliation by browsing livestock. 'The palm population structure ... thus appears to be

changing from stands of tall, fruit-bearing stemmed palms of various heights to short palm scrub consisting of clumped juvenile plants' (Sullivan *et al.*, 1995: 368). This may be cause for concern regarding the long-term viability of the palm population in this area.

Commercial farmland

Most other quantitative studies regarding impacts of livestock and people on vegetation resources have been conducted in commercial farming areas and are directed towards improving livestock yields in these areas (cf. Bester, 1995: 95-97).

1) Strohbach (1992), for example, has conducted a quantitative study on the 'loss of genetic diversity due to veld degradation' in the commercial farming area of Grootfontein District characterised by northern Kalahari sandveld. This study includes sampling of woody and herbaceous plants along a gradient of 'various stages of overgrazing' within the camp system of a commercial farming area, i.e. with minimal grazing intensities in the far reaches of the camp, and maximum intensities closest to the watering point (Strohbach, 1992: 103). A multivariate approach was used to analyse the data generated by this study and indicated the following (Strohbach, 1992: 104-114):

- Intensity of grazing had a strong impact on the composition of samples, explaining nearly 60% of the variance in the dataset.
- Tree density increased with increasing grazing pressure, but the diversity of encroaching woody plants was highest at moderate levels of grazing and lower with heavy grazing.
- The diversity of grass species declined with increasing grazing intensity, with those classified as palatable perennials showing the strongest decline. The only palatable perennial grasses to increase were *Eragrostis trichophora* and *Sporobolus fimbriatus*, classified as Increaser III or pioneer species (following Bosch and Janse van Rensburg, 1987). Unpalatable perennials also showed a general decline, while annual species, particularly those classified as unpalatable, increased (e.g. *Aristida adscensionis*, *A. rhiniochloa*, *Tragus berteronianus*, *T. racemosus*, and *Triraphis purpurea*).

2) A more recent study using this methodological approach also established a gradient in the species composition of samples located in the highveld commercial farming area of Khomas Hochland and the Daan Viljoen Game Reserve (Joubert, 1997). This was interpreted as being due to differences in grazing intensity experienced by the sample sites, although it is unclear from the DCA ordination of this dataset as to what extent this gradient actually represented grazing *versus* other environmental factors (Joubert, 1997: 73-74). Even so, this gradient is considered to significantly reduce grass basal cover and is used to interpret the response of individual grass species to grazing intensity (Joubert,

1997: 77-84). Importantly, several of these species displayed different responses to those recorded in previous studies; for example, *Monelytrum leuderitzianum* was unresponsive to grazing pressure but is described as a pioneer species by Müller (1984), and *Stipagrostis uniplumis* is usually considered as a sub-climax species but occurred as an Increaser IV species in this study, i.e. achieving maximum relative abundances with heavy utilisation and decreasing with reduced grazing. These results emphasise potential within-species variability in their responses to environmental conditions, and the consequent difficulty in assessing vegetation condition on the strength of species composition in relation to grazing gradients.

3) Part of the DRFN's 1996 Summer Desertification Project aimed to establish for three commercial farms in west Khomas Region the relationship between distance from waterpoints on grass height and soil factors. The results were as follows:

- The relationship between grass height and distance from waterpoints was positive (Munukayumbwa, 1997: 2) for distances of up to 1000m. Greater quantities of grass biomass were not recorded for the farm with the highest average rainfall as was expected, but it is not clear whether or not differences in grass biomass between farms were statistically significant and therefore justify the conclusion that this farm was experiencing 'greater land degradation' (Munukayumbwa *et al*, 1997: 2-4).
- With regard to soil factors, differences in bioassay results and soil organic carbon on the commercial farms between sample locations at various distances between 50m and 500m from waterpoints were non-significant and significant respectively (Munukayumbwa *et al*, 1997: 3-4) making conclusions of a gradient in degradation problematic.

Summary

The studies reviewed above indicate that a common argument in much of the literature regarding the arid and semi-arid areas of Namibia is that farming practices are causing environmental degradation through 'overgrazing' and 'overuse' of natural resources. As suggested in the discussion of options for a communal lands policy in section 4.2.2 (Chapter 4), these problems are considered particularly noticeable in communal areas due to insufficient controls on resource access. The perceived importance of degradation processes has been amplified in recent years due to the 'desertification' rhetoric pervading discussion of environmental issues within Namibia.

Two features characterise the way in which research findings are interpreted in the few Namibian studies which attempt to address issues of degradation in a rigorous and comparable way. These are:

1) A tendency to interpret observed patterns with reference to degradation processes, when other factors may contribute explanations which are in fact more parsimonious. In

particular, the role of abiotic constraints, primarily the temporal and spatial effects of variable rainfall and the largely spatial effects of topography and substrate, is not given enough emphasis.

2) A reluctance to situate the implications of small-scale gradient effects of people and livestock around settlement foci within the context of patchy landscapes which are generally sparsely populated and utilised at low levels. Related to this, there is a danger of confirming degrading land-use effects of people and livestock by extrapolating results from small 'sacrificial areas' to imply vegetation changes over larger spatial and temporal scales.

5.1.3 Arid land ecology: measured impacts at smaller scales

Despite the assertions of degradation made in the Namibian studies of resource-use outlined above, review of the wider ecological literature concerned with the measured effects of human and particularly livestock utilisation on dryland vegetation at relatively small spatial scales proves largely inconclusive. Selected recent material is discussed below in relation to the arid and semi-arid environments of southern Africa, Australia and North America.

Grazing versus *abiotic factors*

O'Connor (1994: 155-156) demonstrates that even in a relatively moist savanna habitat (600-650mm a^{-1}) in the eastern Transvaal, South Africa, the abundance, recruitment, plant basal area and mortality of dominant perennial grasses is 'more strongly influenced by rainfall variability than by cattle grazing'. Additionally, 'the population growth rates of most species were positively correlated, indicating that an extrinsic force, presumably rainfall, had the greatest effect on population growth' (O'Connor, 1993: 119; see also O'Connor, 1991). In this study grazing by cattle had a generally positive effect on seedling recruitment by producing gaps in the vegetation and stimulating vegetative reproduction. An earlier study indicated, however, that palatable, seed-reproducing species, in this case *Heteropogon contortus*, *Bothriochloa insculpta* and *Themedra triandra*, were negatively affected through the impact of heavy grazing on seed banks and grass tuft size, although seed production also reflected the dynamics of rainfall and soil moisture availability (O'Connor and Pickett, 1992: 247, 254). These species may thus be 'prone to local extinction' due to the reduced availability of seed under the combined effects of heavy grazing and drought (O'Connor, 1994: 156, 168). Overall, O'Connor (1993: 119) concludes for mesic savanna conditions that the structure and composition of such vegetation communities is affected by grazing but in a manner which is dependent on the 'prevailing rainfall regime, especially on sequences of years of above or below average rainfall'[5]. Substantial variations in population growth rates thus occur from

[5]See also Austin and Williams (1988: 43) who draw the same conclusions for semi-arid environments in Australia. Further case studies illustrating similar patterns for various, relatively mesic, environments in southern Africa are presented in O'Connor (1985: 23-43) who emphasises the overriding role of rainfall even in the presence of varying grazing treatments, stating that 'The evidence suggests that rainfall variability has a primary effect on trends in basal cover or yield, irrespective of grazing treatment' (p. 67).

year to year; prolonged drought conditions in O'Connor's study area for example, favoured the fragmentation of tufts and a corresponding relative increase of plants in the smallest size classes (1993: 130).

Similarly, in an earlier study in the 'sandy highveld' of north-eastern Transvaal (788mm a^{-1}) which is also dominated by *Themeda triandra* and *Heteropogon contortus*, winter grazing by sheep during four consecutive years reportedly 'had no detrimental effect on production, cover or seed production' although concern was expressed regarding the possible negative effects of extending the grazing period into spring and autumn (Rethman *et al*, 1971: 55).

Danckwerts and Stuart-Hill (1988: 218), on the other hand, maintain that the post-drought recovery of grass species in the False Thornveld of the Eastern Cape (±420mm a^{-1}) was sensitive to grazing immediately following the drought, but that veld classified as in 'moderate' condition recovered to pre-drought species composition more rapidly than that classified as in 'good' condition. Problems with interpretation of these results, however, include the use of 'veld condition scores' based on the classification of species in relation to their successional stage (see Chapter 7), the influence of factors other than grazing important in determining 'veld condition' (primarily marked differences in soil stoniness (Danckwerts and Stuart-Hill, 1988: 220), and pseudoreplication errors in sampling design. Further monitoring of this area in fact indicated that 'rainfall had an overriding effect on vegetation change' (Martens *et al*, 1990: 187).

With regard to areas dominated by animal wildlife as opposed to livestock or mixed grazing regimes, Thrash *et al* (1991a: 121, 129-130) found that the establishment of a water-point in 1973 for animal wildlife in the lowveld savanna of Kruger National Park (450-550mm a^{-1}) had a negative impact on the basal cover of herbaceous plants and affected the relative basal cover of grasses, forbs, increaser and decreaser grass species. They concluded that this was due to 'overutilisation by game' and the sensitivity of herbaceous species to trampling. In a similar study of the woody vegetation in the same area, only the larger size classes of *Combretum apiculatum* demonstrated sensitivity to the impact of animal wildlife around the waterpoint, related to the selective use and damage of this species, particularly by elephants; regrowth of this species from persistent root stocks was promoted by such use, however, and all other parameters including species composition and richness, total density and density by height class, were statistically unaffected by distance from the dam (Thrash *et al*, 1991b: 131-132, 139, 145-7). Moreover, a further study indicated that there was only a 'slight concentration of large herbivore rangeland use' around permanent water points (Thrash *et al*, 1993: 87), thereby casting doubt on one of the predicates on which conclusions drawn concerning herbivore impact were based. Wentzel *et al* (1991: 51, 57) in fact concludes for Kruger National Park that 'localised over-utilisation is an integral part of the natural grazing mosaic' and should be considered essential for the maintenance of herbivore diversity in extensive conservation areas.

In areas characterised by greater aridity any linear relationship between herbivory and measures of vegetation degradation becomes extremely difficult to demonstrate. Fourie *et al* (1980: 53) in a 15 year study of Kalahari duneveld vegetation (217mm a^{-1}) utilised by wild ungulates conclude that 'rainfall is clearly the main determinant of forage production ... and since it varies widely from year to year, ... forage production varies widely over time'. Additionally, 'Plant density appears to be closely related to this rainfall pattern, so that botanical composition is extremely dynamic' (p.53). Van Rooyen *et al* (1994: 349), contradicting their earlier conclusions from the same area (Van Rooyen *et al*, 1991), found that 'grazing intensity was not associated with distance from artificial watering points' and, importantly, state that neither grazing nor distance from water-points significantly influenced plant species composition in a range of habitats surveyed in the Kalahari Gemsbok National Park (±210-230mm a^{-1}). Soil moisture had high explanatory power in relation to plant species composition in riverbeds (Van Rooyen *et al*, 1994: 352). They concluded that, in river terrace and shrub savanna habitat types, 'grazing/trampling immediately around a waterhole is restricted and no definite grazing gradient is discernible away from a watering point' and that, in a more general sense, 'the effect of drought surpasses the effect of grazing pressure' (Van Rooyen *et al*, 1994: 357; see also Van Rooyen, 1990: 63, 80).

Conversely, a study of the environmental effects of borehole establishment in livestock ranches established in the eastern Kalahari as part of the Tribal Grazing Lands Policy of Botswana indicates a steep gradient in herbivore use intensity with distance from boreholes (Perkins and Thomas, 1993: 186-187). As a result of the exponentially increasing area of land available to livestock at further distances from waterpoints, however, the authors point out that 'degradation is highly localized' around waterpoints and is 'likely to remain so over time because of the inherent constraints placed on ... herbivore use intensities by the piosphere effect' (Perkins and Thomas, 1993: 188).

A common theme in considerations of environmental degradation in South Africa (see references in Beinart, 1996: 57-63) is the perceived expansion of semi-arid Karoo shrubland vegetation, described emotively by Nicholas (1952: 15) as the 'invading Karoo' and by Tidmarsh (1948: 522) as a 'fifth desert invasion' in South Africa's recent geological history. This is attributed to either climatic factors or human mismanagement. In terms of the former, Tyson (1986: 6) considers that 'under prolonged dry conditions the desertification potential (as defined by UNCOD, 1977, see Introduction) rises and the eastward and north-eastward advance of Karoo and desert-like conditions ... may in fact occur'. The occurrence of desiccation in southern Africa in historical times has in fact been hotly debated since the 19th century, but, in spite of repeated assertions of diminishing rainfall (cf. Tidmarsh, 1948: 524-526), recent in-depth analysis of records from the early part of this century do not support the idea that climatic conditions are becoming progressively drier (although on a longer time-scale it does appear that conditions in Namibia began to get drier <1,000BP) (Tyson, 1986: 12, 55, 68). Perceptions of degradation and desertification due to misuse of the

environmental resources in southern Africa's arid areas are more common (cf. de Klerk, 1947; Klintworth, 1949: 89; Roux, 1980: 15-16); as Tainton *et al* (1980: 40) assert, for example; 'Particularly in the karroo, climatic climax sites may be difficult to locate because of extensive degradation of this type of veld' and Dean and Macdonald (1994: 295) conclude that 'irreversible changes in the diversity and abundance of Karoo vegetation have taken place'.

A reassessment of vegetation change in the arid eastern Karoo, based on analysis of travellers' accounts from the 1700s and 1800s, repeat photography over the last 60-70 years and ecological survey data from the last thirty years (Hoffman and Cowling, 1990), fundamentally contradicts received wisdom of livestock-induced vegetation degradation in this area (cf. de Klerk, 1947; Tidmarsh, 1948; Klintworth, 1949). The eastern Karoo is generally thought to have been altered in the last 200 years from a perennial grassland to a less productive dwarf shrubland which is expanding north-east into the former Orange Free State. Hoffman and Cowling (1990: 286) instead maintain that this area 'may not have been dominated by perennial grasses (in pre-colonial times) and that seasonal rainfall effects might be responsible for much of the perceived vegetation change'. Nevertheless, this interpretation is far from conclusive (cf. Dean *et al*, 1995). Dean and Macdonald (1994: 281), for example, show that from 1911-1981 stocking rates fell by greater amounts in the more arid magisterial districts of this region (<300mm a^{-1}), and conclude that this 'is unrelated to market forces or state policy' and indicates 'that the production potential of drylands has decreased markedly' in Cape Province. Interpretation of these results is complicated, however, by the fact that past and present stocking rates are also significantly correlated with mean annual rainfall for all four grouped districts, but no indication is given of the differences in rainfall in these two time periods (Dean and Macdonald, 1994: 286, 288). In a reanalysis of a relatively long-term (23 years) floristic dataset for the Karoo (361mm a^{-1}), O'Connor and Roux (1995: 612, 619) conclude that;

> "Community change was mostly driven by rainfall variation, but the influence of grazing treatments on longer-lived plants became more important over a longer time period. The community was therefore a matrix of longer-lived perennial grasses and dwarf shrubs within which dramatic variations in the abundance of annual and ephemeral forbs took place." Also, "the nature of change in species composition differed among some grazing treatments but grazing overall did not have a particularly marked effect."

Despite the relatively recent influence of domestic livestock in the semi-arid rangelands of Australia (cf. Griffen and Friedel, 1985) and north America, similar results can be demonstrated for these environments. A long-term (20 years) experimental study of sheep grazing in a heavily utilised Australian Mediterranean-type environment (between the 300mm and 450mm rainfall isohyets), for example, indicated that within a range of grazing treatments

there was no measured effect of grazing intensity, although analysis of species composition using multivariate approaches revealed 'progressive divergence of successional trends' between quadrats which were grazed *versus* those which were not (Austin *et al*, 1980: 201-203). These trends were compounded by the markedly different responses of perennial grass species to grazing and, additionally, community types were sensitive to differences in winter rainfall over and above the effects of grazing. Conversely, in the *Astrebla* grasslands of Australia Orr (1980: 807) found that increased forage use in the dry period prior to heavy rainfall reduced the increase in basal area and cover of the palatable *Astrebla lappacea* relative to lightly grazed treatments; additionally, lower yields of *Astrebla* were associated with higher yields of annual grasses and forbs, particularly of the 'poisonous pioneers' (p. 818) *Amaranthus mitchellii* and *Tribulus terrestris* in heavy forage use treatments. Moderate grazing, however, did not have a detrimental effect on *Astrebla* productivity and 'underutilisation' was in fact shown to cause loss of vigour in seed production of this species (Orr, 1980: 807, 817). The short duration of this study (one growing sesaon) means that caution is needed in the interpretation of these results, particularly in view of any extrapolation to larger timescales (see also Eldridge *et al*, 1990: 510).

With regard to the semi-arid regions of America, the results of field experiments conducted by Fowler (1986: 545, 551) to assess changes in density under different conditions indicate that density-dependent effects, including interspecific competition, for a natural population of a perennial bunchgrass (*Bouteloua rigidiseta*) were weak and overshadowed by the density-independent effects of the highly variable climate of the region. Fowler (1986: 553) thus concludes 'that many plant communities of arid and semi-arid regions may be similarly free of strong density-dependent population regulation much of the time, since they also often are subject to population-reducing droughts' (see also Chambers and Norton, 1993: 261-275).

Species establishment in arid areas thus tends to involve the occurrence of exceptional rainfall events (cf. Jones and Mott, 1980: 222). As Austin and Williams (1988: 47) describe, the establishment of desirable *Astrebla* species in the *Astrebla*-dominated grasslands of semi-arid Australia is dependent on substantial rainfall events, which overshadow the effects of livestock grazing and complicate assumptions that overstocking causes changes to a community dominated by the less desirable *Dichantheum sericeum* in periods between these rainfall events. They conclude that the population demography of these and other pasture species in semi-arid Australia has been, over the last century, 'related to catastrophic events ... in the form of interactions between climate, the impact of European land use (sheep, cattle, rabbits) and the rabbit myxoma epizootic'. In terms of climate, 'major long-term changes ... are generated by extreme sequential events rather than by random isolated events', in this case related to the El Niño/Southern Oscillation (ENSO) climatic phenomenon (Austin and Williams, 1988: 43). Climate is thus an 'extrinsic forcing factor' with the effect that 'the long-term dynamics of plant communities initiated by sequential events may bear little resemblance to predicted communities offered by models on random climatic events' (Austin

and Williams, 1988: 43). As Frost *et al* declare (1986: 27), 'the composition of the herbaceous layer in dry savannas appears to be affected primarily by year to year and longer-term variations in rainfall.'

Autecological factors

Finally, but not surprisingly, autecological factors contribute a further source of complexity to the dynamic patterns observed at the community level. There are numerous examples in the ecological literature which could be drawn on to illustrate this point; only a few will be presented here. Carter and O'Connor (1991: 231, 234), for example, observed that savanna grassland patches (650mm a^{-1}) dominated by either *Setaria incrassata* or *Themeda triandra* in a so-called 'two-phase herbaceous vegetation mosaic' were due to the former's association with 'a tree canopy and deeper soils of higher organic content' (the latter a possible effect of accumulating rhizome material of *Setaria*). In the case of *Setaria*, vegetative propagation promotes small-scale contagion and exclusion of other species, thus facilitating the maintenance of monospecific stands (Carter and O'Connor, 1991: 234).

Similarly, grass species may show differing degrees of sensitivity to so-called disturbance effects such as herbivory, as was found by Hodgkinson *et al* (1989: 45) in a comparative experimental study of *Cenchrus ciliaris* and *Themedra triandra*, i.e. two erect, tussocky perennial grasses capable of reproducing vegetatively through the production of basal tillers. These were observed to be tolerant and intolerant of frequent heavy defoliation respectively. Defoliation caused a change in morphology in *C. ciliaris* allowing it to reproduce vegetatively through the growth of horizontally oriented nodal tillers. No such response occurred in *T. triandra*, which nevertheless was able to sustain very rapid initial regrowth following a 'one-off' instance of defoliation, enabling this species to survive through flooding the system with a single-aged stand which then quickly becomes moribund and unpalatable to herbivores, thus ameliorating the potentially negative effects of defoliation by grazing animals (Hodgkinson *et al*, 1989: 52)[6].

Competitive interactions related to life history features and resulting in resource partitioning between plant individuals may also become an important factor in conditions of relative stability. This has been described for several species of perennial grasses occurring on the sides of sand dunes in the Namib which provide a relatively favourable environment for deep-rooted species (Yeaton, 1990). Further complicating the relationship between plant species and herbivory is the issue of variable palatability; livestock preferences for individual plant species may vary between seasons (Theron and Booysen, 1966: 115) and in relation to the environmental conditions of different localities, as well as by species of herbivore.

---

[6]See also Tainton and Booysen (1963) and Rethman and Booysen (1968) for a discussion of the effects of different defoliation treatments on the grasses *Themeda triandra* and *Tristachya hispida* in 'Tall Grassveld' (650mm a^{-1}), and their relation to autecological factors, and Bosch and Theunissen (1992: 101-108) for a discussion of the heterogeneity of ecotypic variation displayed in southern Africa by the pasture species *T. triandra*, *Eragrostis racemosa* and *Digitaria eriantha*.

Summary

The above studies indicate that both abiotic and autecological factors are responsible for a large amount of observed variability and complexity in arid and semi-arid ecosystems, in many cases overriding the measured effects of herbivory. This situation appears to contradict the assertions of degradation in Namibia's communal areas summarised in Sections 5.1.1 and 5.1.2 above. There are two possible reasons for this: either the Namibian case is exceptional and long-term degradation is occurring as a result of natural resource utilisation; or ideological factors are encouraging the interpretation of observed ecological patterns as due to degradation through mismanagement, when in fact they may reflect the influence of alternative phenomena.

As a response to this situation, the effects of settlement pressure on vegetation resources in southern Kunene were tested, using a variety of standard ecological parameters and relating these to direct and indirect measures of resource-use. This approach accords with Dregne's (1985) statement that desertification, as a process of ecosystem 'deterioration', should be displayed by measurable indices such as 'reduced productivity of desirable plants' and 'undesirable alterations in the biomass and the diversity of ... flora'. It intentionally treats the environment as 'analytically separable' from people (cf. Leach and Mearns, 1996: 11) because this reflects the way in which discourse regarding desertification in the area is framed. Based on the literature review above, a number of testable predictions, listed in Section 5.2, were identified.

5.2 Environmental degradation in north-west Namibia: predictions

In accordance with ideas of cumulative degradation in the north-west of Namibia (see Sections 5.1.1 and 5.1.2), it is proposed that the existence of vegetation degradation in the study area, resulting from direct and indirect pressure by people and livestock and related to gradients of use around settlement foci, should be manifest in the following quantifiable ways:

5.2.1 Floristics and diversity

Comparable habitats will differ in woody and herbaceous plant species composition. It is hypothesised that:

1) Vegetation community patterns will be strongly associated with, and explained by, resource utilisation parameters.

2) Species diversity will be affected by people and livestock. There are a number of ways, including the following, in which such effects may emerge;

- species diversity will be reduced through utilisation pressure, resulting in the dominance of hardy, 'pioneer' species with little economic value around settlements;
- conversely, species diversity may be promoted by utilisation pressure through stimulating the presence of a variety of 'weedy' species.

5.2.2 Measures of population

Woody vegetation

It is hypothesised that the 'deforesting' effects of woody vegetation utilisation will cause:

Density

1) A gradient of change in plant density with different proximities to settlements, resulting in either:

- a reduction in plant density with close proximity to settlement foci, as a result of the removal of woody species;
- or possibly an increase in plant density with increasing proximity to settlements reflecting the stimulation of vegetative reproduction as a response to utilisation pressure.

Cover

2) Similarly, it is hypothesised that plant cover may be affected in a gradient around settlements in the following ways:

- basal area will decline with closer proximity to settlements due to the reduction of mature individuals through timber utilisation, and/or the prevention of recruitment to these size classes due to intensive browsing of young individuals by livestock;
- conversely, basal area could increase with proximity to settlements, reflecting a reduction in the incidence of individuals in the smaller size classes and indicating a lack of regeneration potential in these areas.

Dominance

3) It is hypothesised that the gradients in absolute plant density and cover postulated above will also be manifest as trends with distance from settlement in the relative contribution of different woody plant species, reflecting predicted floristic patterns.

Population structure

4) For selected species, it is suggested that skewing in population structure will occur due to:

- the cutting of mature individuals for timber resulting in fewer individuals in the taller height size classes with proximity to settlement;
- the browsing of seedlings by livestock which will prevent recruitment into mature size classes resulting in fewer individuals in the smaller height and basal diameter size classes with proximity to settlement.

Herbaceous vegetation

With regard to herbaceous ground cover, it is predicted that the direct and indirect impacts of livestock will result in the following measurable impacts:

Cover

1) Live above-ground herbaceous biomass will be lower:

- with closer proximity to settlement;
- within unfenced plots subject to grazing by livestock compared to fenced plots from which livestock have been excluded;
- and the latter effect will be more pronounced in the second year of study.

Dominance

2) as with the woody vegetation dataset, and corroborating the predicted floristic patterns, it is hypothesised that the relative contribution of different species to the herbaceous vegetation samples will be affected by differences in livestock pressure.

5.3 Methods

This final section of Chapter 5 details the field and analytical methods employed in the testing of the above predictions regarding the degradation of woody and herbaceous vegetation around settlement foci north of the veterinary cordon fence in the former Damaraland 'homeland'.

5.3.1 Field methods

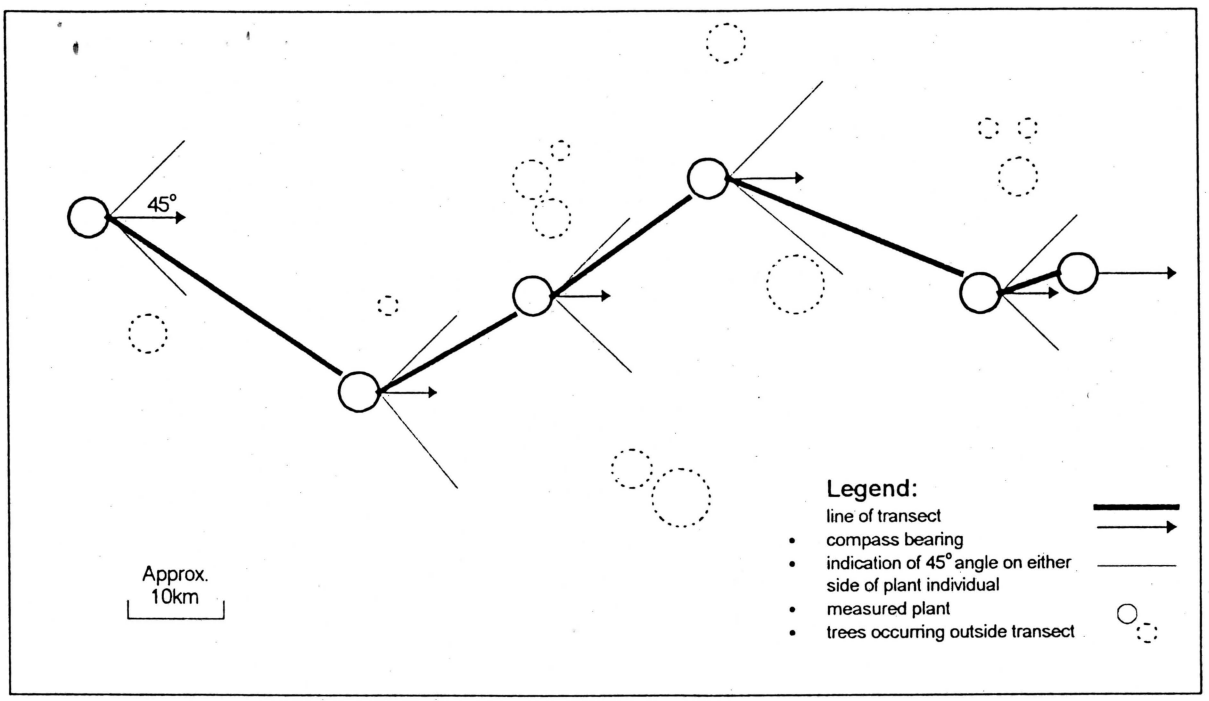
Different sampling strategies were used for woody and herbaceous vegetation to reflect their different growth forms and spatial and temporal scales of distribution. The measures chosen for these two broad categories of vegetation also reflect these differences. The field methods used are therefore outlined separately below for woody and herbaceous vegetation respectively.

Woody vegetation

Sampling strategy

In a semi-arid environment such as north-west Namibia, indigenous perennial woody species, adapted to conditions of low and irregular rainfall, can act as longer-term indicators of environmental change caused by settlement impacts. The woody vegetation of the so-called Sesfontein-Khowarib basin was surveyed using a 'zig-zag' transect method (following Leithead, 1979) (Figure 5.1). In this method each consecutive individual is sampled according to its proximity to the preceding individual, providing it is within 45° on either side of a stated compass-bearing from this individual. The first individual is selected randomly. The strength of this technique lies in the fact that it makes no assumptions regarding density or distribution of species, and thus the vegetation itself dictates the length of the transect. This feature of the technique is highly appropriate for surveying dryland vegetation where species distributions are far from random; instead they are characteristically patchy and dispersed, and clumping of individual or associated species may be common (cf. Prentice and Werger, 1985; Ben-Shahar, 1991).

• Figure 5.1. Selection of tree individuals using a zig-zag transect (following Leithead, 1979: 29).



In order to take into account the substantial differences in topography and substrate in this area, as well as to sample vegetation under different degrees of settlement and use pressure, sampling was stratified into a number of levels. At the broadest level the area was divided into three topographic categories, i.e. plains, riverine and mountain terrains, based on geomorphological and plant physiognomic characteristics. These were further stratified on the basis of soil characteristics or substrate (following preliminary soil surveys reported in Infoscience (1994: 11-12) and corroborated by fieldwork in southern Kunene (Mouton, 1995: 17)), such that the plains samples were classified as occurring on either alluvial silts or sandy loams, riverine samples always occurred on alluvial silts, and the more varied mountain samples had substrates of calcrete, dolomite or schist. Stratification of the survey on the basis of broad geomorphological categories is consistent with results from previous descriptions of plant communities in the pro-Namib of north-west Namibia by this author (Sullivan, 1993a and b; Sullivan and Konstant, 1997) and by Cowlishaw and Davies (1997), and follows Walter's (1986) suggestion that geomorphological features may comprise effective units for classification of desert ecosystems[7]. For the mountain samples, the effects of aspect were controlled for by ensuring that all transects on calcrete had a southerly aspect, while those on dolomite and schist had a westerly aspect; this standardisation reflected the local topography of these substrates. Aspect is therefore not included as an environmental variable in the analysis of this dataset. The final level of stratification involved sampling at different distances from the primary permanent

[7] Olsvig-Whittaker *et al* (1983: 161-163) also demonstrate the significance of substrate factors in causing spatial heterogeneity in vegetation assemblages in a watershed of the Negev Desert (92mm a^{-1}), largely through effects on soil moisture availability.

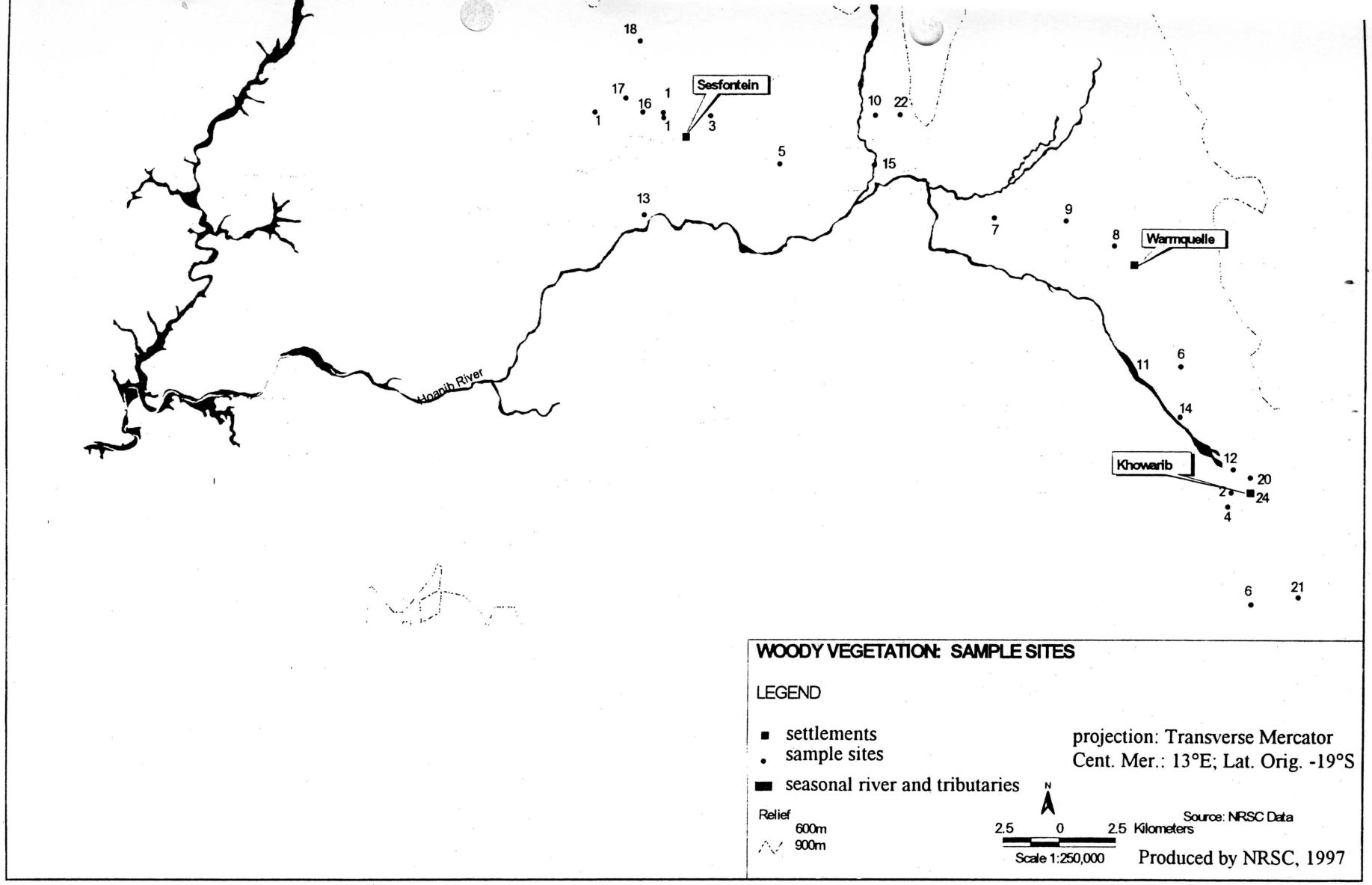
settlements in the area, i.e. Sesfontein, Warmquelle and Khowarib, in each of these topographic and substrate categories. Distance from a settlement was thus used as an indirect measure of resource-use pressure with transects located within settlement, on the outskirts of settlement, and at distances ranging from 3kms to 20kms from settlement. The study design can be described as a 'comparative mensurative experiment', the location of samples in space comprising the range of 'treatments' of these samples (cf. Hurlbert, 1984: 189).

A total of 53 transects were sampled in 1995 and 1996. The objective for each transect was to measure 40 plant individuals; in a small number of cases, such as when a watercourse or obvious change in substrate or topographic stratum, as defined above, was encountered transects were shortened accordingly. The 1995-1996 dataset is thus comprised of measurements for 2115 individuals. This dataset has been augmented by a further 22 transects comprised of some 635 individuals, which were measured in a preliminary survey of this area by the author in 1992, conducted using the methodology described above, with the exception of measuring slightly fewer (normally 30) individuals in each transect (Sullivan, 1993a, 1993b; Sullivan and Konstant, 1997). The full dataset analysed here therefore consists of 75 transects with measurements for 2760 individuals. Pseudoreplication was avoided by surveying at least 3-4 transects in the majority of sample locations (cf. Hurlbert, 1984: 190). Site and transect location were recorded using a Global Positioning System (GPS). Table 5.1 summarises the structure of this dataset and Map 5.1 presents a map of the location of transects.

• Table 5.1. Samples and individuals by site characteristics

Topographic category	*substrate*	*distance from settlement (km)*	*settlement*	*site no.*	*no. of transects (transect no.)*	*no. of plant Individuals*
plains	alluvial silts	0	Sesfontein	1	4 (1-4)	160
			Khowarib	2	4 (5-8)	115
		0.5	Sesfontein	3	3 (9-11)	120
			Khowarib	4	5 (12-16)	160
		5	Sesfontein	5	4 (17-20)	160
			Khowarib	6	3 (21-23)	110
		10	Sesfontein/Warmquelle	7	3 (24-26)	115
	sandy loams	0	Warmquelle	8	3 (27-29)	120
		0.5	Warmquelle	9	3 (30-32)	120
		8	Sesfontein/Warmquelle	10	3 (33-35)	115
			Warmquelle/Khowarib	11	2 (36,37)	60
riverine	alluvial silts	0.5	Khowarib	12	3 (38-40)	120
		3	Sesfontein	13	3 (41-43)	90
		5	Khowarib	14	4 (44-47)	120
		8	Sesfontein	15	3 (48-50)	120
mountain	calcrete	0	Sesfontein	16	3 (51-53)	120
		0.5	Sesfontein	17	3 (54-56)	120
		3	Sesfontein	18	3 (57-59)	120
		5	Sesfontein	19	3 (60-62)	120
	dolomite	0.5	Khowarib	20	4 (63-66)	150
		5	Khowarib	21	1 (67)	25
		8	Sesfontein	22	3 (68-70)	120
		20	Sesfontein/Warmquelle	23	3 (71-73)	120
	schist[6]	0.5	Khowarib	24	2 (74,75)	60
				TOTAL	75	2760

[6] These two samples on schist from the 1992 dataset are included in this analysis to further highlight the variability in the 'mountain' topographic category.



WOODY VEGETATION: SAMPLE SITES

LEGEND

- settlements
- sample sites
- seasonal river and tributaries

Relief
600m
900m

projection: Transverse Mercator
Cent. Mer.: 13°E; Lat. Orig. -19°S

N

2.5 0 2.5 Kilometers

Scale 1:250,000

Source: NRSC Data

Produced by NRSC, 1997

Information recorded

Individual attributes

For each individual >2cm diameter, the following attributes were recorded:

- The species was identified. Plant nomenclature follows the current species list of the NBRI (1996; see also Kolberg *et al*, 1992). Assistance with species identification was provided by Pat Craven and Gillian Maggs of the NBRI, Windhoek. In cases where species are currently unidentified the author's collection number is included to assist with the future identification of specimens of these species. Naturalised species are marked with an asterix.
- Basal diameter, using a diameter reading forestry tape. This measure was recorded in preference to the more commonly used diameter at breast height to ensure that cut, broken and coppiced stems were included and in recognition of the shrubby and often stunted growth-forms that characterise many arid-adapted woody species. For taller trees, basal diameter was measured above the basal swellings characteristic of this growth-form.
- Height, using a Suunto direct-reading hypsometer. Heights were not recorded for the 1992 Khowarib dataset due to the lack of necessary measuring equipment.

Measures of human and livestock impact

- Woody species are cut by people for a variety of reasons, primarily to obtain poles for construction purposes, less frequently for firewood (for which dead wood is preferred) and, as observed among pastoralist groups elsewhere, to enable livestock to reach otherwise inaccessible green browse, particularly in the dry season, through partial lopping or pollarding (cf. Morgan, 1981: 104 for the Turkana; Homewood and Hurst, 1986: 6; for the Il Chamus of Baringo; Barrow, 1988: 7 for the Pokot). The degree of **branch removal** or **lopping** for human use, identified by the occurrence of clean cut marks through the branches or main stem and clearly distinguishable from utilisation by desert-dwelling elephants (as assessed by Viljoen and Bothma, 1990), was classified according to the following scale:
    - 0 = no branch removal;
    - 1 = slight branch removal; 1-2 large branches or only small branches removed;
    - 2 = moderate; 25-50% of branches removed;
    - 3 = severe; >50-75% of branches removed;
    - 4 = very severe; >75% of branches removed, often with a loss of plant height;
    - 5 = cut through the main stem/s so that the height of the plant is substantially reduced, but regrowth by coppicing is observed;
    - 6 = cut through the main stem and dead; i.e. no sign of coppicing.

- the evidence of **browsing** by livestock was recorded on a 4-point scale as follows:
  - 0 = no sign of browsing;
  - 1 = slight; only a few leaves affected;
  - 2 = moderate; often with a noticeable browse line;
  - 3 = heavy; affecting the shape of the plant.

Herbaceous vegetation

Sampling strategy

Six study sites were located at different distances from permanent settlements such that they represented varying degrees of livestock pressure on herbaceous vegetation; one was located at the abandoned settlement site of Otjimdagwe, near Sesfontein (resettled following the growing season of 1995), three were located at 0.5km, 5kms and 10kms from Sesfontein, and two were located at 0.5kms and 5kms from Khowarib. These site locations corresponded with sites 1 (Otjimdagwe and within Sesfontein) and 3-6 for the woody vegetation dataset (see Table 5.1). As outlined in Chapter 1, subsistence patterns and land-use are broadly similar at these settlements and they are considered to represent qualitatively comparable pressures on resources. Map 5.2 shows the location of these sample sites and Table 5.2 indicates the distance of each site from the nearest settlement.

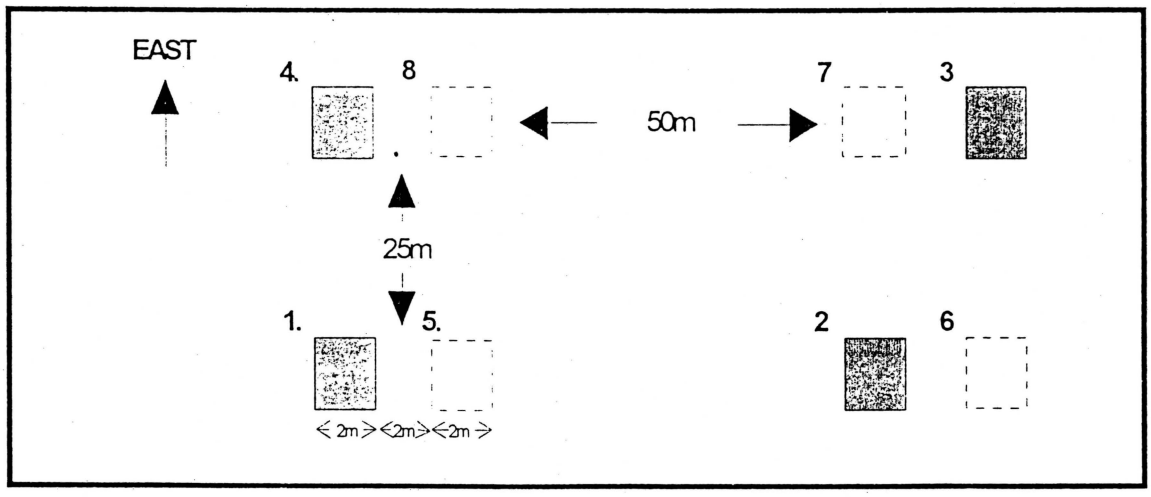
Given that the aim of this component of the study was to assess the effects of livestock on herbaceous ground cover, the sites were located so as to control, to the greatest possible extent, the effects of physical environmental factors; each site was thus located on substrates classified as alluvial silts within the plains topographic category as identified for the woody vegetation dataset. As described by Noy-Meir (1973), under the arid conditions of north-west Namibia these fine-grained, relatively fertile (Abrams *et al*, 1997: 33), clayey soils can be expected to show 'the so-called inverse texture effect' (Van Rooyen *et al*; 1994: 358); their low infiltration rates, high permeability and consequent susceptibility to evaporation from the surface layers of the soil means that they tend towards greater aridity than sandy soils under equivalent climatic conditions, despite their greater water-holding capacity (O'Connor, 1985: 5; Frost *et al*, 1986: 10-11).

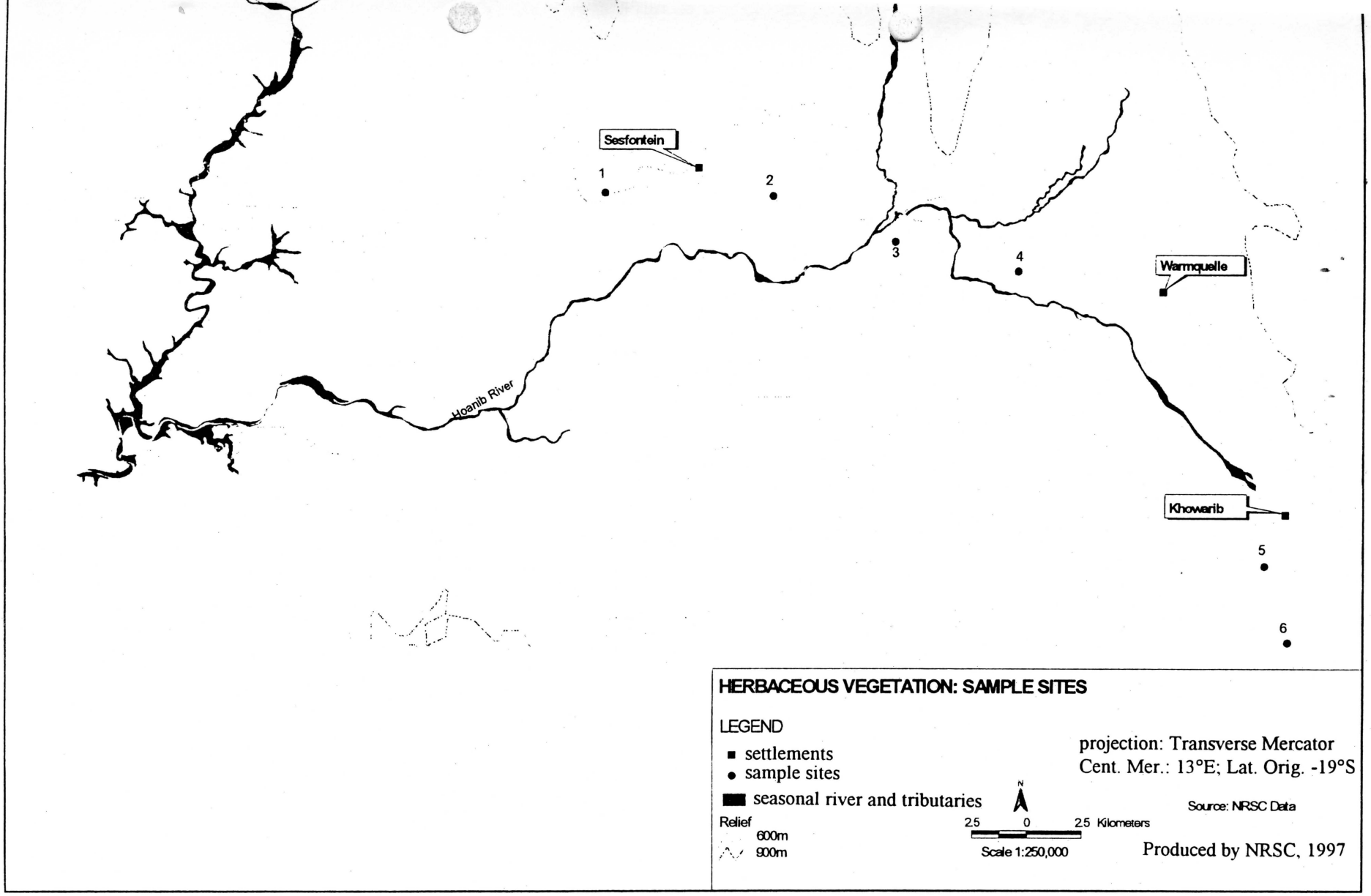
Sampling was again designed so as to avoid common pseudoreplication errors (cf. Hurlbert, 1984: 190-192). At each site eight 2m x 2m qūadrats were laid out on a standardised grid pattern, as depicted in Figure 5.2. The layout was rectangular in recognition of the enhanced ability of this shape to accurately reflect species counts given the tendency towards clumping of vegetation (cf. Mueller-Dombois and Ellenburg, 1974: 70). Of these quadrats, four were fenced (enclosed) in order to prevent grazing by domestic livestock. Populations of grazing wildlife also form an important ecological component of the landscape in the study area; their densities are much lower than those

of livestock, however, and even though these species were also excluded from fenced plots it is considered that quadrat enclosure primarily reflected the effects of exclusion of livestock. On the other hand, fencing does not remove the effects of grazing invertebrates which can have enormous, and irregular, impacts on plant biomass. It is assumed that these will be the same both within and outside enclosed quadrats and that comparison between fenced and unfenced plots remains a meaningful way of testing the effects of grazing livestock. Fenced and unfenced quadrats were placed in pairs to ensure interspersion of treatments; within these pairs, the decision for which quadrat should be enclosed was random, i.e. made by tossing a coin. Plots were fenced to a height of 1.4m using fine-meshed chicken wire supported by three levels of fencing wire.

This sampling framework of 48 quadrats was established in January-February 1995, i.e. at the beginning of the rather late growing season for this year, and ground cover was monitored and recorded at the end of the growing season (May) in both 1995 and 1996. The study design thus incorporates both mensurative (spatial location and year of data collection) and manipulative (enclosure) variables or 'treatments' (cf. Hurlbert, 1984: 189).

• Figure 5.2. Schematic diagram of quadrat lay-out, in this case for site 1. The shaded squares represent enclosed quadrats and those with a dashed outline represent unenclosed quadrats.





HERBACEOUS VEGETATION: SAMPLE SITES

LEGEND

- settlements
- sample sites
- seasonal river and tributaries

Relief

- 600m
- 900m

projection: Transverse Mercator
Cent. Mer.: 13°E; Lat. Orig. -19°S

N

2.5 0 2.5 Kilometers

Scale 1:250,000

Source: NRSC Data

Produced by NRSC, 1997

Information recorded

Within-quadrat measurements

Within each quadrat ground cover was measured using a point-cover method on a standardised grid pattern as illustrated in Figure 5.3. This entails sampling the ground cover at a series of points placed some distance (20-40cms in this case) from the quadrat boundary in order to avoid possible distortion through edge-effects (cf. Goldsmith *et al*, 1986). A total of 36 points were sampled for each quadrat; this somewhat low number was considered to provide adequate representation due to the within-site and within-quadrat homogeneity of species composition and cover. Table 5.2 illustrates the former. With regard to the latter, a test quadrat in site 3 was subjected to measures at a much-inflated 119 points, which yielded a mean number of species at each point of 1.1 (standard deviation = 0.33), extremely similar to the mean of 1.2 species recorded at each point measured in the remaining 7 quadrats at this site, surveyed at only 36 points (mean standard deviation = 0.45).

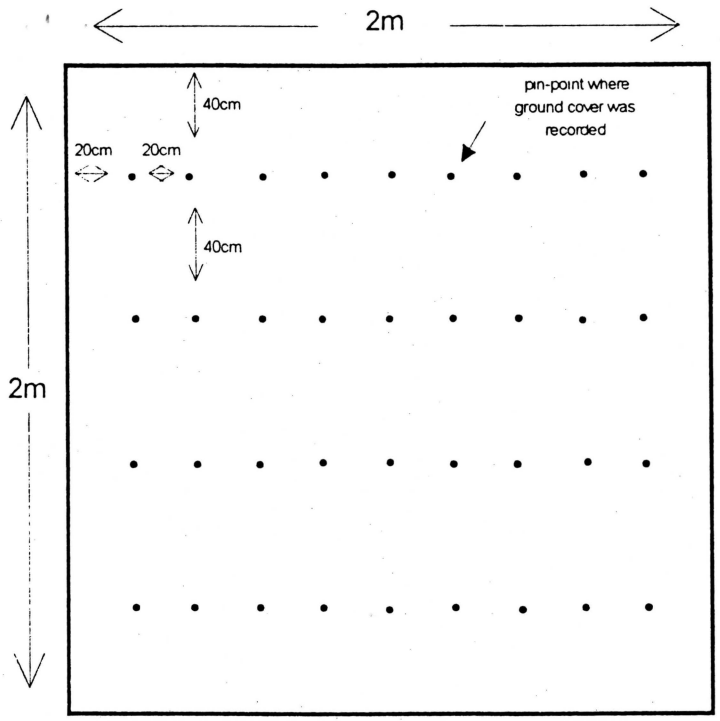
For this study, ground cover was defined as 'the proportion of the ground occupied by a perpendicular projection of the aerial parts of individuals' of growing herbaceous species (Goldsmith *et al*, 1986: 449), as well as plant-litter and bare-ground. The number of times each species touched the pin (i.e. cover repetition) was recorded in order to provide some estimate of plant biomass (Mueller-Dombois, 1974: 86; Goldsmith *et al*, 1986: 452). Plant litter was treated in a similar fashion whereas the value for bare-ground, for obvious reasons, could only ever be 1 at each point. Values for live herbaceous biomass only, converted to percentages, were used in floristic analysis of this dataset (Chapter 6), while the absolute values for herbaceous species, plant litter and bare-ground were used in a comparative analysis of plant cover and productivity (Chapter 7).

Site measurements

The following abiotic factors were measured at each site:

- A crude measure of soil moisture was obtained following the height of the 1995 rain season by sun-drying weighed soil samples of 400g for one week, re-weighing these samples and attributing the recorded loss in weight to the evaporation of soil moisture. Weights were measured using Soehnle digital scales to an accuracy of 2g.
- Rainfall was measured at each site during the wet season of 1995-1996 (September-March) using stainless steel rain-gauges. Evaporation of rain water from these gauges in between monitoring was prevented by covering the base of each gauge with a film of 1mm of engine oil; this rises to the surface of any collected water thus impeding direct contact with sunlight.
- Simple bioassays were carried out on soil samples to provide a basic and comparable measure of fertility at each site. Soil samples with an undried weight of 300g were planted with a standardised measure of cress seeds; following two weeks of growth the cress biomass was sifted of soil, dried for 24hrs in a constant 80°C laboratory oven, and the dried samples weighed to a high degree of accuracy on laboratory scales.
- Altitude was measured using a Global Positioning System (GPS), which was also used to record coordinates for site location.

• Figure 5.3. Lay-out of each quadrat showing how ground-cover was sampled.



• Table 5.2. Within-site homogeneity for the herbaceous vegetation dataset demonstrated by the mean number of species recorded in each quadrat in 1995 and their standard deviations (s) and coefficients of variation (cv) (nb. these measures are not sensitive to the relative contributions made by each species to the quadrat). The proximity of each site to settlement is also indicated.

Site	Settlement nearest to	distance from settlement (km)	SPECIES: mean (n=8)	s	cv
site 1	Otjimdagwe	0	6.25	1.04	16.6%
site 2	Sesfontein	0.5	5.63	1.30	23.2%
site 3	Sesfontein	5	4.75	0.89	18.7%
site 4	Sesfontein	10	5.75	1.28	22.3%
site 5	Khowarib	0.5	6.00	1.41	23.5%
site 6	Khowarib	5	8.25	2.05	24.9%

Problems

Apart from the rather difficult logistics associated with establishing a field experiment of this nature in a remote area and on communal land, very real problems were experienced in the sites closest to settlements due to the rubbing of cattle and donkeys against the fencing wire. The damage caused by this forced the abandonment of three enclosed quadrats, two from site 1 and one from site 5, in the 1996 repeat survey. This can be viewed in positive terms, however, in that it supports the consideration that pressure from livestock will be more intense with increasing proximity to settlements.

5.3.2 Analysis

A number of components of the woody and herbaceous vegetation datasets were analysed to paint a picture of the ways in which the effects of human and livestock utilisation are

manifested in broadly different habitat types under different degrees of resource utilisation pressure. These include the following:

- in-depth analysis of the factors driving floristic patterns in the datasets (Chapter 6);
- assessment of the relationship between resource-use pressure and vegetation productivity, as expressed for woody species by measures of density and basal cover, and for herbaceous species by cover abundances (Chapter 7);
- analysis of the population structure of selected common woody species, with multi-purpose use-value, under different utilisation pressures (Chapter 7).

Each of these are discussed in turn below.

Floristics and diversity

A suite of exploratory and analytical multivariate techniques was applied to samples-by-species matrices constructed for the vegetation datasets and used to define the relationship between floristic indicators, including species diversity and composition for each sample, and the environmental variables characterising each sample. The latter are listed for each of these datasets in Table 5.3. Community classification and indirect and direct ordination techniques were used; these are outlined below and explained more fully in Appendix 4. The recent use of similar approaches by Sullivan (1993) and Sullivan and Konstant (1997) in the Hoanib catchment area, Cowlishaw and Davies (1997) in the Pro-Namib, and their proposed use for the analysis of vegetation communities in the Kaokoveld (Jürgens, 1995), suggests a growing interest in applying multivariate methods to the Namibian context. In addition, they have been used to explore gradients of degradation in commercial farming areas of the Northern Kalahari (Strohbach, 1992) and the Khomas Hochland (Joubert, 1997)[9].

[9] See also Martens *et al* (1990) and Skarpe (1990) for examples of the use of multivariate techniques in analyses of vegetation communities elsewhere in southern Africa.

• Table 5.3. Environmental variables used in the multivariate floristic analyses of the woody and herbaceous vegetation datasets.

environmental variables	woody vegetation	herbaceous vegetation
physical site factors:	topography substrate altitude	site location, reflecting measures for: soil moisture (1995) rainfall (1996) soil fertility (bioassays for 1995) year, reflecting differing productive potentials of different growing seasons†
measures of resource utilisation:		
direct	branch removal/lopping browsing	removal of livestock impact through enclosure of quadrats
indirect	distance from settlement nearest settlement	distance from settlement year, reflecting cumulative effects of grazing livestock on enclosed and unenclosed quadrats†

Classification

Both datasets were classified using the TWINSPAN (Two-Way Indicator Species Analysis) program (Hill, 1979b). In order to 'run' the TWINSPAN algorithm, species values were entered as abundances for each sample and then transformed to percentages so as to offset any distortions caused by having different total abundances for each sample (i.e. caused by having slightly different numbers of individuals in the woody vegetation dataset, and by having count records for the contribution of herbaceous species to quadrats). The number of cut-levels for pseudospecies (see Appendix 4) used in the analysis was set at six, i.e. 0, 2, 5, 10, 20 and 50 (corresponding with a percentage contribution to the sample of 0-1%, 2-4%, 5-9%, 10-19%, 20-49% and 50-100% respectively). This means, for example, that in a sample in which *Acacia tortilis* comprised 60% of the plant individuals, this species would be present at all 6 pseudospecies cut-levels, while if present at only 12% of the sample it would be present at only the first 4 cut-levels. This is set slightly higher than the default values in order to reflect the broad spread of species abundances ranging from very rare to very dominant in both datasets. In all other cases the default values were used.

Ordination

Ordination techniques are multivariate methods which organise community data on the basis of species abundance by arranging species and samples in a low-dimensional space such that similar species and samples are close together and *vice versa* (Gauch, 1982: 109, 115; James and McCulloch, 1990; Gaillard *et al*, 1992: 7). The strength of each

†It is recognised that the use of year in this way represents temporal pseudoreplication due to the fact that the sampling units from both years are correlated with each other (Hurlbert, 1984: 204-205); nevertheless, because the aim of this component of the study is to assess between-year differences in the same sites, as represented by plots with replicated treatments, comparisons carried out in this manner are considered valid.

axis in explaining the variance in the dataset is measured as an eigenvalue such that the higher the value, the more important the ordination axis (Ter Braak, 1987c: 39, 1990: 5). Both detrended and canonical correspondence analyses (DCA and CCA) were undertaken. The former is a method for indirect gradient analysis which, by using information on the occurrence of species in samples, allows complex species-environment relationships to be explored and described in a qualitative manner (ter Braak, 1986: 1167). The latter incorporates the environmental variables within the ordination thereby relating sample composition directly to environmental conditions.

In the ordination diagrams constructed from the CCAs, the species and samples are represented as points, and the environmental variables as vectors portrayed in two ways: as arrows if the variable is ordinal or continuous (i.e. altitude, browsing, lopping and distance from settlement), or by points if the variable is nominal or dichotomous (i.e. settlement and site location, topographic and substrate categories, treatment of quadrats as enclosed or unenclosed, and year) (ter Braak, 1986: 1167, 1987c: 51-53). In the case of ordinal variables, the strength of the variable is related to the length of the arrow, and the position of the arrowhead is determined by the eigenvalues of the axes and the intraset correlations of that variable with the axes. As such, the length of the arrow is a measure of how much species change is accounted for by a particular environmental variable. This means that the more important variables (i.e. those with higher eigenvalues) are represented by longer arrows. Nominal environmental variables, on the other hand, are represented by points located at the centroid (i.e. weighted average) of the sites belonging to that environmental class. The completed ordination diagram, therefore, shows visually the dominant patterns in the community produced by the relationship of species and sites to the environmental variables.

Significance tests were also carried out to statistically test the relationship between the environmental variables and the variance in the species data. Monte Carlo permutation tests were used to select a number of random permutations for the samples-by-species data and thereby assess the probability that the observed pattern in the dataset in relation to the environmental data was not a product of chance alone (ter Braak, 1988: 159, 1987c: 35-36; Gaillard *et al*, 1992:7). Two test statistics were used in this analysis. The first provides a measure of the strength of the overall relationship between the species-by-samples dataset and the environmental variables as represented by the sum of all the eigenvalues (the trace test statistic), and the second tests the relationship between the species data and the first ordination axis, again represented by its eigenvalue.

Finally, partial analyses were carried out in which the effects of particular environmental variables were eliminated from the analysis by specifying them as 'covariables', allowing the assessment of the contribution of the remaining variables to the residual variation in the sample-by-species dataset (ter Braak, 1987c: 2). This technique illuminates the

relationship of samples and species with specific environmental variables and, through partialling out 'background' variables as covariables, overcomes the problem of close association between them. These relationships can then be tested statistically using forward selection of environmental variables by Monte Carlo permutation testing. In doing this, the percentage of variation in species abundance that can be attributed to a particular variable is revealed as the probability of that variable contributing significantly to the assemblage after a number of permutations (ter Braak, 1987b: Gaillard *et al*, 1992: 7-9). The data are thus considered analogous to experimental data; each environmental variable is viewed as a 'treatment' imposed on the vegetation, and the resulting community pattern as the 'response' to this treatment (Gaillard *et al* 1992: 9). In this way exploratory analysis by canonical ordination can be complemented by confirmatory tests (ter Braak, 1987c: 4).

This analytical method was used to test specific hypotheses concerning the influence of particular environmental variables on the variance in the species data revealed by CCA. The relationships tested are explained in full in the context of the analysis. The default selection of 99 permutations was used in all instances, providing a measure of significance of p=0.01.

DCA and CCA were applied to the vegetation datasets using the computer program CANOCO (CANOnical Community Ordination) 3.12 (Ter Braak, 1991) which uses iterative ordination algorithms for extracting axes in partial, detrended and canonical correspondence analyses (Ter Braak, 1987c: 39). This program is an extension of the Cornell Ecology program DECORANA which is used for DCA and reciprocal averaging (Hill, 1979a). For both DCA and CCA analyses all the species and samples were treated as active and thus jointly determine the ordination. Rare species can have a disproportionate effect on community classification and were therefore downweighted for these analyses; the new values used in the ordinations are tabulated in the results sections for both the woody and herbaceous datasets. This follows Cowlishaw and Davies (1997: 286), who demonstrate the significance of rarity and patchiness in the dispersion of species in a similar pro-Namib environment by indicating the disparity between observed species-area curves for this area and a theoretical curve representing a random distribution of species.

Diversity

CANOCO was also used to produce Hill's N2 diversity index (Hill, 1973) for each sample, in order to relate measures of species diversity, taking equitability between samples into account, to the relevant environmental variables. This index is based on Simpson's index (λ) which, as Box 5.1 demonstrates, calculates the proportion that each species represents in a population and the probability that an individual drawn at random from this population will be of a particular species (Simpson, 1949). Hill's N2 index uses the

reciprocal of λ to produce a single figure which represents the number of effective or dominant species in a sample such that a high N2 value indicates low dominance and thus high diversity, and *vice versa* (Ludwig and Reynolds, 1988: 85, 90-91). The relationship between the N2 diversity values calculated by CANOCO and topography, substrate and distance from settlement were explored statistically with one-way analysis of variance (ANOVA) using SPSS 7.0 for Windows (cf. Norušis/SPSS Inc., 1994). This procedure was complemented by using *post hoc* multiple comparison tests[10] to assess which of these categories were significantly different from each other.

- Box 5.1. Simpson's diversity index following Goldsmith *et al* (1986: 461-462) and Ludwig and Reynolds (1988: 90-91).

Simpson's diversity index $$\lambda = 1 - \sum_{i=1}^{S} (p_i)^2$$

(Equation 5.1)

where p_i = the proportional abundance of the ith species given by $p_i = \frac{n_i}{N}$

i = 1, 2, 3,...S

n_i = the number of individuals of the ith species

and N = the known total number of individuals for all the S (species) in the population.

Simpson's index varies from 0-1 and gives the probability that two individuals drawn at random from a population will belong to the same species. If this probability is high then diversity is low.

λ only applies to finite communities, i.e. those where all members of the population have been counted so that the sample (n) = the population (N). An unbiased estimator $\hat{\lambda}$ developed by Simpson is therefore used (Equation 5.2), in recognition of the fact that ecological data are generally samples of wider populations.

$$\hat{\lambda} = \sum \frac{^{S} n_i (n_i - 1)}{_{i=1} n(n-1)}$$

(Equation 5.2)

The reciprocal of $\hat{\lambda}$ yields Hill's second diversity number (N2).

Measures of population

Woody vegetation

Density

The mean distance between trees can provide an idea of differing plant densities in relation to varying environmental conditions. For this dataset, the relationship between this measure and the various sampling categories was explored with one-way analysis of variance (ANOVA) and general-factorial generalised linear modelling (GLM) procedures,

[10] The Bonferroni test was used whenever *post hoc* multiple comparison tests were applied. This adjusts the observed significance level according to the number of comparisons being made (cf. Norušis/SPSS Inc., 1993: 273).

again using SPSS 7.0 for Windows (cf. Norušis/SPSS Inc. 1994). Absolute and relative density measures were derived for the woody vegetation dataset following the procedures outlined by Mueller-Dombois and Ellenberg (1974) and Leithead (1979: 30). These are summarised in Box 5.2.

• Box 5.2. Calculation of absolute and relative density for distance measures, as used for the woody vegetation dataset (following Mueller-Dombois and Ellenberg (1974) and Leithead (1979: 30).

Mean distance $(\bar{d})$ for each transect = $\frac{\sum d}{n}$

(Equation 5.3)

where d = distance between the individual trees

and . n = the number of trees of all species in each transect.

Absolute density (D) = $\frac{area}{\bar{d}^2}$

(Equation 5.4)

For example, where distance and density measures are in metres,

absolute density per hectare = $\frac{10{,}000}{\bar{d}^2}$

Density D_a for each individual tree species a = $\frac{\sum species_a}{n} \times absolute\ density\ (D)$

(Equation 5.5)

Cover

Plant cover or dominance is considered to be a measure of greater ecological significance than density due to the fact that it provides a more accurate representation of plant biomass (Mueller-Dombois and Ellenberg, 1974: 80). For woody vegetation, stem cover was defined as 'the projection of the basal area to the ground surface' and measured for each individual using the following formula:

$$\text{basal area } (ba) = \left(\frac{1}{2}di\right)^2 \times \pi$$

(Equation 5.6)

where di = diameter (Mueller-Dombois and Ellenberg, 1974: 80, 95).

Differences in stem cover in relation to sampling category were analysed using ANOVA and GLM techniques as described above.

Dominance

The relative importance of each species by topography, substrate and distance from settlement was assessed following the conversion of the density and basal area measures for each species by sampling category into a single measure of plant dominance, calculated using the following formula (cf. Mueller-Dombois and Ellenberg, 1974: 113-114):

relative dominance = $\bar{x}$ basal area of species$_a$ $\times D_a$

(Equation 5.7)

where $\bar{x}$ = the mean and D_a = density of species *a*.

Population structure of selected woody species

Reproductive capacity in woody plants is generally related to size, and 'stand structure', or 'the numerical distribution of differently sized individuals within each species' (Mueller-Dombois and Ellenberg, 1974: 94), thus reflects both the historical opportunities for individual plant recruitment and the future potential for recruitment from juvenile individuals (Harper, 1977: 600-604). Analysis of plant population structure using the size measures of height and basal diameter under different utilisation pressures can therefore illuminate the effect that these pressures have on both past and potential recruitment (cf. Sullivan *et al*, 1995). Levels of branch removal and browsing were correlated with distance from settlement (see Chapters 6 and 7) and the latter indirect measure of use pressure was used as the independent variable in one-way ANOVA of height and basal diameter of two common species. Patterns in the size class distribution for heights and basal diameter measures were further explored graphically.

Two common species were selected for analysis of population structure within the topographic and substrate categories in which they were dominant:

1) *Acacia tortilis*, from the alluvial plains samples (samples 1-26, see Table 5.1);

2) and *Colophospermum mopane*, from the plains samples on sandy loams (samples 27-37, see Table 5.1).

These species are the dominant sources of timber for firewood and building poles (see Tables 3.11 and 3.12 in Chapter 3), and are considered significant fodder species for livestock with the pods of *A. tortilis* being particularly nutritious (see Annexe 1). In addition, the pods and gum of *A. tortilis* are consumed by people as food and *C. mopane* provides a variety of medicinal treatments as well as being host to the edible mopane caterpillar *Imbrasia belina* (see Table 3.6 and details in Annexe 1).

As height measures were not recorded for the small 1992 dataset from around Khowarib settlement which has been incorporated within the larger 1995-1996 dataset, there are

slightly fewer height measures than total basal diameter measures for each species. The structure of the dataset used for this analysis is presented in Table 5.4.

• Table 5.4. Structure of samples used for the analysis of population structure for *Acacia tortilis* and *Colophospermum mopane*.

	no. individuals with both height and basal diameter measures	total basal diameter measures
Acacia tortilis	507	673
Colophospermum mopane	309	341

Herbaceous vegetation

Density

For the herbaceous vegetation dataset measures of density were avoided due to the difficulties associated with recognising and defining individuals of the low-growing life-forms characteristic of these samples (cf. Mueller-Dombois and Ellenberg, 1974: 68-69).

Cover and dominance

Cover was analysed for the herbaceous vegetation dataset by applying the multivariate classifications and ordination techniques described above to the absolute values (i.e. pin-strikes) recorded for each species at each sample point, together with measures for the contribution of plant litter and bare-ground to these samples. As Rutherford (1980: 53) points out, it is recognised that such 'productivity' values obtained at the end of the growing season 'seldom closely approach the value of annual above-ground net primary productivity'. This is because 'losses during the growth season in the form of death of new material and separation of this and previously dead material from the plant, ... and translocation to (and from) below-ground parts, are unaccounted for'. While inexact for these reasons, the measures used in this study are considered sufficiently robust for the assessment of between-site livestock impacts presented here.

Cover values for live above-ground plant biomass (and its subdivision into various life-form categories such as grasses, succulent forbs and dwarf shrubs), plant litter and bare ground, and the relationships of these with the various environmental parameters characterising the dataset, were analysed statistically using factorial-ANOVA and both DCA and CCA multivariate ordination procedures. The relative cover of individual species was assessed from the graphical and numerical presentation of their cover values by sample site.

Chapter summary

This chapter shifts the focus of the thesis away from the ways in which Damara farmers use and manage natural resources, as discussed in Chapters 2 to 4, towards the measurement of indices of resource degradation potentially caused by these practices around concentrations of settlement in north-west Namibia. The chapter is divided into three sections.

Section 5.1 presents a background to issues of dryland degradation, concentrating first on assertions of degradation within the study area and elsewhere in Namibia's communal areas. Quantitative ecology studies of resource-use impacts in Namibia are summarised, followed by a review of literature regarding similar processes in dryland environments elsewhere. It is emphasised that there is a tendency within Namibia to explain observed ecological patterns with reference to perceived degradation processes due to human mismanagement of natural resources, when in fact other factors, highlighted by wider literature review, may be more important.

Based on considerations of vegetation degradation within the study area, Section 5.2 lists some testable predictions regarding the possible manifestations of such degradation for both woody and herbaceous vegetation.

Finally, Section 5.3 details the field and analytical methods used to test these predictions.

Chapter 6

Floristics and diversity

In assessing the effects of direct and indirect pressure by people and livestock it is postulated that comparable habitats will differ in plant species composition as a result of this pressure. More specifically, and as stated in Chapter 5, it is predicted that:

1) The vegetation of the study area, classified using TWINSPAN, will form different assemblages of associated species according to the intensity of utilisation pressure, such that community patterns will be most strongly associated with, and explained by, resource utilisation parameters, including distance from settlements.

2) Species diversity will be affected by people and livestock. There are a number of ways, including the following, in which such effects may emerge:

- species diversity will be reduced through utilisation pressure, resulting in the dominance of hardy, 'pioneer' species with little economic value around settlements;
- conversely, species diversity will be promoted by utilisation pressure and/or manuring by livestock which may stimulate the presence of a variety of 'weedy' species.

The results of testing these predictions are presented separately below for the woody and herbaceous datasets respectively.

6.1 Woody vegetation

This section presents results of floristic analysis of the woody vegetation dataset, detailed separately for community classification, direct and indirect ordination, and diversity.

6.1.1 Classification

The results of the TWINSPAN classification are represented by an ordered two-way table of the original data, with the values for species transformed into 'pseudospecies' (Table 6.1). A cursory glance at Table 6.1 demonstrates the strong pattern that emerged from the TWINSPAN analysis, with species ordered in the top third of the table preferential to the left of the first division and *vice versa*. A number of further well-defined groups have also been classified within this primary dichotomy and are described below. The dendrogram in Figure 6.1a provides a more complete list of the indicator and preferential[1] species characterising each of these groups at pseudospecies cut-levels of ≥3, together with the eigenvalues measuring the explanatory strength of each division, while Figure 6.1b shows the relationship between the classification of community data and site location.

[1]Pseudospecies and species that are at least twice as likely to occur on a particular side of the division, with indicator species being the most strongly differential (Hill, 1979b: 27).

Level 1:

The first division of the dataset generally split the samples into those which occurred in the plains and riverine topographic categories (on the left side of Table 6.1) (**Group 1**) versus those which were sampled in the mountain topographic category (on the right side of Table 6.1) (**Group 2**) (eigenvalue = 0.66). This pattern is described in more detail below.

Group 1:

Preferential species in this group of predominantly plains and riverine samples are *Acacia tortilis*, *Salvadora persica* and *Colophospermum mopane*, the latter at the sixth or highest pseudospecies cut-level. Other species associated with this group are *Acacia erioloba*, *Faidherbia albida*, *Combretum wattii*, *Tamarix usneoides*, *Combretum imberbe* and *Pechuel-Loeschea leubnitziae*.

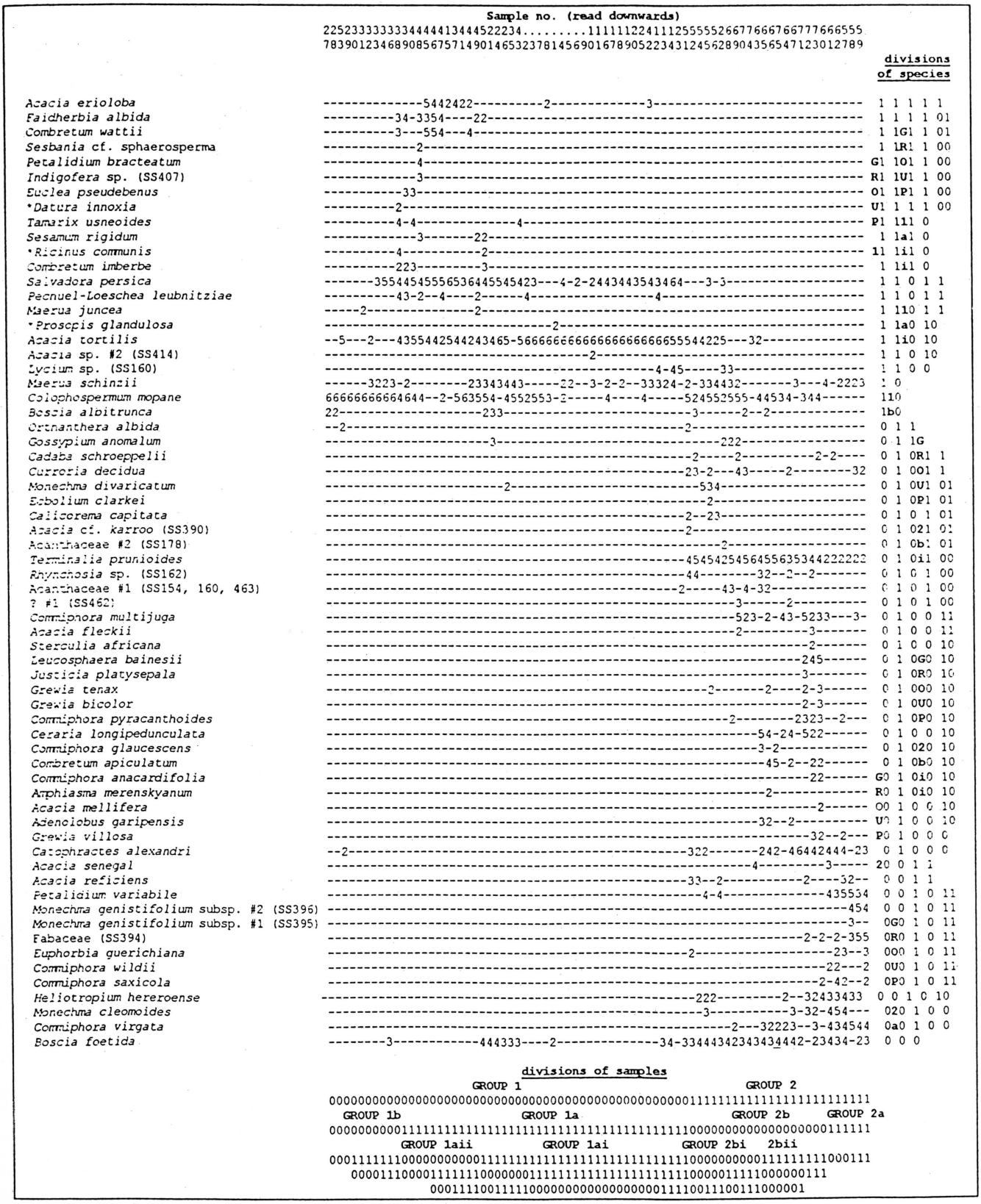
Group 2:

The single indicator species for the first division of the dataset is *Terminalia prunioides* (at pseudospecies cut-levels of 1 and above), which only occurs in the samples on the positive side of the division (the right side of Table 6.1). Other strong preferentials of the samples in this group include *Acacia reficiens*, *Boscia foetida*, *Catophractes alexandri*, *Combretum apiculatum*, *Curroria decidua*, *Ceraria longipedunculata*, *Commiphora multijuga*, *C. pyracanthoides*, *C. virgata*, *Heliotropium hereroensis*, *Monechma cleomoides*, *Petalidium variabile* and *Rhynchosia* sp.

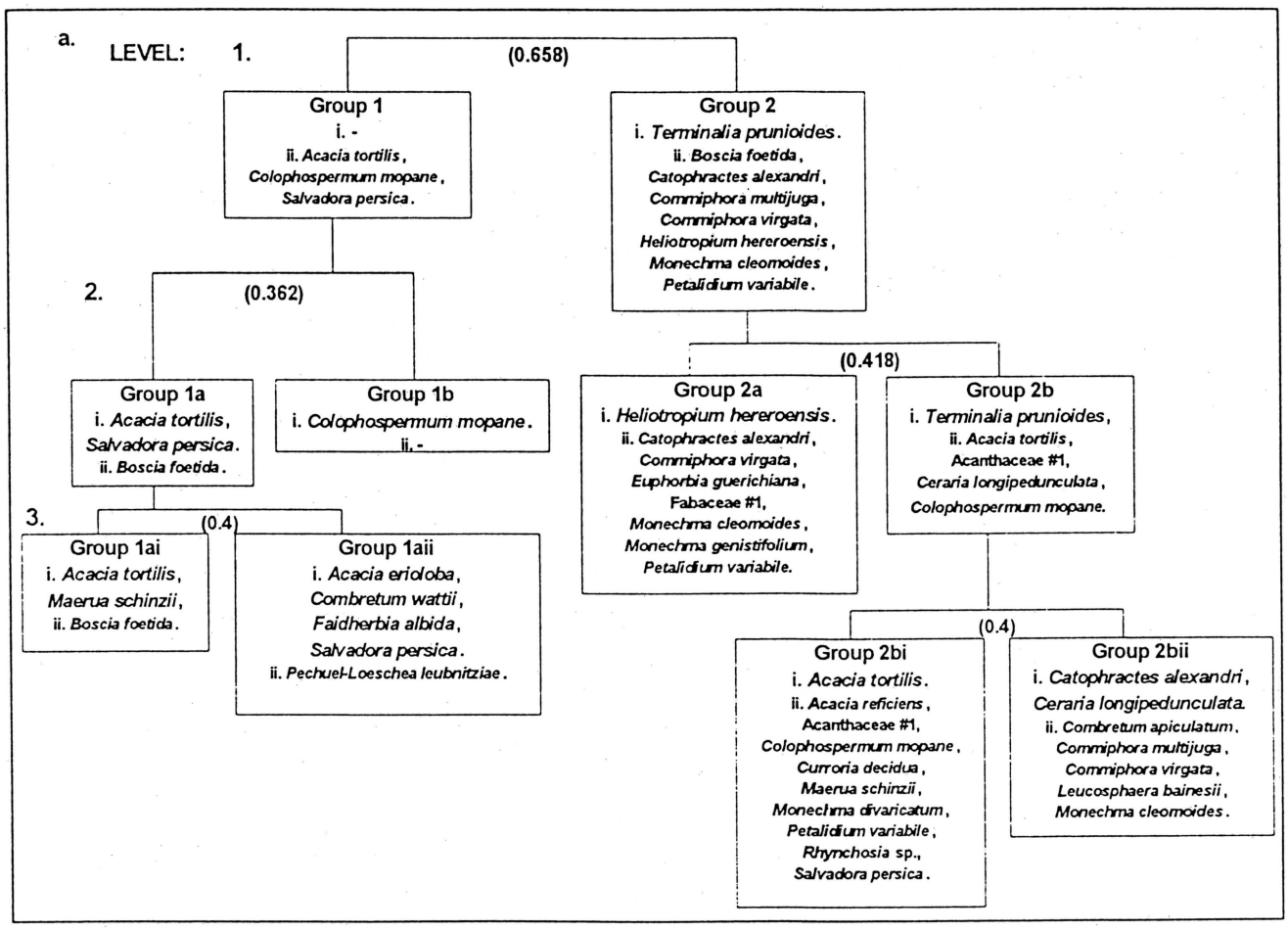
The samples occurring on this side of the division are almost exclusively those located in the mountain topographic category. They represent the distinctive species assemblage of the rugged mountain slopes surrounding the plains of the Hoanib River as it traverses the Sesfontein-Khowarib area. A single sample (22) from the plains topographic category on alluvial silts is included as a borderline representative of this group; closer examination of this sample shows that while it contains a few species characteristic of the mountain assemblage including the indicator species *Terminalia prunioides* it is primarily comprised of species which are also common to the plains and riverine samples, and therefore cannot be considered a severely outlying sample. Conversely, the only mountain sample which has not been classified by TWINSPAN as part of this group (53) is a transect located on calcrete slopes within the settlement of Sesfontein. This sample contained no representatives of the indicator species *T. prunioides* but is otherwise characterised by a rather generalised mixture of species occurring in mountain, plains and riverine topographic categories. Finally, at this first level there are five 'indifferent' species, i.e. those which occur with relatively equal values on both sides of this initial two-way division. These are *Colophospermum mopane* (at pseudospecies cut-levels lower than 6), *Maerua schinzii, Boscia albitrunca, Orthanthera albida and Gossypium anomalum.*

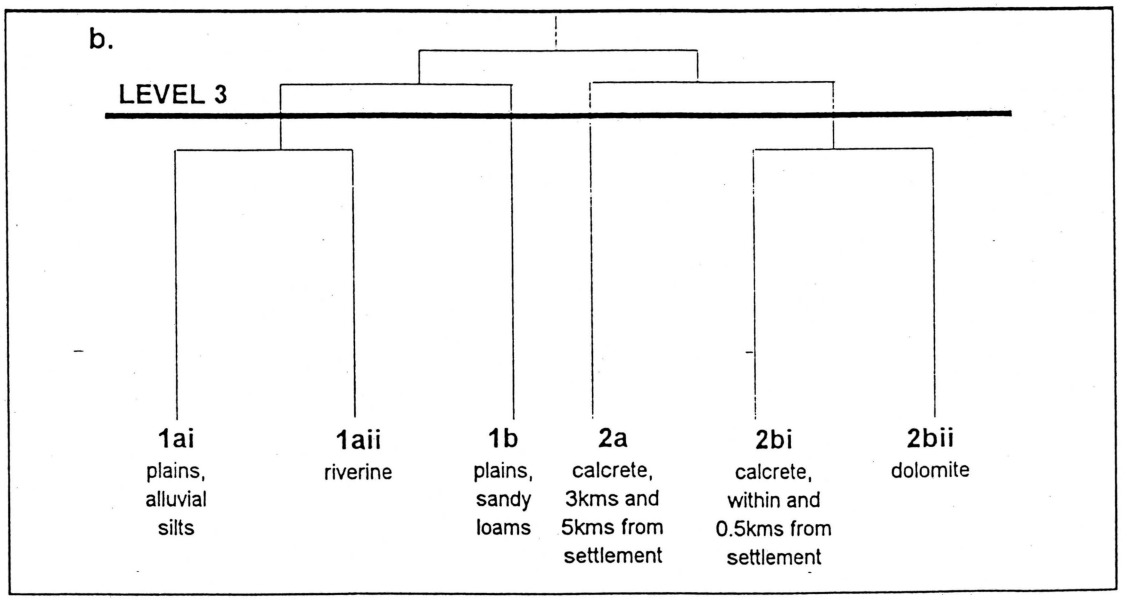
There appears to be no obvious impact of settlement pressure on species assemblages at this level of classification, the division being more-or-less entirely explained by the location of samples in different topographic categories.

• Table 6.1. Ordered two-way table of the original samples-by-species matrix produced by TWINSPAN classification. The groups identified in the text are indicated on the table for both samples and species. TWINSPAN pseudospecies for each sample are as follows: - = the species is absent from the sample, while 1, 2, 3, 4, 5, 6 = the species contributes >0-1%, 2-4%, 5-9%, 10-19%, 20-49% and 50-100% to the floristic composition of the sample respectively. Naturalised species are indicated with an asterix.



• Figure 6.1a and b. Dendrograms showing TWINSPAN groups for the woody vegetation dataset. In Figure 6.1a, indicator species are listed (i), as well as preferential species (ii) at pseudospecies cut-levels ≥3. (Nb. the same species can occur in different groups at the same level of the division at different pseudospecies cut-levels). The figures in brackets are the eigenvalues for each division.





Levels 2 and 3:

The second level of the TWINSPAN classification splits these two broad groups into a further four groups. The first division of this level (on the left side of Table 6.1) essentially introduces a simple dichotomy in samples in the plains and riverine topographic categories between those located on alluvial silts (plains and all riverine transects) (**Group 1a**) and those on a substrate of sandy loams (plains only) (**Group 1b**) (eigenvalue = 0.36). The second division further classifies the mountain samples on the right side of Table 6.1 into groups defined by both substrate and distance from settlement (0.42). These groups are described in detail below.

Group 1a

Group 1a is characterised by the indicator species *Acacia tortilis* and *Salvadora persica*, with *Acacia erioloba*, *Faidherbia albida*, and *Boscia foetida* as further preferential species.

The third level of the classification further separates group 1a into the following groups (eigenvalue = 0.4):

Group 1ai

This group consists of all except one of the samples occurring in the plains topographic category on alluvial silts, together with a number of riverine samples from distance categories both close to and far from settlements. *A. tortilis* at very high levels (pseudospecies cut-level 6) and *Maerua schinzii* are the indicator species for this group, in association with the preferential species *Boscia foetida*.

Group 1aii

Conversely, this group is comprised almost entirely of samples from the riverine topographic category, again from a range of the distance classes occurring in this category. Common species are the indicators *Faidherbia albida*, *Acacia erioloba*, *Salvadora persica*, and *Combretum wattii*, in conjunction with the preferential species *Combretum imberbe*. These tree species are classic representatives of 'healthy' riparian forest in this area.

The fact that the plains and riverine samples are split into these groups in a manner which is apparently unrelated to distances from settlements indicates that, at this level of resolution, the magnitude of the impact of settlements on species composition is relatively low in comparison with abiotic factors. Level four of the classification is again inconclusive regarding this relationship. All except 5 of the 26 plains samples (on alluvial silts) are classified in a single group at this level, and 22 of these remain in this grouping into the fifth level of the classification, i.e. with no differentiation on the basis of distance from settlement. Classification of the riverine samples is again ambiguous with regard to the effects of settlement pressure on floristics; the three TWINSPAN groups dominated by samples from the riverine topographic category share samples from distances near to, and far from, settlements.

Group 1b

The indicator species of this group is *Colophospermum mopane* at the sixth pseudospecies cut-level (i.e. indicating a very high dominance of this species), together with one preferential species, *Boscia albitrunca*. This group consists almost exclusively of samples on a substrate of sandy loams. The only exception is the single sample (53) from the mountainous calcrete substrate category which, as described above, has been classified as part of **group 1**. Due to its high level of *C. mopane* this sample falls into **group 1b** at this level of the classification.

Non-preferential species in this division are *C. mopane* at pseudospecies cut-levels of <5, *Maerua schinzii*, and *Salvadora persica* at cut-levels of 5 and 6, indicating that, while these species are common to both **group 1a** and **1b**, a very high level of *C. mopane* is a distinguishing feature of **group 1b**.

A small number of plains samples do not fall exactly into the simple TWINSPAN classification of samples occurring on alluvial silts versus those on sandy loams. These are two samples (37 and 39) on sandy loams at distances of >5kms from a settlement which have been classified as part of **group 1aii** in this division, together with a third sample (35) in this substrate category which is classed as a borderline representative of this group. With regard to the first two of these samples, this is partly because they contain slightly lower values for the indicator species *C. mopane*, and is also related to their higher values of species such as *M. schinzii*, *Acacia tortilis*, *S. persica* and *Acacia. erioloba*. The borderline sample is classified as such because it contains *Boscia foetida*, a species normally found in samples on alluvial silts or in the mountain topographic category. The classification of these samples could be interpreted somewhat tentatively at this stage in the analysis as indicating greater species diversity on sandy loams with lower utilisation pressure related to increasing distance from a settlement.

Group 2a

The six samples that are classified into this group are those located on calcrete slopes in the two distance classes for this substrate category which are the furthest away from a settlement. The indicator species for this group is *Heliotropium hereroensis*, and preferential species are a suite of *Commiphoras* (*C. saxicola*, *C. virgata* and *C. wildii*) as well as the shrubs *Ecbolium clarkei*, *Monechma genistifolium* (subsp. #2, SS396), *M. cleomoides*, *Petalidium variabile* and *Catophractes alexandri*.

At the third TWINSPAN level this group is split such that the samples are divided according to their distance classes, i.e. 3kms and 5kms away respectively. On examination of the species composition of these samples, however, it can be seen that these two distance classes broadly share the same assemblage of species, the division having been made on the basis of different pseudospecies cut-levels for species shared by samples in both distance classes.

Group 2b

This group of mountain samples is characterised by the indicator species *T. prunioides*, in association with the preferential species *A. tortilis*, *Combretum apiculatum*, *Ceraria longipedunculata*, *C. mopane*, *Grewia tenax*, *Rhynchosia* sp. and an unidentified Acanthaceae species. The remaining samples located on calcrete slopes, but in the distance classes closest to the settlement, fall into this group, indicating that distance from settlement may be having some effect on the species composition of samples on this substrate. Contrary to this, all the mountain slope samples on dolomite and schist substrates are classified within this group, indicating that settlement is not having an effect on the classification of samples on these substrates at this level.

The third level of the classification splits group 2b into two further groups referred to here as **groups 2bi** and **2bii** (eigenvalue = 0.4).

Group 2bi

This group consist of almost all the samples located on calcrete slopes near to the settlement of Sesfontein, together with samples on dolomite slopes >5kms away from this settlement and one of the two samples on schist. The indicator species for this group is *A. tortilis*, associated with *Maerua schinzii*, low levels of *Salvadora persica*, and the shrubby species *A. reficiens*, *Calicorema capitata*, *Curroria decidua*, *Gossypium anomalum*, *Lycium* sp., *Monechma divaricatum* and *Petalidium variabile*.

At the fourth level of the classification TWINSPAN further splits this group into samples on calcrete slopes versus those primarily on dolomite, thus illustrating the importance of substrate and related factors at this level.

Group 2bii

The samples classified as part of this group are those on a substrate of dolomite at various distances from settlements, with the exception of a single sample located on schist. *Ceraria longipedunculata* and *Catophractes alexandri* are indicator species for this group. Again, it appears at this preliminary stage of the analysis that distance from a settlement is not an important determining factor of species assemblages within this substrate category.

At level four of the classification, however, TWINSPAN does separate out the three samples which were located at the distance class furthest away from a settlement (approx. 20kms), thus indicating that settlement pressures may be contributing to the species composition of the samples in this substrate category, but only at a relatively fine level of classification. The indicator species for this group is the dwarf shrub *Leucospaera bainesii*, occuring in association with an array of relatively rare species for this dataset, including *Commiphora anacardifolia*, *C. multijuga* and *C. saxicola*, as well as *Acacia fleckii*, *A. mellifera* and *A. reficiens*, and the shrubs *Grewia bicolor*, *G. tenax*, *Heliotropium hereroensis* and *Justicia platysepala*.

6.1.2 Multivariate ordination

Detrended Correspondence Analysis (DCA)

The species weights assigned by CANOCO after downweighting rare species in the woody vegetation dataset are presented in Table 6.2.

- Table 6.2. Species in the woody vegetation dataset assigned full weights and those downweighted to <0.2 for DCA and CCA ordinations. Species not listed here have weights ≥0.2 and ≤1. Naturalised species are marked with an asterix.

Species assigned full weight of 1 (n = 12)	Species downweighted to values <0.2 (n =13)
Acacia erioloba	Acanthaceae sp. #2 (SS178)
Acacia tortilis	*Acacia mellifera*
Boscia albitrunca	*Amphiasma merenskyanum*
Boscia foetida	*Acacia* cf. *karroo*
Catophractes alexandri	*Acacia* sp. (SS414)
Colophospermum mopane	**Datura innoxia*
Commiphora multijuga	*Ecbolium clarkei*
Commiphora virgata	*Indigofera* sp. (SS407)
Heliotropium hereroensis	*Monechma genistifolium* subsp. #1 (SS395)
Maerua schinzii	*Petalidium bracteatum*
Salvadora persica	**Prosopis glandulosa*
Terminalia prunioides	*Sterculia africana*
	Sesbania cf. *sphaerosperma*

When DCA was applied to the data-set it was apparent that, while the overall variance was high (gradient length or sum of eigenvalues = 4.81), a considerable amount of this variation could be explained by the first two axes constructed to fit the data; Axis 1 had an eigenvalue of 0.79 and accounted for 16.4% of the variance in the vegetation data, while axis 2 had an eigenvalue of 0.46, accounting for a further 9.4% of the variance. The cumulative percentage variance accounted for by these two axes was thus 25.8%, and totalled 36% for the first four axes. Given the extremely noisy nature of multivariate community data, these figures indicate that a relatively large amount of variation in the species data could be explained by the ordination axes, suggesting the presence of an underlying explanatory structure to the dataset.

Table 6.3 lists the ordination scores for samples and species in order of their position on axis 1. Correlation coefficients for DCA axis 1 samples and species scores with the TWINSPAN group in which the samples and species occurred were significant (r = 0.88 for both samples and species, p=0.01). Their ranks thus reflect to a large extent the TWINSPAN results, corroborating the underlying pattern in the dataset outlined in Section 6.1.1 above. In other words: the dataset is strongly divided between samples (and their associated species) which occur in the mountain topographic category (axis 1 scores from 39 to 209 on Table 6.3) *versus* those located in plains or riverine areas (axis 1 scores ≤4). Substrate accounts for a substantial amount of the sample ranking within these topographic categories. For example, all samples with axis 1 scores ≤-55 occur on alluvial silts, while those with scores of ≤209 and ≥166, ≤165 and ≥128, and ≤4 and ≥0 occur on calcrete, dolomite and sandy loams

respectively. Within this general pattern distance from a settlement appears to be having a somewhat inconclusive effect. For example, while the samples on mountain substrates located further from settlements tend to be those with higher axis 1 scores, suggesting that utilisation pressure is having an effect on the floristic composition of these samples, this is by no means unambiguous; samples sharing the same distance classes are generally not grouped together. The ranks of samples located on alluvial silts in both plains and riverine topographic categories apparently bear no relation to the distance categories of these samples as would be expected if settlement impacts were having an overriding effect on species composition; similarly, the settlement from which distance was measured (i.e. Sesfontein, Khowarib or Warmquelle) has no discernible effect on the order of the axis 1 scores.

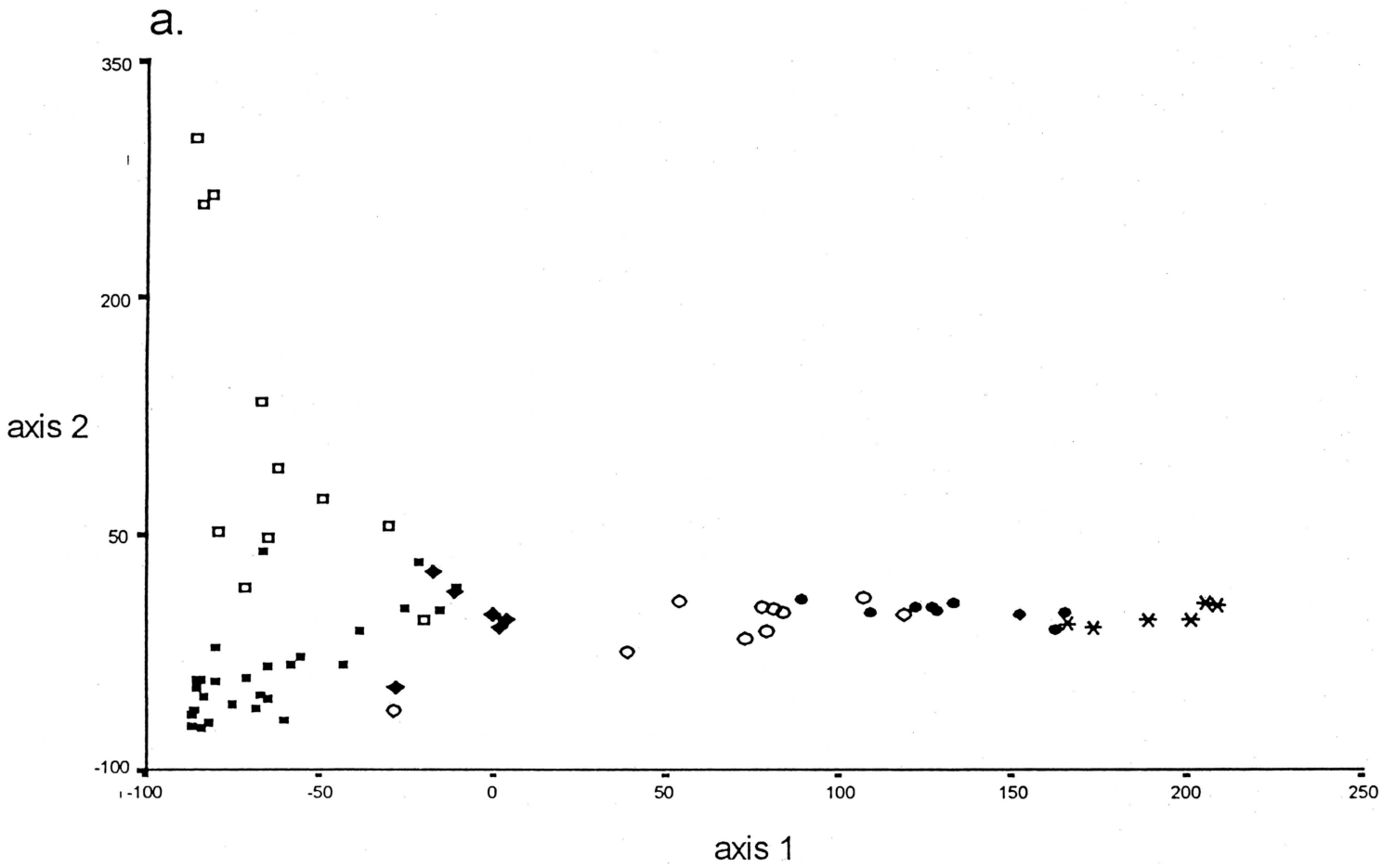
At this exploratory stage in the analysis the dataset is indicative of an area which is floristically similar over a wide geographical range within a number of topographic and substrate categories, and which, in terms of floristic composition, displays few effects of settlement pressure.

The graphical presentation of the DCA ordination and the TWINSPAN classification groups described above is shown in Figures 6.2a, b and c for axes 1 and 2 and Figures 6.3a and b for axes 1 and 3. Figures 6.2a and b clearly show how samples and species are separated by axis 1 into those in the plains and riverine topographic categories (the left side of the graph), *versus* those located on mountain slopes (the right side of the graph). Figure 6.2c provides an enlargement of the full array of species characterising the mountain samples. Axis 2 (the y-axis in Figures 6.2a and b) further pulls apart the majority of riverine samples (towards the top of the graphs) from plains samples on alluvial silts, the former characterised by species such as *Faidherbia albida*, *Acacia erioloba*, *Combretum imberbe* and *C. wattii*, and the latter dominated by *Acacia tortilis* (located in the bottom left corner of Figure 6.2b). The plains samples on a substrate of sandy loams, which are dominated by *Colophospermum mopane*, are situated towards the centre of the graph, illustrating their greater affinity in terms of floristic composition with the mountain samples. Axis 3 (which explains 5.9% of the variance in the dataset), illustrated by the y-axis in Figures 6.3a and b, further teases out the variability in the mountain samples, largely along the lines of the TWINSPAN groups identified above. The close proximity of the plains and riverine samples and their characteristic species in these figures indicates their floristic similarity when the variability described by axis 2 is removed (i.e. the axis 2 values for samples and species are subtracted from the cumulative fit of the first three ordination axes (Smilauer, 1992: 58)).

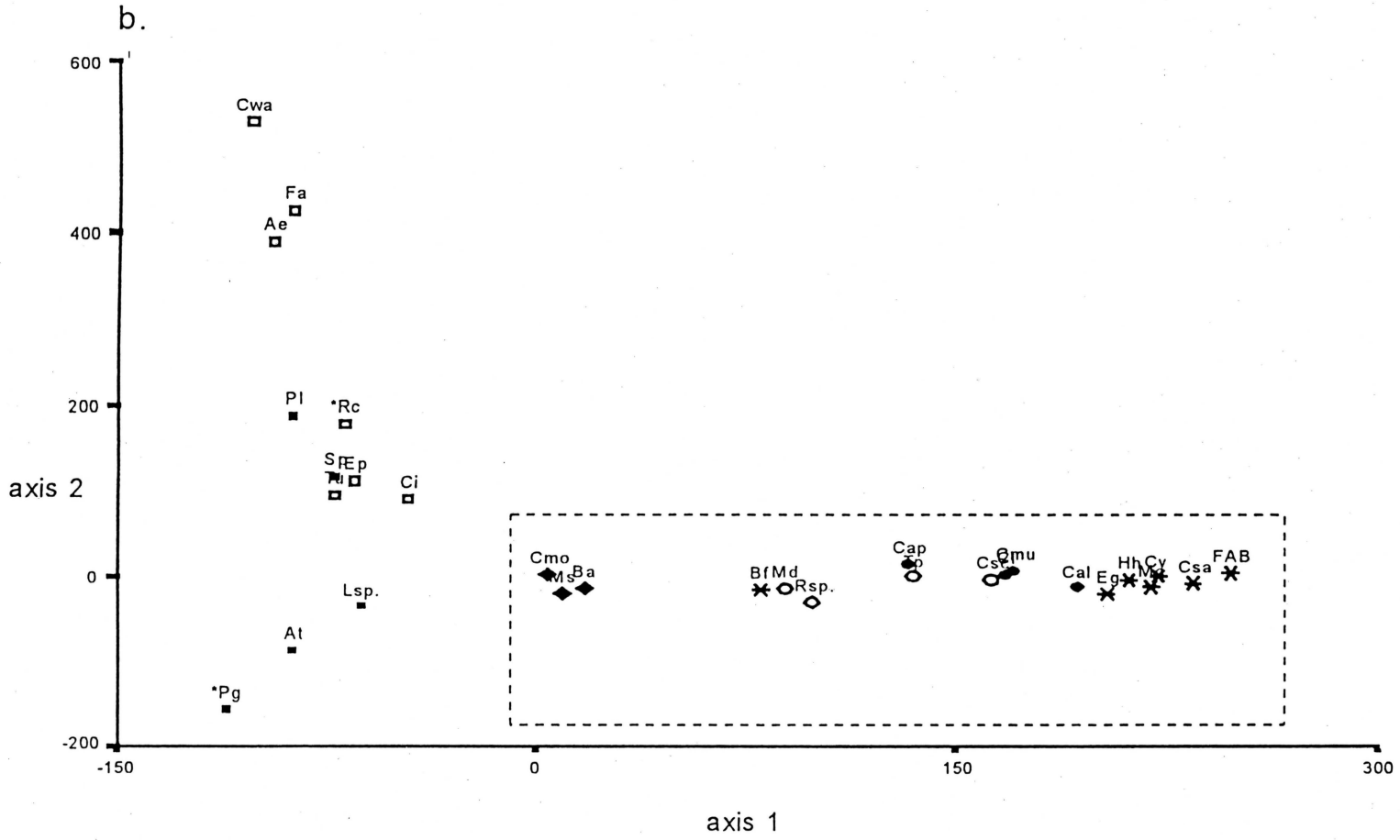
• Table 6.3. Ranked scores for samples and species in relation to the axis 1 ordination scores produced by detrended correspondence analysis. The relationship between both sample and species scores and the groups produced by TWINSPAN classification as described above is indicated. Naturalised species are marked with an asterix.

TWINSPAN groups for samples	sample n=75	ranked axis 1 scores	TWINSPAN groups for species	species n=65	ranked axis 1 scores
2a	57	209	2a	*Monechma genistifolium* subsp. #1 (SS395)	266
2a	58	205	2a	*Monechma genistifolium* subsp. #2 (SS396)	257
2a	61	201	2a	FABACEAE species (SS394)	248
2a	59	189	2a	*Commiphora saxicola*	235
2a	62	173	2a	*Commiphora wildii*	235
2a	60	166	2a	*Commiphora virgata*	222
2bii	71	165	2a	*Monechma cleomoides*	220
2bii	67	162	2a	*Petalidium variabile*	213
2bii	72	152	2a	*Heliotropium hereroensis*	212
2bii	73	133	2bii	*Justicia platysepala*	209
2bii	64	128	2a	*Euphorbia guerichiana*	204
2bii	75	127	2bii	*Grewia villosa*	194
2bii	65	122	2bii	*Catophractes alexandri*	193
2bi	74	119	2bii	*Sterculia africana*	193
2bii	63	109	2bii	*Commiphora pyracanthoides*	184
2bi	69	107	2bii	*Grewia bicolor*	182
2bii	66	89	2bii	*Commiphora anacardifolia*	181
2bi	56	84	2bii	*Leucosphaera bainesii*	180
2bi	70	81	2bii	*Acacia fleckii*	179
2bi	54	79	2bii	*Commiphora multijuga*	171
2bi	68	78	2a	*Acacia senegal*	170
2bi	52	73	2bii	*Acacia mellifera*	168
2bi	55	54	2bii	*Ceraria longipedunculata*	168
2bi	51	39	2bi	*Cadaba schroeppelii*	163
1b	27	4	2bii	*Grewia tenax*	156
1b	28	4	2bii	*Amphiasma merenskyanum*	155
1b	29	4	2bii	*Adenolobus garipensis*	146
1b	30	4	2a	*Acacia reficiens*	145
1b	31	4	2bi	? species #1 (SS462)	142
1b	32	2	2bi	*Curroria decidua*	138
1b	33	0	2bi	*Terminalia prunioides*	135
1ai	50	-10	2bii	*Combretum apiculatum*	133
1b	36	-11	2bii	*Commiphora glaucescens*	130
1ai	49	-15	2bi	*Rhynchosia* sp. (SS162)	99
1b	34	-17	2bi	*Monechma divaricatum*	89
1aii	41	-20	2bi	*Calicorema capitata*	88
1ai	35	-21	2a	*Boscia foetida*	80
1ai	21	-25	2bi	*Ecbolium clarkei*	69
1b	53	-28	2bi	Acanthaceae species #1 (SS154, SS161, SS463)	54
2bi	22	-29	2bi	*Acacia* cf. *karroo*	49
1aii	39	-30	2bi	*Gossypium anomalum*	20
1ai	43	-38	1b	*Boscia albitrunca*	17
1ai	26	-43	1b	*Maerua schinzii*	9
1aii	37	-49	2bi	*Orthanthera albida*	7
1ai	24	-55	1b	*Colophospermum mopane*	4
1ai	23	-58	1ai	*Maerua juncea*	-7
1ai	7	-60	2bi	Acanthaceae species #2 (SS178)	-37
1aii	38	-62	1aii	*Combretum imberbe*	-46
1ai	13	-65	1aii	*Sesamum rigidum*	-54
1ai	25	-65	1ai	*Lycium* sp.	-63
1aii	40	-65	1aii	*Euclea pseudebenus*	-65
1ai	14	-66	1aii	**Ricinus communis*	-69
1ai	16	-67	1ai	*Salvadora persica*	-72
1aii	44	-67	1aii	*Tamarix usneoides*	-72
1ai	3	-68	1aii	**Datura innoxia*	-79
1ai	12	-71	1ai	*Acacia tortilis*	-87
1aii	48	-72	1aii	*Faidherbia albida*	-87
1ai	8	-75	1ai	*Pechuel-Loeschea leubnitziae*	-87
1aii	15	-79	1aii	*Indigofera* sp. (SS407)	-92
1ai	4	-80	1aii	*Petalidium bracteatum*	-92
1ai	42	-80	1aii	*Sesbania* cf. *sphaerosperma*	-92
1aii	47	-81	1aii	*Acacia erioloba*	-94
1ai	10	-82	1aii	*Combretum wattii*	-102
1ai	18	-83	1ai	*Acacia* sp. (SS414)	-104
1ai	2	-84	1ai	**Prosopis glandulosa*	-111
1ai	5	-84			
1aii	45	-84			
1ai	11	-85			
1ai	19	-85			
1ai	17	-86			
1ai	20	-86			
1aii	46	-86			
1ai	1	-87			
1ai	6	-87			
1ai	9	-87			

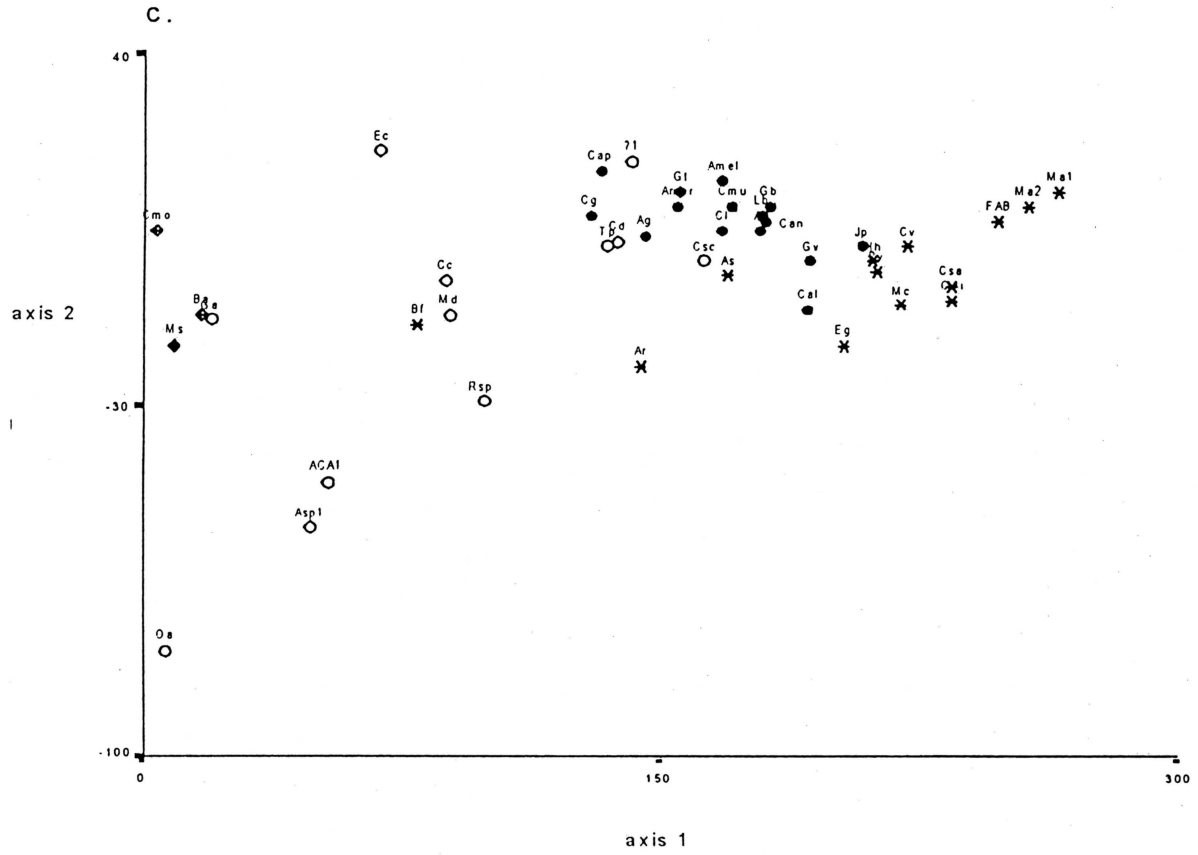
• Figure 6.2a, b and c. DCA ordination diagrams showing the location of a. samples and b. species on ordination axes 1 and 2. Figure 6.2c is an enlargement of the boxed area of Figure 6.2b, showing in greater detail the species characterising the mountain topographic category. While all the species contribute to the DCA several species have been omitted from 6.2b in order to increase clarity.
Key: the symbols indicate the TWINSPAN groups identified above as follows; ■ = 1ai, □ = 1aii, ◆ = 1b, ★ = 2a, ○ = 2bi, and ● = 2bii.



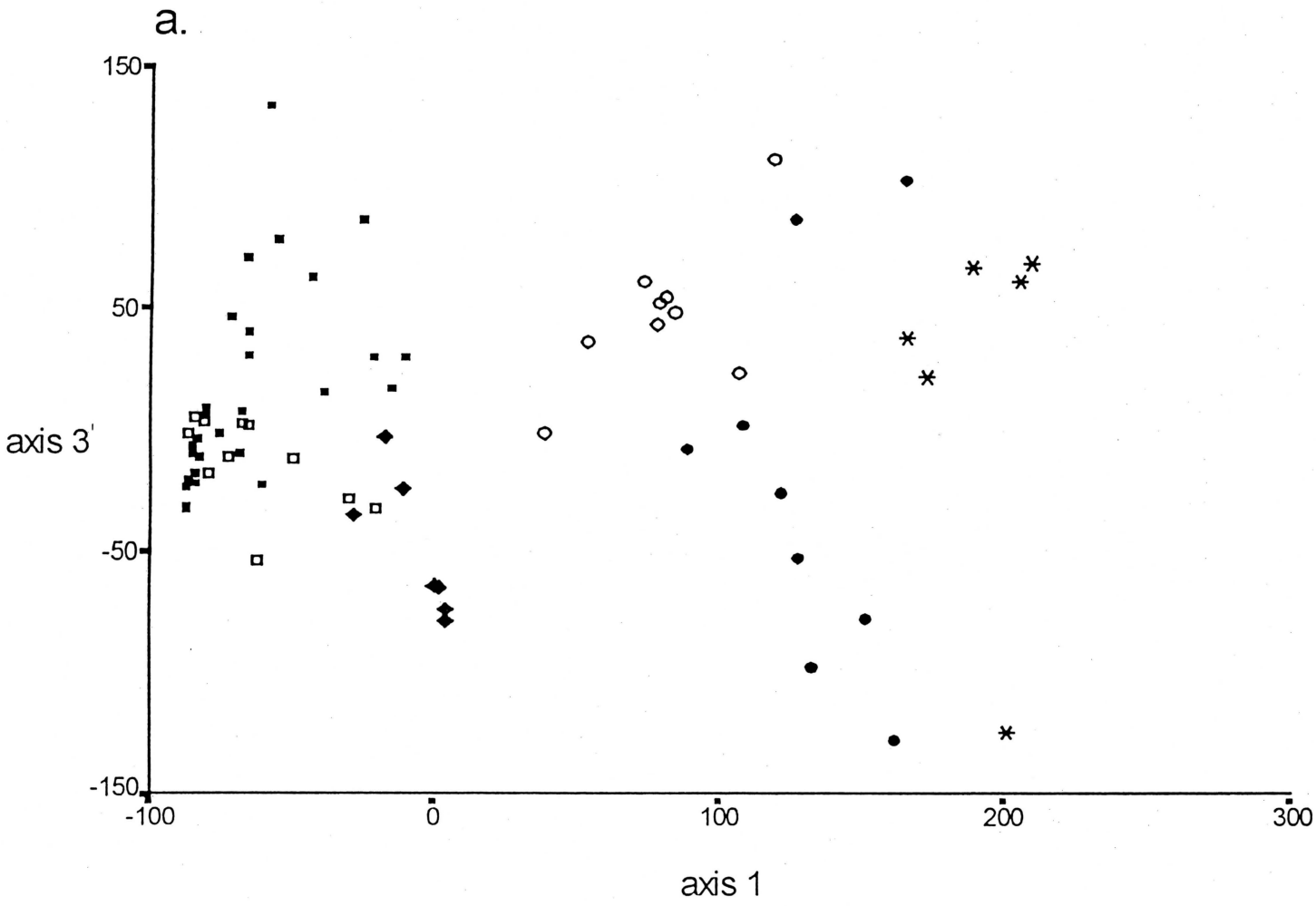
Key (in alphabetical order of the full species name and naturalised species are marked with an asterix): Ae = *Acacia erioloba*, At = *Acacia tortilis*, Ba = *Boscia albitrunca*, Bf = *Boscia foetida*, Csc = *Cadaba schroeppelii*, Cal = *Catophractes alexandri*, Cmo = *Colophospermum mopane*, Cap = *Combretum apiculatum*, Ci = *Combretum imberbe*, Cwa = *Combretum wattii*, Cmu = *Commiphora multijuga*, Csa = *Commiphora saxicola*, Cv = *Commiphora virgata*, Ep = *Euclea pseudebenus*, Eg = *Euphorbia guerichiana*, Fa = *Faidherbia albida*, FAB = Fabaceae species (SS394), Lsp. = *Lycium* sp. (SS160), Ms = *Maerua schinzii*, Mc = *Monechma cleomoides*, Pl = *Pechuel-Loeschea leubnitziae*, *Pg = *Prosopis glandulosa*, *Rc = *Ricinus communis*, Rsp. = *Rynchosia* sp. (SS162), Sp = *Salvadora persica*, Tu = *Tamarix usneoides*, Tp = *Terminalia prunioides*.



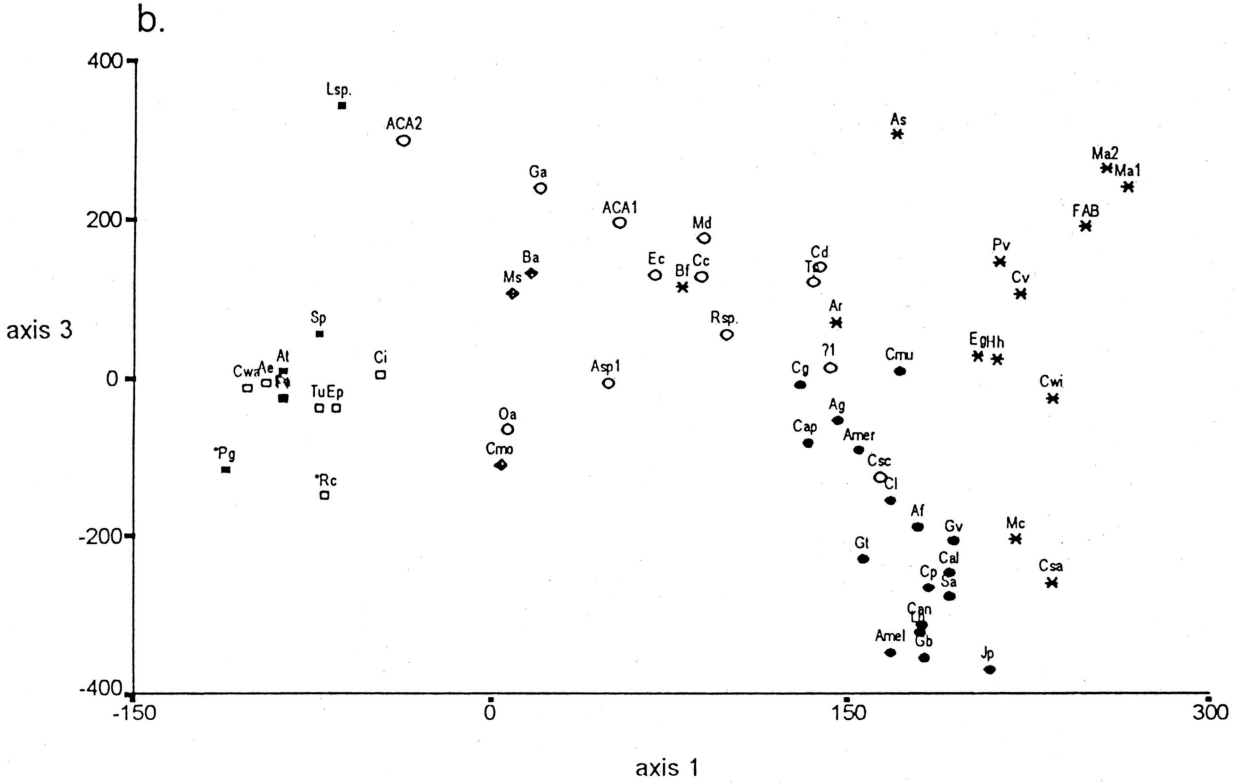
Key (in alphabetical order of the full species name; naturalised species are marked with an asterix): Af = *Acacia fleckii*, Asp1 = *Acacia* cf. *karroo* (SS390), Amel = *Acacia mellifera*, Ar = *Acacia reficiens*, As = *Acacia senegal*, ACA1 = Acanthaceae species (SS154, SS161, SS463), ACA2 = Acanthaceae species (SS178), Ag = *Adenolobus garipensis*, Amer = *Amphiasma merenskyanum*, Ba = *Boscia albitrunca*, Bf = *Boscia foetida*, Csc = *Cadaba schroeppelii*, Cc = *Calicorema capitata*, Cal = *Catophractes alexandri*, Cl = *Ceraria longipedunculata*, Cmo = *Colophospermum mopane*, Cap = *Combretum apiculatum*, Can = *Commiphora anacardifolia*, Cg = *Commiphora glaucescens*, Cmu = *Commiphora multijuga*, Cp = *Commiphora pyracanthoides*, Csa = *Commiphora saxicola*, Cv = *Commiphora virgata*, Cwi = *Commiphora wildii*, Cd = *Curroria decidua*, Ec = *Ecbolium clarkei*, Eg = *Euphorbia guerichiana*, FAB = Fabaceae species (SS394), Ga = *Gossypium anomalum*, Gb = *Grewia bicolor*, Gt = *Grewia tenax*, Gv = *Grewia villosa*, Hh = *Heliotropium hereroensis*, Jp = *Justicia platysepala*, Lb = *Leucosphaera bainesii*, Ms = *Maerua schinzii*, Mc = *Monechma cleomoides*, Md = *Monechma divaricatum*, Ma1 = *Monechma genistifolium* subsp. #1 (SS395), Ma2 = *Monechma genistifolium* subsp. #2 (SS396), Oa = *Orthanthera albida* , Pv = *Petalidium variabile*, Rsp. = *Rynchosia* sp. (SS162), Sa = *Sterculia africana*, Tp = *Terminalia prunioides*, ?1 = SS462.



• Figure 6.3a and b. DCA ordination diagrams showing the location of a. samples and b. species on ordination axes 1 and 3.
Key: the symbols correspond to the the TWINSPAN groups identified above as follows; ■ = 1ai, □ = 1aii, ◆ = 1b, ★ = 2a, O = 2bi, and ● = 2bii.



Key (in alphabetical order for the full species name; naturalised species are marked with an asterix): ACA1 = Acanthaceae species (SS154, SS161, SS463), ACA2 = Acanthaceae species (SS178), Ae = *Acacia erioloba*, Af = *Acacia fleckii*, Asp1 = *Acacia* cf. *karroo* (SS390), Amel = *Acacia mellifera*, Ar = *Acacia reficiens*, As = *Acacia senegal*, At = *Acacia tortilis*, Ag = *Adenolobus garipensis*, Amer = *Amphiasma merenskyanum*, Ba = *Boscia albitrunca*, Bf = *Boscia foetida*, Csc = *Cadaba schroeppelii*, Cc = *Calicorema capitata*, Cal = *Catophractes alexandri*, Cl = *Ceraria longipedunculata*, Cmo = *Colophospermum mopane*, Cap = *Combretum apiculatum*, Ci = *Combretum imberbe*, Cwa = *Combretum wattii*, Can = *Commiphora anacardifolia*, Cg = *Commiphora glaucescens*, Cmu = *Commiphora multijuga*, Cp = *Commiphora pyracanthoides*, Csa = *Commiphora saxicola*, Cv = *Commiphora virgata*, Cwi = *Commiphora wildii*, Cd = *Curroria decidua* , Ec = *Ecbolium clarkei* , Eg = *Euphorbia guerichiana*, Ep = *Euclea pseudebenus*, FAB = Fabaceae species (SS394), Fa = *Faidherbia albida*, Ga = *Gossypium anomalum*, Gb = *Grewia bicolor*, Gt = *Grewia tenax*, Gv = *Grewia villosa*, Hh = *Heliotropium hereroensis*, Jp = *Justicia platysepala*, Lb = *Leucosphaera bainesii*, Lsp. = *Lycium* sp. (SS160), Ms = *Maerua schinzii*, Mc = *Monechma cleomoides*, Md = *Monechma divaricatum*, Ma1 = *Monechma genistifolium* subsp. #1 (SS395), Ma2 = *Monechma genistifolium* subsp. #2 (SS396), Oa = *Orthanthera albid*, *Pl = *Pechuel-Loeschea leubnitziae*, Pv = *Petalidium variabile*, *Pg = *Prosopis glandulosa*, *Rc = *Ricinus communis*, Rsp. = *Rynchosia* sp. (SS162), Sp = *Salvadora persica*, Sa = *Sterculia africana*, Tu = *Tamarix usneoides*, Tp = *Terminalia prunioides*, ?1 = (SS462).



Canonical Correspondence Analysis (CCA)

Community classification and indirect ordination techniques indicated a strong division in the dataset between samples and species occurring in the plains and riverine topographic categories *versus* those characterising mountain slopes. Similarly, a direct gradient analyses of the full dataset using canonical correspondence analysis (CCA) suggested that topographic and substrate factors had a much higher explanatory value, explaining a cumulative variance of 1.73 compared with 0.25 for the combined measures of resource-use (i.e. distance, lopping and browsing), following forward selection of the environmental variables. Significance testing following partialling out of various combinations of variables as covariables indicated that only topographic and substrate factors maintained a statistical contribution in determining the patterns in the dataset at p=0.01. As anticipated, distance from settlement was negatively correlated with the utilisation measures of branch lopping and browsing (-0.46 and -0.50 respectively, p=0.01), suggesting that distance from settlement reflects use-pressures on vegetation resources.

Given the overriding importance of topography and substrate in community analyses of the full dataset, subsequent CCAs were applied to two reduced datasets comprised of the plains and riverine, and the mountain samples respectively. The aim was to remove the strong topographic effect allowing assessment of the contribution of resource-use to community patterns within broadly similar habitats. These two analyses are presented in full below.

Plains and riverine samples

The reduced dataset for all non-mountain samples consisted of 50 samples and 28 species. As with the full dataset the species were downweighted in the CCA, and Table 6.4 indicates the new weights for these 28 species.

• Table 6.4. Species assigned full weights and those downweighted to <0.2 for CCA ordinations. Species not listed here have weights ≥0.2 and ≤1. Naturalised species are marked with an asterix.

Species assigned full weight of 1 (n = 6)	Species downweighted to values <0.2 (n =13)
Acacia erioloba	Acanthaceae sp. #2 (SS178)
Acacia tortilis	*Acacia* sp. (SS414)
Boscia foetida	**Datura innoxia*
Colophospermum mopane	*Indigofera* sp. (SS407)
Maerua schinzii	*Monechma divaricatum*
Salvadora persica	*Petalidium bracteatum*
	**Prosopis glandulosa*
	Sesbania cf. *sphaerosperma*
	Terminalia prunioides

The CCA for the plains and riverine samples had a total inertia of 2.08 and the first four species and species-environmental variables axes explained 49.5% and 93.5% of this variance respectively. The eigenvalues, cumulative percentage variances, correlation coefficients and canonical coefficients for each environmental variable with the first 2

canonical axes[2] are tabulated in Table 6.5. Figures 6.4a and b present the graphical spread of the environmental variables with samples and species respectively. Monte Carlo permutation testing indicated that the explanatory value of the combined environmental variables was statistically significant (trace test statistic = F-ratio 4.39, p=0.01, and test statistic for the first ordination axis (eigenvalue 0.58) = F-ratio 15.05, p=0.01). Further features of the CCA are:

- The first canonical axis is primarily correlated with the location of samples on alluvial silts *versus* sandy loams (nb. all samples in this reduced dataset which were not located on alluvial silts were situated on the substrate classified as sandy loams). Branch removal and location in Warmquelle settlement display relatively weak positive correlations with this axis, reflecting both the location of Warmquelle on sandy loams, and the high incidence of branch removal around this settlement.
- The second canonical axis draws out the influence of the riverine topographic category on the species composition of samples. The negative correlation with branch removal for this axis indicates that this measure of resource utilisation is of minor importance for vegetation sampled within this category, while the weaker positive correlation with distance is related to the lack of riverine samples located within any of the focal settlements, for the simple reason that settlements tend to be located some distance from the Hoanib river as protection against flooding.
- Canonical axes 3 and 4 were of minor explanatory value (eigenvalues were 0.1 and 0.05 respectively) and therefore contribute little to the pattern in the dataset and are not discussed here.

[2] Note that the species axes calculated by CCA reflect weighted abundances of species by samples, i.e. they effectively summarise all the information on both species and samples.

• Table 6.5. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed by CCA, and canonical coefficients with t-values ≥4, for the reduced dataset of plains and riverine samples. Coefficients ≥0.5 and ≤-0.5 are printed in bold.

	SPECIES:		ENVIRONMENTAL:		CANONICAL COEFFICIENTS[3] with t-values ≥0.4	
Eigenvalue/species-environment correlation:	axis 1[4] .58	axis 2 .31	axis 1[5] .94	axis 2 .83	axis 1	axis 2
Cumulative percentage variance:	27.8%	42.6%	52.5%	80.5%		
Environmental variables						
topographic category						
riverine/plains		.59		.71	.40	.35
substrate						
alluvial silts/sandy loams†	-.80		-.85	.34	-.51	
altitude	.33		.36			
settlement						
Sesfontein	-.38		-.41			
Khowarib		.39		.47		
Warmquelle	.67		.72	.44		
Warmquelle/Sesfontein						
Warmquelle/Khowarib						
distance		.32		.39		
resource-use impact						
lopping	.43	-.48	.45	-.58		
browsing				-.33		

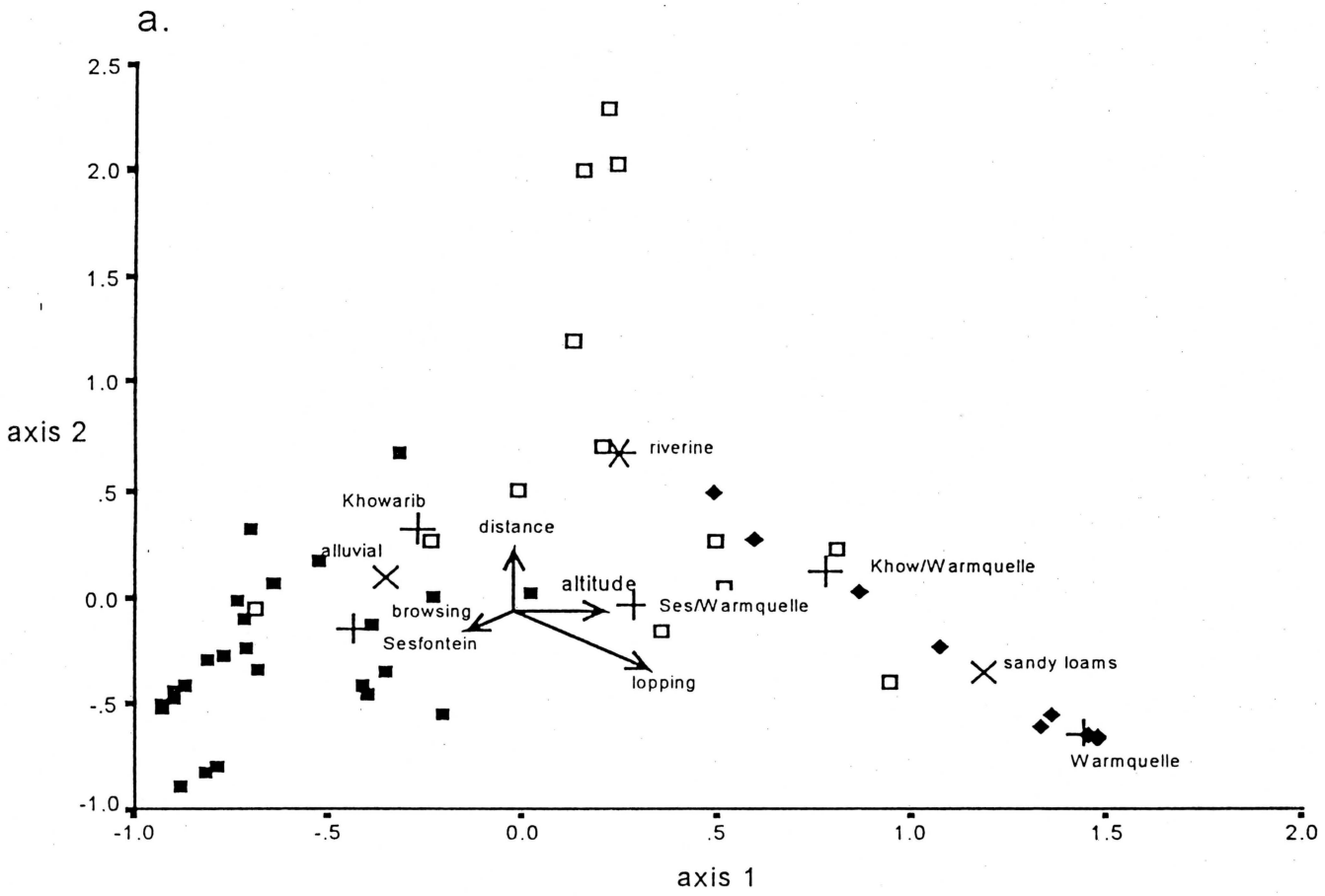
[3] Canonical coefficients are derived from the least squares fit of the weighted multiple regression of the sample scores on the environmental variables, calculated separately for each ordination axis within the CCA iterative ordination algorithm. They have greater variance than 'normal' regression coefficients. Nevertheless, they do provide a measure for the extent of contribution each environmental variable makes to the fit of the species data on the ordination axes (ter Braak, 1987c: 47-49).

[4] Each species axis is derived from the samples scores calculated for each sample by weighted averaging of its species abundances, at different iterations of the ordination algorithm (see ter Braak, 1987c: 41).

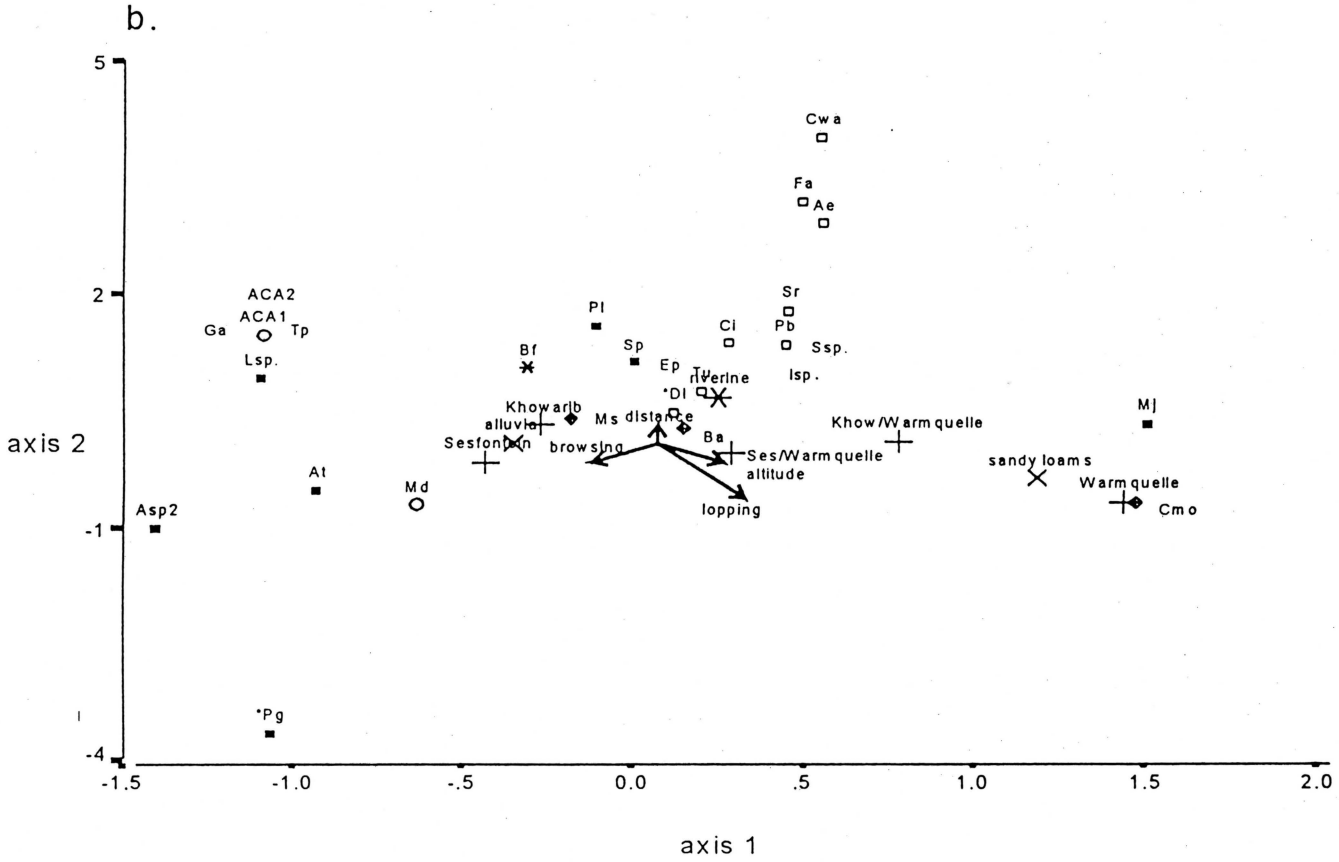
[5] Each environmental axis is constructed from samples scores calculated as linear combinations of environmental variables through weighted regression analysis of the sample scores on the environmental variables (ter Braak, 1987c: 47-48).

† These variables are collinear and therefore explain the same amount of variance when tested using both forward selection of environmental variables and partial CCA.

- Figure 6.4a and b. CCA ordination diagrams for the reduced dataset of plains and riverine samples and environmental variables showing the location of a. samples, and b. species on ordination axes 1 and 2.
  Key: the small symbols correspond to the topographic and substrate sampling categories, i.e. ■ = plains on alluvial silts, □ = riverine, ◆ = plains on sandy loams. The larger symbols indicate centroids for the environmental variables as follows: ★ = topographic category, x = substrate, and + = settlement location.



Key: the symbols indicate centroids for the environmental variables as follows; ★ = topographic category, x = substrate, and + = settlement location. The species abbreviations in Figure are listed below (in alphabetical order for the full species name; naturalised species are marked with an asterix): ACA1 = Acanthaceae species (SS154, SS161, SS463), ACA2 = Acanthaceae species (SS178), Ae = *Acacia erioloba*, At = *Acacia tortilis*, Asp2 = *Acacia* sp. (SS414), Ba = *Boscia albitrunca*, Bf = *Boscia foetida*, Cmo = *Colophospermum mopane*, Ci = *Combretum imberbe*, Cwa = *Combretum wattii*, *Di = *Datura innoxia*, Ep = *Euclea pseudebenus*, Fa = *Faidherbia albida*, Ga = *Gossypium anomalum*, Isp. = *Indigofera* sp. (SS407), Lsp. = *Lycium* sp. (SS160), Ms = *Maerua schinzii*, Md = *Monechma divaricatum*, Mj = *Maerua juncea*, Ms = *Maerua schinzii*, Pb = *Petalidium bracteatum*, Pl = *Pechuel-Loeschea leubnitziae*, *Pg = *Prosopis glandulosa*, *Rc = *Ricinus communis*, Rsp. = *Rynchosia* sp. (SS162), Sp = *Salvadora persica*, Sr = *Sesamum rigidum*, Ssp. = *Sesbania* cf. *sphaerosperma*, Tu = *Tamarix usneoides*,Tp = *Terminalia prunioides*.



With regard to significance testing of the environmental variables representing settlement impact, only branch lopping was significant following forward selection of environmental variables (F-ratio = 3.81, p=0.01). This relationship was not maintained when the residual variation of this variable was tested through partialling out the other variables (trace = 0.03, F-ratio = 1.05, p=0.41) (see Table 6.6). Treating the environmental variables as covariables in fact revealed that browsing and distance made a more robust contribution to the community data (browsing: trace = 0.05, F-ratio = 2, p=0.03; distance: trace = 0.05, F-ratio = 2.14, p=0.03). The combined effects of all the measures of resource-use following partialling out of the other environmental variables was significant at p=0.01(trace = 0.15, F-ratio = 1.99; test of significance of first axis = 0.08, F-ratio = 3.17).

As was the case with the significance tests for the full dataset, however, topography and substrate were revealed as contributing the greatest **degree** of the variance in the data: forward selection of the environmental variables calculated F-ratios for these variables of 13.59 and 9.83 respectively and indicated that they explained a cumulative variance of 0.74 compared with 0.2 for the measures of settlement impact. The significance of this contribution was maintained for each of these varaibles following partialling out of all other environmental variables. Analysis of the combined effects of topography and substrate after partialling out the other variables was also significant with much higher test statistics than those listed above for settlement impact (trace = 0.31, F-ratio = 6.23; test of significance of first axis = 0.27, F-ratio = 10.13).

Despite the relative homogeneity of these samples, and thus the greater likelihood that settlement impacts on resources may play a more prominent role in determining their floristic composition, the effects of underlying substrate again appear to be of primary importance in influencing the structure of the dataset as revealed by CCA.

• Table 6.6. Monte Carlo permutation tests of significance for each environmental variable in the reduced dataset of plains and riverine samples following forward selection of these variables and after partialling out the effects of all other variables. The results for variables significant at p=0.01 are printed in bold and marked with an asterix.

	Monte Carlo permutation tests of significance following forward selection of environmental variables				Monte Carlo permutation tests of environmental variables following partialling out of all other variables as covariables		
	selection order	p	F-ratio	variance explained TOTAL = 2.32	p	F-ratio	trace statistic
Environmental variables							
topographic category							
plains/riverine†	2	*.01	9.83	.28	*.01	9.79	.25
substrate							
alluvial silts/sandy loams†	1	*.01	13.59	.46	*.01	9.79	.25
altitude	6	.16	1.47	.04	.21	1.38	.03
settlement							
Sesfontein	4	.02	2.48	.06	.44	1.05	.03
Khowarib	8	.34	1.14	.02	.73	0.70	.02
Warmquelle	9	.39	0.99	.03	.31	1.05	.03
Warmquelle/Sesfontein & Warmquelle/Khowarib†	10	.87	0.46	.01	.84	0.46	.01
resource-use impact							
lopping	3	*.01	3.81	.10	.41	1.05	.03
browsing	5	.02	2.32	.06	.03	2.00	.05
distance	7	.18	1.43	.04	.03	2.14	.05

Mountain samples

The reduced dataset for the mountain topographic category consisted of 25 samples, the relative diversity of which, when compared with the plains and riverine samples analysed above, is crudely illustrated by the fact that they represented some 48 species. The weights assigned to these species by CANOCO after downweighting for rare species are presented in Table 6.7.

In this case, total inertia was 3.2 and the first four species and species-environmental variables axes explained 44.1% and 73.6% of this variance respectively. Table 6.8 displays the correlation and canonical coefficients, the eigenvalues and percentages of variance explained by each axis for axes 1 and 2 of this analysis. The explanatory value of all environmental variables was significant (trace test statistic = 1.92, F-ratio = 0.3 at p=0.01).The main points illustrated by this second CCA analysis are summarised as follows:

- In this case, axis 1 (F-ratio 3.41, p=0.01) appears to be rather more strongly represented by the use measures of branch lopping and browsing, and has a relatively high correlation with lopping, supported by a somewhat weaker correlation

† These variables are collinear and therefore explain the same amount of variance when tested using both forward selection of environmental variables and partial CCA.

with browsing. Its correlation with the third measure of settlement impact, namely distance from settlement, is negligible, however, despite the fact that weighted correlations for distance with lopping and browsing (-0.48 and -0.61 respectively) suggest a strong relationship between these three variables. The species subject to the heaviest utilisation pressures, such as *Colophospermum mopane*, *Acacia tortilis*, *Boscia albitrunca* and the nutritious legume *Rhynchosia* sp., are those on calcrete slopes occurring in close proximity to the settlement of Sesfontein (located in the top left-hand corner of Figure 6.5b). Also complicating floristic patterns for samples on calcrete is the positive correlation between altitude and distance from settlement (0.54). Equally high correlation coefficients for the calcrete and dolomite substrate categories also suggests that resource utilisation is not the primary influence on floristics within this topographic category (these are positive for calcrete and negative for dolomite, reflecting floristic differences between these two rocky substrates). The highest canonical coefficient for this axis is in fact that for calcrete, which indicates that the fit of the species data in relation to this axis is more strongly attributable to calcrete than to any other variable (see ter Braak, 1987c: 49).

- In terms of the strength of their correlations with axis 2, almost all the environmental variables appear to be contributing significant amounts to the fit of the species data along this axis. The highest correlation coefficients are for the substrate categories of calcrete and dolomite with, as described above for axis 1, a positive value for calcrete and *vice versa*. The high negative correlation coefficient for distance can be interpreted, at least in part, as reflecting the further distances from settlements characterising samples on dolomite (weighted correlations between distance and dolomite and calcrete are 0.5 and -0.39 respectively). Similarly, the coefficients for the three settlements around which samples on mountain slopes were situated reflect the substrate type occurring nearest to each settlement. The positive coefficient for Sesfontein thus reflects the proximity of samples on a substrate of calcrete, while the negative coefficients for Khowarib and sites in between Warmquelle and Sesfontein reflect the location of samples on dolomite and schist near these settlements. The positive correlations for lopping and browsing suggest, as described above, that these are having a greater impact on the flora characterising calcrete slopes than on the composition of samples on dolomite and schist.
- Axes 3 and 4, which explained a further 15% and 25.1% of the variance in the species data and in the relationship between species and environmental variables, broadly iterate the pattern described above. The only notable correlation coefficient is between samples on schist and axis 4 (species axis 4 = 0.51 and environmental axis 4 = 0.53); the resource-use measures of lopping, browsing and distance display only weak correlations with these axes.

• Table 6.7. Species assigned full weights and those downweighted to <0.3 for CCA ordinations of the reduced dataset of mountain samples. Species not listed here have weights ≥0.3 and ≤1.

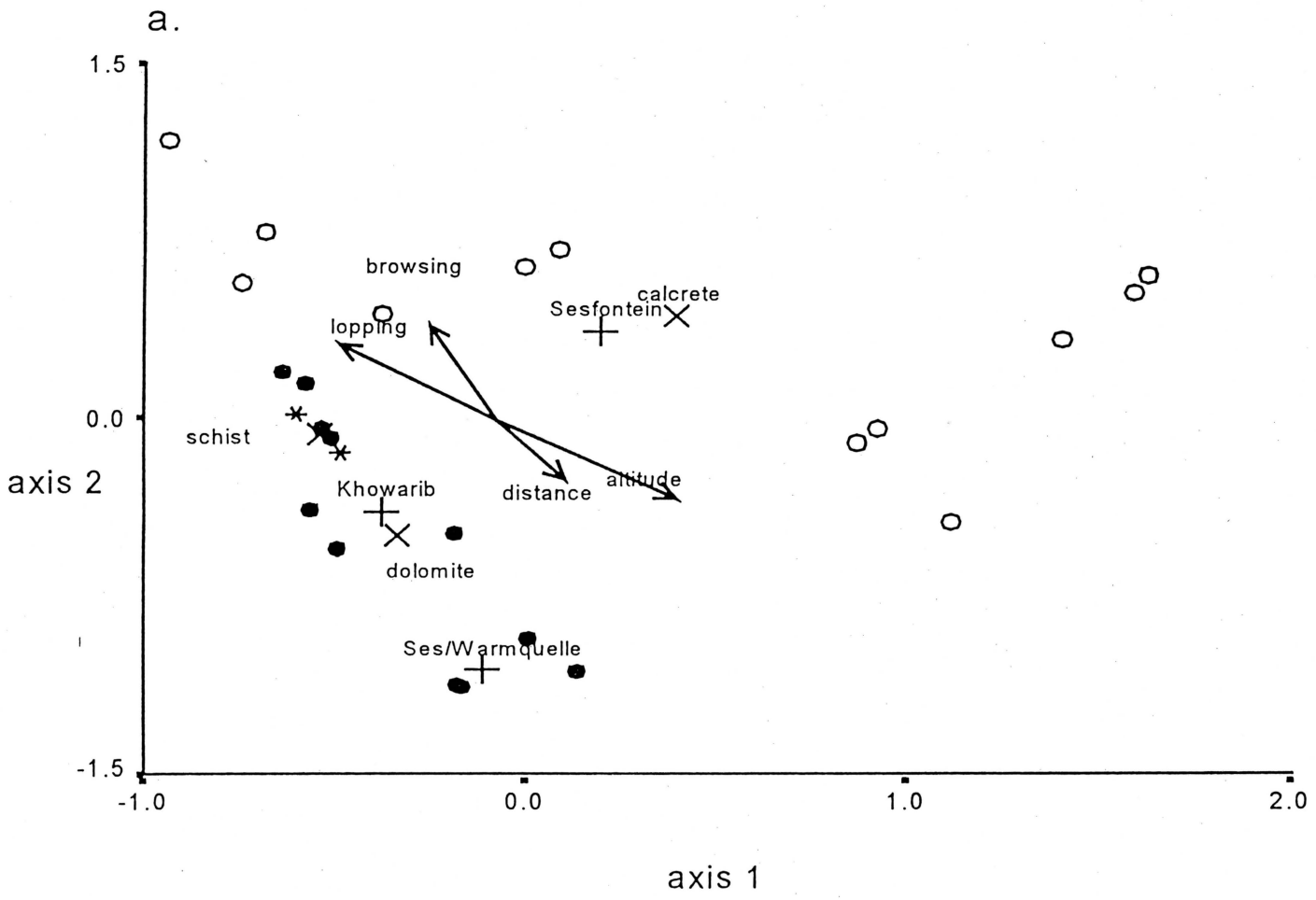
Species assigned full weight of 1 (n = 18)	Species downweighted to values <0.3 (n =9)
Acacia reficiens	*Acacia mellifera*
Acacia tortilis	*Amphiasma merenskyanum*
Boscia foetida	*Acacia* cf. *karroo*
Cadaba schroeppelii	*Ecbolium clarkei*
Catophractes alexandri	*Justicia platysepala*
Ceraria longipedunculata	*Lycium* sp.
Colophospermum mopane	*Monechma genistifolium* subsp. #1 (SS395)
Commiphora multijuga	*Sterculia africana*
Commiphora pyracanthoides	*Salvadora persica*
Commiphora virgata	
Curroria decidua	
Euphorbia guerichiana	
Heliotropium hereroensis	
Maerua schinzii	
Monechma cleomoides	
Petalidium variabile	
Rhynchosia sp.	
Terminalia prunioides	

• Table 6.8 Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed by CCA, and canonical coefficients with t-values ≥4, for the reduced dataset of samples in the 'mountain' topographic category. Coefficients ≥0.5 and ≤-0.5 are printed in bold.

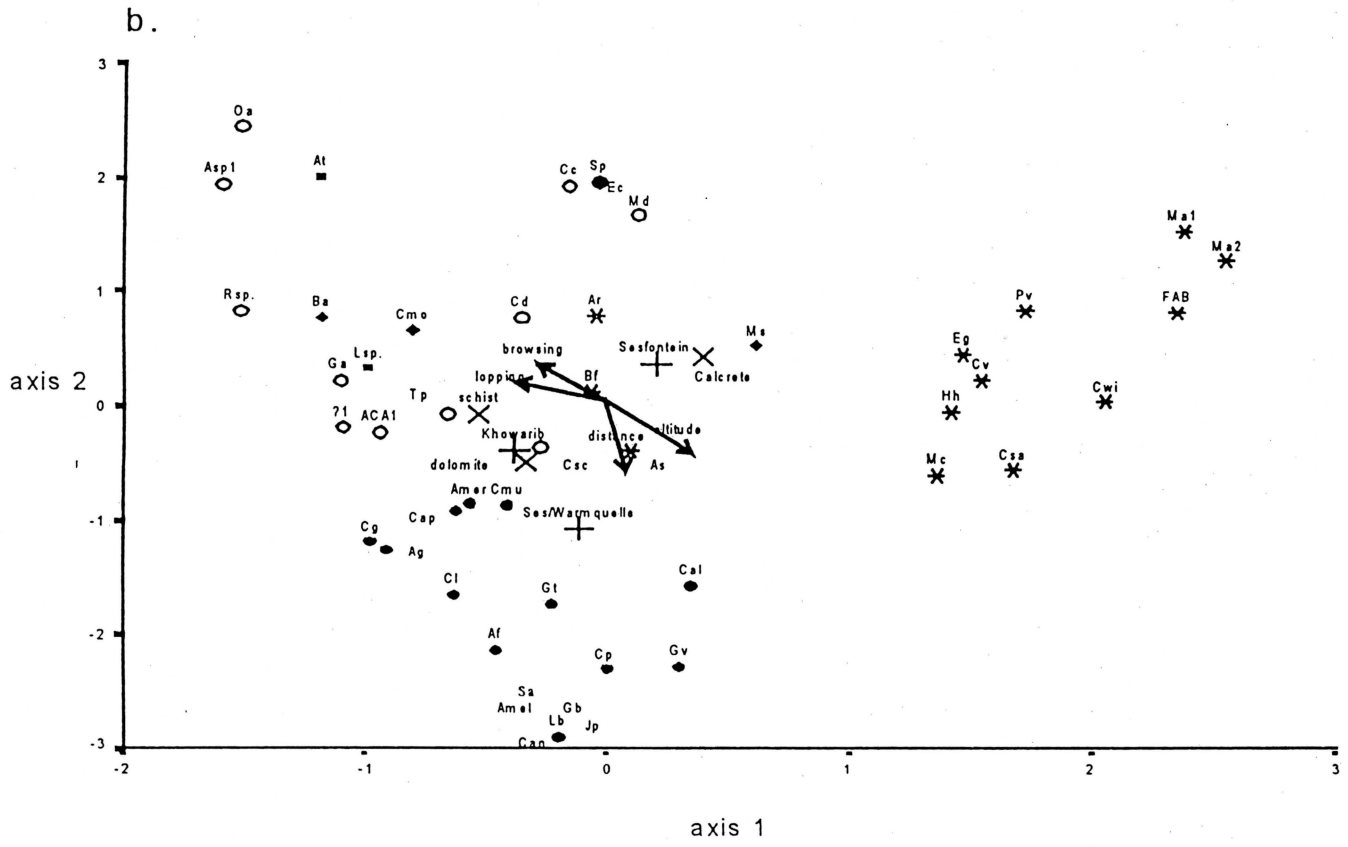
	SPECIES:		ENVIRONMENTAL:		CANONICAL COEFFICIENTS with t-values ≥4	
Eigenvalue/species environment correlation:	axis 1 .562	axis 2 .368	axis 1 .981	axis 2 .979	axis 1	axis 2
Cumulative percentage variance:	17.6%	29.1%	29.3%	48.5%		
Environmental variables:						
substrate						
calcrete	.50	.69	.51	.70	.78	
dolomite/schist†	-.39	-.68	-.39	-.69		
altitude	.39	-.55	.40	-.56		
settlement						
Sesfontein	.32	.75	.33	.76		
Khowarib	-.31	-.39	-.32	-.40		-1.57
Warmquelle/Sesfontein		-.60		-.62		
distance		-.64		-.65		-1.36
resource-use impact						
lopping	-.55	.49	-.56	.49		
browsing	-.39	.59	-.40	.60	-.46	

† These variables are collinear and therefore explain the same amount of variance when tested using both forward selection of environmental variables and partial CCA.

• Figure 6.5a and b. CCA ordination diagrams of the mountain samples showing the relationship of the environmental variables with a. samples and b. species on ordination axes 1 and 2. Key: the small symbols correspond to the substrate sampling categories, i.e. O = calcrete, ● = dolomite, and * = schist. The larger symbols indicate centroids for the environmental variables as follows: x = substrate, and + = settlement location.



Key: the symbols indicate centroids for the environmental variables as follows: x = substrate, and + = settlement location. The species abbreviations are listed as follows (in alphabetical order for the full species name; naturalised species are marked with an asterix): ACA1 = Acanthaceae species (SS154, SS161, SS463), Af = *Acacia fleckii*, Asp1 = *Acacia* cf. *karroo* (SS390), Amel = *Acacia mellifera*, Ar = *Acacia reficiens*, As = *Acacia senegal*, At = *Acacia tortilis*, Ag = *Adenolobus garipensis*, Amel = *Amphiasma merenskyanum*, Ba = *Boscia albitrunca*, Bf = *Boscia foetida*, Csc = *Cadaba schroeppelii*, Cc = *Calicorema capitata*, Cal = *Catophractes alexandri*, Cl = *Ceraria longipedunculata*, Cmo = *Colophospermum mopane*, Cap = *Combretum apiculatum*, Can = *Commiphora anacardifolia*, Cg = *Commiphora glaucescens*, Cmu = *Commiphora multijuga*, Cp = *Commiphora pyracanthoides*, Csa = *Commiphora saxicola*, Cv = *Commiphora virgata*, Cwi = *Commiphora wildii*, Cd = *Curroria decidua*, Ec = *Ecbolium clarkei*, Eg = *Euphorbia guerichiana*, FAB = Fabaceae species (SS394), Ga = *Gossypium anomalum*, Gb = *Grewia bicolor*, Gt = *Grewia tenax*, Gv = *Grewia villosa*, Hh = *Heliotropium hereroensis*, Jp = *Justicia platysepala*, Lb = *Leucosphaera bainesii*, Lsp. = *Lycium* sp. (SS160), Ms = *Maerua schinzii*, Mc = *Monechma cleomoides*, Md = *Monechma divaricatum*, Ma1 = *Monechma* cf. *genistifolium* (SS395), Ma1 = *Monechma* cf. *genistifolium* (SS396), Oa = *Orthanthera albida*, Pv = *Petalidium variabile*, Rsp. = *Rynchosia* sp. (SS162), Sp = *Salvadora persica*, Sa = *Sterculia africana*, Tp = *Terminalia prunioides*, ?1 = (SS462).



Significance tests for the reduced dataset of mountain samples revealed a somewhat different pattern to that described above for the plains and riverine dataset (see Table 6.9). In particular, values representing the effects of substrate are somewhat less distinguishable from the contribution of either the variables reflecting settlement impact or those for settlement location. This is corroborated by analysing the combined effects of the variables representing settlement impact, substrate, and settlement location respectively, following partialling out of all other environmental variables. These three analyses were all significant at p=0.01 with test statistic values as follows:

- settlement and resource-use impacts: trace statistic = 0.63, F-ratio = 2.63; test of significance of first axis = 0.31, F-ratio = 3.15;
- substrate: trace statistic = 0.48, F-ratio = 3.01; test of significance of first axis = 0.3, F-ratio = 3.34;
- settlement location: trace statistic = 0.4, F-ratio = 2.52; test of significance of first axis = 0.26, F-ratio = 2.99.

• Table 6.9. Monte Carlo permutation tests of significance for each environmental variable in the reduced dataset of mountain samples following forward selection of these variables and after partialling out the effects of all other variables. The results for variables significant at p=0.01 are printed in bold and marked with an asterix.

	Monte Carlo permutation tests of significance following forward selection of environmental variables				Monte Carlo permutation tests of environmental variables following partialling out of all other variables as covariables		
	selection order	p	F-ratio	variance explained TOTAL = 2.32	p	F-ratio	trace statistic
Environmental variables							
substrate							
calcrete	1	*.01	3.15	.39	*.01	3.26	.26
dolomite/schist†	6	.04	1.92	.17	*.01	2.24	.18
altitude	8	.04	1.92	.16	.04	1.92	.15
settlement							
Sesfontein & Warmquelle/Sesfontein†	5	*.01	2.11	.20	.03	2.01	.16
Khowarib	4	*.01	2.29	.23	*.01	2.40	.19
resource-use impact							
lopping	7	*.01	1.98	.16	.04	1.96	.16
browsing	2	*.01	3.74	.40	*.01	2.27	.18
distance	3	*.01	2.01	.21	.02	2.51	.20

6.1.3 Diversity

The relationship between diversity and the various environmental parameters characterising the woody vegetation dataset was tested using analysis of variance (ANOVA) techniques. This yielded the following results:

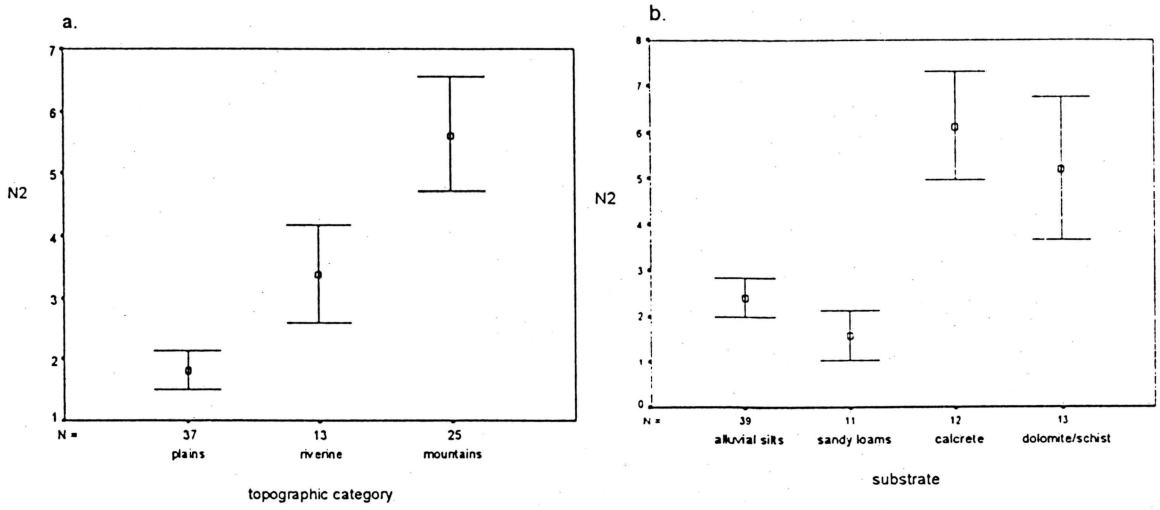
† These variables are collinear and therefore explain the same amount of variance when tested using both forward selection of environmental variables and partial CCA.

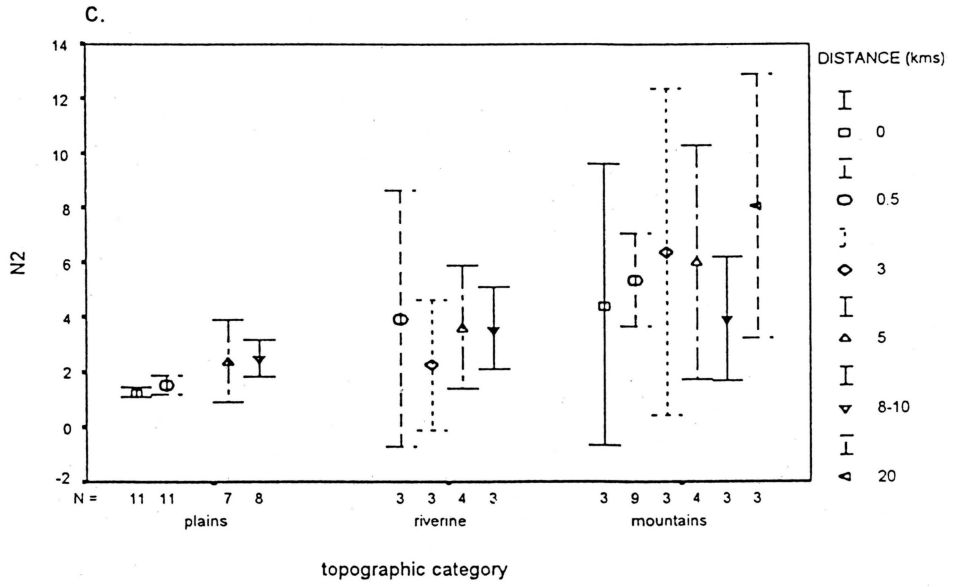
- N2 Diversity values were significantly different when analysed by topographic category (one-way ANOVA, F-ratio = 44, p=0.0001), and multiple comparison tests indicated that each of these categories was significantly different from each other at p=0.05. Figure 6.6a demonstrates that samples located in the mountain topographic category were characterised by the highest species diversity and the highest range in diversity values, while the reverse was true for plains samples.

- Similarly, ANOVA demonstrated that diversity was significantly different according to substrate (F = 25.6, p=0.0001). In this case, however, the greatest differences lay between samples on the plains and riverine substrates *versus* those on the mountain substrates (p=0.05), while differences between samples on alluvial silts and sandy loams on the one hand, and calcrete and dolomite/schist on the other were not significant (see Figure 6.6b). This further supports the division of the dataset along these lines for CCA analysis in section 6.1.2.

- Given the significant differences between topographic category, and the similarity between substrates characterising the plains and mountain samples respectively, the effect of distance from settlement (and therefore resource-use) on N2 values was analysed by topographic category. Figure 6.6c indicates that the relationship between these variables was generally nonlinear. ANOVA yielded strongly significant results for the plains samples only, although the low F-ratio suggests that the differences between distance classes were relatively small (F-ratio = 4.82, p=0.01). *Post hoc* multiple comparison tests in fact revealed that the only significant differences were between samples within settlements and those located at distances furthest away from settlement, demonstrating the rather similar diversity values shared by samples at intermediate distances. The relationship between distance and diversity was barely significant for the mountain samples (one-way ANOVA, F-ratio = 2.67, p=0.054) and multiple comparison tests revealed no significant differences between pairs of groups, even though distances within this topographic category ranged from 0.5km to 20kms. Finally, the relationship between distance and diversity was not significant for riverine samples (one-way ANOVA, F-ratio = 0.99, p=0.441).

• Figure 6.6. Error bars showing 95% confidence intervals for N2 diversity values characterising the following parameters; a. topographic category, b. substrate, and c. distance within topographic category.





6.1.4 Summary: resource-use impacts on community patterns in woody vegetation

To summarise, the above analyses indicate that resource-use, as expressed by direct measures of branch cutting and browsing and indirectly by distance from settlement, display the following relationships to community composition:

1) In analysis of the full woody species dataset, the effects of topography in separating the floristic composition of plains and riverine samples from those on mountain slopes override any effects of settlement pressure and resource-use by people and livestock.

2) Direct gradient analysis of the floristically similar plains and riverine samples again suggests that the abiotic factors of topography and substrate have a greater and more statistically significant explanatory power than measures of resource.

3) With regard to the reduced dataset of the mountain samples, the combined measures of resource-use had a statistically significant impact but with a slightly smaller F-ratio than the effects of substrate. These apparently greater impacts of settlement pressure on woody vegetation floristics are complicated, however, by the positive correlation between distance from settlement and altitude.

4) The relationship between the species diversity of samples and utilisation pressure within the three topographic categories is nonlinear such that diversity does not appear to either consistently increase or decrease with distance from settlement.

6.2 Herbaceous vegetation

The section begins with a description of the physical site characteristics for the herbaceous vegetation sample sites, followed by the floristic analysis of the dataset, detailing results for community classification, direct and indirect ordination, and diversity.

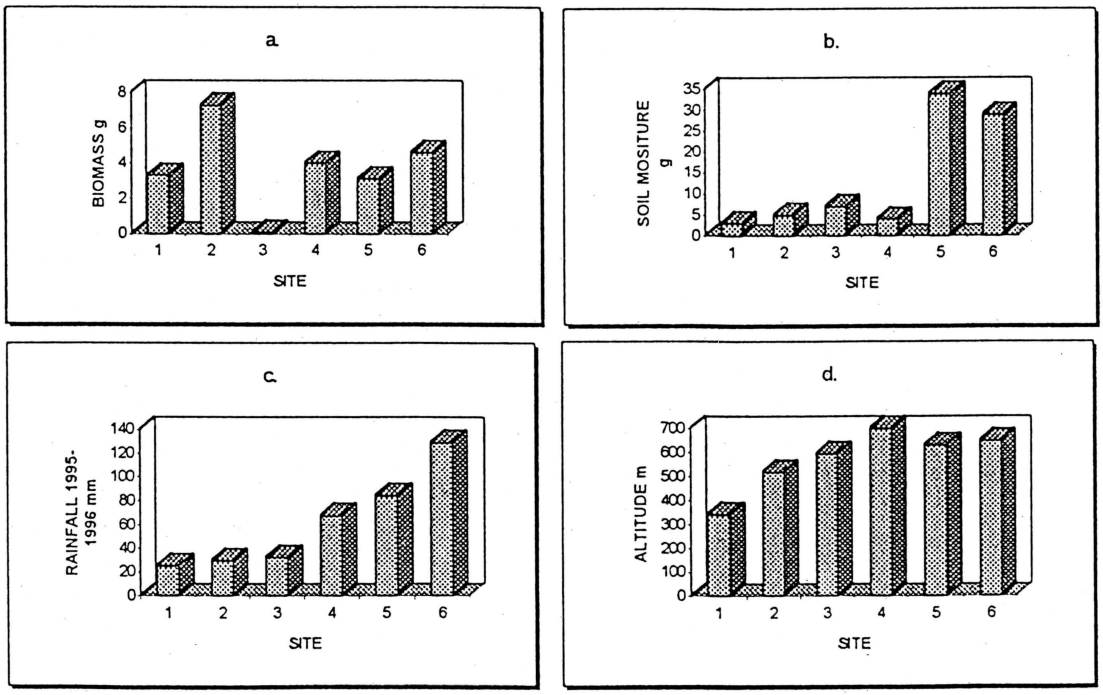
6.2.1 Physical site characteristics

The various measures made of the physical environment at each of the sites established for the monitoring of herbaceous vegetation are presented in Table 6.10 and Figures 6.7a-d and Figure 6.8. The relevant features of these parameters will be discussed below in relation to the analyses of the floristic and cover abundance data for the herbaceous vegetation dataset presented in this chapter and Chapter 7 respectively.

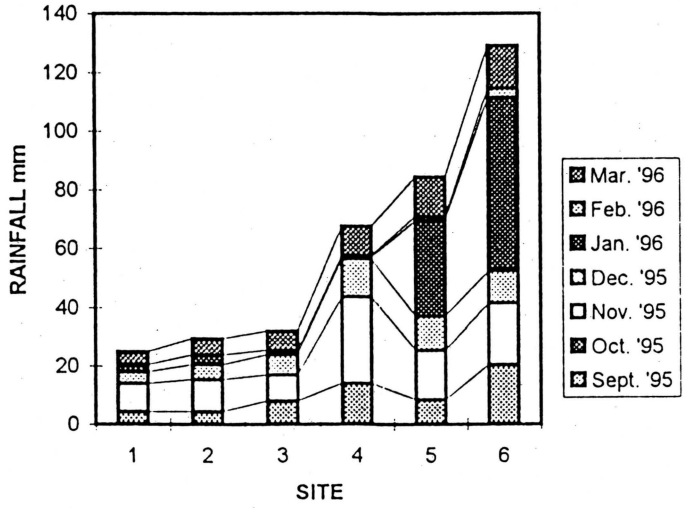
- Table 6.10. Physical site characteristics for herbaceous vegetation quadrats. s = standard deviation of the mean and cv = the coefficient of variation (i.e. the standard deviation expressed as a percentage of the mean). Methods for deriving values for soil fertility and moisture are described in Chapter 5. (Nb. floristic data are available for two growing seasons while data regarding physical site characteristics are not available for both monitoring periods.)

SITE	SOIL FACTORS: fertility g. (weight of plant biomass after drying)	moisture g. (difference between original weight of 400g and dried weight)	altitude m.	RAINFALL mm: Sept. '95	Oct. '95	Nov. '95	Dec. '95	Jan. '96	Feb. '96	Mar. '96	TOTAL
1	3.3	3	342	4.5	0	9.5	4	2.5	0	4.5	25
2	7.3	5	520	4.5	0	11	5	3.5	0	5.5	29.5
3	0.1	7	595	8	0	9	7	1.5	0	6.5	32
4	4.0	4	700	14	0	29.5	13	0.5	0.5	10	67.5
5	3.1	34	629	8.5	0	17	11.5	32.5	1.5	13.5	84.5
6	4.6	29	650	20.5	0	21	11	59	3	14.5	129
mean	3.7	13.7	572.7	10	0	16.2	8.6	16.6	0.8	9.1	61.3
s	2.4	13.9	127.9	6.2	0	8.1	3.7	24.1	1.2	4.2	40.9
cv (%)	63.2	102.2	22.34	62.1	0	49.8	43.7	145.8	145.4	46.8	66.7

- Figure 6.7a-d. Physical site factors for the herbaceous vegetation dataset; a. plant biomass measured in bioassays, b. soil moisture in 1995, c. rainfall for the wet season of 1995-1996, and d. altitude. (The methods used for soil bioassays and measuring soil moisture are explained in Chapter 5).



• Figure 6.8. Rainfall measured at each of the six herbaceous vegetation field sites for the 1995-1996 wet season.



6.2.2 Classification

The herbaceous vegetation dataset displays radical floristic differences for the two growing seasons under study; monitoring of samples in 1995 yielded a species complement of some 37 species, compared with only 11 in 1996 when 13 samples had no species records whatsoever. These differences appear to reflect, at a rather crude level, the high degree of variation in moisture availability for the two years of data collection and thus the importance of rainfall in driving herbaceous productivity in the Kunene environment. Floristic classification using TWINSPAN, therefore, was applied separately to these two years of data, allowing preliminary assessment of the importance of other factors in influencing species composition within years of differing moisture availability.

Year 1

By level 3 of the TWINSPAN classification the herbaceous vegetation dataset had been divided in a manner which, barring two samples (19 and 20), fitted exactly the distribution of samples into the six sites in which they were located. This indicates two things: first, that herbaceous assemblages in the study area are rather patchy and diverse, even when substrate is controlled for to the greatest possible degree; and second, that the exclusion of livestock grazing appears to be having very little effect on species composition after a single growing season. The characteristics of the first three levels of the classification are discussed in more detail below, and the results are tabulated in Table 6.11 and depicted as a dendrogram in Figure 6-9.

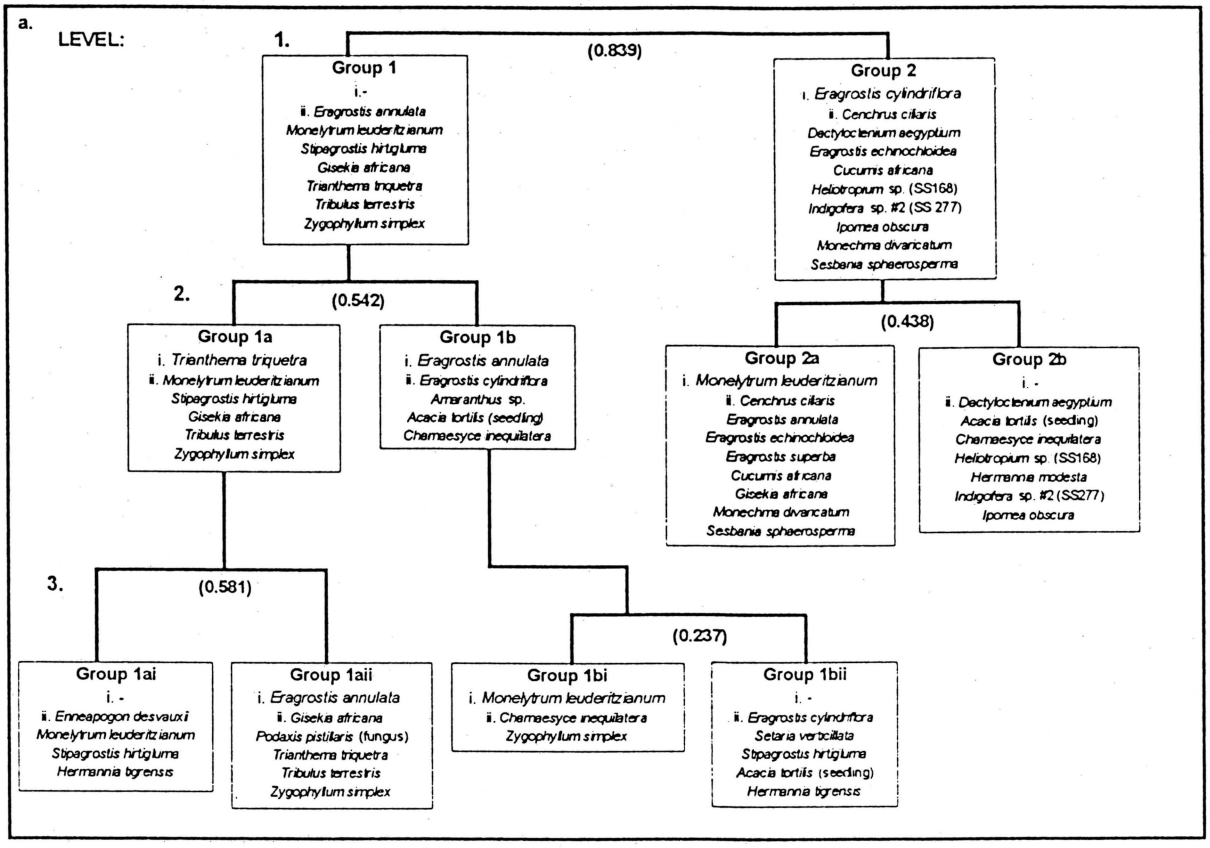
• Table 6.11. Ordered two-way table of the samples-by-species matrix produced by TWINSPAN classification of the herbaceous dataset for 1995. The groups identified in the text are indicated on the table for both samples and species. TWINSPAN pseudospecies for each sample are as follows: - = the species is absent from the sample, 1, 2, 3, 4, 5 and 6 = the species contributes >0-1%, 2-4%, 5-9%, 10-19%, 20-49% and 50-100% to the floristic composition of the sample respectively.

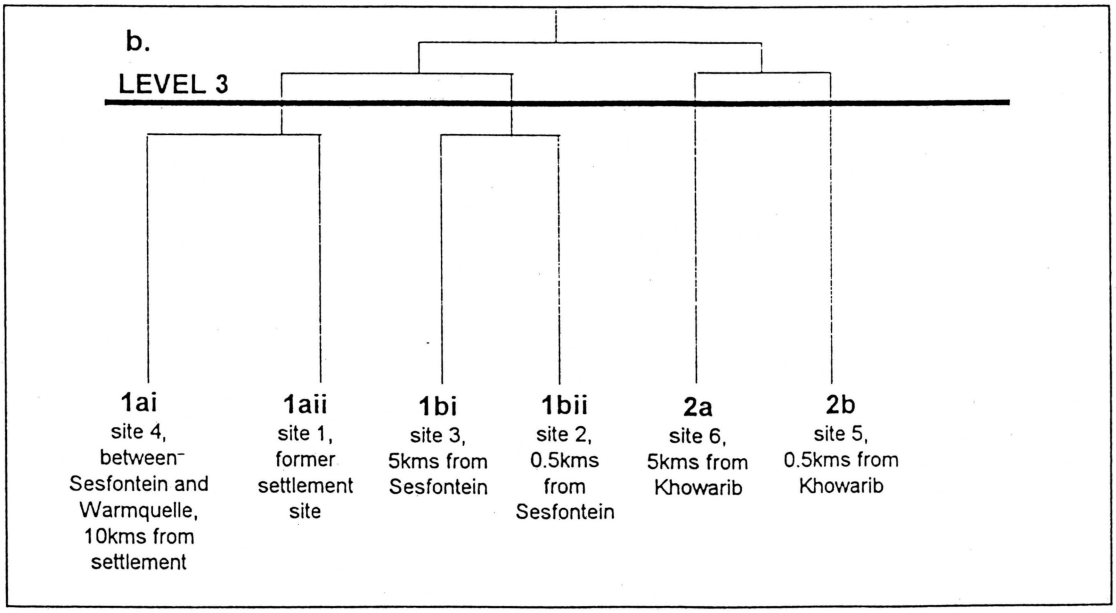
```
                                          sample no. (read downwards)
                                   22322323........1212221111111.124444444433333334
                                   782591602614583782713423601459906345712834567890
                                                                                  divisions
                                                                                 of species
Colophospermum mopane (seedling)   1------------------------------------------------  0  0  000
Enneapogon desvauxii               -----112----------------------------------------  0 G0 G000
Stipagrostis hirtigluma            544666661-------------------11------------------  0 R0 R000
Trianthema triquetra               15311112-1556622-------------------------------- G0 O0 O0010
Aristida cf. stipitata             ----------1------------------------------------- R0 U0 U0011
Gisekia africana                   ---1------453255------1------------------------- O0 P0 P0011
Indigofera sp. #1                  --------2-------------------------------------- U0  0  0011
Podaxis pistillaris (fungus)       --------11------------------------------------- P0 10 10011
Panicum sp.                        ---------------2-------------------------------  0 a0 a0011
Tribulus terrestris                --1--1--45312344-------------------------------- 10  0  0011
Zygophyllum simplex                433112226645346532121121-1111111---------------  0  0  01
Chamaesyce glanduligera            -----1----------1-------------------------------  0  01
Monelytrum leuderitzianum            666534111-1-12-14422221111111-1121111221-------- 0  01
Hermannia tigrensis                -1----1---------------1-11---1------------------  0 G1000
Amaranthus sp.                     ---------1--------1--2-----1-1-2----------------  0 R1001
Eragrostis annulata                -1---111424354326666666666666666661111112---------  0 O1001
Enneapogon cenchroides             ---------------------------1--------------------  0 U1001
Setaria verticillata               -------------------------111--------------------  0 P1001
Chamaesyce inequilatera            ----------------1-1111--------13--------11------  0  101
Acacia tortilis (seedling)         -------------------1--11111--1-----------1----1-  0 111
Hermannia modesta                  ------------------------------1---------11------  1 b00
Dactyloctenium aegyptium           ------------------------------------------1--1111  1  0100
Eragrostis sp. (SS275)             ---------------------------------------------1-  1  0100
Danthoniopsis dinteri              ------------------------------------------1------  1 20101
Heliotropium sp. (SS168)           ----------------------------------------1232-11-  1 b0101
Ipomea obscura                     ----------------------------------------1-1-1111 G1  0101
Indigofera sp. #2 (SS277)          ---------------------------------11-11-12122222 R1  011
Eragrostis cylindriflora           ---------------1---------11-12-26666666666666666 O1  10
Monechma divaricatum               --------------------------------322223222-21-1-1 U1  10
Cenchrus ciliaris                  ---------------------------------11111------11-- P1  110
Cucumis africanus                  ---------------------------------11111----------  1  11100
Eragrostis echinochloidea          ---------------------------------111111---------  21 211100
Eragrostis nindensis               ---------------------------------------1---------  1 a11101
Geigaria alata                     --------------------------------2-21------------  1  11101
Sesbania sphaerosperma             --------------------------------44444444--------  1  11101
Eragrostis superba                 --------------------------------1--1------------  1  1111
Urochloa brachyura                 --------------------------------1---------------  1  1111

                                                divisions of samples
                                              GROUP 1                GROUP 2
                                   00000000000000000000000000000000001111111111111111
                                       GROUP 1a        GROUP 1b      GROUP 2a GROUP 2b
                                   00000000000000001111111111111111000000000111111111
                                      1ai     1aii    1bi      1bii
                                   000000001111111100000011111111110111111100001111
                                   00011111001111110011110000000011 0000011
                                      00011  000011       00011111   00001
                                                           00001
```

Level 1

The first level of the classification split the dataset into samples which occurred closest to Khowarib settlement (**Group 2**) (on the bottom-right-side of Table 6.11), versus all other samples (**Group 1**), and had a high explanatory value as indicated by its eigenvalue of 0.84. *Eragrostis* cf. *cylindriflora* was the single indicator species for this division, and dominates the Khowarib samples of sites 5 and 6, where it occurs in association with the preferential species *Monechma divaricatum* and *Indigofera* species #2 (SS277). **Group 1** is broadly characterised by high levels of the grasses *Eragrostis annulata*, and *Monelytrum leuderitzianum*, as well as the succulent *Zygophyllum simplex*.

- Figure 6-9a and b. Dendrograms showing TWINSPAN groups for year 1 of the herbaceous vegetation dataset. In Figure 6-9a, indicator species are listed (i), as well as preferential species (ii). Species are listed alphabetically, and grass species, where they occur, are listed first under preferential species.





Level 2

At the second level of classification, TWINSPAN divided the dataset as follows:

Group 1

This group was split into sites 2 and 3 (**Group 1b**), located 0.5km and 5kms away from the settlement of Sesfontein respectively, and sites 1 and 4 (**Group 1a**), which comprise the former settlement of Otjimdagwe and the site in between Sesfontein and Khowarib, the latter of which is the site furthest away from settlement in this dataset. Each of these groups had a single indicator species, the succulent *Trianthema triquetra* for the former, and the grass *Eragrostis* cf. *annulata* for the latter. In **group 1a** these occurred in association with *Gisekia africana*, *Tribulus terrestris* and *Zygophyllum simplex*, as well as the grasses *Stipagrostis hirtigluma* and *Monelytrum leuderitzianum*, while **group 1b** was dominated by *Amaranthus* species, the grasses *Eragrostis cylindriflora* and *E. annulata* and seedlings of *Acacia tortilis* .

Group 2

TWINSPAN divided this group exactly into samples occuring in sites 5 (**Group 2b**) and 6 (**Group 2a**) respectively), thus again indicating the importance of spatially-defined site characteristics in determining quadrat floristics. **Group 2b** is defined by the preferential grass species *Dactyloctenium aegyptium*, as well as *Chamaesyce inequilatera*, *Hermannia* cf. *modesta*, *Ipomea obscura*, *Indigofera* species #2 (SS277) and the perennial herb *Heliotropium* sp. (SS 168). **Group 2a**, on the other hand, is characterised by the indicator species for this level, *Monelytrum leuderitzianum*, with the cucurbit *Cucumis africana*, the grasses *Cenchrus ciliaris*, *Eragrostis annulata* and *Eragrostis* cf. *echinochloidea*, the perennial 'shrubby herb' *Monechma divaricatum* and a high incidence of the legume *Sesbania sphaerosperma* .

Level 3

At this level **Group 1** is again divided into subgroups which correspond almost exactly with the site location of the samples. **Groups 1ai** and **1aii**, derived from **Group 1a**, thus consist of samples from sites 4 and 1 respectively, while **Groups 1bi** and **1bii** are comprised of samples from sites 3 and 2. The only two exceptions to this pattern are samples 19 and 20 from site 3 which have been classified by TWINSPAN along with the site 2 samples; the relatively low eigenvalue calculated for this division, however, emphasises the similar species composition shared by these two groups of samples despite the differences with respect to distance from settlement in site location (i.e. these sites were located at 5kms and 0.5kms from the settlement of Sesfontein respectively) .

In terms of floristics, Table 6.11 indicates that these groups share a number of species, notably *Zygophyllum simplex*, *Monelytrum leuderitzianum* and *Eragrostis annulata*. Their differences are summarised as follows:

- **group 1ai**, comprised of samples occurring at the greatest distances from settlement for this dataset, is characterised by *Hermannia tigrensis* and the grass species *Stipagrostis hirtigluma*, *Monelytrum leuderitzianum* and *Enneapogon desvauxii*;
- sharing a similar assemblage with this group is **group 1aii**, consisting of samples located in a former settlement site and differentiated by high occurrences of the succulents *Zygophyllum simplex* and *Trianthema triquetra*, together with *Gisekia africana* and the grass *Eragrostis annulata*;
- **group 1bi** is differentiated from **1bii** by the presence of the indicator species *Monelytrum leuderitzianum* at pseudospecies cut-levels higher than 2, in association with the succulents *Zygophyllum simplex* and *Chamaesyce inequilatera*;
- finally, **group 1bii**, while sharing with **1bi** a high incidence of *Eragrostis annulata* (at pseudospecies cut-level 5), is distinguished by TWINSPAN on the basis of the preferential species *Eragrostis* cf. *cylindriflora, Stipagrostis hirtigluma*, *Setaria verticillata*, *Hermannia tigrensis* and seedlings of *Acacia tortilis*.

Given the strong effect on floristics of spatially-defined site characteristics (as summarised in Table 6.11) it would appear likely that the within-site impacts of livestock grazing, as represented by the treatment of quadrats as enclosed *versus* unenclosed, may only become apparent at lower levels in the TWINSPAN hierarchy. In fact, at levels 4 and 5 there is only one site where samples are divided between those which were fenced and those which remained subject to livestock grazing; this is site 5, for which indicator species for the fenced and unfenced quadrats are *Heliotropium* sp. (SS168) and *Dactyloctenium aegyptium* respectively. The low eigenvalue (0.19) for this division, however, indicates, that it is of relatively little explanatory value and, as Table 6.11 demonstrates, these samples in fact share largely similar floristic compositions.

Year 2

As Table 6.12 illustrates, the floristic classification of the dataset for 1996 is very simple due to the low number of species recorded in this year of data collection. Only the first two divisions are considered to have explanatory value (see also Figure 6.10):

Level 1

The first division of the dataset has an eigenvalue of 1, meaning that it completely explains the variation in the dataset at this level through dividing the samples between those with the indicator species *Zygophyllum simplex* (**group 1**) and those without (**group 2**). The former are, without exception, samples located in sites 1, 2, 3, and 4, i.e. those occurring at varying proximities to the settlement of Sesfontein. The latter contain the remaining 10 species recorded for samples at sites 5 and 6.

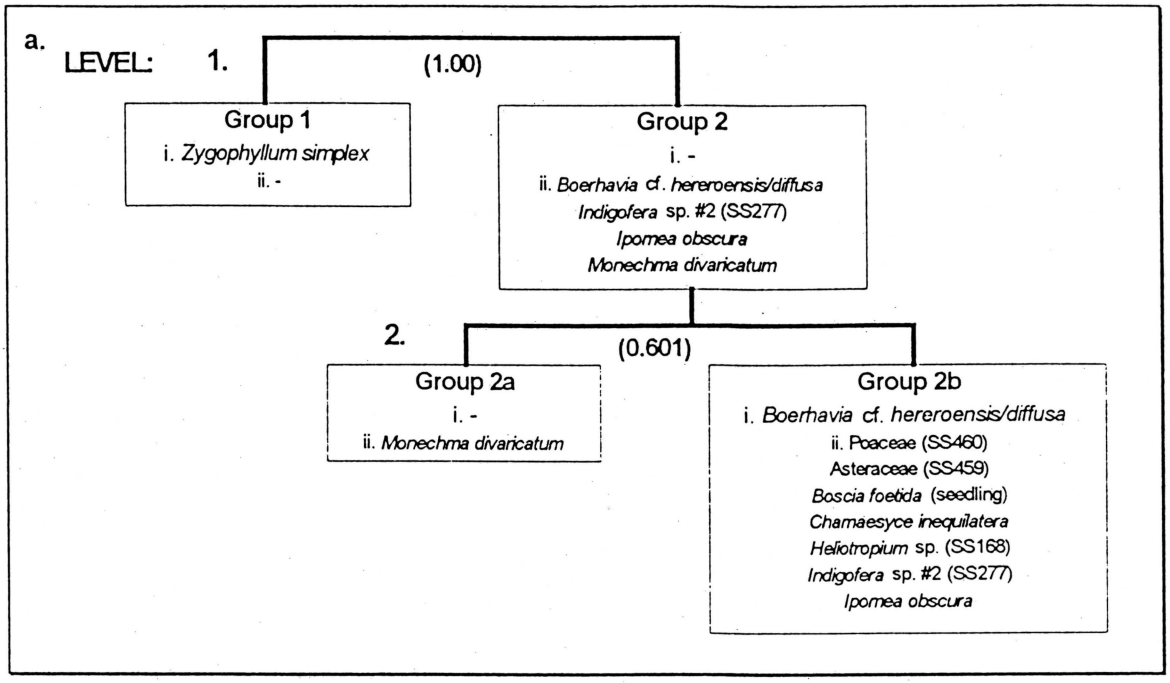
Level 2

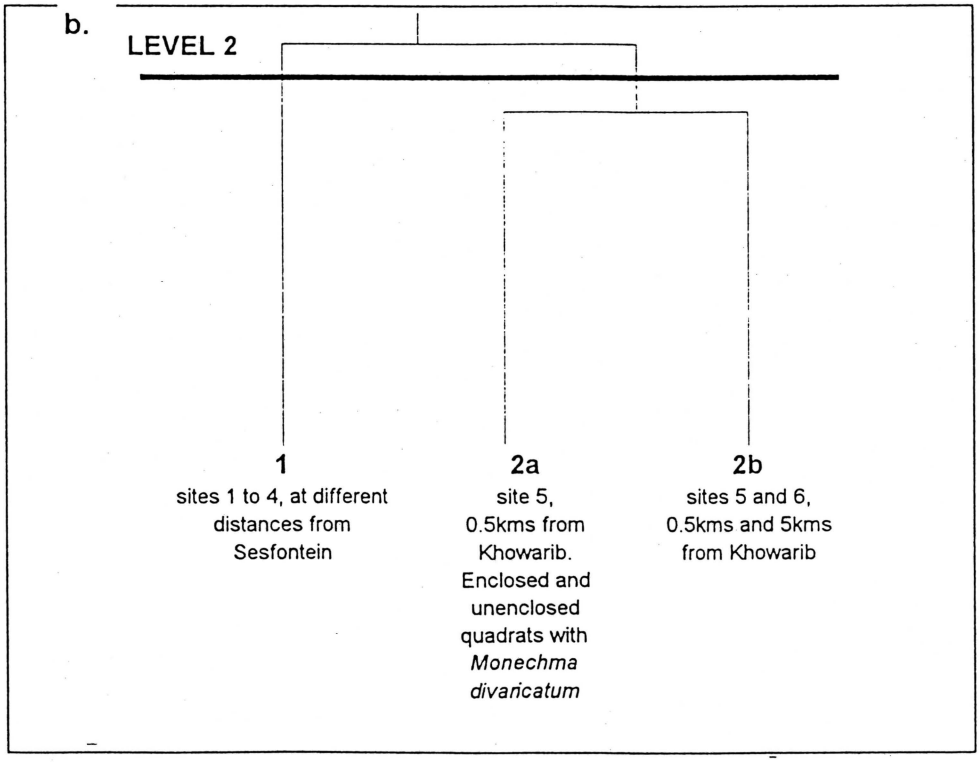
At this level of the classification, TWINSPAN pulls out from **group 2** four relatively diverse samples from site 5 which are not dominated by the indicator species *Monechma divaricatum* (**group 2b**). This group of four samples consists of two enclosed and two unenclosed quadrats, suggesting that the removal of livestock grazing had little effect on the floristic composition of these quadrats, even after two growing seasons. Preferential species for **group 2b** include *Boerhavia* cf. *hereoensis/diffusa* (SS159, SS170), *Chamaesyce inequilatera*, *Ipomea obscura* and *Heliotropium* sp. (SS168).

- Table 6.12. Ordered two-way table of the samples-by-species matrix produced by TWINSPAN classification of the herbaceous dataset for 1996. The groups identified in the text are indicated on the table for both samples and species. TWINSPAN pseudospecies for each sample are as follows: - = the species is absent from the sample, while 1, 2, 3, 4, 5 and 6 = the species contributes >0-1%, 2-4%, 5-9%, 10-19%, 20-49% and 50-100% to the floristic composition of the sample respectively.

```
                                        sample no. (read downwards)
                                    8999999988888885555555566666777 8
                                    9012345654812672345678902478456 0
                                                              divisions of species

Asteraceae (SS459)                  ------------3-------------------  0 G0   00
Boscia foetida (seedling)           -------------5------------------  0 R0   00
Chamaesyce inequilatera             -----------2-------------------- G0 O0   00
Heliotropium sp. (SS168)            -----------4-------------------- R0 U0   00
Poaceae (SS460)                     --------------6----------------- O0 P0   00
Ipomea obscura                      ---------2-53------------------- U0  0   01
Indigofera sp. #2 (SS277)           ----------3435------------------ P0 20   01
Boerhavia cf. hereroensis/diffusa   --------2445656----------------- 0 b0   1
Monechma divaricatum                66666666666225------------------ 20 21
Tribulus terrestris                 ----------2--------------------- 0 a1
Zygophyllum simplex                 ---------------66666666666666666 11

                                          divisions of samples

                                       group 2          group 1
                                    0000000000000001111111111111111
                                     group 2a  group 2b
                                    000000000001111
                                    00000000011
                                    000000001
```

• Figure 6.10a and b. Dendrograms showing TWINSPAN groups for year 2 of the herbaceous vegetation dataset. In Figure 6.10a, indicator species are listed (i), as well as preferential species (ii). Species are listed alphabetically with grass species, where they occur, listed first. The figures in brackets are the eigenvalues indicating the strength of each division.





6.2.3 Multivariate ordination

Indirect and direct ordination analyses were applied to the full herbaceous vegetation dataset, such that the relative effects of growing season on floristic patterns within the dataset could be assessed. Table 6.13 indicates the final weights applied to species in the herbaceous vegetation dataset, and used for DCA and CCA analyses of floristics, following downweighting of rare species by CANOCO.

• Table 6.13. Species in the herbaceous vegetation dataset assigned full weights and those downweighted to <0.3 for DCA and CCA ordinations of sample floristics. Species not listed here have weights ≥0.3 and ≤1.

Species assigned full weight of 1 (n = 14)	Species downweighted to values <0.3 (n =12)
Acacia tortilis (seedling)	*Aristida* cf. *stipitata* subsp. *stipitata*
Cenchrus ciliaris	Asteraceae (SS459)
Eragrostis annulata	*Boscia foetida*
Eragrostis cylindriflora	*Colophospermum mopane*(seedling)
Eragrostis echinochloidea	*Danthoniopsis dinteri*
Hermannia tigrensis	*Enneapogon cenchroides*
Indigofera sp. #2 (SS277)	*Eragrostis nindensis*
Monechma divaricatum	*Eragrostis* sp. (SS275)
Monelytrum leuderitzianum	*Indigofera* sp. #1
Stipagrostis hirtigluma	Poaceae (SS460)
Sesbania sphaerosperma	*Panicum* sp.
Tribulus terrestris	*Urochloa brachyura*
Trianthema triquetra	
Zygophyllum simplex	

Detrended Correspondence Analysis (DCA)

The DCA of the floristic component of the herbaceous vegetation dataset indicated that the overall variation in the data was high (total inertia = 6.22). The first two axes accounted for 15.6% and 29.3% of this variance respectively, and the high explanatory value of these axes is reinforced by their eigenvalues (axis 1, eigenvalue = 0.98; axis 2, eigenvalue = 0.84). The cumulative variance explained by the first four axes was 36.6%.

Axes 1 and 2 of the DCA are presented graphically for samples (classified by TWINSPAN group) and species in Figures 6.11a and b respectively. The pattern which emerges from the dataset contains the following features:

Axis 1

Axis 1 represents a strong division between samples and species located in sites 1 to 4 (on the left side of Figures 6.11a and b) *versus* those from the sites 5 and 6 which were located closest to Khowarib settlement (on the right side of Figures 6.11a and b). For each sample within these two groups the axis 1 values are almost identical, which indicates that:

- The greatest amount of variation in the dataset can be explained with reference to site factors separating the samples into these broad groups. As Table 6.10 and Figures 6.6a-d demonstrate, large differences were recorded for soil moisture in 1995, and rainfall in 1996, between sites located near the settlements of Khowarib and Sesfontein respectively. Both of these variables had higher values for the sites near Khowarib (sites 5 and 6), dramatically so for soil moisture in the above-average rain-season of 1994-1995. It can be considered, therefore, that these physical factors play a primary role in determining the broad, site-related floristic differences demonstrated by these sites in these years.
- The proximity of axis 1 values within these two groups suggests that the variables representing settlement impact and livestock utilisation, i.e. distance from settlement and the treatment of the quadrat as enclosed versus non-enclosed, are unimportant in

determining axis 1 values and, therefore, floristic composition of samples. The effect of year on the dataset, on the other hand, is indicated by the placement of sample records from 1996 (represented by squares and diamonds) towards the outer limits of this axis.

Axis 2

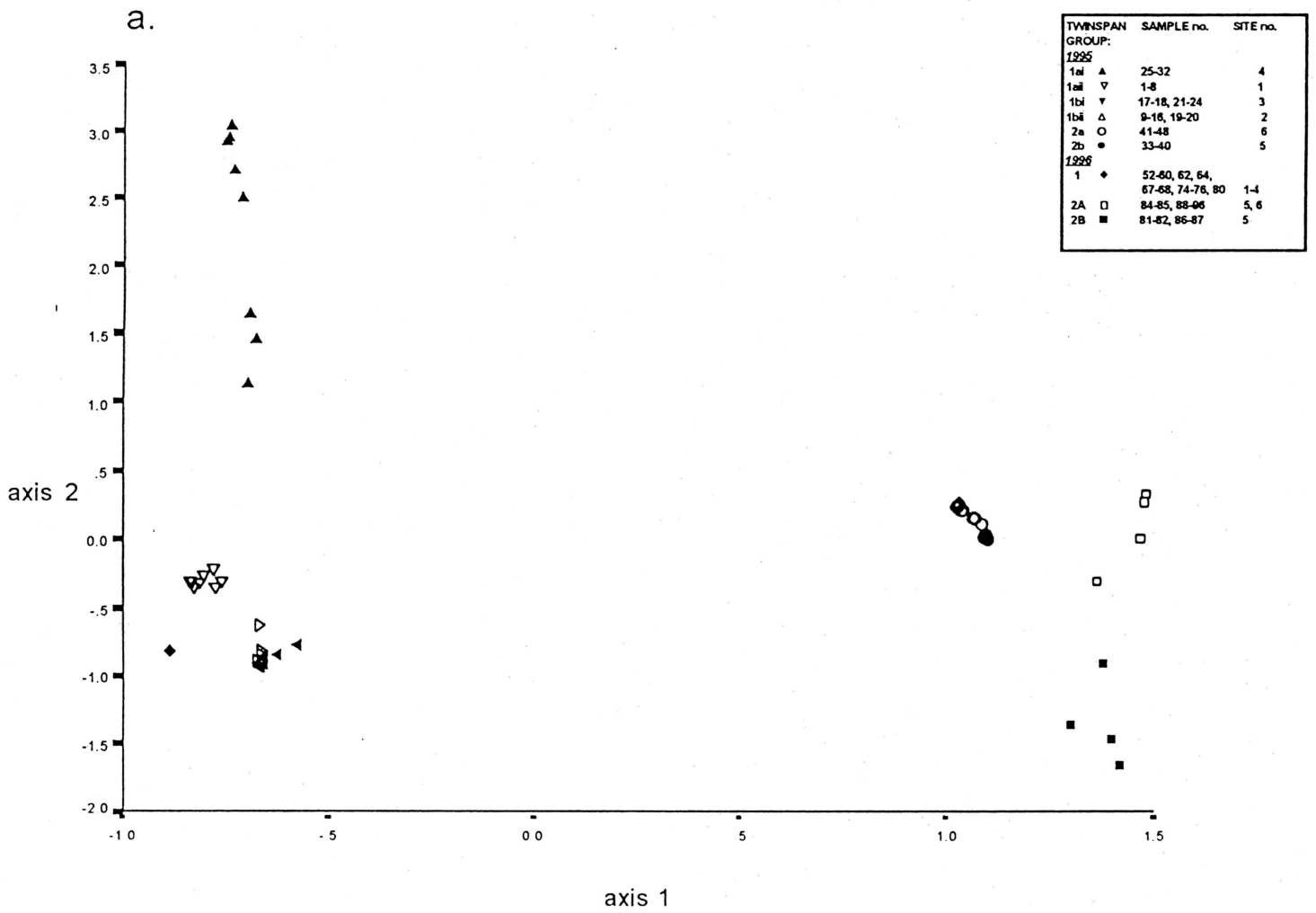
Axis 2 vertically separates the samples, thus describing the secondary importance of both further between-site, and within-site, differences in floristics. These generally follow the pattern described by the separate 1995 and 1996 TWINSPAN classification of the samples. For example:

- Samples from site 4 in 1995 (TWINSPAN **group 1ai**) apparently embody the greatest floristic differences, both in their distance from samples in sites 1, 2 and 3, and in terms of within-site variability. This can largely be attributed to the high levels of *Stipagrostis hirtigluma* and *Monelytrum leuderitzianum* grasses characterising samples from this site following the good rains of 1995, which is in contrast to the dominance of *Eragrostis annulata* at both sites 2 and 3, and the diversity of succulent species and herbaceous pioneers at site 1. Within-site differences at site 4 reflect the tendency for either *S. hirtigluma* or *M. leuderitzianum* to dominate a sample; samples towards the top of this group in Figure 6.11a are characterised by *S. hirtigluma* and *vice versa*. This pattern was random for the eight samples at this site, i.e. it was not related to enclosure of the plots, and is thus thought to reflect physical micro-habitat factors and possibly the effects of competition between these two species.
- Differences in the 1996 floristic composition of sites 5 and 6 (TWINSPAN **groups 2a** and **2b**) are also emphasised by this axis. As pointed out above in the description of the groups identified by TWINSPAN, DCA separates four samples from site 5 (the bottom-left corner of Figure 6.11a), primarily on account of their low values for *Monechma divaricatum* and greater floristic diversity relative to the other samples from these sites. Again, these samples are not differentiated on the basis of their being fenced or unfenced, which suggests that livestock were having a minimal effect on floristics, even after two growing seasons and despite the location of these samples within half a kilometre from a settlement and consequent focus for herds.

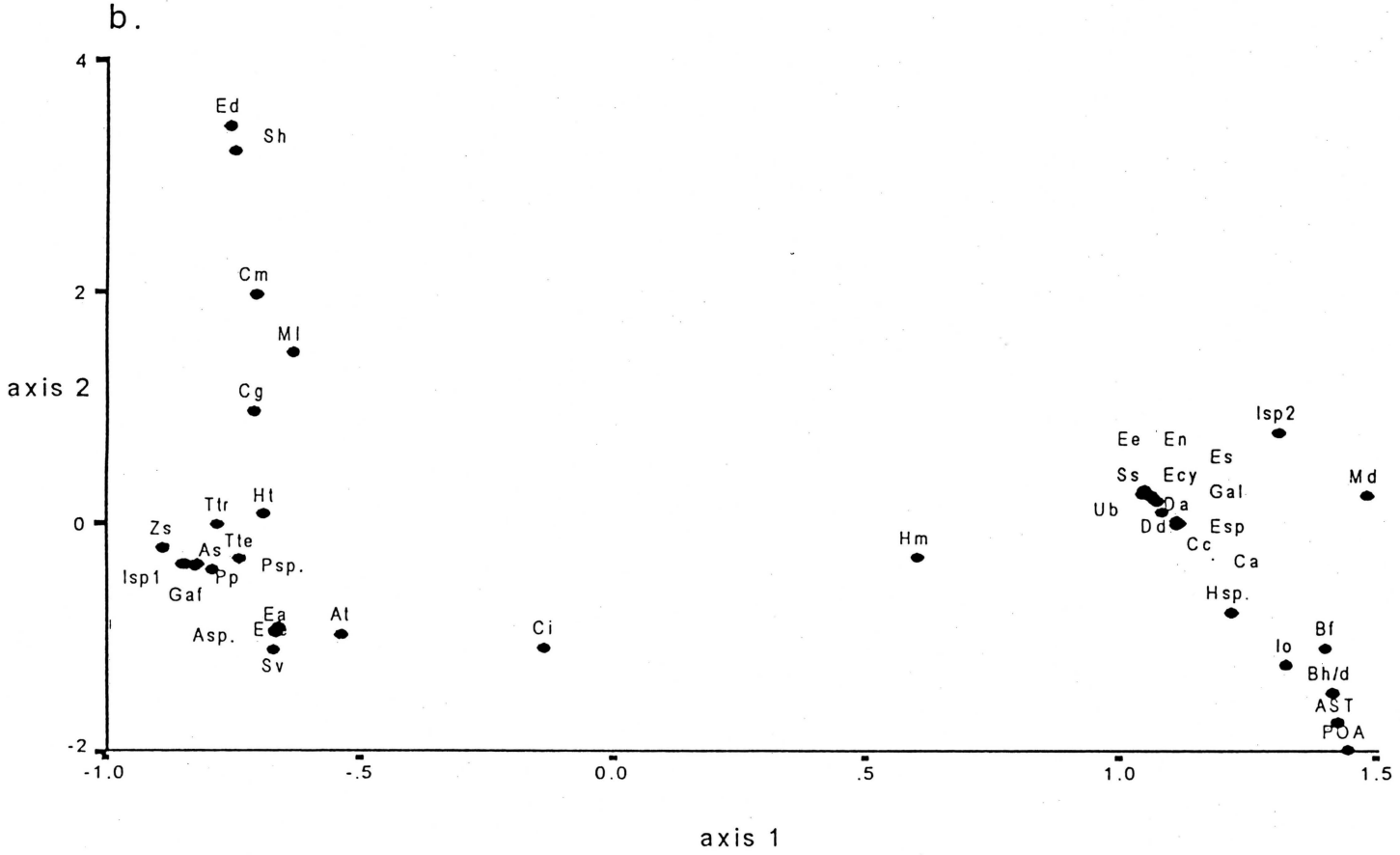
Axes 3 and 4

The third and fourth axes constructed by DCA only account for a further 7.3% of variance in the dataset (eigenvalues; axis 3 = 0.31, axis 4 = 0.15) and are not discussed further here.

• Figure 6.11. Graphical representation of DCA axes 1 and 2 for a. samples and b. species, illustrating floristic composition of the herbaceous vegetation dataset.



Key: the species names in Figure 6.11b are as follows (in alphabetical order for the full species names): Asp. = *Amaranthus* sp., At = *Acacia tortilis* (seedling), As = *Aristida* cf. *stipitata* subsp. *stipitata*, Bh/d = *Boerhavia* cf. *hereroensis/diffusa*, Bf = *Boscia foetida* (seedling), Cc = *Cenchrus ciliaris*, Cg = *Chamaesyce glanduligera*, Ci = *Chamaesyce inequilatera*, Cm = *Colophospermum mopane* (seedling), Ca = *Cucumis* cf. *africanus*, Da = *Dactyloctenium aegyptium*, Dd = *Danthoniopsis dinteri*, Ece = *Enneapogon cenchroides*, Ed = *Enneapogon desvauxii*, Ea = *Eragrostis annulata*,, Ecy = *Eragrostis* cf. *cylindrifolia*, Ee = *Eragrostis* cf. *echinochloidea*, En = *Eragrostis nindensis*, Es = *Eragrostis superba*, Esp. = *Eragrostis* sp., Gal = *Geigaria alata*, Gaf = *Gisekia africana*, Hsp. = *Heliotrpoium* sp. (SS168), Hm = *Hermannia modesta*, Ht = *Hermannia tigrensis*, Isp1 = *Indigofera* sp. #1, Isp2 = *Indigofera* sp. #2 (SS277), Io = *Ipomea obscura*, Md = *Monechma divaricatum*, Ml = *Monelytrum leuderitzianum*, Psp. *Panicum* sp. = *Podaxis pistillaris* (fungus), POA = Poaceae (SS460), Sh = *Stipagrostis hirtigluma*, Ss = *Sesbania sphaerosperma*, Sv - *Setaria verticillata*, Tte = *Tribulis terristris*, Ttr = *Trianthema triquetra*, Ub = *Urochloa brachyura*, Zs = *Zygophyllum simplex*.



Canonical Correspondence Analysis (CCA)

The environmental variables had substantial explanatory power when related directly to the samples-by-species dataset for herbaceous vegetation; while the overall variance was very high (total inertia = 6.22), the first four axes explained cumulative percentages of variance of 43.3% and 90.4% in the species data and the species-environment data respectively, and the trace test statistic was significant (F-ratio = 9.45, p=0.01). Similarly, correlation coefficients for the species and environmental axes calculated for the first four canonical axes were 0.99, 0.97, 0.81 and 0.73 respectively.

The amount of variance explained by each environmental variable, and the correlation and canonical coefficients for these variables for the first two species and species-environment ordination axes are presented in Table 6.14, and the graphical representation of the CCA is shown for samples (classified by TWINSPAN group) and species in Figures 6.12a and b respectively (for axes 1 and 2). From these the main features of this analysis can be summarised as follows:

- Axis 1 is correlated with site location, with particularly high positive correlation coefficients for sites 5 and 6. This accounts for the location of these latter sites on the right side of Figure 6.12a, together with their shared species assemblage which includes high proportions of *Eragrostis cylindriflora* in 1995 and *Monechma divaricatum* in 1996. As is described for the DCA above, the primary differences in terms of physical site factors between sites 5 and 6 and the remaining sites 1 to 4 are the higher levels of soil moisture and rainfall recorded for the former sites; the robust nature of this pattern, as indicated here by TWINSPAN, DCA and CCA analyses, reflects the importance of plant moisture availability in constraining herbaceous plant growth and composition in arid environments. The strength of this relationship is indicated by the test of significance for this axis; eigenvalue = 0.98, F-ratio = 13.48 and p=0.01.

- Axis 2 displays a very high correlation with year and accounts for a large amount of the vertical separation of samples in Figure 6.12a such that the 1995 results of sample monitoring are placed to the bottom of the figure and *vice versa*. Again, the effect of year is primarily related to the high variability of rainfall, in this case the above-average rains in 1995 followed by the extremely dry rain season in 1996. It is this which accounts for the higher diversity of species in the bottom half of Figure 6.12b, i.e. this diversity corresponds with the greater rains of 1995 while only those species which could survive the drought conditions of 1996 are represented in the top half of this figure.

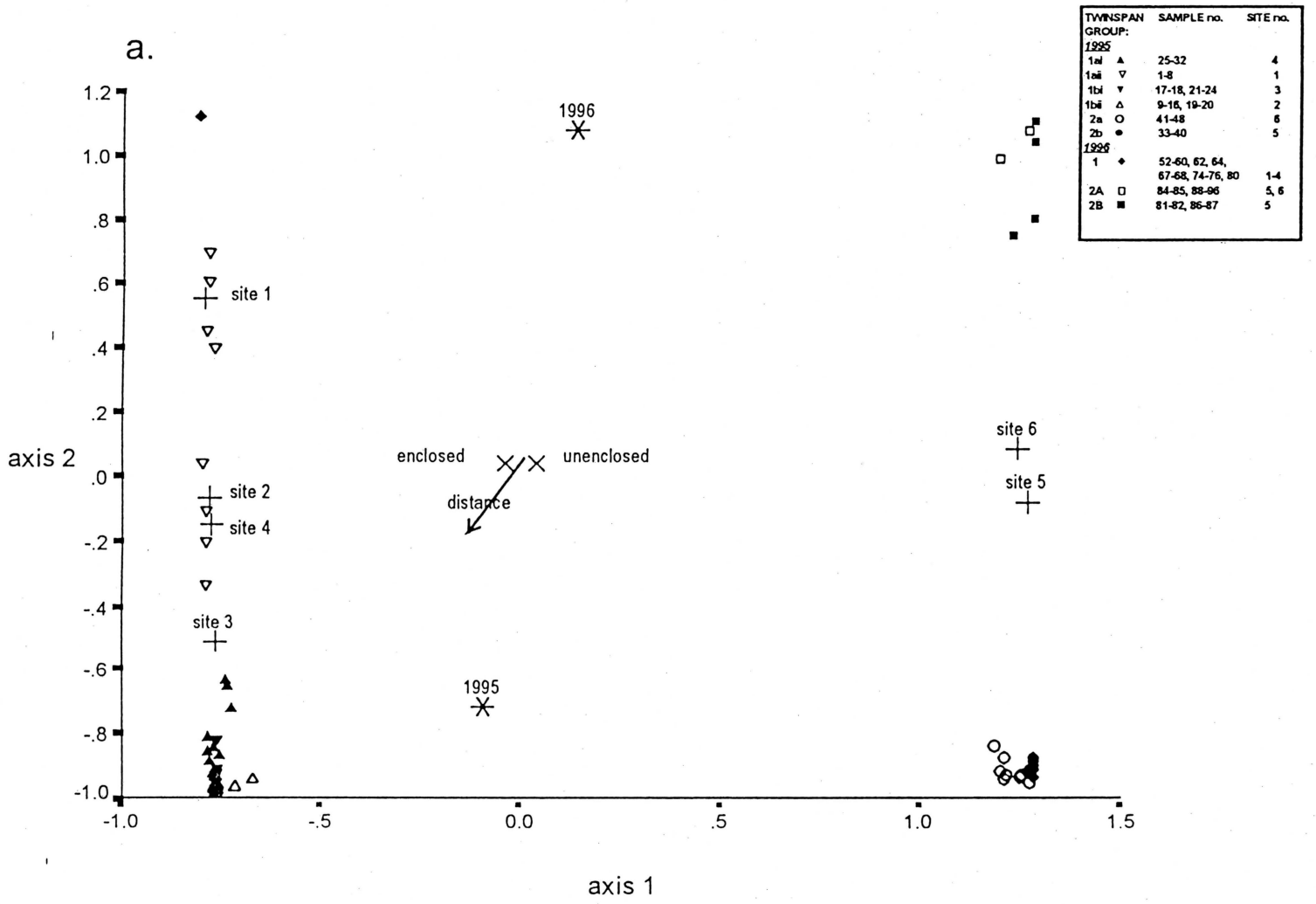
- Site factors, and to a slightly lesser extent distance, continue to display positive correlations with axes 3 and 4. These axes, which explain a further 14% and 29.3% variance in the species and species-environment data respectively, thus have the effect of largely reinforcing the pattern described above in terms of emphasising between-site differences in floristics. They are not presented graphically here.

- The effect of quadrat enclosure is negligible, even after two growing seasons. Correlation coefficients for this treatment of the samples with the first four species and species-environment ordination axes do not exceed values of >0.05 or <-0.05 in any case. It can be concluded, therefore, that removing the effects of livestock on the vegetation monitored in this study had no effect on floristics *during the timescale in question.*

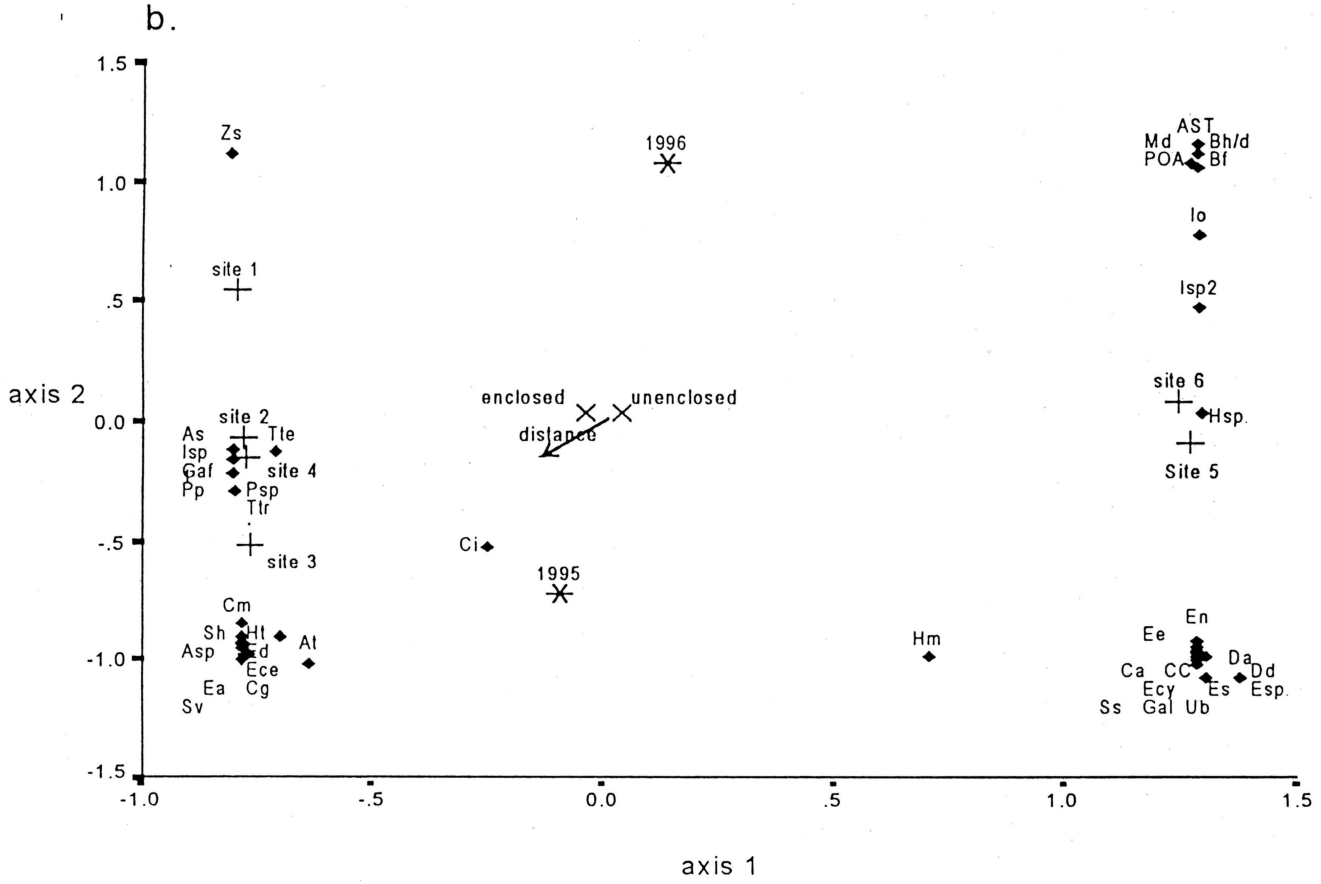
• Table 6.14. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed for the herbaceous vegetation dataset by CCA, and canonical coefficients with t-values ≥4 and ≤–4. Coefficients ≥0.5 and ≤-0.5 are printed in bold.

	SPECIES:		ENVIRONMENTAL:		CANONICAL COEFFICIENTS with t-values ≥4 and ≤–4	
Eigenvalue/species environment correlation:	axis 1 .98	axis 2 .84	axis 1 .99	axis 2 .97	axis 1	axis 2
Cumulative percentage variance:	15.8%	29.3%	32.9%	61.1%		
Environmental variables						
SITE:						
1	-.35		-.35		-.76	.25
2	-.36		-.36		-.78	
3					-.67	
4	-.33		-.33		-.73	
5	.60		.60			
6	.64		.64			
YEAR		.93		.96		-.88
enclosure						
distance						

• Figure 6.12a and b. Graphical representation of CCA axes 1 and 2 for environmental variables with a. samples and b. species.
Key: the larger symbols indicate the centroids for the environmental variables as follows: x = enclosed or unenclosed, + = site location, and ∗ = year.



Key: the larger symbols indicate the centroids for the environmental variables as follows: x = enclosed or unenclosed, + = site location, and * = year. The species names in Figure 6.12b are as follows (in alphabetical order for the full species names): Asp. = *Amaranthus* sp., At = *Acacia tortilis* (seedling), As = *Aristida* cf. *stipitata* subsp. *stipitata*, Bh/d = *Boerhavia* cf. *hereroensis/diffusa*, Bf = *Boscia foetida* (seedling), Cc = *Cenchrus ciliaris*, Cg = *Chamaesyce glanduligera*, Ci = *Chamaesyce inequilatera*, Cm = *Colophospermum mopane* (seedling), Ca = *Cucumis* cf. *africanus*, Da = *Dactyloctenium aegyptium*, Dd = *Danthoniopsis dinteri*, Ece = *Enneapogon cenchroides*, Ed = *Enneapogon desvauxii*, Ea = *Eragrostis annulata*,, Ecy = *Eragrostis cylindrifolia*, Ee = *Eragrostis* cf. *echinochloidea*, En = *Eragrostis nindensis*, Es = *Eragrostis superba*, Esp. = *Eragrostis* sp., Gal = *Geigaria alata*, Gaf = *Gisekia africana*, Hsp. = *Heliotrpoium* sp. (SS168), Hm = *Hermannia modesta*, Ht = *Hermannia tigrensis*, Isp1 = *Indigofera* sp. #1, Isp2 = *Indigofera* sp. #2 (SS277), Io = *Ipomea obscura*, Md = *Monechma divaricatum*, Ml = *Monelytrum leuderitzianum*, Psp. *Panicum* sp. = *Podaxis pistillaris* (fungus), POA = Poaceae (SS460), Sh = *Stipagrostis hirtigluma*, Ss = *Sesbania sphaerosperma*, Sv - *Setaria verticillata*, Tte = *Tribulis terristris*, Ttr = *Trianthema triquetra*, Ub = *Urochloa brachyura*, Zs = *Zygophyllum simplex*.



In terms of significance testing of the contribution of each environmental variable to the pattern described above for herbaceous floristics, and as Table 6.15 summarises, site factors and year were highly significant while the effects of enclosure were statistically negligible. These relationships were maintained following partialling out of variables as covariables: site location and year had the strongest effect on the dataset (for site location, trace test statistic = 1.75, F-ratio = 9.75, p=0.01 and test of significance of first axis = 0.97, F-ratio = 17.4, p=0.01; and for year, trace test statistic = 0.78, F-ratio = 17.3, p=0.01); distance had a weaker but significant effect (trace = 0.16, F-ratio = 5.7, p=0.01); and the effects of enclosure, and thus of livestock, were extremely weak and were not significant (trace = 0.3, F-ratio = 0.66, p=0.78).

- Table 6.15. Monte Carlo permutation tests of significance for each of the environmental variables in the herbaceous vegetation dataset, following forward selection of these variables. The results for variables significant at p=0.01 are printed in bold and marked with an asterix.

	Monte Carlo permutation tests of significance following forward selection of environmental variables			
	selection order	p	F-ratio	variance explained TOTAL = 2.98
Environmental variables				
SITE:				
1	5	*.01	8.28	2.93
2/3†	7	.83	.52	2.98
4	2	*.01	8.95	1.37
5	4	*.01	13.94	2.56
6	3	*.01	8.88	1.88
YEAR	1	*.01	11.63	.81
enclosure	6	.77	.65	2.95
distance†				

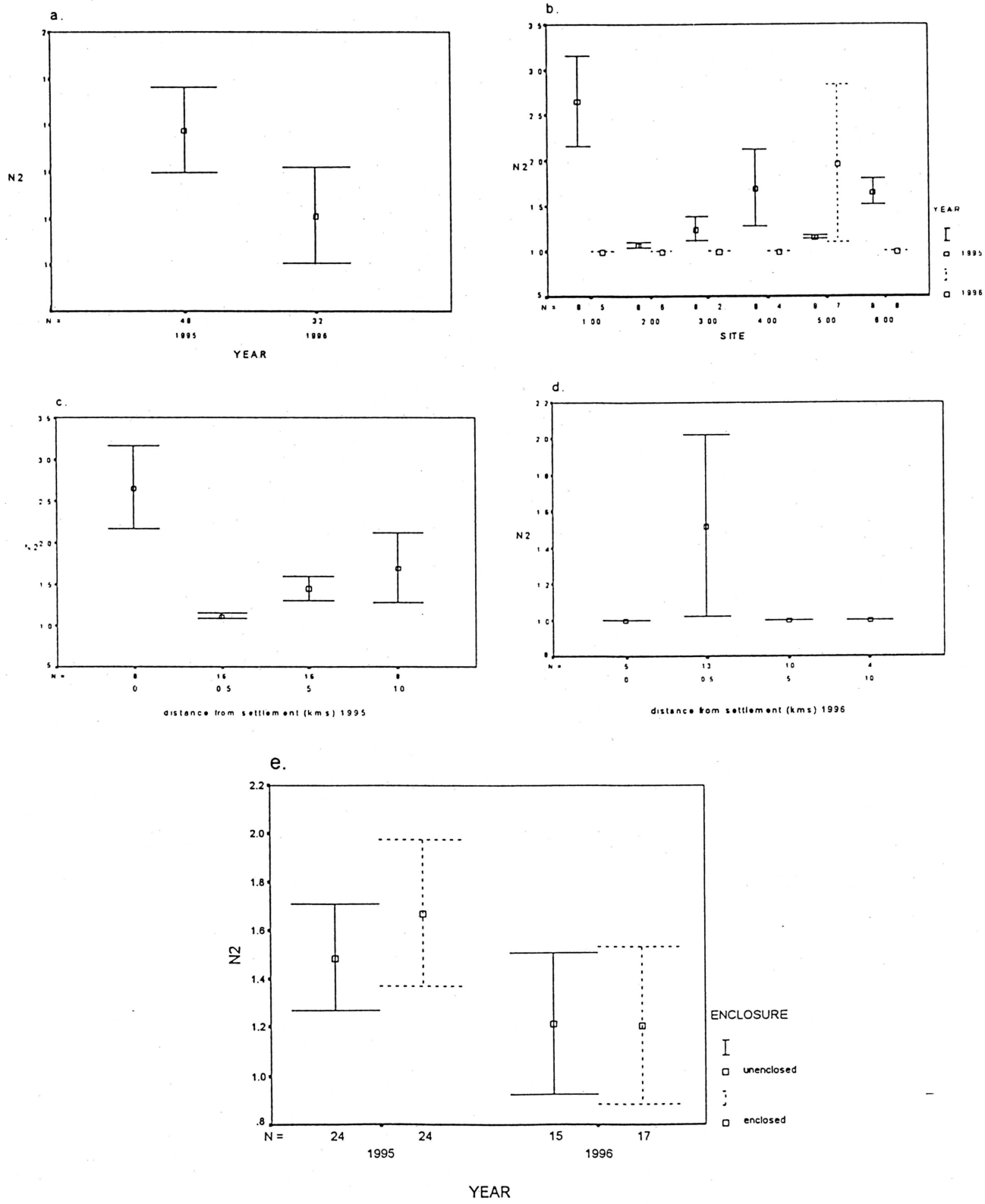
† These variables are colinear (distance class is colinear with sites).

6.2.4 Diversity

When the N2 diversity indices were compared for the different variables influencing the herbaceous vegetation dataset, and as is apparent from Figure 6.13a-e, the pattern that emerged was as follows:

- First, the values for each of the years of data collection were significantly different (one-way ANOVA, F-ratio = 7.09, p=0.01). As is indicated in Figure 6.13a, diversity in 1995 was considerably higher than for 1996 when quadrats with live above-ground biomass were generally characterised by the dominance of a single species. This was *Zygophyllum simplex* for sites 1 to 4, and *Monechma divaricatum* for site 6.
- Figure 6.13b represents the differences in diversity between sites by year (simple factorial ANOVA, F-ratio = 15.42, p=0.0001). This clearly demonstrates the perhaps counter-intuitive result that mean diversity values were highest for site 1 in 1995, i.e. the site which had experienced the greatest disturbance due to settlement impacts. Also of interest are the high values for site 5 in 1996; again, this site was located in close proximity to a settlement, and despite the poor rains of 1996 its mean diversity value compares favourably with values for the above-average rains of 1995. Overall, distance had high, but nonlinear, power in explaining differences in the 1995 values for diversity (one-way ANOVA, F-ratios = 36.02, p=0.0001); its relationship with the 1996 values, on the other hand, was not significant (one-way analysis of variance, F-ratio = 2.36, p=0.09). Figures 6.13c and d illustrate the relationships between mean diversity and distance separately for 1995 and 1996 respectively, demonstrating the interesting finding that this relationship is entirely different depending on the growing season sampled.
- The status of the quadrats as enclosed or unenclosed was of negligible explanatory value (simple factorial ANOVA for enclosure by year, F-ratio = 0.48, p=0.489), again illustrating the low significance of removing grazing livestock from the herbaceous sward during this study (see Figure 6.13e).

- Figure 6.13a-e. Error bars for diversity indices showing the mean values and 95% confidence intervals for different variables characterising the herbaceous vegetation dataset; a. by year, b. for each site in each year, c. by distance from settlement for 1995 and d. for 1996, and e. by enclosure *versus* non-enclosure of the quadrats for each year of the study.



6.2.5 Summary: resource-use impacts on species composition of herbaceous samples

The above analyses demonstrate that spatial and temporal variability, represented by site location and growing season (i.e. moisture availability) respectively, had the greatest value in explaining community patterns in the herbaceous vegetation dataset, while the effects of distance from settlement and quadrat enclosure were negligible. The main points are as follows:

1) Separate classifications of the dataset by growing season indicate that floristic patterns can be explained with reference to site location for, in the case of the 1995 data, up to five successive divisions.

2) Between-site differences and growing season, followed by within-site variability at sites 4 and 5, corresponded to axes 1 and 2 respectively of the indirect ordination of the full dataset. Importantly, the latter were not related to quadrat enclosure, suggesting that livestock grazing did not have a significant effect on floristics over the time-period in question.

3) Direct ordination again emphasised the statistically significant explanatory power of site location and growing season, which had high correlation coefficients with the first and second ordination axes respectively.

4) Sample diversity was significantly affected by year of sampling and site location. For the 1995 growing season, distance from settlement was related to high diversity in the site experiencing the most intense history of settlement pressure, and to higher levels of diversity with increasing distances from settlement for the remaining sites. Distance from settlement was not significantly related to diversity for the 1996 growing season. The removal of livestock due to quadrat enclosure had no significant effect.

6.3 Conclusions

1) Resource utilisation associated with settlement pressure had very little effect in terms of determining species assemblages, even at lower levels of the TWINSPAN classification of the datasets. Instead, environmental factors, including topography, substrate, temporal variability (reflecting rainfall) and geographical location were of primary importance. Possible exceptions to this general pattern for the woody vegetation dataset were:

   - the effects of proximity to settlement on mountain samples on a substrate of calcrete, which were classified such that the two distance classes closest to the settlement of Sesfontein were separated from the remaining distance classes for this substrate;
   - similarly, at a relatively fine level of classification, the three mountain samples on a substrate of dolomite which were located furthest away from settlement were separated from the rest of the dolomite samples.

   Attributing these differences solely to utilisation pressure is problematic, however, due to the fact that distance from settlement was also positively correlated with altitude for the mountain substrate categories.

With regard to the herbaceous vegetation dataset, classification within each of the very different growing seasons studied was very nearly entirely explained with reference to site location; exclusion of livestock bore no relation to the species assemblages defined by TWINSPAN, even at lower levels of the classification and after two growing seasons.

2) Ordination of the datasets indicated that community patterns were most strongly explained by abiotic environmental parameters. For the woody vegetation dataset these were topography and substrate, the effects of the latter emerging in a hierarchical manner within the broad divisions dictated by the former. The various parameters used to measure utilisation pressure, i.e. distance from a settlement, branch lopping and intensity of browsing, were also often found to make a statistically significant contribution to the pattern in the dataset; their small F-ratios, the negligible amount of cumulative variance they explained, their low rank in the order of variables tested using forward selection, and the fact that the significance of these variables was generally not maintained in more rigorous testing following partialling out of the other variables, demonstrated, however, that their impact was relatively small. Specific utilisation effects which did emerge were:

   - Branch removal was positively correlated with proximity to Warmquelle settlement where levels of branch cutting of *Colophospermum mopane* were relatively high. This resulted in a weak correlation of this variable with the second ordination axis constructed to explain the variance in the complete woody vegetation dataset. Mopane, however, coppices vigorously when cut (Scholes, 1990: 147) and, as explored in Chapter 7, the density of this species appears to be actually promoted by the relatively high levels of use around Warmquelle.
   - In the CCA analysis of the reduced dataset of plains and riverine samples, branch removal is negatively correlated with the location of samples in the riverine topographic category, indicating negligible levels of utilisation of timber resources in this habitat.
   - As indicated in the results of classification of the woody vegetation dataset, relatively high correlation coefficients were obtained for the measures of utilisation in analysis of the reduced dataset of mountain samples, and had their strongest effect on species characterising samples on a substrate of calcrete in close proximity to the settlement of Sesfontein. The combined effects of these resource-use impacts, and of browsing in particular, were significant, but the F-ratios representing substrate, forward selection of the environmental variables and tests of individual variables following partialling-out of the other variables again revealed the overriding importance of substrate factors. Additionally, and as mentioned above, utilisation impacts are confounded by the effects of altitude on floristics which, due to the location of settlements in low-lying areas, is positively correlated with distance from settlement for the mountain topographic category.

The floristic pattern in the herbaceous vegetation dataset was largely accounted for by site

location and year of study; these parameters are considered to reflect spatial and temporal variation in moisture availability. The effect of quadrat enclosure on floristics was negligible indicating that livestock did not play an important part in determining within-site species composition during the short timescale in question.

3) The relationship between species diversity and distance from settlement (the latter negatively correlated with utilisation pressure) was ambiguous on all counts. For the woody vegetation dataset, in no instances did diversity change as a linear function of distance from a settlement within the same topographic and substrate categories, and the assumption of a gradient of degradation, manifest in linear changes of species diversity around settlement foci, is thus rejected. The relatively heterogenous rocky habitats of the mountain topographic category were significantly more diverse than the plains or riverine habitats at both the site and sample scales; a study of plant diversity in the similarly arid karoo of southern Africa also recorded higher diversity for rocky substrates at the former but not the latter scale (Cowling *et al*, 1994: 141) and it seems likely that this relationship between diversity and substrate is ubiquitous for desert environments.

   For the herbaceous vegetation dataset, diversity was in fact greatest for the site with the most intense history of resource utilisation; this is related to the promotion of a diversity of forbs, usually considered as 'weedy', pioneer species, associated with disturbed environments. Otherwise, differences were accounted for by between-site and inter-annual sources of variability. At intermediate distances from settlement during the highly productive 1995 growing season diversity was greater with distance from settlement (see Chapter 7). Again, quadrat enclosure did not have a significant effect.

In relation to the predictions made at the beginning of this chapter, it appears that:

1) Utilisation pressure is not a good predictor of floristic patterns; instead, abiotic factors of topography, substrate, site location and moisture availability in different growing seasons have greater explanatory values.

2) Species diversity was generally nonlinearly related to utilisation pressure in both analyses. In most cases, settlement pressure did not cause reductions in diversity, although data from the herbaceous samples for the 1995 growing seasons indicated higher diversity with increasing distance from settlement for all sites except site 1 located within a former settlement. Again for the 1995 growing season, relatively high levels of diversity recorded for this latter site indicated that there is some evidence in support of the prediction that utilisation pressure will promote diversity through stimulating the growth of pioneer, 'weedy' species, but this effect is extremely localised.

Chapter 7

Measures of plant productivity and population structure

7.1 Woody vegetation: density, cover and population structure

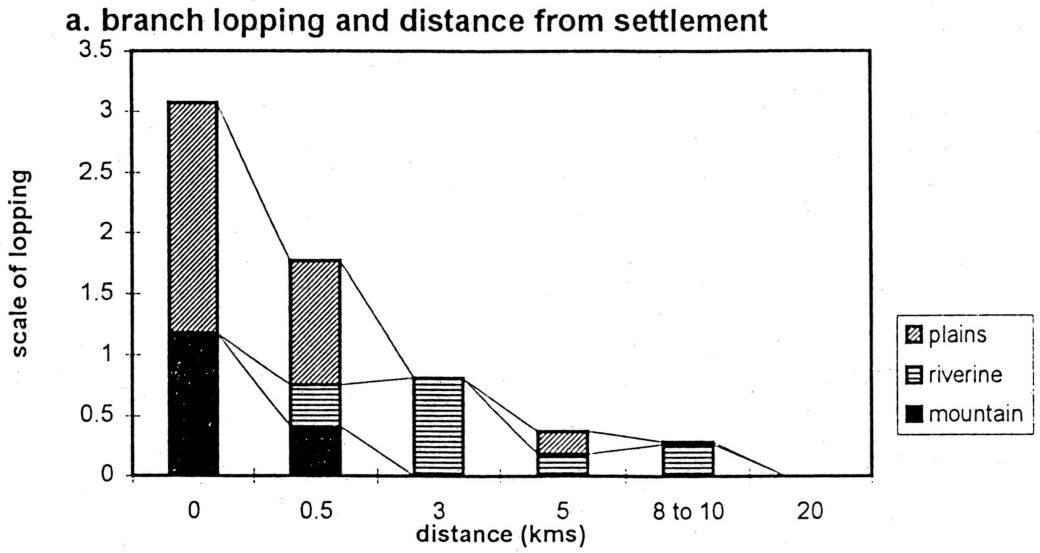
As stated in Chapter 5, it is predicted that the 'deforesting' effects of woody vegetation utilisation will cause:

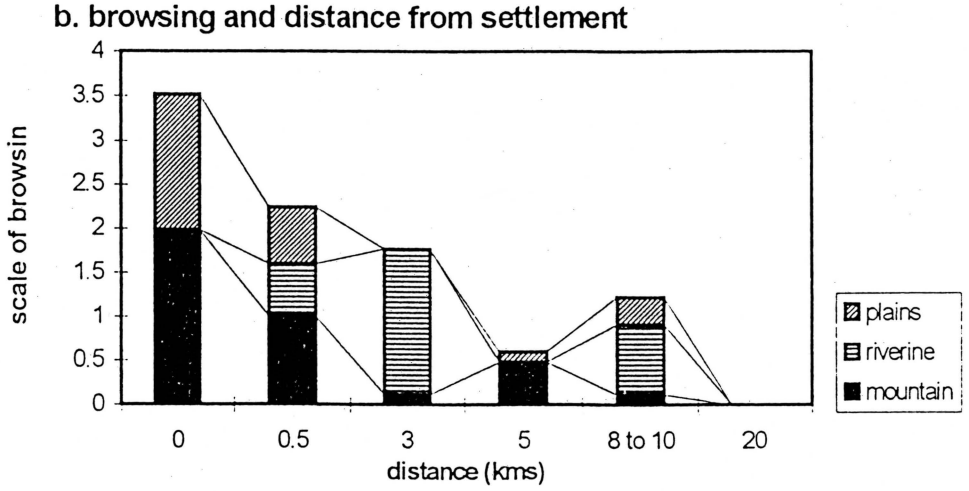
1) A gradient of change in plant density with different proximities to settlements, resulting in either:
   - a reduction in plant density with close proximity to settlement foci, as a result of the removal of woody species;
   - or possibly an increase in plant density with increasing proximity to settlements reflecting the stimulation of vegetative reproduction as a response to utilisation pressure.
2) Plant cover will be affected in a gradient around settlements in the following ways:
   - either basal area will decline with closer proximity to settlements due to the reduction of mature individuals through timber utilisation, and/or the prevention of recruitment to these size classes due to intensive browsing of young individuals by livestock;
   - or basal area will increase with proximity to settlements, reflecting a reduction in the incidence of individuals in the smaller size classes and indicating a lack of regeneration potential in these areas.
3) Finally, it is predicted that the gradients in absolute plant density and cover postulated above will be manifest as trends with distance from settlement in the relative contribution of different plant species to the woody vegetation samples.

Much of the analysis used to test the above hypotheses relied on there being a negative relationship between distance from a settlement and use and pressure on vegetation resources, such that resource utilisation decreases in a gradient around settlements with increasing distance. Multivariate ordination in the previous chapter indicated that this was indeed the case (lopping and browsing had correlation coefficients with distance of -0.46 and -0.5 respectively ($p=0.01$) and, with a coefficient of 0.29, were positively, if weakly, correlated with each other). Figures 7.1a and b provide images of the shape of this relationship.

It could be argued that the browsing of woody perennials in itself indicates an absence of preferred grazing due to degradation of the herbaceous layer. Diet-switching to browse is, however, a dry season strategy employed by all species of livestock throughout dryland areas, and browse may remain an important component of the diet even when grazing resources are abundant (cf. Homewood and Hurst, 1986: 8-9, De Leeuw and Tothill, 1990: 5; Scholte, 1992).

• Figure 7.1a and b. The relationship between resource utilisation, as indicated by a. branch lopping and b. browsing by livestock, and distance from settlement. Figures for scale of utilisation are averages for each topographic-by-distance category and are derived from the use scales defined in Chapter 5.





7.1.1 Density

The mean distance between plant individuals for each of the topographic and substrate categories, and at different distances from settlements, is displayed in Figures 7.2a to d and absolute and relative plant densities by topography, substrate and distance from a settlement are presented in Tables 7.2 and Appendix 5. These relationships were assessed using analysis of variance (ANOVA) and generalised linear modelling (GLM) [1] techniques, which indicated the following:

- The mean distance between plant individuals for each of the topographic categories was significantly different (one-way ANOVA; F = 55.8, p=0.0001), and Bonferroni *post hoc* multiple comparison tests indicated that all of the three categories were significantly different from each other at at least p=0.01. Figure 7.2a demonstrates that transects in the plains topographic category had longer distances between plant individuals (mean =

[1] The SPSS default settings for the calculation of sums of squares were used in all GLM analyses.

11.19m, SE = ±0.39), while those in the mountain topographic category had the shortest (mean = 6.05m, SE = ±0.21).

- Substrate also accounted for significant differences in distance between plant individuals, over and above those attributable to broad differences in topography; a general factorial GLM with topography entered as a fixed factor (i.e. which groups the dependent variable thus allowing the effects of covariables to be tested within these groupings), and substrate as a covariable produced an overall F-test statistic of 74.9, p=0.0001, the value for substrate alone being F = 108.5 at p=0.0001. As Figure 7.2b makes clear, key differences within topographic categories which emerge as a result of substrate factors include the following:
  - within the plains topographic category, which generally speaking is characterised by relatively large distances between plant individuals, small distance values were recorded between plant individuals on sandy loams (mean = 5.16m, SE = ±0.32);
  - transects on alluvial silts yielded relatively high distance measures for the plains topographic category (mean = 13.87m, SE = ±0.52) compared with the mean value of 8.88m (SE = ±0.47) recorded for plant individuals comprising the riverine transects, reflecting the generally higher density characteristic of riparian vegetation;
  - and within the mountain topographic category, the smallest distances between plant individuals were recorded for transects on a dolomite substrate (mean = 4.19m, SE = ±0.23, compared with 7.36m, SE = ±0.33, and 8.56m, SE ±0.68, for calcrete and schist respectively).
- With regard to settlement pressure, and as shown in Table 7.1, a general factorial GLM with topographic category and substrate entered as fixed factors and distance from a settlement assessed as a covariable, produced significant differences in distances between plant individuals by distance from settlement. The F-test statistics presented in Table 7.1, however, indicate that the strength of the effect of distance from settlement is lower than that of either topography or substrate.

Table 7.1. F-test statistics and significance levels for general factorial GLM analysis of the effect of distance from a settlement on distance between plant individuals grouped by topographic category and substrate.

	F	p
model	59.83	0.0001
intercept	374.30	0.0001
fixed factors:		
topographic category	41.98	0.0001
substrate	56.87	0.0001
covariable:		
distance	37.23	0.0001

In addition, Figures 7.2c and d demonstrate that this relationship is ambiguous and nonlinear. In Figure 7.2c, for example, it is only within the mountain topographic category that the mean

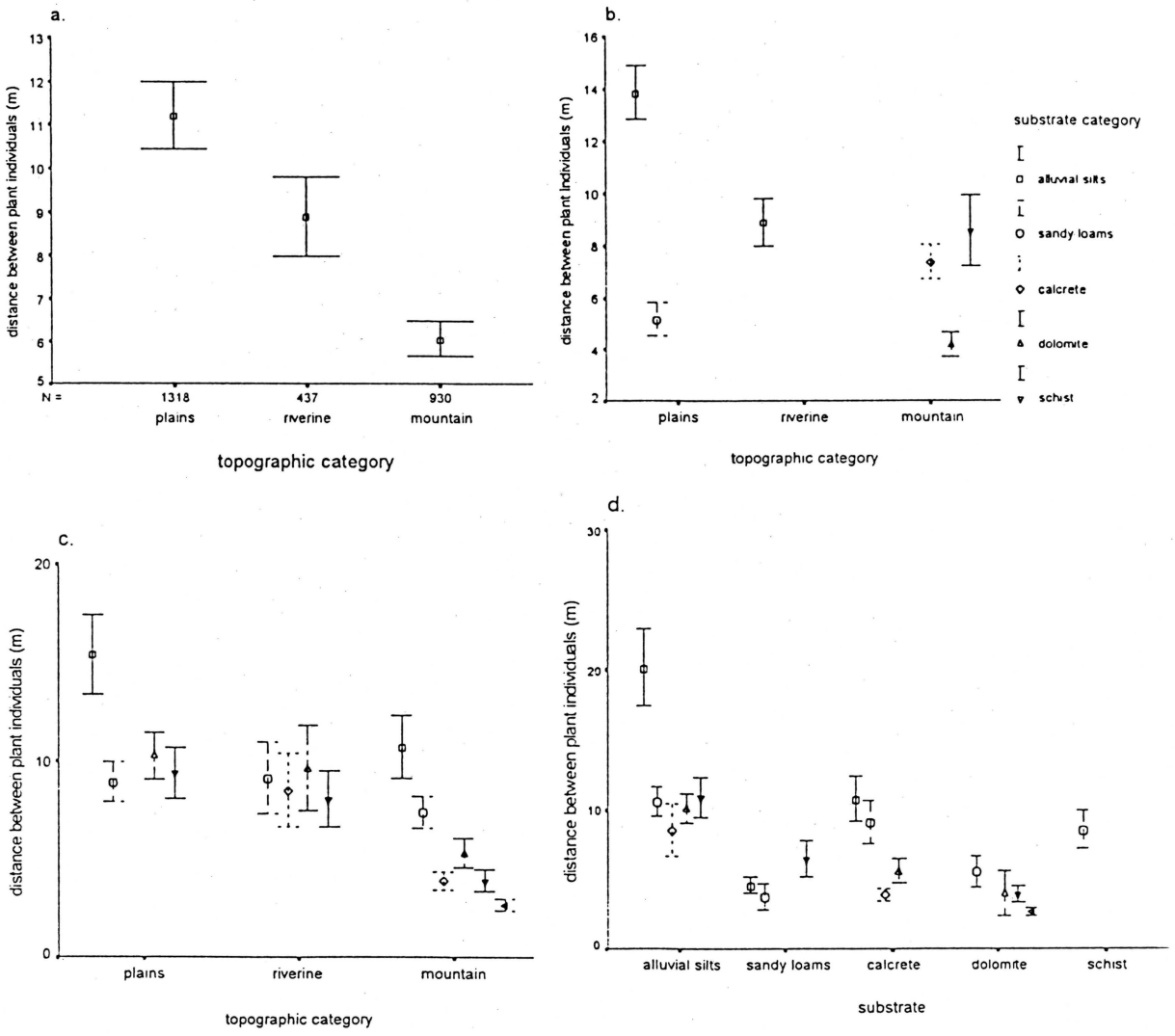
distances between plant individuals tend to decrease with increasing distances from settlement and thus can be considered broadly indicative of a gradient of pressure on these resources around settlement foci. This pattern is even less clear, however, when the mean distances between plant individuals are assessed by substrate (Figure 7.2d); in this case, only the distance measures for dolomite show a slight linear decrease with increasing distance from settlement.

Notwithstanding the general lack of a gradient in resource pressure around settlements in terms of increasing distances between plant individuals, the mean distance between individuals is in fact highest for the transects located nearest to settlements for all sampling categories except the riverine topographic category and the sandy loams substrate. This pattern is indicative of areas of localised impacts on vegetation within settlements. It is also echoed by the measures of absolute density; Table 7.2 shows that the lowest densities were recorded for samples closest to settlements for substrates of alluvial silts, calcrete and dolomite but that there was little indication of a linear increase in plant density with increasing distances from areas of settlement.

- Table 7.2. Absolute density by hectare (*D*/ha) by topographic category, substrate and distance from settlement for the woody vegetation dataset (values are averages for transects within each sampling category). See Table 5.1 for numbers of transects by sampling category.

topographic category	*D*/ha	N	substrate	*D*/ha	N	distance (kms)	*D*/ha	N
plains	84.32	1355	alluvial silts	55.03	940	0	26.08	275
						0.5	84.79	280
						5	99.60	270
						10	55.45	115
			sandy loams	396.83	415	0	500.50	120
						0.5	742.39	120
						8	250.38	175
riverine	128.55	450	alluvial silts	128.55	450	0.5	125.41	120
						3	146.56	90
						5	114.88	120
						8	160.64	120
mountain	288.27	955	calcrete	184.60	480	0	86.21	120
						0.5	120.49	120
						3	647.67	120
						5	315.56	120
			dolomite	569.48	415	0.5	320.00	150
						5	618.81	25
						8	641.03	120
						20	1362.39	120
			schist	136.48	60	0.5	136.48	60

• Figure 7.2a-d. 95% confidence intervals for the mean distance between plant individuals for the woody vegetation dataset for a. topographic category, b. substrate, c. topographic category by distance from settlement, and d. substrate by distance from settlement. Key for c. and d. regarding distance from settlement: □ = 0kms, O = 0.5kms, ◇ = 3kms, ▲ = 5kms, ▼ = 10kms and ◁ = 20kms.



7.1.2 Cover

The mean total basal area by sample, measured in cm^2, was also analysed by topographic category, substrate and distance from settlement again using ANOVA and GLM techniques, and is presented graphically in Figures 7.3a to d. The measures for absolute and relative basal area are tabulated in Tables 7.4 and Appendix 5 respectively. This analysis indicated the following:

- One-way ANOVA and *post hoc* multiple comparison tests confirmed that there were significant differences in total basal area between each of the three topographic categories at p=0.0001 (F = 91.9). As Figure 7.3a demonstrates, plants in the mountain topographic category had the smallest basal area (mean = 253.5cm^2, SE = ±13.9) while those occurring in riverine habitat, with access to deeper soils and greater underground water supplies, had the largest basal areas (mean = 1750.1cm^2, SE = ±182.5).

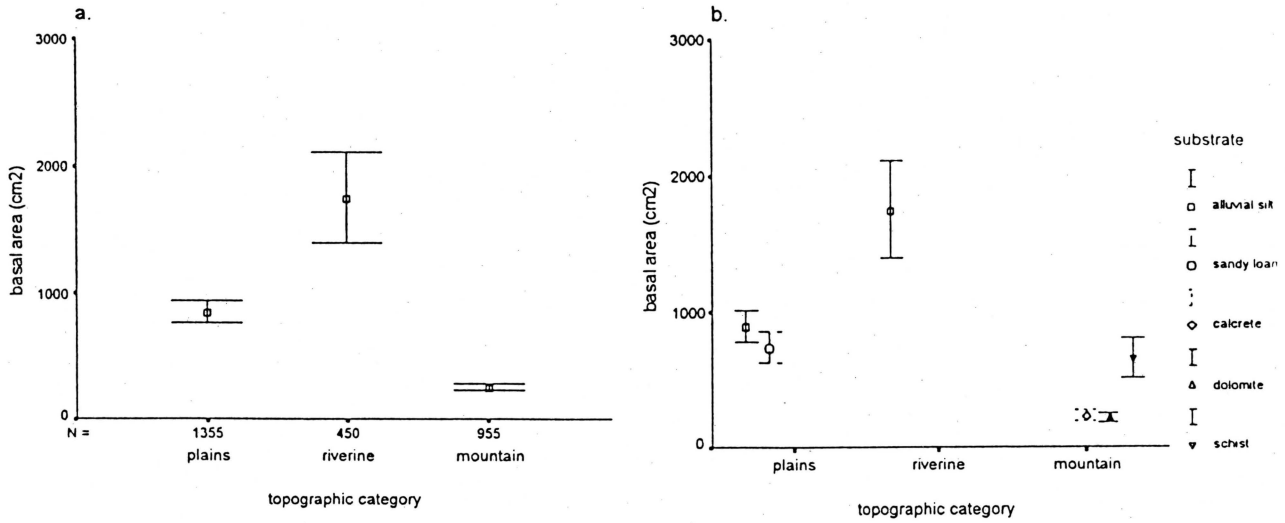
- The effect of substrate on basal area was calculated using a general factorial GLM with topographic category entered as a fixed factor and substrate as a covariable. This produced a significant F-test statistic for the overall model (F = 61.2, p=0.0001) but the effect of substrate alone was not significant (F = 0.5, p=0.83). As Figure 7.3b demonstrates, both substrates within the plains topographic category had similar total basal areas (plants on alluvial silts and sandy loams had mean basal areas of 896.5cm^2 and 741.6cm^2 respectively, SE = ±57.78 and ±57.3). Basal areas for both calcrete and dolomite substrates in the mountain topographic category were also alike (mean = 233.8cm^2 and 217.2cm^2 respectively, SE = ±46.6 and ±16.6), while plants on schist had a larger mean basal area (mean = 662.3cm^2, SE = ±72.3), although this could be an artefact of the smaller sample size for this substrate category (N = 60).

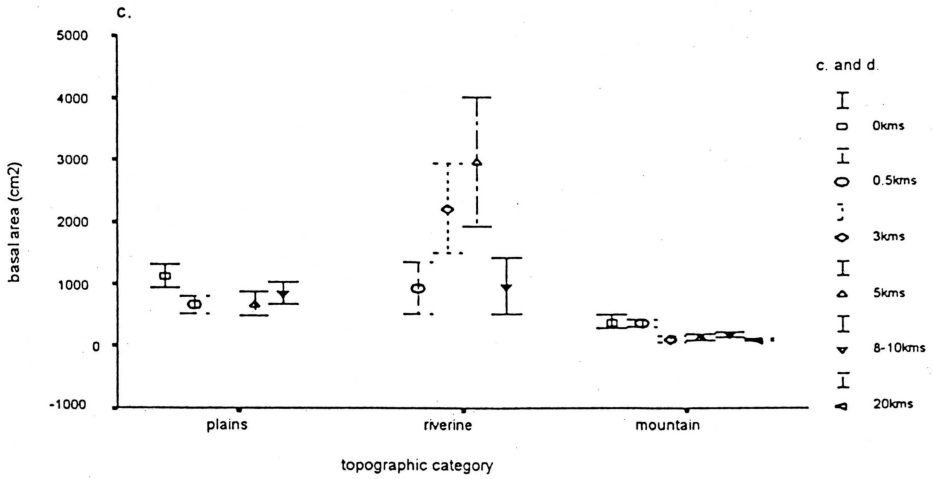
- The relationship between basal area and settlement pressure, within the topographic and substrate categories, was assessed using a general factorial GLM with basal area as the dependent variable, distance from settlement as a covariable, and topography and substrate entered as fixed factors. The results of this are summarised in Table 7.3 from which it is clear that the role of distance from a settlement in determining basal area is extremely small (F = 2.66) and is not significant (p=0.1). This is corroborrated by Figures 7.3c and d which also make clear the lack of trend in the dataset associated with distance from a settlement.

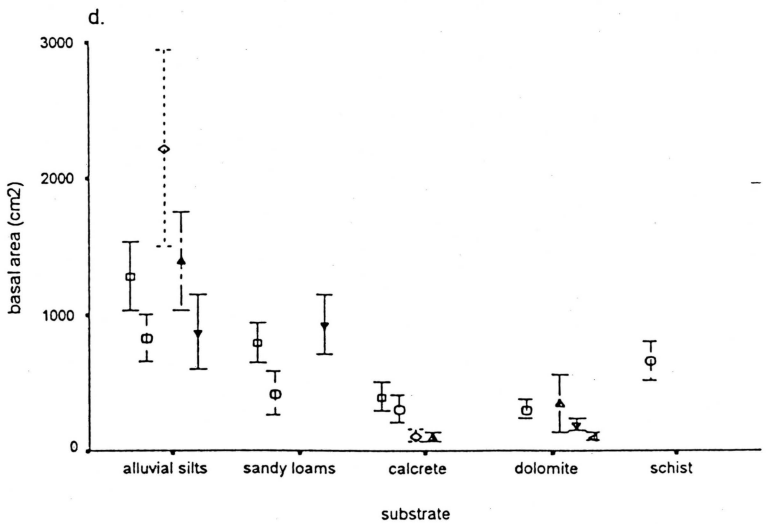
• Table 7.3. F-test statistics and significance levels for general factorial GLM analysis of the relationship between distance from a settlement and plant basal area grouped by topographic category and substrate.

	F	p
model	31.88	0.0001
intercept	99.62	0.0001
fixed factors:		
topographic category	61.38	0.0001
substrate	1.28	0.2790
covariable:		
distance	2.66	0.1030

• Figure 7.3a-d. 95% confidence intervals for the mean basal area in cm^2 of plant individuals for the woody vegetation dataset for a. topographic category, b. substrate, c. topographic category by distance from settlement, and d. substrate by distance from settlement.







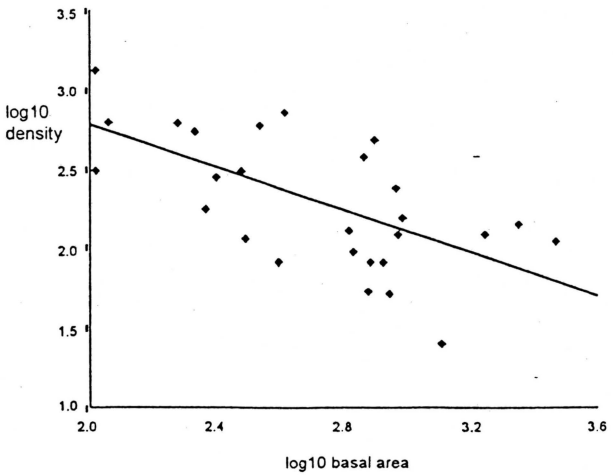
• Table 7.4. Absolute basal area in cm^2 for all plant individuals by topographic category, substrate and distance from settlement for the woody vegetation dataset. Values are averages for transects within each sampling category.

topographic category	*basal area*	N	substrate	*basal area*	N	distance (kms)	*basal area*	N
plains	849.06	1355	alluvial silts	896.48	940	0	1281.21	275
						0.5	777.08	280
						5	685.84	270
						10	761.72	115
			sandy loams	741.64	415	0	794.79	120
						0.5	418.75	120
						8	926.61	175
riverine	1750.1	450	alluvial silts	1750.05	450	0.5	946.47	120
						3	2221.67	90
						5	2972.00	120
						8	977.95	120
mountain	253.49	955	calcrete	233.75	480	0	401.65	120
						0.5	312.28	120
						3	115.62	120
						5	105.44	120
			dolomite	217.21	415	0.5	304.38	150
						5	347.82	25
						8	192.69	120
						20	105.55	120
			schist	662.29	60	0.5	662.29	60

7.1.3 Dominance

In order to assess the relative importance of each species within the different topographic, substrate and distance-from-settlement categories, the density and basal area measures were combined into a single measure of plant dominance, to provide a more accurate quantitative measure of the contribution, in terms of biomass, of a species to a vegetation community. Overall, the woody vegetation dataset displayed a strong linear relationship between the log-transformed values for absolute density and basal area measures calculated for each of the sampling categories ($R^2 = 0.37$, $F = 16.3$, $p=0.0001$, $N = 27$). As Figure 7.4 demonstrates, this takes the form of a tendency for larger basal areas to occur where plant density is relatively low and *vice versa*.

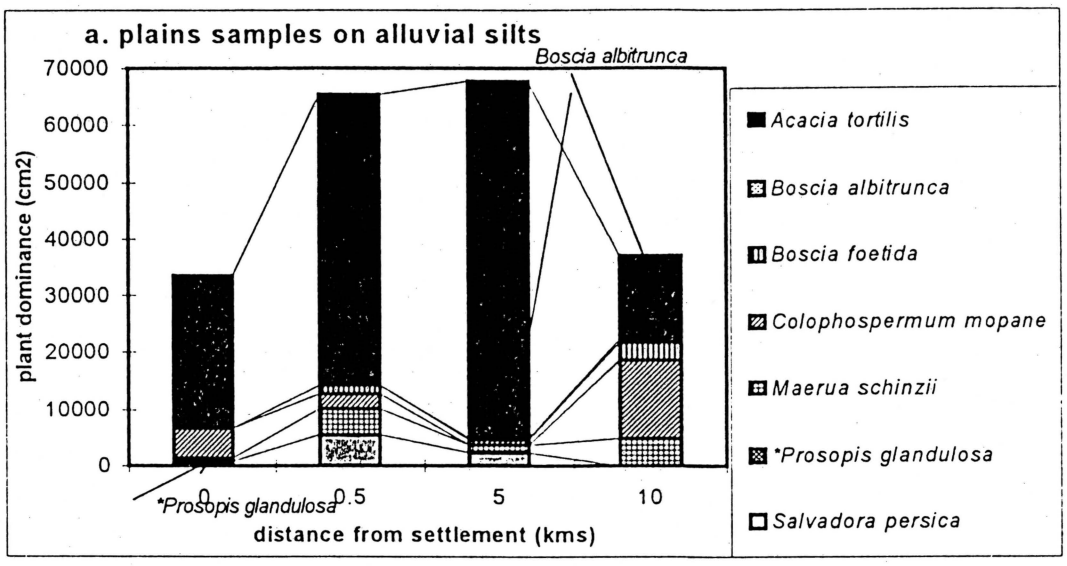
• Figure 7.4. Scatter graph and regression line demonstrating the relationship between the log-transformed values for plant density (individuals per hectare) and cover (basal area in cm^2) calculated by sampling category.

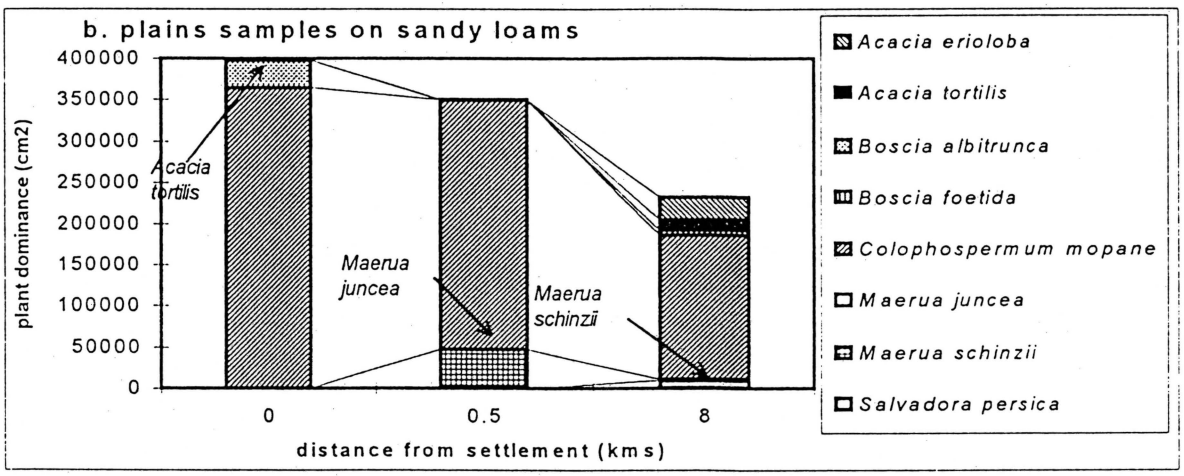


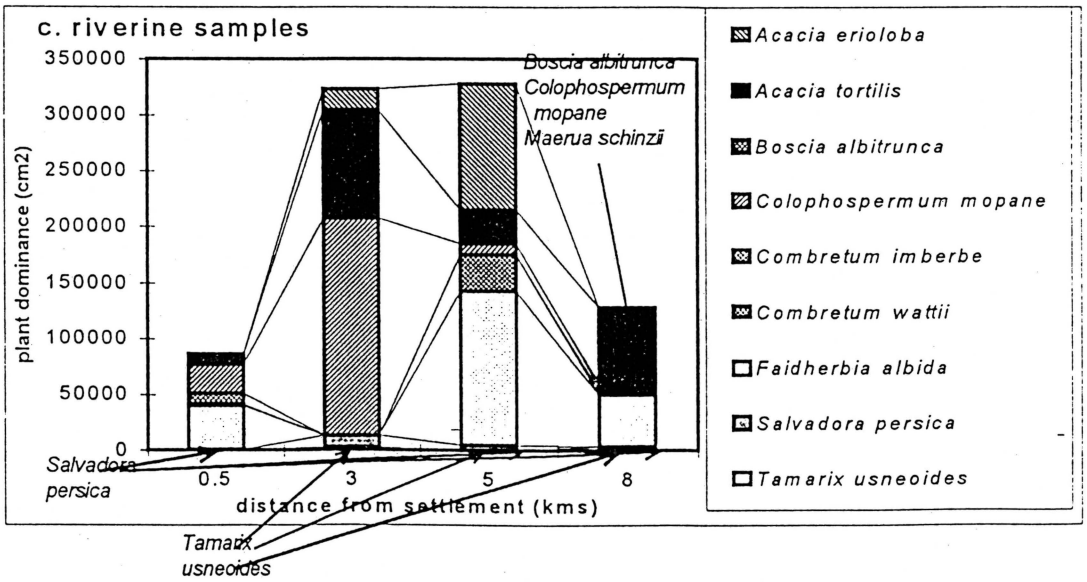
Relative species dominance by distance from settlement is presented graphically for each substrate in Figures 7.5a-e and is tabulated by topography, substrate and distance in Appendix 5. At least the five highest ranking species are presented for each sampling category. Again, the most important feature of this analysis is the overall lack of directional trend in species dominance with distance from a settlement. For example, the graphs in Figures 7.5a to e clearly show that both relative dominance, and absolute dominance as represented by the species included in these graphs, are extremely variable between different distances from settlements. Features which may bear a causal relationship to settlement and use pressures on these vegetation resources include:

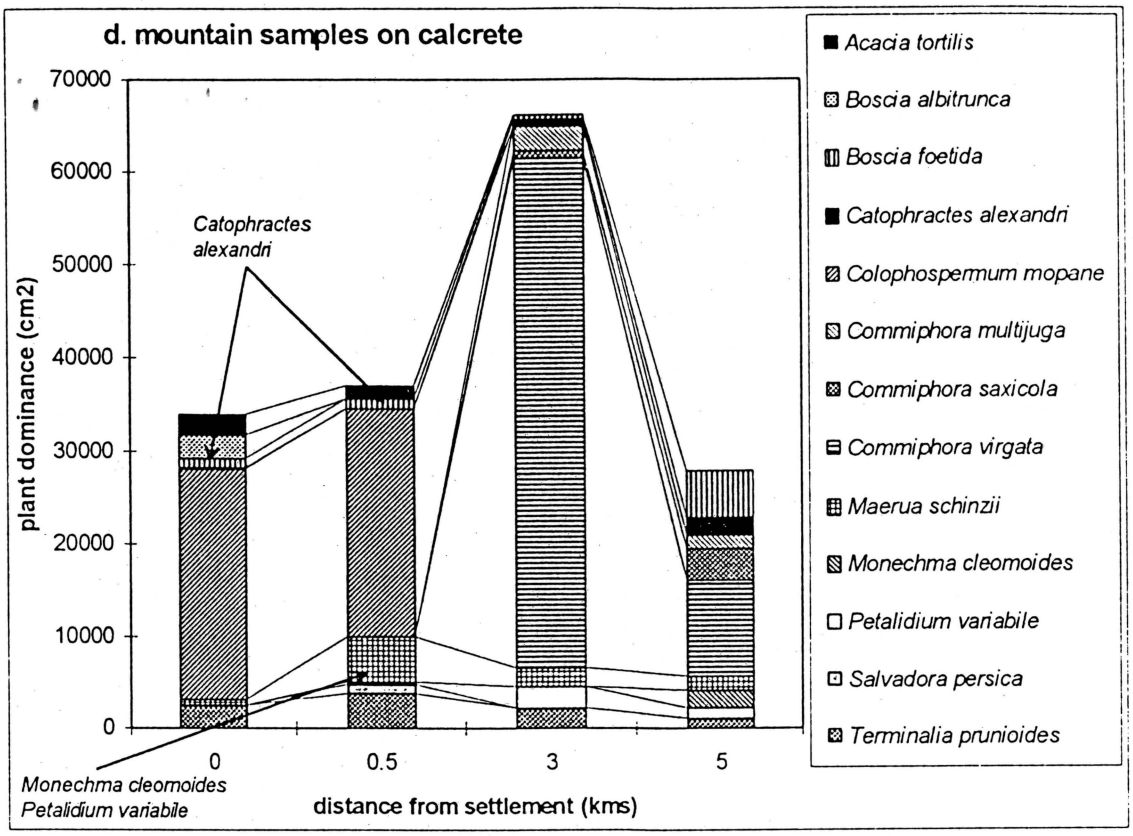
- For all the substrate categories except sandy loams, low figures for total dominance arise for the distance class with the closest proximity to settlement. This may indicate that settlement pressure is acting to reduce the biomass of woody vegetation. This type of interpretation is problematic, however, due to the extremely small margin by which these figures are low compared to the remaining distance classes, and by the fact that for all substrate categories total dominance is also relatively low for the distances furthest away from settlements.
- Conversely, for the sandy loams substrate category total plant dominance was highest for the samples with the closest proximity to settlement, which may indicate that pressure from utilisation is actually promoting the productivity of woody vegetation, specifically *Colophospermum mopane*.
- With regard to the relative dominance of different species, again there is a great deal of non-directional variation between distances from settlement. Possible distance effects include:
    - Figure 7.5b demonstrates that *Colophospermum mopane* on sandy loams decreases in dominance with distance from settlement; this reflects a corresponding reduction in overall biomass accompanied by a greater diversity of species in the distance class furthest from settlement;
    - the dominant species for samples on calcrete, as shown in Figure 7.5d, changes with distance such that *C. mopane* is dominant with closer proximity to settlement while *Commiphora virgata* dominates in the two distance classes further away from settlement.

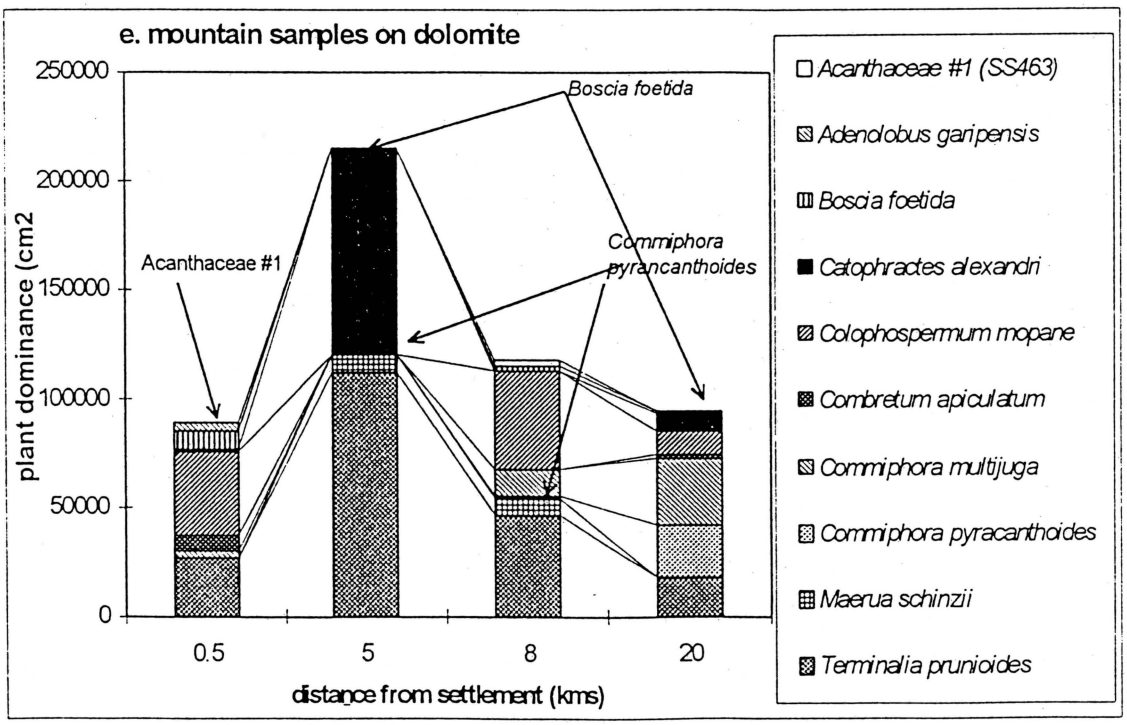
- Figure 7.5a to e. Relative dominance of (at least) the five highest ranked species for each substrate category by distance from a settlement. Nb. because the species ranks are not the same for each distance class, more than 5 species may be represented for a class.








d. mountain samples on calcrete
plant dominance (cm2)
70000
60000
50000
40000
30000
20000
10000
0
Catophractes alexandri
Monechma cleomoides
Petalidium variabile
0
0.5
3
5
distance from settlement (kms)
Acacia tortilis
Boscia albitrunca
Boscia foetida
Catophractes alexandri
Colophospermum mopane
Commiphora multijuga
Commiphora saxicola
Commiphora virgata
Maerua schinzii
Monechma cleomoides
Petalidium variabile
Salvadora persica
Terminalia prunioides


e. mountain samples on dolomite
plant dominance (cm2
250000
200000
150000
100000
50000
0
Boscia foetida
Acanthaceae #1
Commiphora pyracanthoides
0.5
5
8
20
distance from settlement (kms)
Acanthaceae #1 (SS463)
Adenolobus garipensis
Boscia foetida
Catophractes alexandri
Colophospermum mopane
Combretum apiculatum
Commiphora multijuga
Commiphora pyracanthoides
Maerua schinzii
Terminalia prunioides

7.1.4 Population structure of selected species

For the two species selected for analysis of population structure, measures of branch cutting and browsing were significantly correlated with distance from settlement (see Table 7.5), thus indicating that the latter variable was a good indirect measure of utilisation pressure.

- Table 7.5. Correlation coefficients for measures of branch cutting and browsing with distance from settlement for the two species selected for analysis of population structure.

	Acacia tortilis (N = 663)		*Colophospermum mopane* (N = 341)	
	cut	browse	cut	browse
Spearman's rank	-0.486	-0.479	-0.726	-0.664
p	0.0001	0.0001	0.0001	0.0001

One-way analyses of variance for the size measures of height and basal diameter by distance from settlement were again highly significantly different (see Table 7.6), suggesting that use pressure was having a significant effect on the population structure of *Acacia tortilis* and *Colophospermum mopane*.

- Table 7.6. Results of one-way ANOVA of height and basal diameter measures by distance from settlement for *Acacia tortilis* and *Colophospermum mopane*.

	Acacia tortilis		*Colophospermum mopane*	
	height	basal diameter	height	basal diameter
N	507	663	309	341
F	8.772	5.187	20.678	24.547
p	0.0001	0.002	0.0001	0.0001
df	3	3	2	2

Figures 7.6 and 7.7 graphically depict both the means and the size class distributions of the height and basal diameter measures for *Acacia tortilis* and *Colophospermum mopane* respectively. The implications of these results are discussed separately below for these two species.

Acacia tortilis

Figures 7.6a and c indicate that both height and basal diameter measures were smaller with increasing distance from settlement. This could be interpreted as suggesting that recruitment of juveniles, i.e. smaller individuals, is adversely affected by settlement pressure, possibly with long-term consequences for the viability of the population. *Post hoc* multiple comparison tests, however, demonstrated that any damage to potential recruitment, as reflected by these size measures, was extremely localised being confined to individuals within settlements: the mean differences for height were only significant (at at least p=0.003) between individuals located within settlements and those from the remaining distance classes, while basal diameter measures from within settlements were significantly different to those from 0.5 and 10kms from settlement. The mean differences in height and basal diameter measures from 0.5, 5 and 10kms from settlements were not significantly different to each other.

A rather different picture emerges from analysis of the size class distributions for both height and basal diameter in Figures 7.6b and d respectively. For example, Figure 7.6b shows that

the reason for the relatively high mean heights for *Acacia tortilis* measured within settlements is the higher frequency of extremely tall individuals in these samples which has the effect of pulling the mean upwards; frequencies of individuals in the <2m regeneration size classes were comparable to those from distances further away from settlement. These could perhaps be due to the effects of branch cutting in reducing the size of otherwise larger individuals; the extremely significant positive correlation between height and basal diameter (Pearson's correlation = 0.8, p=0.0001, N = 507), however, suggests that levels of cutting are not high enough to reduce the positive relationship between these size measures. This relationship remains significant and positive when only those individuals from within settlements, i.e. those subject to the greatest utilisation pressure, are correlated (Pearson's correlation = 0.82, p=0.0001, N = 135).

With regard to basal diameter, Figure 7.6d suggests that the data conforms well to the reverse J-shaped distribution associated with healthy tree populations displaying high recruitment potential, and that the size distributions of individuals from all distances from settlements is closely related.

Colophospermum mopane

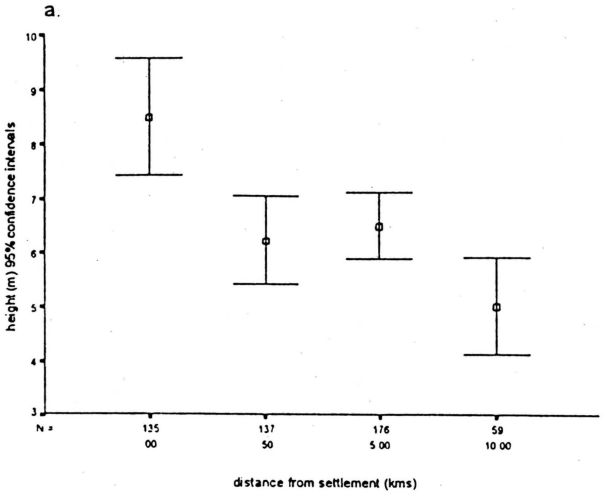
Figures 7.7b and d suggest that *Colophospermum mopane* is considerably taller within settlements than in populations on the outskirts and 8kms away from settlements, while mean basal diameter varies non-linearly by distance from settlement with individuals within settlements being intermediate between those sampled 0.5 and 8kms away. *Post hoc* multiple comparison tests confirm this; the height of *C. mopane* occurring within settlement is significantly different from measured individuals located elsewhere, while significant differences in basal diameter occur between individuals measured within and on the outskirts (0.5kms away) from settlement, and between those 0.5 and 8kms away from settlement (all significant at p=0.0001).

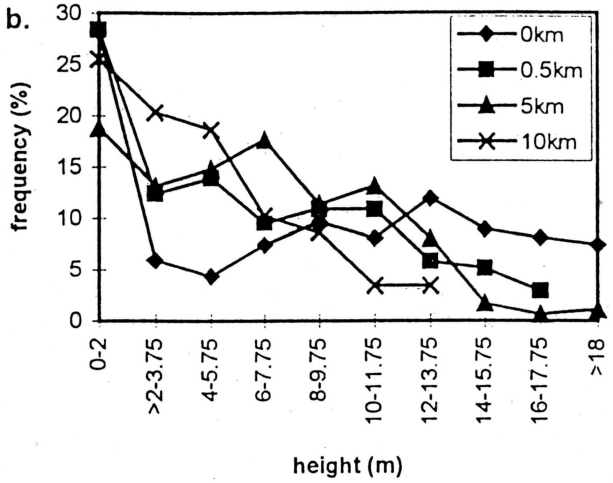
Analysis of the size class distributions shown in Figures 7.7b and d indicates that, as with *Acacia tortilis*, part of the reason for the high mean for height for individuals measured within settlement is due to the high frequency of individuals >6m tall; there are similar frequencies of individuals in the smallest height classes, i.e. <2m, compared with those recorded for distances 0.5 and 8kms from settlement, although somewhat smaller frequencies in the recruitment size classes, i.e. 2-4m. In Figure 7.7d low frequencies for the smallest size classes for individuals located within settlement possibly indicate localised negative effects on regeneration, but high numbers of seedlings for samples 0.5kms away from settlement suggest that, if this is the case, the effects are extremely small-scale.

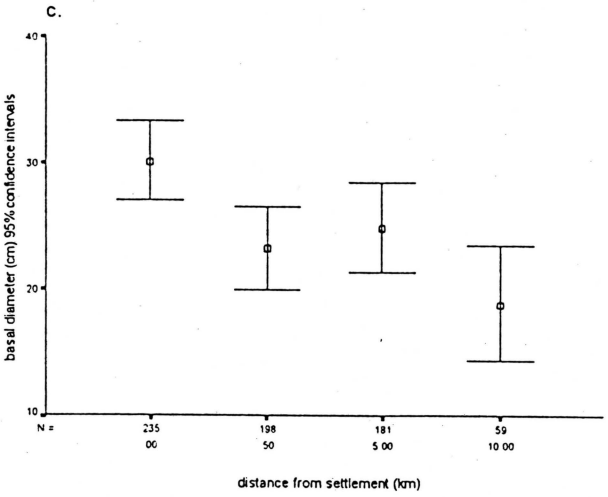
Height and basal diameter measures were again positively correlated, both for the whole sample (Pearson's correlation = 0.68, p=0.0001, N = 309), and for individuals located within settlement (Pearson's correlation = 0.7, p=0.0001, N = 118), indicating that the higher

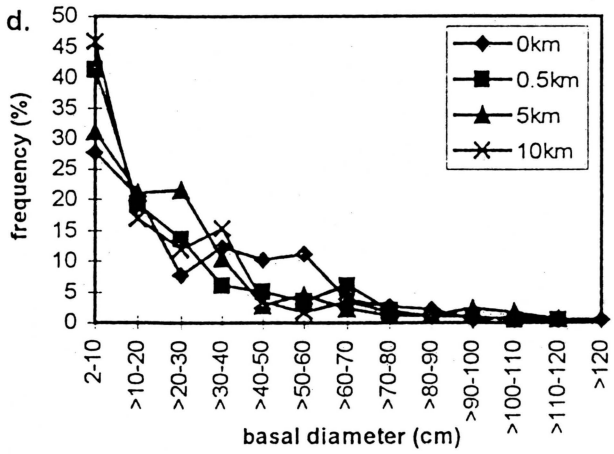
incidence of cutting with proximity to settlement was not significantly affecting this relationship through reducing the height of individuals.

- Figure 7.6a to d. Population structure of *Acacia tortilis* by distance from settlement; a. 95% confidence intervals for height by distance, b. height class distribution by distance, c. 95% confidence intervals for basal diameter by distance, and d. basal diameter size class distribution by distance

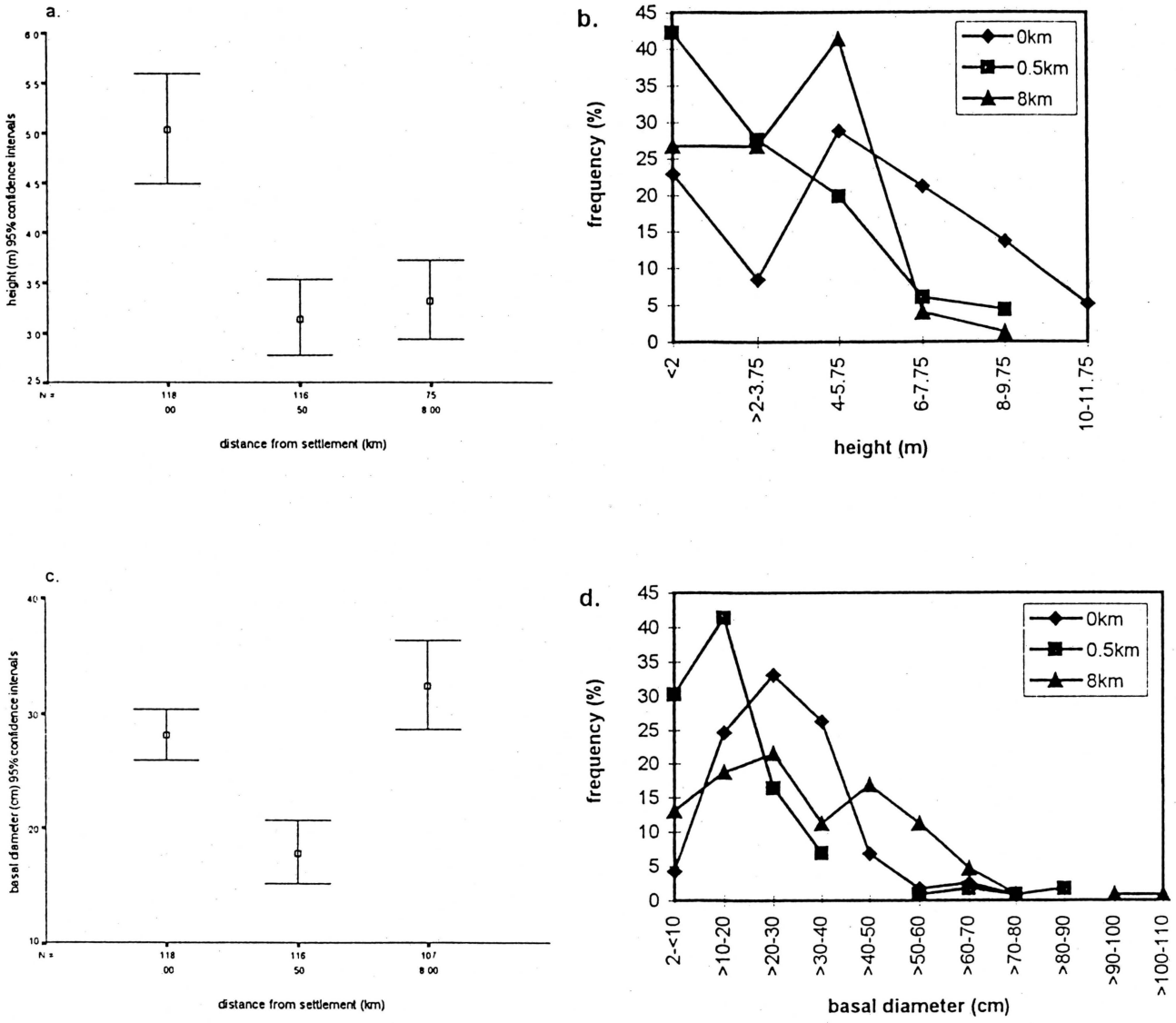








• Figure 7.7a to d. Population structure of *Colophospermum mopane* by distance from settlement; a. 95% confidence intervals for height by distance, b. height class distribution by distance, c. 95% confidence intervals for basal diameter by distance, and d. basal diameter size class distribution by distance.



7.1.5 Summary: resource-use impacts on population parameters for woody vegetation

Testing of the effects of settlement pressure on various parameters of woody vegetation population structure indicated the following:

1) The greatest effects on mean distance between trees, i.e. a measure which reflects plant density, were by topographic category followed by substrate, although distance from settlement also had a high and significant explanatory value. The relationship between mean distance between woody plants and distance-from-settlement, echoed by the density values calculated for these sampling categories, however, was nonlinear. Relatively large mean distances between trees and low densities for samples within settlements, for all substrates except sandy loams, may nevertheless reflect the effects of localised impacts on timber resources.

2) Variations in plant cover were explained largely by topographic factors. Distance from settlement had a negligible and statistically insignificant effect.

3) Absolute and relative plant dominance (combining measures of plant density and cover) varied greatly in relation to distance from settlement but these variations were non-directional. Relatively low dominance values for samples closest to settlement may again reflect the effects of localised pressure on resources. These values are generally within the total range demonstrated by topographic and substrate categories, however, suggesting that settlement pressure does not exceed the spatial variability displayed at the scale of observation employed in this study.

4) Analysis of the population structure of *A tortilis* and *C. mopane* suggests that the former conforms to a healthy size class distribution for all distances from settlement, while regeneration of the latter appears slightly lower for samples within settlement. High and significant positive correlations between height and basal diameter for both species suggest that levels of cutting are not high enough to distort the expected form of this relationship.

7.2 Herbaceous vegetation

7.2.1 Cover and dominance

Herbaceous ground cover was assessed to test the following predicted effects of direct and indirect pressure by livestock:

1) Cover values for live above-ground herbaceous biomass and plant litter will be higher, and for bare ground will be lower:
   - with increasing distance from settlement;
   - within fenced plots from which livestock have been excluded;
   - and the latter effect will be more pronounced in the second year of study.

2) As with the woody vegetation dataset, it is predicted that the relative contribution of different species to the herbaceous vegetation samples will be affected by differences in livestock pressure.

Cover abundances recorded for both total and species-specific above-ground live biomass, plant litter and bare ground, and the relationship of these with the various environmental parameters recorded for this dataset, were analysed using multivariate ordination procedures and analysis of variance complemented by paired samples t-tests. The results of these are discussed separately below.

Analysis of variance (ANOVA)

A simple factorial ANOVA procedure[2] was used to test for differences in the means of the cover abundances recorded for each sample, and the extent to which these differences could be explained by enclosure of the plots, growing season and site, as well as the interaction of these with each other[3]. These parameters were entered as factors in the model with cover abundance, namely of above-ground live biomass, grasses, forbs, plant litter and bare-ground, as dependent variables. Separate analyses were conducted to assess variations in cover for quadrat enclosure by year, and enclosure by site, in order to draw out differences in particular components of cover which would be masked by a single analysis combining enclosure, year and site as factors. The results are tabulated in Table 7.7 and explored graphically in Figures 7.8a-f. Table 7.8 contains the mean and percentage pin strikes for total above-ground biomass, plant litter and bare ground, while Appendix 6 and Figures 7.9a-c present the relative cover values for each species. Important features of this analysis include the following:

- The effects of both year and site were highly significant with regard to all of the cover variables, although the higher F-ratios for year indicate that temporal variability had a stronger impact on productivity than spatial variability (see Table 7.7). This corroborates the floristic analysis of the dataset which indicated that site location and growing season were determining the patterns in the dataset, and emphasises the spatial and temporal patchiness of this dryland environment. Figures 7.8a, c and e illustrate these differences demonstrating that values for live above-ground biomass were highest for the first growing season when they were particularly high for sites 5 and 6, while bare ground and, to a lesser extent, plant litter, had higher values in the second year of study. These reflect the different rainfall conditions of the two growing seasons represented by this study. It should also be noted that the high productivity displayed in 1995 occurred despite the location of sites on fine-textured soils which are considered to readily exhibit apparent signs of degradation through erosion and surface crusting (cf. Jobst, 1995: 36). Figures 7.10 of fixed point photographs taken at different times during the course of fieldwork at four of the herbaceous vegetation sites give a visual indication of this extreme variability in herbaceous biomass.
- The relationship between the location of the different sites with regard to distance from a settlement and the between-site differences in cover abundances is rather ambiguous. For example:
    - sites 5 and 6, with the highest values for live above-ground biomass in 1995 occurred

---

[2] Nb. this procedure is interchangeable with the General Factorial GLM option in SPSS release 7.

[3] Despite having matched pairs for the enclosed *versus* unenclosed quadrats and repeat measures for the data recorded by growing season, this type of ANOVA was used in preference to a mixed-factorial MANOVA to allow all the data to be included in the analysis, given that three plots were lost from the 1996 dataset due to damage by livestock (see Chapter 5).

- at 0.5km and 5kms from a settlement respectively, while site 2, with high biomass values relative to sites 1, 3 and 4, occurred only 0.5km from the settlement of Sesfontein to which it was much closer than either sites 3 or 4 (see Figure 7.8a);
- site 1, despite its relatively high values for diversity (Chapter 6), had the lowest values for both plant biomass and litter (see Figures 7.8a and c). Given that this was the site with the most intense history of settlement, this result conforms to the first prediction stated above;
- site 6 in the second year of the study had by far the highest values for plant litter. This in part reflects the high live biomass values for this site in 1995, but is also due to the high incidence of dead material from the relatively robust legume *Sesbania sphaerosperma* at this site which, through its ability to withstand the effects of weathering and trampling by livestock, contributed to the high litter values recorded for this site in 1996 (see Figure 7.8c);
- the values for bare-ground varied substantially between sites, although for both years of the study they are highest at site 1 and lowest at site 6, thus reflecting the low and high values for plant biomass and litter recorded for these sites respectively (see Figure 7.8e), which in turn reflects the differences in soil moisture and rainfall recorded for these sites in 1995 *versus* 1996;
- site 1, which occurred within a former and now reclaimed settlement site, produced, as would be expected, the highest values for bare ground. Conversely, however, site 4, which was located at the furthest distance away from a settlement for this dataset, had the second highest values for bare ground in both years of the study (again, see Figure 7.8e).

■ Treatment of the quadrats as enclosed or unenclosed was only ever significant for plant litter and bare ground and not for above-ground biomass (see Table 7.7). This effect of enclosure was maintained only in combination with year and not when tested in combination with site. Figures 7.8d and f demonstrate that the differences due to enclosure emerged in the second year of data collection when plant litter was substantially higher within the fenced quadrats and bare-ground was correspondingly higher in the quadrats which remained unfenced. Both these variables had extremely similar values for the first year of the study irrespective of enclosure of the quadrat, and this was also true for the values for live above-ground biomass for both years of the study (see Figure 7.8b). Paired samples t-tests emphasise these differences; the effect of enclosure in the first year of study was not significant for any of the cover variables but

was highly significant for plant litter and bare ground in the second year of study (t = -4.59, df = 20, p=0.0001 and t = 6.5, df = 20 and p=0.0001 respectively)[4].

- Table 7.7. Results of simple factorial ANOVA of cover abundances by treatment of quadrats as enclosed or unenclosed, year and site. Results significant at less than p=0.01 are printed in bold and marked with an asterix.

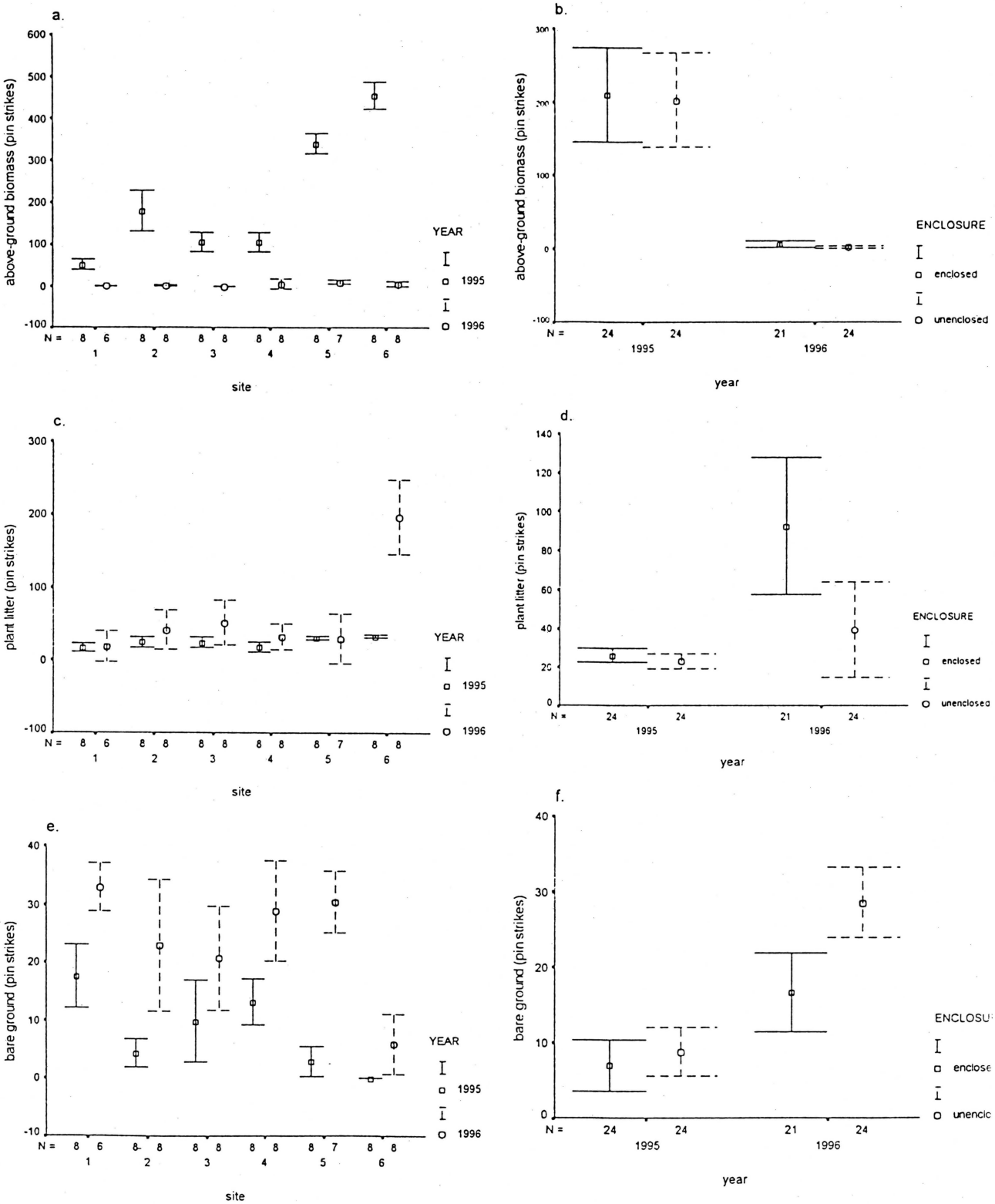
enclosure by year:	**main effects:**						**interaction:**		
	enclosure			year			enclosure by year		
	df	**F**	**p**	**df**	**F**	**p**	**df**	**F**	**p**
total live above-ground biomass	1	0.06	0.8100	**1**	**79.96**	***0.0005**	1	0.01	0.9410
grasses	1	0.01	0.9450	**1**	**79.52**	***0.0005**	1	0.01	0.9430
forbs	1	0.67	0.4160	**1**	**25.02**	***0.0005**	1	0.00	0.9580
plant litter	1	**8.12**	***0.005**	**1**	**17.66**	***0.0005**	**1**	**6.59**	***0.012**
bare ground	1	**11.67**	***0.001**	**1**	**54.07**	***0.0005**	**1**	**6.46**	***0.013**
enclosure by site:	**main effects:**						**interaction:**		
	enclosure			site			enclosure by site		
	df	**F**	**p**	**df**	**F**	**p**	**df**	**F**	**p**
total live above-ground biomass	1	0.15	0.6990	**5**	**5.58**	***0.0005**	5	0.02	1.0000
grasses	1	0.05	0.8310	**5**	**5.41**	***0.0001**	5	0.02	1.0000
forbs	1	1.37	0.2450	**5**	**9.44**	***0.0005**	5	0.14	0.9840
plant litter	1	**7.14**	***0.009**	**5**	**10.57**	***0.0005**	5	0.26	0.9340
bare ground	1	**8.67**	***0.004**	**5**	**6.59**	***0.0005**	5	0.38	0.8610

[4] Due to the loss of three fenced plots in the second year of study (as explained in the methods section) the number of matching pairs of enclosed and unenclosed plots for each year of the study was 21.

• Table 7.8. Relative cover abundances by site and year for above-ground live biomass, plant litter and bare ground. The figures for each site are the means for that site.

site:	1		2		3		4		5		6	
year:	(n=8) 1995	(n=6) 1996	(n=8) 1995	(n=8) 1996	(n=8) 1995	(n=8) 1996	(n=8) 1995	(n=8) 1996	(n=8) 1995	(n=7) 1996	(n=8) 1995	(n=8) 1996
total pin strikes (%):												
above-ground live biomass	51.6 (60.4)	0.6 (1.2)	178.9 (86.2)	2.2 (03.2)	105.3 (75.7)	0.2 (01.4)	105.4 (77.3)	6.3 (09.4)	339 (91.0)	10.5 (14.9)	454.1 (93.2)	5.3 (02.6)
plant litter	16.4 (19.2)	18.3 (35.4)	24.3 (11.7)	41.4 (61.0)	24.1 (17.3)	51.4 (71.2)	17.9 (13.1)	32.1 (47.7)	30.8 (08.3)	29.7 (42.1)	33.0 (06.8)	195.6 (94.6)
bare ground	17.5 (20.5)	32.8 (63.4)	4.3 (02.1)	24.3 (35.8)	9.8 (07.0)	20.6 (28.5)	13.1 (09.6)	28.9 (42.9)	2.9 (00.8)	30.4 (43.1)	0 (00.0)	5.9 (02.9)

- Figure 7.8a to f. 95% confidence intervals illustrating the relationship between the cover values recorded for above-ground biomass, plant litter, and bare ground with site by year (Figures 7.8a, c and e) and enclosure by year (Figures 7.8b, d and f).

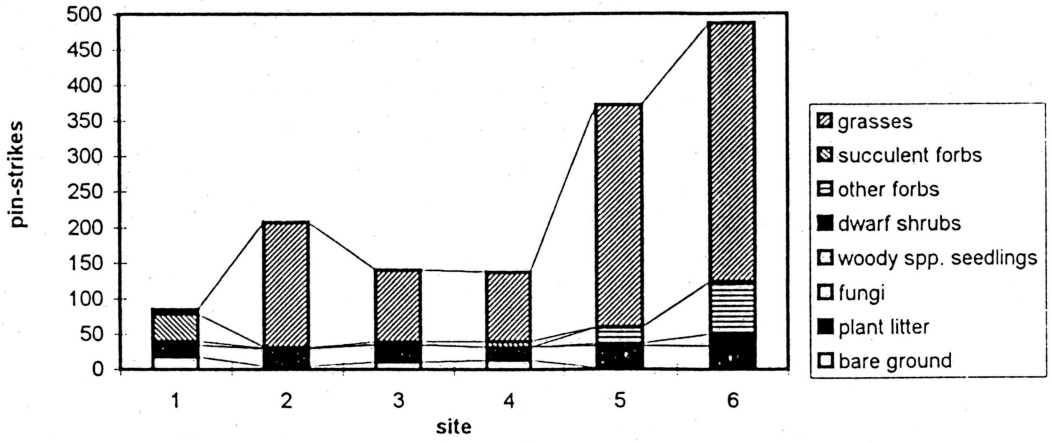


In terms of the relative cover values for different species and categories of species recorded following the good rains of 1995, and as noted for the woody vegetation dataset above, herbaceous vegetation showed a high degree of variation, little of which appeared to be related to proximity to settlement (see Figures 7.9a to c and Appendix 6a and b). Important points include:

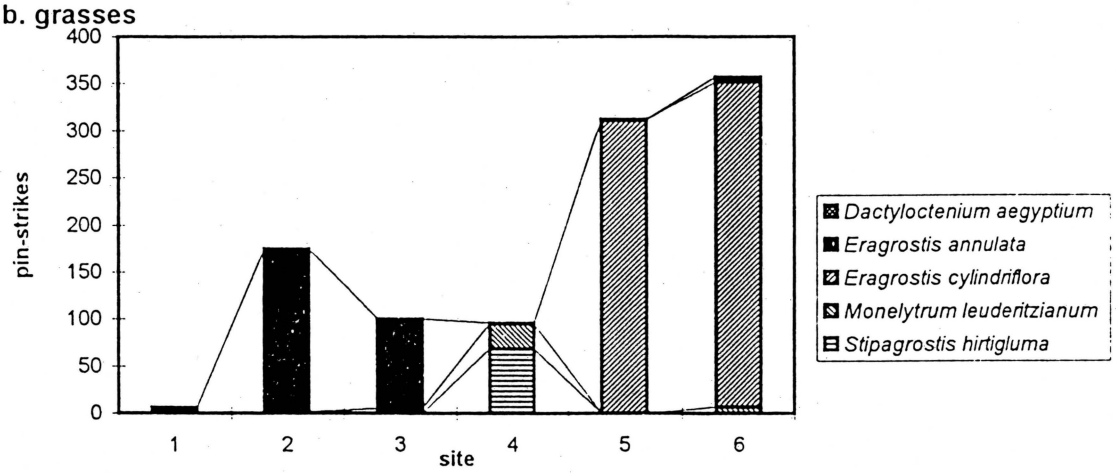
- Grass biomass was relatively high compared to other herbaceous species at all sites except site 1. This latter site had a higher proportion of forbs, particularly the succulent species *Zygophyllum simplex* and *Trianthema triquetra*, which may reflect substantial changes from a species assemblage dominated by grasses to one characterised by pioneer 'weedy' species. In the remaining sites, differences in the biomass of grasses *versus* forbs were consistently of an order of magnitude, with grasses accounting for at least five times the plant cover attributable to forbs in all cases. Both the highest absolute cover values for forbs, and the highest proportion of total plant cover accounted for by forbs, occurred at sites 5 and 6 (see Appendix 6) where productivity was generally greater, reflecting high soil moisture values for these sites;
- Figures 7.9b and c emphasise the variability between sites in both species composition and productivity of grasses and forbs. With regard to distance from settlement, the following points are of interest:
  - sites 3 and 4, and sites 5 and 6, are characterised by very similar values for grass biomass; the latter pair by the same species, *Eragrostis* cf. *cylindriflora*, and the former pair by different species. The sites within each of these pairs are separated by several kilometres with regard to settlement and these values indicate that distance from settlement has little effect on the productivity of grass biomass;
  - site 2, occurring on the outskirts of the settlement of Sesfontein, displayed considerably higher grass cover values than site 3 which was located several kilometres from the same settlement, despite sharing extremely similar species assemblages;
  - the proportion of biomass accounted for by forbs, often considered as indicative of environmental degradation and occurring at the expense of more highly valued grass species, achieved its second highest value for site 6 which was situated 5kms from settlement and which also had the highest cover values for grasses. A similar result was observed for sites in southern Kunene where *Geigaria ornativa*, considered an invasive pioneer species and indicator of degradation, had its highest cover values in association with samples displaying the greatest proportion of grass biomass (Jobst, 1995: 32).

• Figure 7.9a to c. Relative cover values by site for the 1995 growing season for a. total live above-ground plant biomass, plant litter and bare ground, b. grasses and c. forbs. For b. and c., the top two-ranking species (at least) are presented for each site.

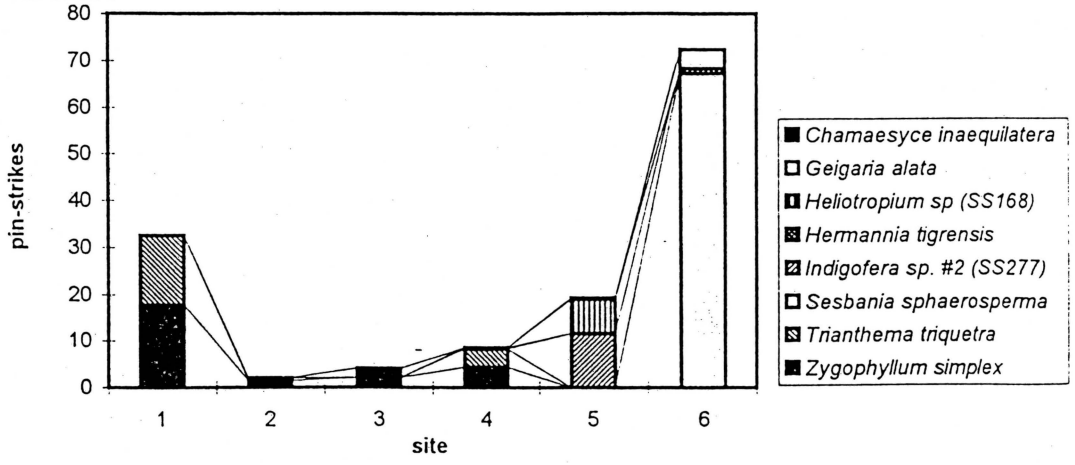
a. live above-ground plant biomass, plant litter and bare ground



b. grasses



c. forbs



10 Fixed point photographs taken during the course of the project at a site 3, b site 4, c site 5
te 6. The month and year in which each image was taken is indicated on the photographs

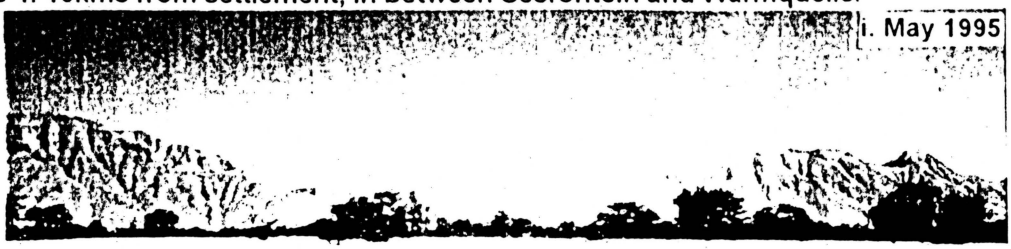
3: 5kms from the settlement of Sesfontein.



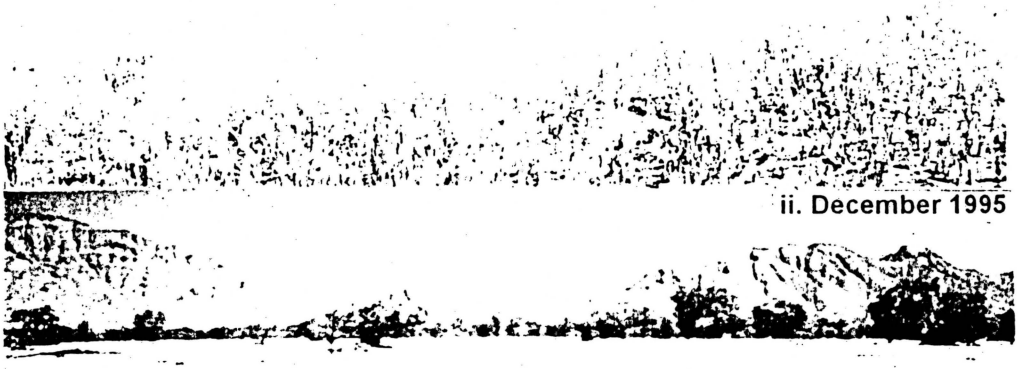




b. Site 4: 10kms from settlement, in between Sesfontein and Warmquelle.



i. May 1995



ii. December 1995

iii. July 1996

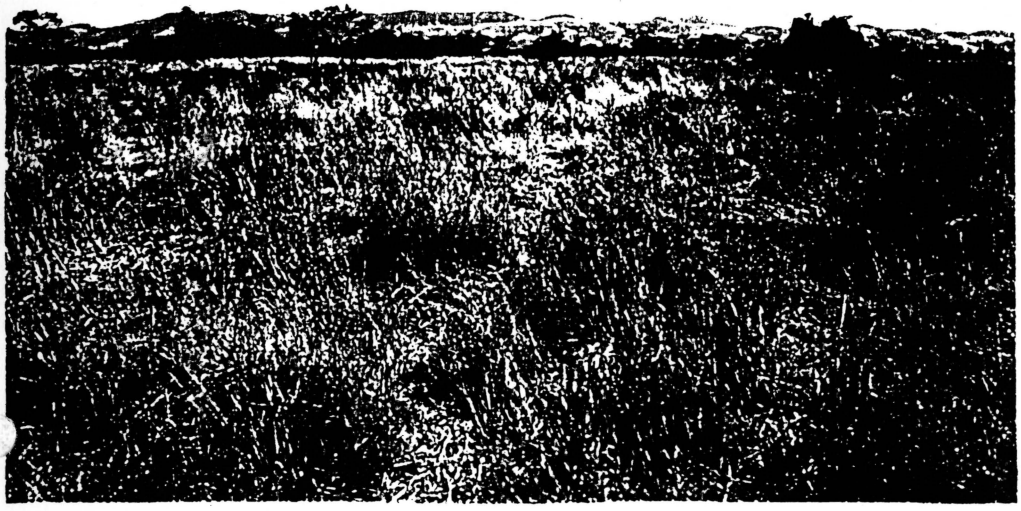


e 5: outskirts of Khowarib settlement.

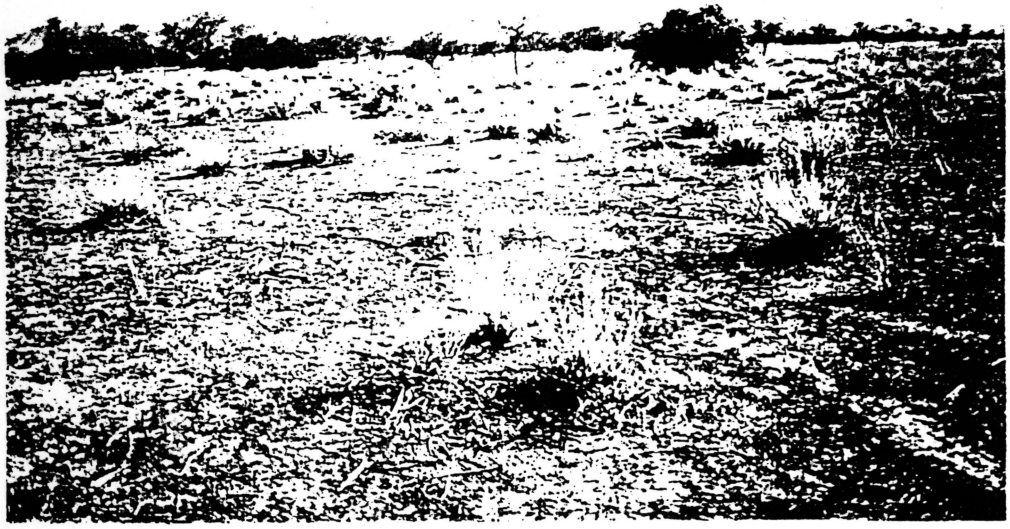
i. May 1995



ii. December 1995

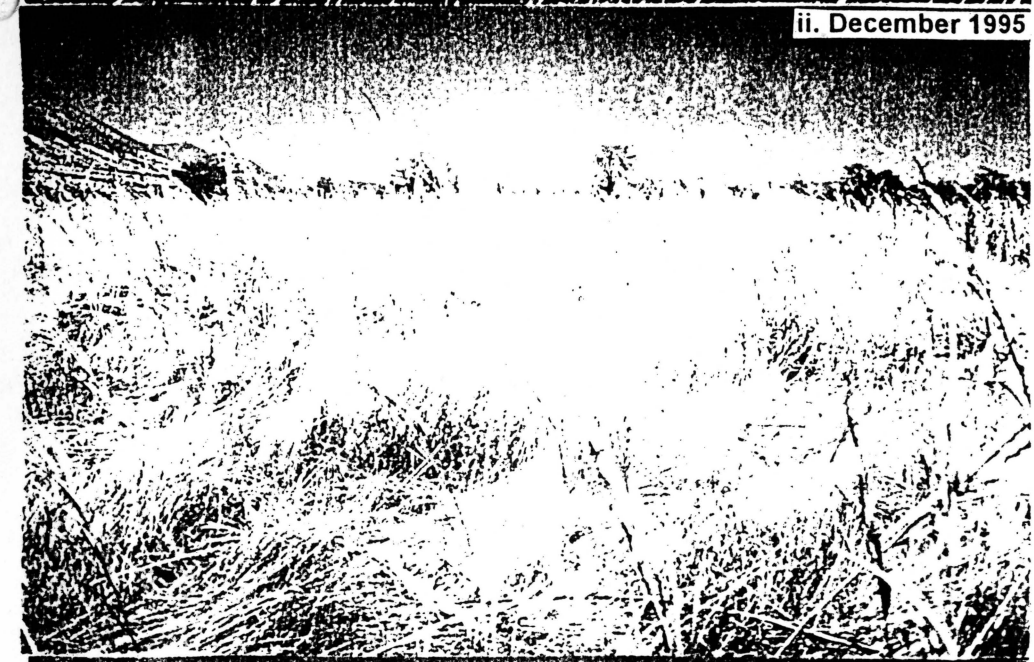


iii. July 1996



Site 6: 5kms from Khowarib settlement.







Multivariate ordination

As described in Chapter 5, a second multivariate ordination analysis was applied to the cover abundance data for the herbaceous vegetation dataset, including values for bare ground and plant litter, in order to elucidate potential differences between floristic and biomass patterns. Table 7-9 shows the final values used for DCA and CCA analyses of cover abundances for the herbaceous vegetation dataset following downweighting by CANOCO.

- Table 7-9. Cover values in the herbaceous vegetation dataset assigned full weights and those downweighted to <0.3 for DCA and CCA ordinations. Values not listed here have weights ≥0.3 and ≤1.

Cover values assigned full weight of 1 (n = 7)	Cover values downweighted to values <0.3 (n =17)
bare ground	*Aristida* cf. *stipitata* subsp. *stipitata*
litter	Asteraceae (SS459)
Eragrostis annulata	*Boscia foetida*
Eragrostis cylindriflora	*Chamaesyce glanduligera*
Eragrostis echinochloidea	*Colophospermum mopane* (seedling)
Monechma divaricatum	*Danthoniopsis dinteri*
Zygophyllum simplex	*Enneapogon cenchroides*
	Enneapogon desvauxii
	Eragrostis nindensis
	Eragrostis superba
	Eragrostis sp. (SS275)
	Geigaria alata
	Indigofera sp. #1 (SS?)
	Poaceae (SS460)
	Podaxis pistillaris (fungus)
	Panicum sp.
	Urochloa brachyura

Detrended Correspondence Analysis (DCA)

The use of cover values, and the incorporation of values for bare-ground and litter, reduced the amount of variance in the herbaceous vegetation dataset substantially (total inertia = 3.291 compared with 6.217 for the floristic data alone (see Section 6.2.3)). In this case, the first two axes explained 25.6% and 40.4% of the variance in the dataset respectively (eigenvalues = 0.84 and 0.49). Figures 7.11a and b represent the axes 1 and 2 DCA values for samples and species respectively. The overriding pattern which emerges clearly in Figure 7.11a is of between-site variability in species composition and productivity following the good growing season of 1995 (the filled-in symbols located around the periphery of Figure 7.11a), compared with the relative uniformity of sites following the very dry season of 1996 (the open symbols clustered towards the centre of Figure 7.11a). This is strongly suggestive of an 'equalising' impact of drought conditions, over and above the effects of other factors; geographically separate sites which experience different settlement and use pressures thus display extremely similar low values for species diversity and productivity, even though values for these variables may be highly disparate in years of good rainfall.

Other interesting features of this analysis are largely similar to those described in section 6.2.3 on the floristic analysis of this dataset. For example, axis 1 emphasises both the differences in 1995 between samples in sites 1 to 4 versus those in sites 5 and 6, and the similarities within these two groups of samples, while axis 2 describes the between-site differences of sites 1 to 4 as well as within-site variability, particularly of site 4. Again, axes

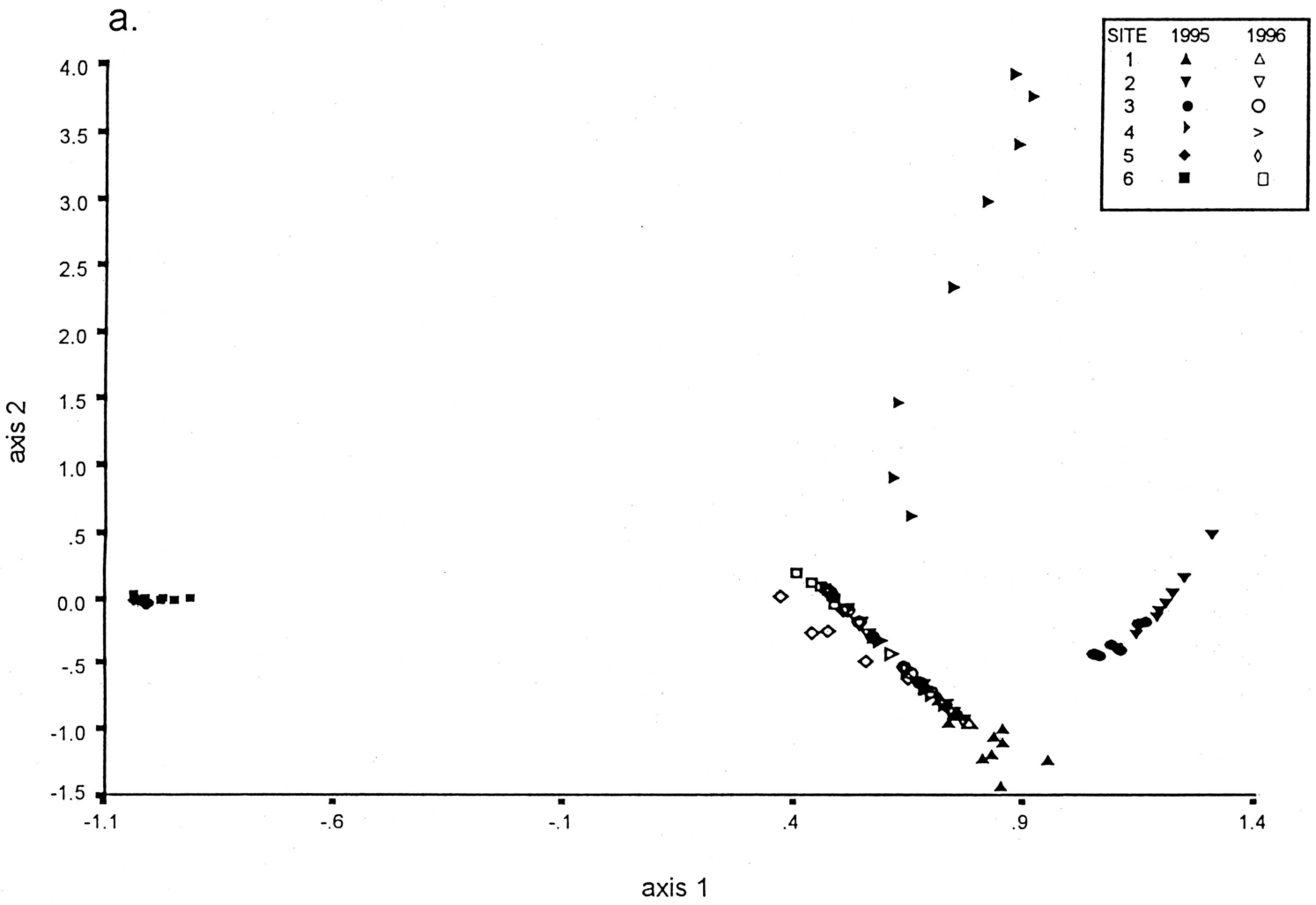
3 and 4 have rather lower explanatory power and are not discussed further here (additional cumulative percentage variance explained = 8.4%; eigenvalues = 0.21 and 0.06 for axis 3 and 4 respectively).

Canonical Correspondence Analysis (CCA)

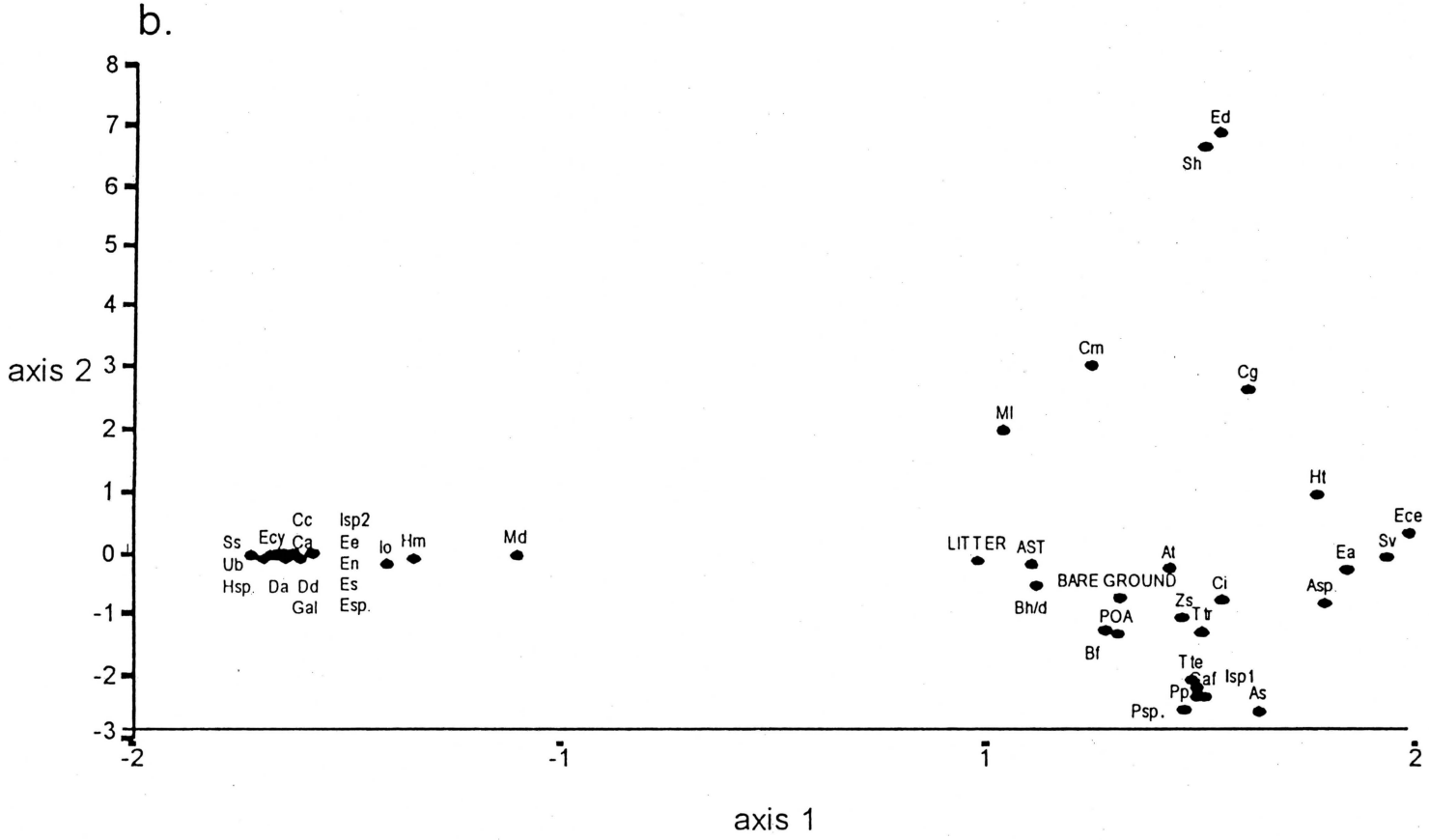
When compared with the CCA of the floristic data only (Section 6.2.3), the incorporation of cover values for species, and of values for bare-ground and litter, increased the cumulative variance explained by each of the first four axes, although the eigenvalues for these axes were slightly reduced. Values for axes 1 and 2 are presented in Table 7.10. The strength of the overall relationship between the cover value data and the environmental data is indicated by the species-environment correlations of 0.94, 0.9, 0.84 and 0.73 for axes 1 to 4 respectively, and by the significance of the trace test statistic (F-ratio = 16.9, p=0.01).

As was the case for the floristic analysis of the herbaceous vegetation dataset, site location and year again account for most of the variation in the dataset; in this case the effect of year, and thus of rainfall and soil moisture availability, is particularly important with both axes 1 and 2 displaying high correlation coefficients with this variable. The test of significance for the first axis was significant (eigenvalue = 0.71, F-ratio = 23.2, p=0.01), again reinforcing the important influence of temporal variability for biomass productivity and the relative abundances of an array of species and of bare-ground and plant litter.

• Figure 7.11a and b. Graphical representation of DCA axes 1 and 2 for a. samples and b. species, illustrating the cover abundances for the herbaceous vegetation dataset.



Key: the species names in Figure 7.11b are as follows (in alphabetical order for the full species names): Asp. = *Amaranthus* sp, At = *Acacia tortilis* (seedling), As = *Aristida* cf. *stipitata* subsp. *stipitata*, Bh/d = *Boerhavia* cf. *hereroensis/diffusa*, Bf = *Boscia foetida* (seedling), Cc = *Cenchrus ciliaris*, Cg = *Chamaesyce glanduligera*, Ci = *Chamaesyce inequilatera*, Cm = *Colophospermum mopane* (seedling), Ca = *Cucumis* cf. *africanus*, Da = *Dactyloctenium aegyptium*, Dd = *Danthoniopsis dinteri*, Ece = *Enneapogon cenchroides*, Ed = *Enneapogon desvauxii*, Ea = *Eragrostis annulata*,, Ecy = *Eragrostis cylindrifolia*, Ee = *Eragrostis* cf.*echinochloidea*, En = *Eragrostis nindensis*, Es = *Eragrostis superba*, Esp. = *Eragrostis* sp., Gal = *Geigaria alata*, Gaf = *Gisekia africana*, Hsp. = *Heliotrpoium* sp. (SS168), Hm = *Hermannia modesta*, Ht = *Hermannia tigrensis*, Isp1 = *Indigofera* sp. #1, Isp2 = *Indigofera* sp. #2 (SS277), Io = *Ipomea obscura*, Md = *Monechma divaricatum*, Ml = *Monelytrum leuderitzianum*, Psp. *Panicum* sp. = *Podaxis pistillaris* (fungus), POA = Poaceae (SS460), Sh = *Stipagrostis hirtigluma*, Ss = *Sesbania sphaerosperma*, Sv - *Setaria verticillata*, Tte = *Tribulis terristris*, Ttr = *Trianthema triquetra*, Ub = *Urochloa brachyura*, Zs = *Zygophyllum simplex.*



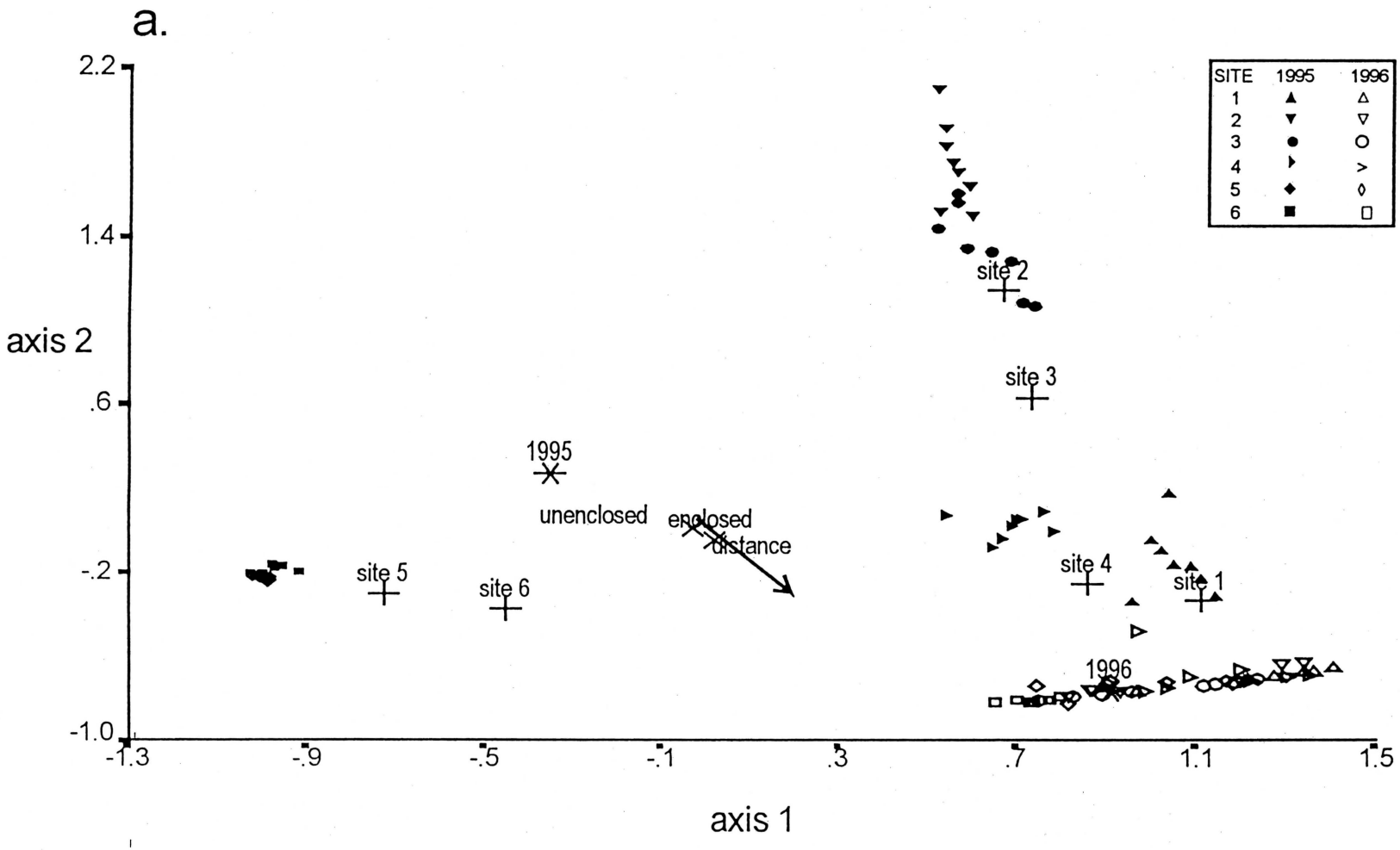
Figures 7.12a and b illustrate graphically the dominant structure within the dataset following CCA. Of interest are the following features:

- Samples from year two of the study, clustered in the bottom right-hand corner of Figure 7.12a (the open symbols) are dominated by high values for bare-ground and litter which are similarly placed in this corner of Figure 7.12b. Conversely, the greater biomass productivity and species diversity present in the first year of study has resulted in a concentration of the values for species away from the bottom-right quarter of Figure 7.12b and with a much greater spread in ordination space.
- Axis 1 values for sites 1 to 4 on the one hand, and sites 5 and 6 on the other, are rather similar. Axis 2 values vertically separate these sites, particularly those in the former group. Within this group sites 1 and 4 are placed in relatively close proximity to each other, despite the fact that the former was located on an old settlement site whereas the latter was some 10kms from a settlement; distance from settlement thus appears to be a poor predictor of species assemblages and productivity in this area. Similarly, samples from sites 5 and 6 are placed very close together, indicating that they share many features in terms of recorded cover abundances, even though they are separated by some 5kms in distance with site 5 located less than ½km from a settlement in contrast with site 6 which is at least 5kms from this same settlement.
- The lack of graphical distance between the treatment of the quadrats by fencing or leaving unfenced (enclosed versus unenclosed) demonstrates the minor importance of livestock impacts within the two years of study in structuring the pattern in the dataset.

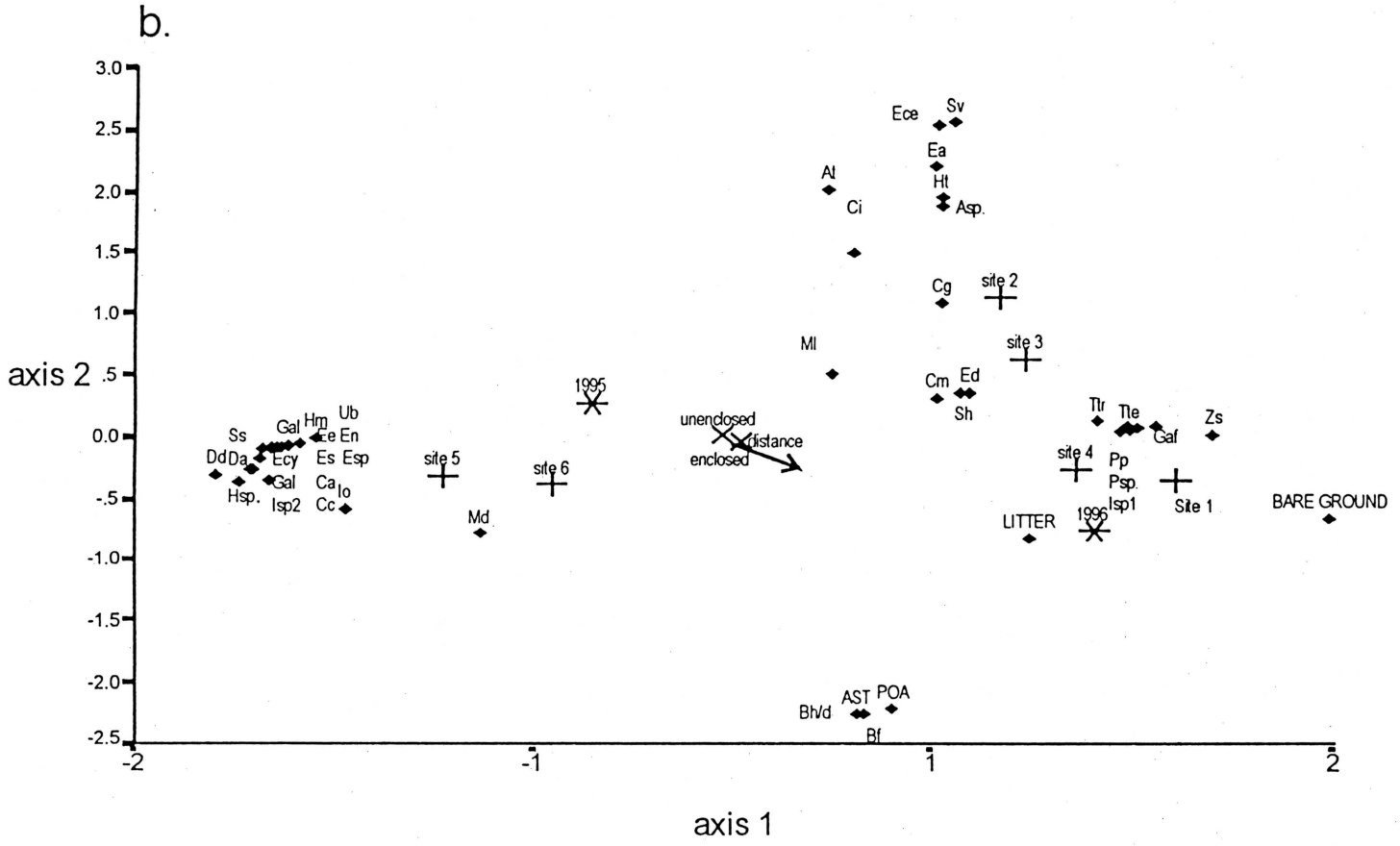
• Table 7.10. Correlation coefficients ≥0.3 and ≤-0.3 between the environmental variables and the first two species and environmental axes constructed for the cover values of the herbaceous vegetation dataset by CCA, and canonical coefficients with t-values ≥4 and ≤-4. Coefficients ≥0.5 and ≤–0.5 are printed in bold.

	SPECIES:		ENVIRONMENTAL:		CANONICAL COEFFICIENTS with t-values ≥4 and ≤–4	
Eigenvalue/species environment correlation:	axis 1 .94	axis 2 .9	axis 1 .84	axis 2 .73	axis 1	axis 2
Cumulative percentage variance:	21.4%	38.2%	36.8%	65.6%		
Environmental variables						
SITE:						
1	-.31		.34		.36	
2	-.31	.59	.33	.65	.42	.52
3			.31		.36	.33
4			.32		.34	
5	-.44		-.47			
6	-.37	-.34	-.4	-.37		
YEAR	.63	.57	.67	.63	-.51	.48
enclosure						
distance						

• Figure 7.12a and b.Graphical representation of axes 1 and 2 constructed by the CCA of cover values and environmental variables for the herbaceous vegetation dataset for a. samples and b. species.
Key: the larger symbols indicate centroids for the environmental variables as follows: x = enclosed or unenclosed, + = site location and * = year.



Key: the larger symbols indicate centroids for the environmental variables as follows: x = enclosed or unenclosed, + = site location and * = year. The species names in Figure 7.12b are as follows (in alphabetical order for the full species names): Asp. = *Amaranthus* sp. (SS?), At = *Acacia tortilis* (seedling), As = *Aristida* cf. *stipitata* subsp. *stipitata*, Bh/d = *Boerhavia* cf. *hereroensis/diffusa*, Bf = *Boscia foetida* (seedling), Cc = *Cenchrus ciliaris*, Cg = *Chamaesyce glanduligera*, Ci = *Chamaesyce inequilatera*, Cm = *Colophospermum mopane* (seedling), Ca = *Cucumis* cf. *africanus*, Da = *Dactyloctenium aegyptium*, Dd = *Danthoniopsis dinteri*, Ece = *Enneapogon cenchroides*, Ed = *Enneapogon desvauxii*, Ea = *Eragrostis annulata*,, Ecy = *Eragrostis cylindrifolia*, Ee = *Eragrostis* cf. *echinochloidea*, En = *Eragrostis nindensis*, Es = *Eragrostis superba*, Esp. = *Eragrostis* sp., Gal = *Geigaria alata*, Gaf = *Gisekia africana*, Hsp. = *Heliotrpoium* sp. (SS168), Hm = *Hermannia modesta*, Ht = *Hermannia tigrensis*, Isp1 = *Indigofera* sp. #1, Isp2 = *Indigofera* sp. #2 (SS277), Io = *Ipomea obscura*, Md = *Monechma divaricatum*, Ml = *Monelytrum leuderitzianum*, Psp. *Panicum* sp. = *Podaxis pistillaris* (fungus), POA = Poaceae (SS460), Sh = *Stipagrostis hirtigluma*, Ss = *Sesbania sphaerosperma*, Sv - *Setaria verticillata*, Tte = *Tribulis terristris*, Ttr = *Trianthema triquetra*, Ub = *Urochloa brachyura*, Zs = *Zygophyllum simplex*.



As Table 7-11 makes clear, Monte Carlo permutation testing following forward selection of the environmental variables again produced statistically significant results for both site location and year in their relationship with species abundance, litter and bare-ground. Significance testing after partialling-out environmental variables as covariables produced similar results, alluding to the robust nature of these relationships. The effect of year and site location were thus highly significant (year, trace = 0.54, F-ratio = 33.42, p=0.01; site location, trace = 1.1, F-ratio = 17.05, p=0.01 and test of significance of first axis, eigenvalue = 0.63, F-ratio = 28.7, p=0.01); distance, on the other hand, made a much weaker but significant contribution to the structure of the dataset (trace = 0.09, F-ratio = 5.34, p=0.01). The effects of enclosure were not significant (trace = 0.02, F-ratio = 1.64, p=0.15).

• Table 7-11. Monte Carlo permutation tests of significance for the effect of each of the environmental variables on cover estimates for the herbaceous vegetation dataset, following forward selection of these variables. The results for variables significant at p=0.01 are printed in bold and marked with an asterix.

	Monte Carlo permutation tests of significance following forward selection of environmental variables			
	selection order	p	F-ratio	variance explained TOTAL = 1.91
Environmental variables				
SITE:				
1	3	*.01	13.93	1.55
2	4	*.01	15.28	1.28
3	5	*.01	14.49	1.8
4	6	*.01	13.33	.93
5/6†	7	*.01	5.34	1.89
YEAR	1	*.01	19.69	.59
enclosure	9	.18	1.54	1.91
distance†				

7.2.2 Summary: settlement impacts on herbaceous cover

As with the floristic analysis of the dataset, herbaceous cover was most strongly influenced by site location and growing season, reflecting both temporal and spatial variability. The removal of grazing livestock had a negligible effect on live above-ground biomass, but contributed to the retention of higher quantities of plant litter in the second year of study. Cover indices did not display a linear relationship with distance from settlement. Conclusions drawn regarding specific details of this analysis are discussed below.

† These variables are colinear (distance class is colinear with sites).

7.3 Conclusions

1) Density:

Analysis of the woody vegetation dataset demonstrated the existence of areas of localised pressure around settlements in several of the habitat categories surveyed; the mean distance between plant individuals was highest for transects located nearest to settlements for three of the sampling categories, namely plains on alluvial silts, and mountain samples on both calcrete and dolomite. The relationship between plant density and increasing distance from settlement is nonlinear, however; the predicted gradient of increasing plant density with increasing distance from settlement, which would reflect settlement effects over a larger spatial scale, is not borne out by this analysis.

2) Cover:

Analysis of plant basal area for the woody vegetation dataset also indicated a lack of correlation with increasing distance from settlement. Similarly, combined density and basal area measures revealed that although total plant dominance was relatively low for the distance classes occurring closest to settlements, equally low figures were recorded for samples furthest away from settlement. This suggests that the effects of settlement pressure on woody plant biomass are well within the range of variability expressed over the geographical scale of analysis considered here. Again, there is little support for the predicted gradient of use pressure for this scale of observation, a finding which is supported by analysis of aerial photographs from 1943 to 1994 which indicate slight increases in woody vegetation for most sites within and up to 7kms from Sesfontein (Rohde, 1997b: 369-374).

With regard to the herbaceous vegetation dataset, spatial and temporal variability, represented by site location and growing season, had the strongest effects on all of the plant cover categories analysed. In terms of the predictions made at the beginning of Section 7.2:

- Live above-ground biomass was extremely variable between sites following the first growing season and was not strongly related to distance from settlement; the hypothesis that productivity will be lower with closer proximity to settlement can be rejected. This is indicative of high spatial heterogeneity, as observed in other arid environments; Fowler (1986: 553), for example, notes for a field experiment of a perennial bunchgrass (*Bouteloua rigidiseta*) in a semi-arid North American environment that 'the magnitude of the treatment effects varied significantly among quadrat sets'.
- Exclusion of livestock from fenced plots had no effect on live above-ground biomass; this again reinforces the overriding strength of climatic and site factors in determining variability in productivity. Exclusion of livestock did have an effect, however, on the cover values recorded for bare-ground and litter such that, following the second growing season, the values for the former were significantly higher in the unfenced plots and *vice versa*. This could indicate that removing livestock would have a positive effect on soil fertility through allowing the build-up of plant organic matter and thus suggest that

the levels of livestock pressure characterising the study area are having a detrimental effect on soil fertility through preventing the accumulation of plant litter. Such an interpretation should be balanced, however, against evidence for the promotion of soil fertility through manuring by livestock; bioassays carried out for this study, for example, indicated a relatively high potential for plant growth in sites close to settlements where livestock pressure was concentrated (see also Perkins and Thomas, 1993: 188; Mouton, 1995: 16) and an increase in soil fertility due to manuring by grazing livestock may also enhance the nutritional value of herbaceous species (cf. Rethman *et al*, 1971: 57).

- As stated above, the interaction of year and quadrat enclosure was only significant with regard to the cover values for bare-ground and plant litter recorded at the end of the second growing season; differences in live above-ground biomass were indistinguishable between enclosed and unenclosed plots, and this remained true in the second year of the study. In fact, the differences in growing potential represented by the two seasons monitored in this study completely preempted any anticipated effect of the exclusion of livestock on above-ground biomass; the clear pattern is one of between-site variability in species composition and productivity in response to the good growing season of 1995, followed by extreme uniformity between sites due to the dry conditions of 1996. Extremely high differentials in productivity in relation to variable rainfall have similarly been described for desert dune habitats of the Namib (Seely and Louw, 1980: 32-37), for *Eragrostis* spp. and *Aristida* spp. in the semi-arid eastern Karoo (360mm a^{-1}) (Hoffman *et al* 1990: 463; see also O'Connor and Roux, 1995: 619-621), and coefficients of variation of >50% were the norm for a range of life history parameters of serotinous plants in the central Namib (Günster, 1994b: 152). Drought thus acts as an 'equaliser' in areas that in fact retain the potential to be extremely productive and diverse given appropriate abiotic conditions, although it should be noted that Foran *et al* (1986 *in* Martens *et al*, 1990:186) claim that 'where veld is degraded, temporal changes are inclined to be greater than veld in good condition, particularly in arid and semi-arid regions'.

  It is well-known that productivity in desert ecosystems is dependent on an absolute minimum amount of precipitation (the zero-yield threshold), above which productivity tends to increase linearly with increasing rainfall (cf. Walter, 1939; Noy-Meir, 1973; Seely, 1978; Rutherford, 1980; Hadley and Szarek, 1981: 747-748; Le Houérou, 1984: 213). In addition, fine-tuned combinations of temperature, precipitation, soil conditions and topography are significant in defining the potential for productivity and allowing the establishment of species (cf. Ludwig and Whitford, 1981: 294; Cox, 1984; Günster, 1995: 107). With this in mind, the herbaceous cover recorded in this study following the 1995 growing season indicates that, given the right combination of conditions, the nutrient-rich silts of the Hoanib Basin can be extremely productive, despite the long-

term use of this area for grazing by communal farmers and despite the tendency for these soils to have a disproportionately low water-retaining capacity in arid environments (as discussed in Chapter 5). In this case, saturation of the system by torrential rain over a short time period early in February 1995, combined with reduced evaporation due to a run of cloudy days, appear to have been the elements which allowed 'escape' of primary productivity in north-west Namibia during this season.

3) Dominance:

Analysis of the relative biomass contribution of individual species to each sampling category also indicated a lack of directional change with distance from settlement. For the woody vegetation dataset the strongest trend was, in fact, the higher dominance of *Colophospermum mopane* on sandy loams with proximity to the settlement of Warmquelle, indicating that settlement pressure is actually promoting the growth of this species. Branch lopping promotes vegetative reproduction or coppicing which is known to be an important means of regeneration in seasonal environments such as the dry tropics where seedling establishment is especially problematic (Cole, 1986: 9). *Colophospermum mopane* has a remarkable coppicing ability making it extremely resilient at an individual and population level, even though it is a species which is sought-after for both building poles and firewood.

With regard to herbaceous vegetation, the following patterns were observed:

Grass *versus* forbs

The majority of sites had high values for grass cover relative to forbs in the good growing season of 1995, although the reverse situation for site 1, which was located at the site of a recently abandoned settlement, is possibly indicative of a change towards an assemblage dominated by 'weedy', generally succulent, species such as *Zygophyllum simplex*. This interpretation is problematic, however; as well as being considered a pioneer species, *Z. simplex*, for example, is halophilous (Walter, 1986: 261) and consequently may be an indicator of salinity over and above disturbance (although, as noted earlier, salinity increases with the intensity of livestock pressure due to the effects of manuring (Mouton, 1995: 16)). As Walter describes for the Namib-Naukluft National Park, *Z. simplex* also dominates habitat patches in the absence of livestock, and historical sources indicate that it similarly dominated particular habitats more than a century ago. Hahn (1928: 224) writing about the Omaruru River in 1871 exclaims, for example, that 'The earth was everywhere carpeted by a succulent plant of all possible shades, from the freshest green to sulphur and orange colour, ...', a description which exactly matches the appearance of *Z. simplex*. Within this general pattern, cover values for different species and species groups were variable between sites in a manner which bore little relation to distance from settlement or enclosure of quadrats.

Grass species composition

The dominant grass species recorded for the study sites were either *Eragrostis annulata* or *E.* cf. *cylindriflora*, with varying amounts of *Monelytrum leuderitzianum*, and with *Stipagrostis hirtigluma* and *M. leuderitzianum* at site 4.

As pointed out by Hurt and Bosch (1991: 131), and due to the influences in the 1930s and 1940s of state officials well-versed in the orthodoxies of North American and European ecology (cf. Beinart, 1996: 57-59; Scoones, 1996: 35-38), it is conventional within southern African rangeland ecology to 'use proportional species composition as a basis for calculating some form of range conditional assessment'. Following American range science, species are thus defined as Decreasers and Increasers I, II, and III according to their 'successional status' with reference to the perceived climax community or 'benchmark' for a given area[5] (cf. de Klerk, 1947: 352-353; Foran *et al*, 1978; Tainton *et al*, 1980; Vorster, 1982: 84; Bosch and Janse Van Rensburg, 1987; Danckwerts and Stuart-Hill, 1988; Trollope, 1990; Bosch and Gauch, 1991; Bosch and Theunissen, 1992; Strohbach, 1992; Joubert, 1997)[6].

Under this system of classification *Eragrostis* spp., while generally considered to be palatable for livestock especially when green, tend to be described as 'sub-climax' or 'pioneer' grasses, and are defined as common on disturbed ground (Müller, 1984: 142-174). The perennial *M. leuderitzianum* and the annual *S. hirtigluma* subsp. *hirtigluma* are also considered as pioneer species although they are additionally described as 'reasonably valuable' and 'well-utilized' (Müller, 1984: 190, 252).

Given this classification of species, and in the absence of long-term ecological data for this area, it would be easy to interpret the dominance of these so-called 'sub-climax' species as indicating a trend towards degradation. Van Rooyen *et al* (1991: 63, 70, 1994: 358), however, suggest that for semi-arid Kalahari savanna conditions species such as *Eragrostis lehmanniana* and *Chloris virgata*, which are commonly viewed as pioneers or Increasers and thus as indicators of degradation in the moist eastern savanna areas of southern Africa[7], should not be viewed as such in environments characterised by greater aridity[8]. Similarly, and as found in Kalahari duneveld vegetation by Fourie *et al* (1987: 53), species classified as relatively undesirable pioneers may increase under successive wet years but not at the expense of the more desirable so-called Decreaser species **and** under 'relatively undisturbed conditions', despite their conventional association with degraded areas. This has been observed, for example, for *Eragrostis annulata* and *Enneapogon desvauxii* in the Kalahari (Van Rooyen, 1990: 85-86). Assessment of veld condition based on the relative

---

[5] This may be defined as a 'fire' climax or 'climatic' climax depending on the dominant abiotic parameter considered to affect the area (cf. Trollope *et al*, 1990).

[6] Barnes (1990a and b) has also introduced a classificatory scheme for the south-eastern Transvaal highveld (730-790mm^{a-1}) based on palatability of grasses.

[7] cf. Rethman *et al* (1971: 60) for an example of increasing *Eragrostis* spp. with relatively heavy grazing in moist highveld grassland.

[8] See also Bosch and Janse Van Rensburg (1987: 143, 146-147) for a discussion of the problem of extrapolating classifications based on observations in the more humid eastern grasslands to the semi-arid grasslands (±620mm^{a-1}) of western Transvaal.

proportions of species classified conventionally as Increasers and Decreasers would, in this case, erroneously conclude that 'veld condition declines during wet periods, even though the increase in the density of Increaser species is not accompanied by a decline in the density of Decreaser species' (Fourie *et al*, 1987: 53).

In more arid areas 'pioneer' species may in fact represent a healthy and palatable response to relatively marginal and variable conditions. The so-called South African 'lovegrasses' or *Eragrostis* spp., for example, are known to be persistent under a range of drought conditions (Cox, 1984: 160) and can be considered desirable species in arid areas such as north-west Namibia. Even in relatively moist areas species normally classified as unpalatable may be consumed by livestock 'with relish' during particular times of the year, as noted for *Eragrostis plana* in the high altitude 'sourveld' of north-eastern Transvaal during winter grazing by sheep (Rethman *et al*, 1971: 57).

An alternative interpretation, therefore, is that irruptive grass species, (i.e. shorter-lived species with prolific seed production which can respond positively to rainfall variability and grazing) which are usually classified as pioneers or Increasers, should not be considered as an early stage of a classical successional progression held back by overgrazing. Instead they can be viewed as a 'normal' component of a dynamic mosaic of species in an assemblage conferring resilience in arid and variable conditions (cf. Frost, 1986: 57; Mace, 1991).

Additional complexity is bestowed by ecotypic variation which may cause the same species to respond differently under various environmental conditions (cf. Bosch and Theunissen, 1992: 95, 100). For example, the ability of some ephemeral species to behave as perennials under favourable conditions, as described for two grass species (*Stipagrostis ciliata* and *S. gonatostachys)* of the Namib desert dunes (Seely and Louw, 1980: 29), makes any definition of the ecological status and value of these species extremely problematic. As pointed out by Shackleton (1991: 114) with reference to grass species in southern Africa, there is a clear need for detailed autecological information for so-called pioneer or 'undesirable' species in these 'extreme' environments before these species can be used as definitive indicators of degradation[9].

In relation to the predictions made regarding the expected responses of woody and herbaceous vegetation to utilisation pressure, the findings of this study suggest the following:

1) Woody vegetation:

Indices of plant density, cover, dominance and population structure do not display gradients

---

[9] But see Van Niekerk and Wasserman (1976) for an early discussion of the 'environmental correlates' of *Schmidtia kalahariensis* and *Enneapogon cenchroides* in Namibia.

of change with respect to distance from settlement. In some cases, settlement appears to have localised detrimental effects on these measures within topographic and substrate categories, but, with no exceptions, these are within the range of variability displayed for these categories.

2) **Herbaceous vegetation:**

Patterns in both total and relative cover values were largely explained by site location and growing season; distance from settlement and the removal of grazing livestock were extremely poor predictors of the variability displayed by these indices. The prediction that the effects of excluding livestock would be more pronounced for the second year of study was only borne out for plant litter and bare ground, which were found to have higher and lower values respectively within enclosed quadrats.

Chapter 8

Conclusions

This final chapter attempts to draw the strands of the thesis together in an assessment of overall implications for policy initiatives affecting Damara farmers and natural resources in arid north-west Namibia. It begins with a review of the main findings of the thesis. This focuses first on the patterns of natural resource-use explored in Chapters 3 and 4 and the evidence for resilient, culturally-informed resource management practices described in Chapter 4. Secondly, it draws out the apparent relationship between settlements and patterns in local vegetation as indicated by ecological data analysis in Chapters 6 and 7. The chapter proceeds to consider how an overriding negative perception of both communal farmers and arid environments leads logically to a misunderstanding of resource-use practices and their impacts in these areas. It concludes with a brief discussion of possible alternative policy approaches in the light of the more optimistic findings of this thesis.

8.1 Review of the main findings

8.1.1 Plant use, local knowledge and resource management practice

Chapter 3 suggests that, contrary to popular perceptions regarding the loss of culturally-informed natural resource-use practices by Damara farmers (as highlighted in Chapter 2), contemporary domestic use of gathered resources occurs at relatively high frequencies and engages a diversity of species. With regard to gathered foods, the highest records of consumption occur at times of greatest availability and not as a response to drought-induced shortages of alternative foods as is widely reported for other arid and semi-arid areas. This implies a positive view of these foods, in that they are procured and consumed even as the availability of alternative foods remains relatively stable.

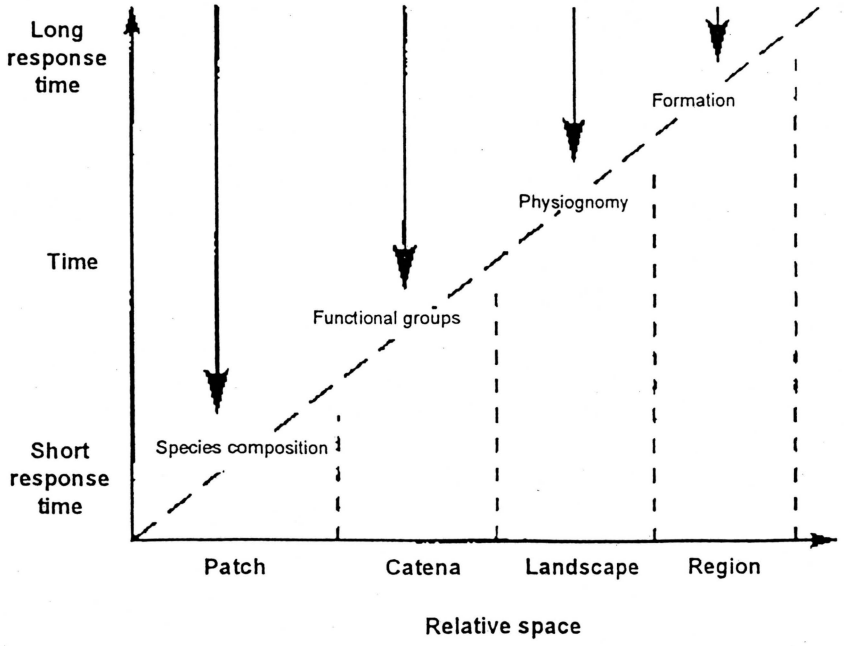
Wealth, summarised in terms of access to alternative foods, is an apparently weak explanatory factor in indicating why gathered resources are consumed at the household level. Instead, emphasis is placed on the role of kinship and social networks in blurring the boundaries between households and families, and in contributing to the flow of resources between individual members of these fluid entities. Links within networks of relatedness may extend way beyond the sphere of the immediate family; the ability to draw on these networks, even if only ephemerally, implies that the relationship between current and potential patterns of resource exchange is extremely dynamic.

Similarly, the relationship between the domestic use of natural resources and settlement and land tenure history is complex and non-deterministic. There is some evidence to suggest that a history of greater displacement exacerbates processes of attrition of natural resource-use practices. Data for both food and medicine use, however, demonstrate that natural resource-use practices retain their cultural legitimacy and practical value, even in the face of the

degradation requires careful consideration of the spatial nature of changes and their relationship with natural environmental perturbations and variability'.

More generally, the results of the ecological dimensions of this study accord with the idea that so-called perturbations may affect smaller scales, both spatial and temporal, more than larger ones, and increasing the spatial or temporal scale of observation may in fact reveal a large degree of ecosystem persistence (Connell and Sousa, 1983: 792; DeAngelis and Waterhouse, 1987: 2-3; Collins, 1995: 96)[1]. In addition, shortlived or transient 'patch dynamics' observed at smaller scales may be crucial elements in the persistence of systems at larger scales or 'higher' hierarchical levels (DeAngelis and Waterhouse, 1987: 2; Costanza *et al*, 1993: 545, 548, 553) which, in accordance with theories of complex systems, can be seen as an emergent property of small-scale instability and variability (Wiens, 1984: 454). This hierarchical relationship between different spatial and temporal scales is summarised in Figure 8.1. According to this view, local variability arising as a result of varying intensities of resource utilisation may be more correctly interpreted as 'positive' in terms of conferring long-term persistence to quantifiable measures of the wider 'ecosystem'. In similar contradiction to orthodox approaches to range management, acknowledgement of the defining role of spatial and temporal environmental heterogeneity for ecosystem health implies significant problems with attempts to calculate average and sustainable range and resource use-rates (cf. Kellner and Bosch, 1992: 99).

- Figure 8.1. A diagrammatic conceptual framework for evaluating ecological hierarchy determinants at various spatial and temporal response scales. The appropriate level of biological analysis is indicated on the diagonal (after Solbrig, 1991, Fig. 1).



[1] Long-term studies, for example, indicate relative botanical stability, despite wide fluctuations in botanical composition in the medium to short-term. This was the case for study sites in the Kalahari Gemsbok National Park where data from two studies 33 years apart were compared (cf. Van Rooyen, 1991: 91-92). The authors still conclude, however, that this could only be the case under the relatively pristine conditions of the National Park, and that this 'sensitive equilibrium can ... be easily disturbed or even destroyed by mismanagement' (p.92), presumably the 'overutilisation commonly observed in adjacent livestock farming systems' (p.91).

These findings have important implications for how the results of ecological studies in this arid environment are interpreted; clearly, data derived in the short-term and at the small-scale need to be situated within an understanding of the range of dynamics that the system under study may display under different conditions. To illustrate this point, it would be tempting to draw the conclusion from the 1996 herbaceous data alone that the study area is experiencing widespread degradation and possibly desertification in the form of reductions in both biomass and species diversity. The extreme differences between the 1995 and 1996 growing seasons in both these variables, however, demonstrate that above-ground biomass in one season in fact may say very little about the potential for future productivity under different abiotic conditions. Hoffman and Cowling (1990: 286-287) make a similar point with regard to the eastern Karoo stating that the accepted ideology of degradation in this area can be traced, at least in part, to a century's worth of publications produced either during or following drought periods (e.g. de Klerk, 1947). In addition, the rapid response of primary productivity to the abiotic, i.e. rainfall, conditions of the 1995 growing season monitored in this study, belies the conventional view that dryland ecosystems are characteristically 'slow to recover' and 'specially vulnerable' to potentially degrading impacts (Warren and Agnew, 1988: 25).

Likewise, the findings of this study for herbaceous vegetation on the alluvial plains of the Sesfontein-Khowarib basin, and coupled with the studies reviewed briefly in Chapter 5, indicate that categorising species as Decreasers or Increasers in relation to a desirable 'climax' state may constitute a fundamentally inappropriate approach for dynamic environments at the more arid end of the scale. In fact, even for the wetter 'western grassland biome' of South Africa (670-700mm^{a-1}), Janse Van Rensburg and Bosch (1990: 11), in a critique of their earlier work in this area, conclude that

> "The ecological grouping ... of species on a grazing gradient differed not only for different topographical units but also for sub-habitats within a certain unit. Broad standardized groupings of species into Decreaser and Increaser groups are therefore scientifically wrong and of little practical use".

As noted elsewhere (cf. references under Footnote 6), these issues call into question generally the validity of building frameworks of analysis built on ecological concepts of progressive Clementsian succession for dryland environments, particularly at smaller spatial and temporal scales.

8.2 Discussion

The ecological analyses of the previous two chapters seem to contradict the charges of widespread degradation and impending environmental collapse levelled at the environment of north-west Namibia and its inhabitants; and Chapters 2 to 4 demonstrate that, instead of having disintegrated into chaos, a range of unformalised management practices, and a wealth of current practical knowledge, are utilised in relation to natural resources, despite the history of impoverishment and land alienation experienced by herders in this region.

If this is an accurate interpretation of the data presented in this thesis, it remains to be asked why, for the former Damaraland in particular and Namibia's communal areas in general, popular and professional opinions of natural resource-users and environment alike are so pervasively negative? It is believed that the roots of these rhetorics can be traced to two ideologies which have influenced perceptions of dryland subsistence and environments throughout sub-Saharan Africa:

1) remnants of a colonial ideology that views African land-use practices as irrational, unproductive and environmentally degrading;

2) a view of the country's arid lands as inherently fragile, in the sense that they are considered easily disturbed from their 'climax' or 'equilibrium' state.

These are discussed separately below.

8.2.1 Intervention justified: an ideology of 'traditional communal farming'

As pointed out for the southern African context by Boonzaier *et al* (1990: 77), there is a tendency by academics, bureaucrats and development officials alike to lump together all African rural production systems under the label 'traditional communal farming' and to proceed to intervene in these systems on the assumption that they are characterised by a number of common flaws[2].

These flaws include the following:

1. 'Traditional' farming practices = environmental degradation

As the statements at the beginning of Chapter 5 exemplify, 'traditional' farming practices are considered necessarily to culminate in environmental degradation. This perception has been widespread in southern Africa and additionally tainted by overtones of politically-justified racial prejudice. Describing the Griquas who inhabited the area between the Orange and Modder Rivers in South Africa, de Klerk (1947: 351), for example, states that 'The Bantu Tribes had scant respect for the soil and kept large herds' ... and 'played an important part in the eradication of our indigenous forests'. Similarly, the so-called 'denuded grazing areas' of the former 'Rhodesian lowveld' is considered by West (1968: 95) to be in an 'advanced stage of deterioration' due to a livestock economy 'based on unrestricted and uncontrollable utilization of ... natural sweetveld'. From a wider perspective, the labelling of local farming practices as inefficient and environmentally damaging acted to justify centralised land-use planning and control by colonial, and later post-independence, administrations throughout Africa (cf. references in Adams, 1990: 106-109; Scoones (1996: 38-46) for Zimbabwe; Fairhead and Leach (1996: 112-115) and Swift (1996: 86-88) for French West Africa).

In Namibia today 'It is widely believed that a combination of poverty and traditional farming

---

[2] See also Little and Brokensha (1987: 203), Cousins (1993: 1) and references in Leach and Mearns (1996: 1-2).

techniques are leading to processes of land degradation and deforestation' (Quan *et al*, 1994a: 16). At the heart of this perception for Namibia's arid and semi-arid communal areas is the attribution of 'desertification' processes to 'overgrazing' livestock, based on the assumption of a dramatic and unmanaged explosion of livestock populations over recent decades. This assumption is usually unquestioned for the former Damaraland. It is not borne out however by available data: figures for Okombahe Reserve from the early 1920s to the present indicate fluctuations between <1LSU/km^2 and 6LSU/km^2, with current levels at just over 2 LSU/km^2 (Rohde, 1997b: 352) and Kakukuru (1995: 80) shows that in the few years between 1949 and 1956 livestock in both the Okombahe and Otjohorongo Reserves fluctuated widely in relation to drought, disease and migration (see also figures for the whole of former Damaraland in Section 1.3.3). Similarly, livestock figures available for this century for north-central Namibia, indicate a widely fluctuating population in this area with only donkeys showing an increase in absolute numbers (cf. Krieke, 1995: 39-41).

Even more disconcerting is the fact that statements such as that by Ward (1997: 2) that 'More than 100 years of heavy grazing has left much of this region (southern Erongo) appearing severely degraded' are rarely situated within a longer historical context. The erosion of regional herding economies through the historical processes outlined in Chapter 1, the devastating effects of the rinderpest epidemic of 1897, the confiscation of the remnants of Herero herds following the 'German-Herero' war of 1904-1907 and the fleeing of formerly wealthy Herero herders to Angola and Botswana at the turn of the century, might never have happened according to discussion of currently perceived range degradation. The implications of all of these, however, is that the Namibian landscape supported successful herding economies prior to these events, and that observed increases in the livestock populations of indigenous farmers since the early part of this century reflect a process of recovery in the wake of these undermining circumstances. Similar observations indicate that this is a continent-wide phenomenon (cf. Bell, 1987: 82; Waller, 1988; and references in Brockington and Homewood, 1996: 92-93). In addition, reference is seldom made to the probable impacts of vast herds of migrating wild ungulate populations occurring within the region up until the 19th century (cf. Hoffman and Cowling, 1990: 287, and Cummings in de Klerk, 1947: 349, for the Karoo and southern Orange Free State respectively).

2. *'Traditional communal farming' = a vacuum of resource management institutions*

Related to the above, it is generally considered that 'traditional' production systems are characterised by a lack of local institutions responsible for the management of resources, either because these institutions never existed effectively (the colonial view) or because they have disintegrated under the pressure of disruptive historical and political processes (the current liberal view). These respective views are exemplified by the quotes by Vedder (1928) and Quan *et al* (1994a) at the beginning of Chapter 4. They have been popularised by the controversial 'Tragedy of the Commons' thesis of Hardin (1968) which uses the 'Free Rider

Theorem' to suggest that the holding of resources in common necessarily leads to a lack of regulation over their use, which in turn leads to a situation of land and resource degradation (cf. Barrett, 1989: 18; Burley, 1990: 201).

These assumptions, while logically constructed, overlook the ongoing and creative adjustments made by farmers and resource-users in contexts of changing circumstances by assuming that these changes are experienced in a passive and quiescent way. The case studies presented and discussed in Chapter 4, however, demonstrate that, even with a repressive political regime as well as centuries of turbulent history, land and resource management is an on-going and opportunistic dynamic among Damara farmers in north-west Namibia, characterised by processes of negotiation and the resilience of informal social and kinship networks.

3. 'Traditional' = cultural homogeneity

It is widely acknowledged that a classificatory approach to African cultures by colonial governments and ethnographers moulded indigenous social demarcations which were fluid and heterogenous into separate and static tribal groupings which, conceptually at least, were easier to administer. Namibia, where imposed 'ethnic categorizations were raised to judico-political entities' in the interests of separate development and the Apartheid state (Fuller, 1993: 83; see also Lau, 1979), is no exception to this. For the Damara this colonial differentiation involved the 'lumping' of at least 11 independent groups (Fuller, 1993: 93), an amalgamation which has since been appropriated as a tribal structure by Damara themselves in a bid to increase their national standing. The previous groupings have an enduring reality, however, influencing, for example, choices of area from which to gather resources (cf. Chapter 4) and underlying variations in names and uses of particular resources (see Annexe 1).

It is the contention here that colonial tendencies to perceive the rural African 'other' in terms of homogeneous groupings unintentionally spill over into contemporary 'community-based' approaches to conservation and development. Much has already been said in this thesis to emphasise local-level heterogeneity and complexity among Damara farmers in north-west Namibia and this issue will not be dwelt on here. What is stressed is that, like the colonial use of the term 'tribe', the term 'community' is opaque and misleading, obscuring social, economic and cultural differences with respect to natural resources.

8.2.2 Ecological dynamics in arid lands: conceptual considerations[3]

Over and above the perception that communal land-use practices promote environmental degradation is an understanding of arid and semi-arid habitats as inherently fragile and

[3] Elements of the following discussion have appeared in Sullivan (1996b).

thereby vulnerable to the pressures imposed by people and livestock (cf. UNCOD, 1977a: 5 *in* Swift, 1996: 80; Slobodkin, 1989: 287-289; Mubita, 1995: 63). Malan and Owen-Smith (1974: 168) in the following statement summarise this perspective with regard to the arid pro-Namib grasslands of Kaokoland, north-west Namibia;

> "the very low and unpredictable rainfall makes the region particularly sensitive to overgrazing and will also greatly retard rehabilitation once a certain threshold of utilisation has been exceeded. For this reason it is essential to establish the carrying capacity before intensive exploitation upsets, perhaps irreversibly, the delicate balance between herbivore and habitat".

Contrary to these perceptions the data presented in Chapters 6 and 7 of this thesis which indicate a lack of large-scale effects of pastoral land-use, combined with findings from other small-scale ecological studies (as reviewed in Chapter 5), indicate that dryland ecosystems are in fact extremely robust under a range of dynamic abiotic and utilisation pressures. It thus appears that there is something fundamentally amiss with the conceptual model constraining popular thinking about environmental degradation in such systems. This, coupled with the acknowledged failure of many livestock development projects in dryland Africa (cf. Goldschmidt, 1981; Grainger, 1992: 29-31; Dahlberg, 1994: 19) and the lack of decline in secondary productivity in many pastoral systems despite assertions of land degradation (e.g. White (1992 *in* Queroz, 1993: 2) for Botswana, and Homewood (1994) for Baringo, Kenya), has made necessary a dramatic re-evaluation of deeply held assumptions regarding ecological dynamics and their validity in providing a framework for thinking about arid and semi-arid environments. To paraphrase Pimm (1991: 17), we need to worry about our 'model' of how arid systems work because it is causing us to make possibly wrong predictions and policy decisions concerning trends within these systems, particularly those related to human use of natural resources.

The equilibrium model: biotic-biotic interactions and the 'balance of Nature'

When conceptualising ecosystems it is implicitly assumed that the fundamental (and desirable) state of communities of species is one of equilibrium; a stable balance of species densities is maintained through inter- and intra-specific interactions which fine-tune the biotic component of the ecosystem within the opportunities and constraints presented by a relatively constant abiotic environment. In other words, ecosystems are treated as isolated and closed biotic systems, the components (i.e. species) of which gradually 'equilibrate' to stable, external conditions through density-dependent interactions producing classical

successional processes (as elaborated by Clements, 1916)[4]. The predetermined end-point, 'climax' or 'global attractor' of this irreversible evolution towards equilibrium, is a perfectly balanced biotic community which is stable through time and to which the system will settle following disturbance. Sources of disturbance are always perceived as external to the (closed) biotic system.

In other words, ecosystems are conceived as rather 'rigid' structures in an effectively 'passive' environment; a view which allows the discipline of ecology to focus on understanding them in terms of the properties of their component species and their configuration, rather than their dynamic behaviour (Jantsch, 1980: 24). Importantly, the focus on defining a community equilibrium state considered to be the 'norm' legitimates the application of the label 'degradation' to any process thought to deflect the biotic system away from this state. More complicated equilibrium models, such as those which view ecosystem behaviour as characterised by stable limit cycles or multiple stable states, integrate elements of dynamic behaviour (cf. Holling, 1973: 2-14; Walker, 1980; Walker and Noy-Meir, 1982: 556). Coppock (1993), for example, considers that the patterns and impacts of range-use by semi-sedentary Borana pastoralists of South Ethiopia display a stable limit cycle which oscillates between dominance of herbaceous followed by woody vegetation, while Dublin *et al* (1990) and Dublin (1991) describe the dynamics of the Serengeti-Mara woodland-grassland ecosystem in terms of shifting discontinuously between multiple stable equilibrium states (for additional examples and discussion see Griffin and Friedel, 1985; Safriel, 1987; Barrett, 1989; Westoby *et al*, 1989; Fuls, 1991: 13, 1992a: 63, 1992b; 192). A dominant interest, however, remains the ability of these systems either to return to equilibrium following disturbance (i.e. resilience), or to retain equilibrium (stability) in the face of disturbance (i.e. resistance)[5].

This conception of ecosystem behaviour lies deep in the very foundations of western science. Its strongest influences are the theoretical constructs and observations of classical thermodynamics which, in turn, are rooted in the Cartesian-Newtonian conception of a mechanistic Nature which obeys laws and is thus predictable and controllable. The crucial point about thermodynamic systems is that *any deflection from normal behaviour or equilibrium is seen as random fluctuation or noise rather than as an integral component of the system*. The mathematical language used to describe such systems and applied to questions in ecology is thus biased towards analytically tractable interactions which are presumed to

---

[4] See, for example, Tainton *et al* (1980), Vorster (1982), Bosch and Janse Van Rensburg (1987) for analysis of veld condition in southern Africa, including the arid karoo and semi-arid grasslands or western Transvaal, with reference to successional dynamics such that areas classified as degraded are considered as stages in 'veld retrogression' from a 'climatic climax' (cf. Trollope *et al*, 1990: 53, 55) or 'benchmark' community. See also Gibson and Brown (1992) for an application of a classical succession framework based on 'relay floristics' in the analysis of grazing impacts in the temperate environment of South Britain, and Noble and Slatyer (1980) for a discussion of the importance of the life-history characteristics of individual species as 'vital attributes' determining future successional shifts in community dominance.

[5] For detailed definitions of these terms see May, 1972: 413; Holling, 1973: 5; Walker, 1980: 79; Walker *et al*, 1981; Connell and Sousa, 1983: 790; Frost *et al*, 1986: 3; DeAngelis and Waterhouse, 1987: 6; Safriel, 1987: 135; Warren and Agnew, 1988.

have a fundamental equilibrium solution (cf. May, 1972, 1977; Hastings *et al*, 1993: 3). As discussed by Ellis *et al* (1993: 31), assumptions of equilibrium also pervade evolutionary and ecological ideas from the 18th century on. They find expression, for example, in both Darwin's exposition on the gradual and adaptive evolution of species through natural selection and competition, and Malthus' 1798 assertion that human populations are regulated through density-dependent feed-back relationships within the constraints of available food resources.

It is significant that these concepts in science evolved in a relatively predictable 'natural' environment, and were intimately linked with an economic system which sought to control and maintain (in the short-term at least) environmental productivity for profit. A northern temperate-zone 'equilibrium-centred view of constant nature' (Holling, 1986: 310, 313) thus provides a logical basis from which to calculate economic measures such as the maximum sustained yield of particular resources given the defined carrying capacity of a particular environment (cf. le Houérou and Hoste, 1977, De Leeuw and Tothill, 1990), and lends itself to conservative management strategies appropriate to maintain them.

A non-equilibrium ecology: integrating abiotic-biotic interactions

As is currently being discussed in the burgeoning literature concerning arid land ecology and land-use practices, the extension of assumptions derived within the framework of equilibrium dynamics is extremely problematic for arid environments[6]. Some ecologists even contend that 'belief in equilibrium theory amounts to verification of a paradigm due to faith in that paradigm', rather than on the weight of empirically tested evidence (Wiens, 1984: 455), leading to the consideration that 'drylands are probably the least well understood environment on Earth' (Warren and Agnew, 1988: 46). The general perception of desert dynamics as 'extreme' or 'atypical', and their consequent 'shoehorning' into a theoretical framework which developed in a totally different environmental context, belies the fact that arid and semi-arid grassland, steppe and desert environments constitute some 30% of the land area of the planet (cf. Hadley and Szarek, 1981: 747; Wiens, 1984: 450).

Most importantly, the assumption of a passive abiotic context external to a closed biotic system fundamentally precludes the possibility that abiotically-driven variability may be integral to 'healthy' ecosystem behaviour. This is nothing short of disastrous for the understanding of arid and semi-arid systems where biological productivity is limited primarily (but not exclusively) by moisture as opposed to nutrients, and rainfall, usually the only source of water, is inherently variable and unpredictable[7]. Together with a negative ideology of

---

[6] See, for example, Sandford, 1983; Wiens, 1984; Coughenour *et al*, 1985, 1990; Caughley *et al*, 1987; Homewood and Rogers, 1987; Ellis and Swift, 1988; Warren and Agnew, 1988; Leslie and Fry, 1989; Westoby *et al*, 1989; Abel and Blaikie. 1990; Adams, 1990, 87-112; Boonzaier *et al*, 1990; Galvin, 1990; Biot *et al*, 1992; Behnke, 1993; Behnke *et al*, 1993; Ellis *et al*, 1993; Dahlberg, 1994; Milton and Hoffman, 1994; Norbury *et al*, 1994; Thomas and Middleton, 1994; Dean *et al*, 1995; Scoones, 1995; Leach and Mearns, 1996.

[7] Cf. Noy-Meir, 1973: 685; Seely and Louw, 1980: 25; Hadley and Szarek, 1981: 747; O'Connor, 1985: iv, 11-23; Safriel, 1987: 135; Wellard, 1987: 35, 49; Robertson, 1987: 50-68; Hoffman *et al*, 1990: 463. See also Mentis and Bailey (1990) for a discussion of non-equilibrium dynamics ensuing from the role of fire in moister savanna environments.

'traditional communal farming' (see Section 8.2.1) it underlies what has been termed 'the lie of the land' (Leach and Mearns, 1996: 6): the conventional wisdom that African environments are experiencing detrimental change due to unsustainable land-use practices.

For arid and semi-arid environments it is hypothesised instead that aperiodic and idiosyncratic rainfall events in time and space drive the biotic system, largely preventing species from reaching a stable state or carrying capacity composed of average densities and regulated by density-dependent feedback control (Ellis and Swift, 1988: 453; Eldridge *et al*, 1990: 510; Chambers and Norton, 1993: 262). This is considered particularly true of smaller temporal and spatial scales (Frost *et al*, 1986: 4)[8]. At the same time, biotic persistence is conferred by species life-history strategies related to physiological and opportunistic behavioural adaptations, meaning that even extreme variability in absolute productivity and population size is unlikely to impose a risk of extinction for these species[9]. Similarly, adaptations displayed by local breeds of livestock in dryland environments include diet-switching (Caughley, 1987: 160) and an ability to lower Basal Metabolic Rate in stress periods (Western and Finch, 1986).

The temporal and spatial patchiness of arid environments with regard to the interrelated factors of rainfall events, topographic variation, vertical and horizontal run-off distribution and edaphic diversity, further increases the likelihood of variability at specified temporal and spatial scales (Seely and Louw, 1980: 34; Olsvig-Whittaker *et al*, 1983: 161-164; Safriel, 1987: 138-139; Safriel *et al*, 1989: 126; Stafford-Smith and Morton, 1990: 256; Noy-Meir, 1993: 33, 35). This creates opportunities for diversity at different scales in terms of life history strategies and physiognomic adaptations, and enables these apparently impoverished environments to support complex food webs (cf. Seely and Louw, 1980: 47-48; Hadley and Szarek, 1981: 749; Safriel *et al*, 1989: 129; Dean and Milton, 1991: 231). Noy-Meir (1979/80), in his 'autoecological hypothesis' of the persistence of arid systems, suggests that the biotic community of such systems is thus structured more by particular responses by individual species to drought-induced stress than by interactions among species. The biotic system, in other words, is characterised by low interaction strength and high flexibility in response to variable abiotic conditions. In addition, ecosystem persistence at larger scales is conferred by randomness at smaller scales which increases the availability of compensatory patches

---

[8] Nb. In some contexts biotic instability may also be caused by strong biotic feedbacks which act as the driving parameter keeping populations and communities at disequilibrium (DeAngelis and Waterhouse, 1987: 1, 3). Mathematical models of interaction indices, for example, indicate that high food web connectance combined with a high degree of interaction strength can result in instability (chaos) beyond a threshold point (May, 1971: 59, 1972: 414). This contradicts earlier considerations that higher species diversity and greater interactions between species produced a corresponding increase in stability (cf. MacArthur, 1955; Elton, 1958; McNaughton, 1977; see discussion in Collins, 1995: 95-96 and Silvertown *et al*, 1995: 287-288). See also, Auerbach (1984: 416-9) and Holling (1986: 309) for a discussion of how the hierarchical organisation of food webs is thought to confer community stability.

[9] Descriptions of some of these remarkable adaptations can be found in Walter, 1971: 242-93, 1986; Brown *et al*, 1979; Seely and Louw, 1980; Hadley and Szarek, 1981: 748-751; Ludwig and Whitford, 1981; Louw and Seely, 1982; Baker, 1987: 76; Wellard, 1987; Dawson *et al*, 1989; Rubenstein, 1989; Safriel *et al*, 1989: 126-129; Viljoen, 1989; Stafford Smith and Morton, 1990: 265-272; Ghazanfar, 1991; Dean *et al* 1992; Günster, 1992, 1994a, 1994b, 1994c; van Rooyen *et al*, 1992; Cowling *et al*, 1994; Norbury *et al*, 1994: 410-418; Jacobson, 1997. In addition, genetic diversity within species has been found to increase into desert environments, indicating an intimate relationship with ecological heterogeneity (Nevo and Beiles, 1989: 241, 243).

utilised by mobile species and provides alternative pools of species experiencing extinction at local spatial and temporal scales.

Like classical equilibrium dynamics, an emphasis on the functional aspects of abiotically-driven 'disturbance' events can find firm theoretical foundations in the 'harder' physical sciences in, for example, the dynamics of what have become known as Prigogine dissipative structures[10]; i.e. physical systems defined by openness and system-environment interactions, non-equilibrium behaviour, multiple levels or scales, and the internal reinforcement of fluctuations (i.e. positive feedback). In accordance with this perspective, ecosystem properties arise as a non-deterministic process driven by dynamic and non-linear interactions both within the biotic system *and between this system and its environment* (Jantsch, 1980: 24; Wolf, 1983: 82).

In contrast, the terms commonly used to describe the situation within north-west Namibia (see Chapter 5), and found in assertions of the degrading effects of pastoral land use throughout sub-Saharan Africa, provide some indication of the unquestioned acceptance of equilibrium thinking, and of the consequent emphasis on management interventions designed to increase stability in the belief that these will ensure sustained levels of productivity (see examples in Foran *et al*: 1978: 27; Skinner, 1981: 15; Tainton *et al*, 1980: 37; Oatham, 1997). For example, implicit in the expression '*over*-grazed' is the existence of some (undefined) 'normal' and acceptable level of grazing which has been over-reached. This is directly related to the concept of carrying capacity, defined from an ecological perspective as the constant level of stocking at which herbivory balances primary productivity (see, for example, Noy-Meir, 1975; May, 1977: 172). It is difficult to see how this can be an appropriate concept in a context where primary productivity is constrained to a large extent by extremely variable, stochastic rainfall events, and not by density-dependent relationships in a resource-limited environment. Assertions of 'severe deterioration', interpreted as a progressive (linear) decline in productivity, also rely on the perceived existence of a 'normal' and definable state; but, if productivity is inherently variable, then such a perception is logically untenable, i.e. its 'normal' state is variable! Similarly, frequent references to so-called 'normal rain years' (cf. Nicholas, 1952: 17; Köhler, 1959: 13-14) act to dismiss the reality that 'abnormal' years such as droughts are equally part of the 'normal' range of variability (Seely and Jacobson, 1994: 27). Finally, descriptions of the area as on the verge of 'system collapse' are the antithesis of a non-equilibrium perspective which sees a wide range of variation as integral to dryland ecosystems (cf. Safriel, 1987; Safriel *et al*, 1989) and has a positive view of such systems as displaying a remarkable degree of qualitative persistence in the face of stochastic abiotic events.

---

[10] After the French chemist and Nobel prize-winner who made these structures his life work. This observation has also be made by Biot *et al* (1992: 28).

A conceptual approach which firmly accepts that variable abiotic parameters are central to ecosystem behaviour, implies a shift in interest to encompass the ways in which a condition of non-equilibrium, characterised by continual and unpredictable fluctuation at different scales, is essential for ecosystem health and resilience (Holling, 1986). In other words, variability or instability, rather than stability (cf. Collins, 1995: 95), is seen as the defining quality of ecosystem persistence. Appropriate questions could focus on the means whereby both ecological and social 'systems' with inherently low quantitative stability maintain the same qualitative relationships, i.e. 'persist', in the face of continual change, and the creative tactics through which resource-users cope with quantitative, non-deterministic fluctuations in resource availability (cf. Prigogine, 1989: 396).

8.3 Beyond 'the lie of the land': some policy approaches

The implications of the above discussion for formulating management and policy initiatives for north-west Namibia which are socially and ecologically appropriate are profound. At a conceptual level, they mean acknowledging that apparently unstable ecological fluctuations and contingent land-use practices are normal phenomena emerging from the non-linear and non-equilibrium behaviour lying at the core of the region's environmental and social health and character. The logical outcome of this at an implementation level, is a radical revision of interventions developed to confer predictability and control over productive systems in relatively constant environments, based on the understanding that these will have exactly the opposite effect in dynamic environments such as arid north-west Namibia.

Instead, the case study of Damara farmers in north-west Namibia presented in this thesis, and epitomised by the quotes at the beginning of Chapter 5, demonstrates that dominant thinking regarding development and natural resource management remains focused on exactly the opposite: on imposing stability of land-use practices through instituting private tenure over demarcated land-holdings (Chapter 4) in order to prevent a 'Tragedy of the Commons'; on conceptualising communal land-use practices within a paradigm moulded on acceptance of progressive degradation and desertification (Chapter 5) in the absence of data confirming this perception (Chapters 6 and 7); on favouring 'community' approaches to development through natural resource management which fail to grasp the significance of the fundamental heterogeneity and fluidity of recipient 'communities' for ensuring effectiveness of these projects (Chapter 4); and on attempting to introduce these approaches without taking time to discover the complexity of 'invisible' resource-use practices (Chapters 2 and 3), or the myriad elements of local ecological knowledge (Chapter 4), to which farmers turn when conditions are appropriate in the context of a variable environment.

Going beyond these lies of the land means exploring realistic policy alternatives. A number of policy implications related to the findings and themes of this thesis have been discussed where appropriate in the preceding chapters. To summarise, interrelated approaches could include:

1. Promotion of the livestock economy

The generally negative perceptions of the effects of livestock farming on the landscape of north-west Namibia have led, like elsewhere (cf. Little and Brokensha, 1987: 197; Oba, 1992: 11; Scoones, 1996: 42-44), to the opinion that every effort should be made to reduce the region's herd. In discussing land-use recommendations for Sesfontein and environs Van Warmelo (1962: 35) exhorts that 'overstocking ... must be avoided like the plague ... through careful supervision of stock and population'; this opinion was echoed in 1996 by the management of the current Ministry of Agriculture development project for this area who, at the outset of the project, felt that all livestock should be removed from the so-called Sesfontein-Khowarib Basin (pers. comm. with Project Manager, 1996; see also Infoscience, 1994: 39)[11]. A plethora of initiatives in post-independent Namibia which aim to promote alternative sources of livelihood are at least partly driven by this agenda of demoting the area's livestock economy. These include attempts to promote commercial crop production and to diversify livelihoods by increasing benefits to farmers from animal wildlife. With regard to the latter approach, and as Ashley *et al* (1994) state, the current focus in Namibia on enabling communal farmers to benefit from both animal wildlife and livestock is perceived as a viable means of reducing 'the risk of environmental degradation' by capitalising on 'the different feeding and watering behaviour of game'.

As well as an uncritical acceptance of the received wisdom of livestock-induced degradation in the area, there is danger in these approaches of misunderstanding the value of livestock as an integral component of the social and economic fabric of the region. Alternatively, and as Hogg (1987:304-305) argues for arid north Kenya, 'Developers and donors should recognise that there is no real economic alternative for the majority of the population'. This is because the potential of livestock for natural increase means that herds will remain by far the most attractive form of investment in variable arid environments. Thus, while pastoralists may have a positive view of new sources of livelihood they are likely to utilise these options opportunistically while continuing to invest in livestock (Hogg, 1987: 297). This apparently inescapable fact implies that successful policy intervention requires a positive view of livestock as its premise (cf. Mearns, 1996).

2. Supporting variability rather than imposing stability

Most intervention is currently informed by the desire to increase predictability in pursuit of ecological and economic sustainability. These latter ideals, however, need not exclude their apparent conceptual opposites of variability and unpredictability.

Currently, for example, drought tends to be treated as an 'unusual occurrence that requires emergency action' (Seely and Jacobson, 1994: 27, 33; see also Bester, 1995: 91; Seely *et al*,

---

[11] Scoones (1996: 43-44) describes similar policy objectives for communal land in Zimbabwe, particularly in the 1960s and 1980s but based on earlier 'crisis narratives' of degradation.

1995: 60), resulting in reactive and short-term interventions which encourage dependence on transient injections of resources to rural areas as 'drought relief' (see also Oba, 1992: 1, 21). A view of drought-related falls in productivity as part of the normal range of variation experienced throughout Namibia would instead emphasise the integration and support of management decisions which 'track' ecological variability (cf. Sandford, 1983; Oba, 1992: 14; Behnke, 1993), thereby maintaining long-term persistence of the qualitative relationships characterising both social and ecological systems (cf. Shepherd and Caughley, 1987: 191: 217). With regard to herd management, this means seizing the opportunities presented for herd growth during good years, in order to minimise losses in bad years. As Chapter 4 describes, this is precisely what both communal farmers **and** the commercial settler farmers preceding them have attempted to do in north-west Namibia, largely through management decisions and negotiation in support of migration across bounded areas to avoid herd losses due to local or regional shortages of grazing.

This has serious implications for the design of an appropriate land tenure policy for the north-west, particularly in the wake of the finding in Chapter 4 that *even under circumstances of secure tenure to large land-holdings the former commercial farmers chose to migrate in response to the environmental conditions of this area*. In other words, making provision for security of tenure to units of land, as appears to be the aim of Namibia's draft lands policy for communal areas, will **not** ensure security of livelihood unless options for unpredictable movements between these units are retained and supported. Alternatively, emphasis should be placed on strengthening procedures and local institutions which guide the allocation of usufructuary rights to, and mediate conflict over, focal resources, rather than on promoting tenure rights to extensive land areas (cf. Behnke, 1993). The relevance of this type of approach can be illustrated by perceptions from another Namibian communal area, Bushmanland, where the Nyae Nyae Farmers' Cooperative conceives of 'resource control as having greater priority than land ownership *per se*' (Biesele *et al*, 1991: 11).

Similarly, the regional farming economy would gain from a policy and market emphasis which anticipates the effects of drought so that farmers benefit meaningfully from the sale of livestock **before** prices fall as animals begin to lose condition (cf. Oba and Lusigi, 1987: 25; Barrett, 1989: 2, 18). This would enable farmers engaging in the formal economy to derive maximum benefits from destocking (i.e. which is perceived as desirable by conservationists), by providing capital which can be reinvested in livestock when environmental conditions are more favourable.

3. Promoting the poor as well as the wealthy

To date, most government intervention has acted to disproportionately benefit large- and middle-scale farmers while excluding the poorest income groups. This trend appears to be maintained in current policy proposals designed to make provision for individual land-holdings in communal areas which emphasise 'qualifications' such as minimum herd size in

order for farmers to be eligible for delineated holdings. Examples of assistance schemes which support wealthy and middle-income farmers over and above small-scale farmers include the following:

- subsidised movement out of Damaraland in the 1980s was only available to farmers with cattle, and similarly farms purchased for emergency grazing in the 1980s were only available to relatively wealthy farmers;
- subsidies of N$120 per breeding cow offered at auctions as an incentive to destock benefited only those with cattle;
- during the drought relief scheme of the early 1990s credit was provided to small-scale farmers. These were based on livestock numbers, however, such that credits of up to N$200 were allocated depending on numbers of animals up to a maximum per farmer of 10 cattle or 50 goats. Although this scheme targeted low-income groups with small herds, credit received on a cumulative scale such as this benefits those with greater numbers of animals, within the limits of the scheme;
- eligibility for the loan scheme offered to middle-income farmers in 1992 to facilitate restocking was based on a minimum number of livestock owned but did not take into account drought-incurred animal losses and excluded the poorest farmers with the greatest need for restocking assistance;
- recently, the advice and sanctioning of migration by Agricultural Extension Officers has benefited those with enough stock to make it worthwhile to migrate. These farmers then impact on resources in areas inhabited by poorer farmers. This occurred in 1994, for example, when a number of large-scale farmers moved to the Ugab River, utilising grazing which local farmers were unable to take advantage of due, at least in part, to the losses they had sustained in previous drought years.

It is not the intention here to advocate avoidance of schemes which support wealthier farmers, but these examples illustrate that a shift in emphasis is necessary to ensure that small-scale farmers also benefit from, and do not bear the costs of, such initiatives. Instead, a progressive approach to assistance schemes might include for example:

- a focus on the **restocking** of small-scale farmers rather than promoting the existing livestock wealth of larger-scale farmers (cf. Barrett, 1989: 19; Mace, 1991);
- the compensation of small-scale farmers for the use of grazing resources by wealthy farmers moving to 'their' area. This is extremely important given the current situation whereby the constitution, in backlash against the Apartheid-driven constraints on movement by indigenous Namibians, allows Namibian citizens to move to wherever they choose on communal land, with potential disregard for existing customary rights of others;

- wealthy farmers who have exercised the option to lease or purchase commercial farms should be restricted from continuing to use communal grazing, or only be allowed to do so if recipient communal farmers can receive suitable compensation;
- administrative integration of commercial and communal farming sectors within the new regions could facilitate the flow of benefits between both sectors. In particular, the instituting of a land tax on commercial holdings, or a progressive tax on livestock (cf. Barrett, 1989: 16), could, if managed at a regional level, be used to fund development and necessary subsidies to small-scale communal farmers.

4. Listening to resource-users

It is self-evident that many of the discontinuities between national policy and local realities relate to a reluctance to invest time, resources and expertise in talking and listening to a diversity of resource-users. This is clearly the case with policy choices being made regarding land tenure reform in the north-west. It is not difficult to listen to farmers' accounts of mobility as an essential component of herd management in the arid north-west; doing so makes transparent the need for a policy environment which supports such fluidity, rather than imposing a policy framework for the fencing of land into fixed, individual holdings. Similarly, the MET's focus in the formulation of a conservancy policy on commercially valuable animal wildlife, despite lip-service to other resources, represents a lack of recognition that alternative resources have the greatest local 'use-value'. Indeed, such an emphasis may be hampering attempts to promote resource conservation at the 'community' level. As Chapter 3 demonstrates, the natural resource base to which people turn is extremely diverse. Moreover, it is used not only out of necessity, but also due to both a desire for variety in available commodities, and a positive view of enacting resource-use practices which are considered to have meaning in their affirmation of cultural identity. Listening to people talk about these practices may be one way of promoting 'community' approaches to resource conservation which are more inclusive; which involve individuals who have a wealth of knowledge concerning the local environment but who are distanced by continuing perceptions of animal wildlife as under the control of a formerly repressive conservation officialdom, and by the selective dialogue between these officials and politically-vocal 'community' members. In these policy areas, and in the words of Leach and Mearns (1996: 5), ecological knowledge held by resource-users in north-west Namibia is instead 'notable mostly by its absence, silenced before it is investigated'.

It remains to be seen whether first, policy-makers will translate the findings of new research on natural resource-use and management into flexible and creative policy and second, whether these changes will become effective in local administrative practice or 'sediment down' to forms which are indistinguishable from preceding approaches (Adams, 1996: 166). Given the 'stickiness' of ideas (Swift, 1996: 73) it is perhaps unlikely that the conventional conceptual

model of degradation, which legitimises land-use planning based on control, will be relinquished in favour of a paradigm which embraces variable and opportunistic management practices. The data and discussion forming the core of this thesis, however, suggest that nothing less is required if Damara farmers and the landscape of the north-west are to be accurately represented in intervention and policy designed to improve livelihoods and maintain ecological integrity.

One final thought to close this thesis. As I was apologising for taking up so much time during the course of an interview with Meda, a woman farmer at ǁGaisoas on the Ugab River, she stopped me short saying that 'you are the first person to ask me what I know'. Meda had every reason not to engage in discussion with me about anything: she had been evicted in the 1950s from her home area, ǁKhaos, in order that it may be proclaimed as Daan Viljoen Game Park for the use of Windhoek's white inhabitants; she had subsequently to provide for her family in an extremely marginal area where her only source of water was a hand-dug well in the nearby Ugab river; and in 1994 elephant, absent from the area for around 50 years, moved back to the river causing damage to local gardens and water installations and forcing Meda to build a new house on a rocky kopje or outcrop as a means of protection against these animals which she both respects and fears. Nevertheless, it is people like Meda who are implicitly blamed in assertions of perceived degradation in Namibia's communal areas. An alternative way of seeing is that 'what Damara farmers know' has enabled them to survive and maintain identity even as the political and ecological odds are stacked against them. For Meda this meant being able to earn money from beer brewing and distilling liquor from grass seeds gathered from harvester ants nests, being recognised and visited as someone with knowledge of local medicines and treatments and retaining a sense of pride in her appearance through the use of plants for perfume, cosmetics and beads. Asking farmers what they know about the details of the landscape they inhabit and use may be a naïve approach to development and conservation; then again, it may be the only way to create an atmosphere of trust, to develop inclusive policy and to foster understanding of the environment based on local experience rather than 'expert' perception.

References

Abel, N. 1993 Carrying capacity, rangeland degradation and livestock development policy for the communal rangelands of Botswana. *Pastoral Development Network Paper.* 35c. ODI, London.

Abel, N.O.J. and Blaikie, P.M. 1990 Land degradation, stocking rates and conservation policies in the communal reangelands of Botswana and Zimbabwe. *Pastoral Development Network Paper.* 29a. ODI, London.

Abrams, M.M., Jacobson, P.J., Jacobson, K.M. and Seely, M.K. 1997 Survey of soil chemical properties across a landscape in the Namib Desert. *J. Arid Environm.* 35: 29-38.

Adams, F. and Werner, W. 1990. *The land issue in Namibia: an enquiry.* NISER, University of Namibia, Windhoek.

Adams, M.E. and Devitt, P. 1992 Grappling with land reform in Namibia. *Pastoral Development Network Paper.* 32a. ODI, London.

Adams, W.M. 1990 *Green development: environment and sustainability in the third world.* Routledge, London.

Adams, W.M. 1996 Irrigation, erosion and famine: visions of environmental change in Marakwet, Kenya. pp. 155-167 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Africare 1993 *Rural water supply maintenance in the Kunene Region, Republic of Namibia.* Unpublished report to the Africa Bureau of the United States Agency for International Development (USAID).

Agarwal, B. 1989 Rural women, poverty and natural resources: sustenance, sustainability and struggle for change. *Econ. and Pol. Weekly.* Oct. 28: 46-63.

Agricultural (Commercial) Land Reform Act 1995 *Government Gazette of the Republic of Namibia. No. 1040.* Office of the Prime Minister, Windhoek, Namibia.

Aharoni, B. and Ward, D. in press. A new predictive tool for identifying areas of desertification that combines Principal Components Analysis and Geographical Information Systems: a case study from Namibia. *Desertification Control Bull.*

Alexander, J. 1984 Early frontiers in southern Africa. pp. 12-23 in Hall, M., Avery, G., Avery, D.M., Wilson, M.L. and Humphreys, A.J.B. (eds.) *Frontiers: southern African archaeology today.* Cambridge Monographs in African Archaeology 10, BAR International Series 207.

Alexander, J.E. 1838 An expedition of discovery into the interior of Africa vol. II. *Africana collectanea.* C. Struik, Cape Town.

Andersson, C.J.1856 *Lake Ngami or explorations and discoveries during four years' wandering in the middle of South West Africa.* Hurst and Blackett, London.

Apollus, A., Kathena, J. and Tjiveze, H. 1997 Land degradation in Otjimbingwe and the surrounding commercial farms: an ecological and sociological investigation. In Ward, D.ed. *Land degradation in the pro-Namib.* Report of the Summer Desertification Project (DRFN) 1996 funded by USAID and SIDA.

Appadurai, A. 1989 Small-scale techniques and large-scale objectives. pp. 250-282 in Bardhan, B.ed. *Conversations between economists and anthopologists: methodological issues in measuring economic change in rural India.* Oxford University Press,Oxford.

Arnold, J.E.M. n.d. *Production of forest products in agricultural and common land systems: economic and policy issues.* A forest policy issues paper prepared for the Agricultural and Rural Development Dept., The World Bank.

1995: 60), resulting in reactive and short-term interventions which encourage dependence on transient injections of resources to rural areas as 'drought relief' (see also Oba, 1992: 1, 21). A view of drought-related falls in productivity as part of the normal range of variation experienced throughout Namibia would instead emphasise the integration and support of management decisions which 'track' ecological variability (cf. Sandford, 1983; Oba, 1992: 14; Behnke, 1993), thereby maintaining long-term persistence of the qualitative relationships characterising both social and ecological systems (cf. Shepherd and Caughley, 1987: 191: 217). With regard to herd management, this means seizing the opportunities presented for herd growth during good years, in order to minimise losses in bad years. As Chapter 4 describes, this is precisely what both communal farmers **and** the commercial settler farmers preceding them have attempted to do in north-west Namibia, largely through management decisions and negotiation in support of migration across bounded areas to avoid herd losses due to local or regional shortages of grazing.

This has serious implications for the design of an appropriate land tenure policy for the north-west, particularly in the wake of the finding in Chapter 4 that *even under circumstances of secure tenure to large land-holdings the former commercial farmers chose to migrate in response to the environmental conditions of this area*. In other words, making provision for security of tenure to units of land, as appears to be the aim of Namibia's draft lands policy for communal areas, will **not** ensure security of livelihood unless options for unpredictable movements between these units are retained and supported. Alternatively, emphasis should be placed on strengthening procedures and local institutions which guide the allocation of usufructuary rights to, and mediate conflict over, focal resources, rather than on promoting tenure rights to extensive land areas (cf. Behnke, 1993). The relevance of this type of approach can be illustrated by perceptions from another Namibian communal area, Bushmanland, where the Nyae Nyae Farmers' Cooperative conceives of 'resource control as having greater priority than land ownership *per se*' (Biesele *et al*, 1991: 11).

Similarly, the regional farming economy would gain from a policy and market emphasis which anticipates the effects of drought so that farmers benefit meaningfully from the sale of livestock **before** prices fall as animals begin to lose condition (cf. Oba and Lusigi, 1987: 25; Barrett, 1989: 2, 18). This would enable farmers engaging in the formal economy to derive maximum benefits from destocking (i.e. which is perceived as desirable by conservationists), by providing capital which can be reinvested in livestock when environmental conditions are more favourable.

3. Promoting the poor as well as the wealthy

To date, most government intervention has acted to disproportionately benefit large- and middle-scale farmers while excluding the poorest income groups. This trend appears to be maintained in current policy proposals designed to make provision for individual land-holdings in communal areas which emphasise 'qualifications' such as minimum herd size in

order for farmers to be eligible for delineated holdings. Examples of assistance schemes which support wealthy and middle-income farmers over and above small-scale farmers include the following:

- subsidised movement out of Damaraland in the 1980s was only available to farmers with cattle, and similarly farms purchased for emergency grazing in the 1980s were only available to relatively wealthy farmers;
- subsidies of N$120 per breeding cow offered at auctions as an incentive to destock benefited only those with cattle;
- during the drought relief scheme of the early 1990s credit was provided to small-scale farmers. These were based on livestock numbers, however, such that credits of up to N$200 were allocated depending on numbers of animals up to a maximum per farmer of 10 cattle or 50 goats. Although this scheme targeted low-income groups with small herds, credit received on a cumulative scale such as this benefits those with greater numbers of animals, within the limits of the scheme;
- eligibility for the loan scheme offered to middle-income farmers in 1992 to facilitate restocking was based on a minimum number of livestock owned but did not take into account drought-incurred animal losses and excluded the poorest farmers with the greatest need for restocking assistance;
- recently, the advice and sanctioning of migration by Agricultural Extension Officers has benefited those with enough stock to make it worthwhile to migrate. These farmers then impact on resources in areas inhabited by poorer farmers. This occurred in 1994, for example, when a number of large-scale farmers moved to the Ugab River, utilising grazing which local farmers were unable to take advantage of due, at least in part, to the losses they had sustained in previous drought years.

It is not the intention here to advocate avoidance of schemes which support wealthier farmers, but these examples illustrate that a shift in emphasis is necessary to ensure that small-scale farmers also benefit from, and do not bear the costs of, such initiatives. Instead, a progressive approach to assistance schemes might include for example:

- a focus on the **restocking** of small-scale farmers rather than promoting the existing livestock wealth of larger-scale farmers (cf. Barrett, 1989: 19; Mace, 1991);
- the compensation of small-scale farmers for the use of grazing resources by wealthy farmers moving to 'their' area. This is extremely important given the current situation whereby the constitution, in backlash against the Apartheid-driven constraints on movement by indigenous Namibians, allows Namibian citizens to move to wherever they choose on communal land, with potential disregard for existing customary rights of others;

- wealthy farmers who have exercised the option to lease or purchase commercial farms should be restricted from continuing to use communal grazing, or only be allowed to do so if recipient communal farmers can receive suitable compensation;
- administrative integration of commercial and communal farming sectors within the new regions could facilitate the flow of benefits between both sectors. In particular, the instituting of a land tax on commercial holdings, or a progressive tax on livestock (cf. Barrett, 1989: 16), could, if managed at a regional level, be used to fund development and necessary subsidies to small-scale communal farmers.

4. Listening to resource-users

It is self-evident that many of the discontinuities between national policy and local realities relate to a reluctance to invest time, resources and expertise in talking and listening to a diversity of resource-users. This is clearly the case with policy choices being made regarding land tenure reform in the north-west. It is not difficult to listen to farmers' accounts of mobility as an essential component of herd management in the arid north-west; doing so makes transparent the need for a policy environment which supports such fluidity, rather than imposing a policy framework for the fencing of land into fixed, individual holdings. Similarly, the MET's focus in the formulation of a conservancy policy on commercially valuable animal wildlife, despite lip-service to other resources, represents a lack of recognition that alternative resources have the greatest local 'use-value'. Indeed, such an emphasis may be hampering attempts to promote resource conservation at the 'community' level. As Chapter 3 demonstrates, the natural resource base to which people turn is extremely diverse. Moreover, it is used not only out of necessity, but also due to both a desire for variety in available commodities, and a positive view of enacting resource-use practices which are considered to have meaning in their affirmation of cultural identity. Listening to people talk about these practices may be one way of promoting 'community' approaches to resource conservation which are more inclusive; which involve individuals who have a wealth of knowledge concerning the local environment but who are distanced by continuing perceptions of animal wildlife as under the control of a formerly repressive conservation officialdom, and by the selective dialogue between these officials and politically-vocal 'community' members. In these policy areas, and in the words of Leach and Mearns (1996: 5), ecological knowledge held by resource-users in north-west Namibia is instead 'notable mostly by its absence, silenced before it is investigated'.

It remains to be seen whether first, policy-makers will translate the findings of new research on natural resource-use and management into flexible and creative policy and second, whether these changes will become effective in local administrative practice or 'sediment down' to forms which are indistinguishable from preceding approaches (Adams, 1996: 166). Given the 'stickiness' of ideas (Swift, 1996: 73) it is perhaps unlikely that the conventional conceptual

model of degradation, which legitimises land-use planning based on control, will be relinquished in favour of a paradigm which embraces variable and opportunistic management practices. The data and discussion forming the core of this thesis, however, suggest that nothing less is required if Damara farmers and the landscape of the north-west are to be accurately represented in intervention and policy designed to improve livelihoods and maintain ecological integrity.

One final thought to close this thesis. As I was apologising for taking up so much time during the course of an interview with Meda, a woman farmer at ǁGaisoas on the Ugab River, she stopped me short saying that 'you are the first person to ask me what I know'. Meda had every reason not to engage in discussion with me about anything: she had been evicted in the 1950s from her home area, ǁKhaos, in order that it may be proclaimed as Daan Viljoen Game Park for the use of Windhoek's white inhabitants; she had subsequently to provide for her family in an extremely marginal area where her only source of water was a hand-dug well in the nearby Ugab river; and in 1994 elephant, absent from the area for around 50 years, moved back to the river causing damage to local gardens and water installations and forcing Meda to build a new house on a rocky kopje or outcrop as a means of protection against these animals which she both respects and fears. Nevertheless, it is people like Meda who are implicitly blamed in assertions of perceived degradation in Namibia's communal areas. An alternative way of seeing is that 'what Damara farmers know' has enabled them to survive and maintain identity even as the political and ecological odds are stacked against them. For Meda this meant being able to earn money from beer brewing and distilling liquor from grass seeds gathered from harvester ants nests, being recognised and visited as someone with knowledge of local medicines and treatments and retaining a sense of pride in her appearance through the use of plants for perfume, cosmetics and beads. Asking farmers what they know about the details of the landscape they inhabit and use may be a naïve approach to development and conservation; then again, it may be the only way to create an atmosphere of trust, to develop inclusive policy and to foster understanding of the environment based on local experience rather than 'expert' perception.

Arnold, J.E.M. 1993 Management of forests as common property. *Commonwealth Forestry Review.* 72(3): 157-161.

Artivor, B. and Mwazi, R. 1995 Role of the UN, donor agencies and NGOs in drought and development. pp. 199-210 in Moorsom, R., Franz, J. and Mupotola, M. (eds.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Ashley, C. 1997 *Wildlife Integration for Livelihood Diversification (WILD) project plan.* Draft document.

Ashley, C. and Garland, E. 1994 Promoting community-based tourism development: why, what and how? *Research Discussion Paper.* 4. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C. and LaFranchi, C. 1997 Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management. *Research Discussion Paper.* 20. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C., Barnes, J. and Healy, T. 1994 Profits, equity, growth and sustainability: the potential role of wildlife enterprises in Caprivi and other communal areas of Namibia. *DEA Research Discussion Paper.* 2. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C., Barnes, J., Brown, C. and Jones, B. 1997 Using resource economics for natural resource management: Namibia's experience. *Research Discussion Paper.* 16. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Auerbach, M.J. 1984 Stability, probability and the topology of food webs. pp. 413-436 in Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence.* Princeton University Press, Princeton.

Austin, M.P. and Williams, O.B. 1988 Influence of climate and community composition on the population demography of pasture species in semi-arid Australia. *Vegetatio.* 77: 43-49.

Austin, M.P., Williams, O.B. and Belbin, L. 1981 Grassland dynamics under sheep grazing in an Australian Mediterranean type climate. *Vegetation.* 47: 201-211.

Babiker, A.B. 1992 The role of rural industries in the arid and semi-arid areas of the Sudan. *Geojournal.* 8: 49-55.

Baker, L.M. and Mutijulu Community 1992 Comparing two views of the landscape: aboriginal traditional ecological knowledge and modern scientific knowledge. *Rangel. J.* 14(2): 174-189.

Baker, R.D. 1987 The diet of herbivores in the sheep rangelands. pp. 69-83 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Barnard, A. 1992 *Hunters and herders of southern Africa: a comparative ethnography of Khoisan peoples.* Cambridge University Press, Cambridge.

Barnes, D.L. 1990a A survey of grazed and ungrazed grassland in south-eastern Transvaal highveld 2. potential floristic composition and patterns of degradation. *J. Grassld. Soc. sth. Afr.* 7(4): 223-231.

Barnes, D.L. 1990b A survey of grazed and ungrazed grassland in south-eastern Transvaal highveld I. palatability, composition and grazing capacity. *J. Grassld. Soc. sth. Afr.* 7(4): 217-222.

Barnes, J.I. 1995 Current and potential use values for natural resources in some Namibian communal areas: a planning tool. *DEA Working Document.* Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Barnes, J.I. and de Jager, J.L.V. 1995 Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy. *Research Discussion Paper.* Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Barrett, S. 1989 On the over-grazing problem. *LEEC Paper* 89-07.

References

Abel, N. 1993 Carrying capacity, rangeland degradation and livestock development policy for the communal rangelands of Botswana. *Pastoral Development Network Paper.* 35c. ODI, London.

Abel, N.O.J. and Blaikie, P.M. 1990 Land degradation, stocking rates and conservation policies in the communal reangelands of Botswana and Zimbabwe. *Pastoral Development Network Paper.* 29a. ODI, London.

Abrams, M.M., Jacobson, P.J., Jacobson, K.M. and Seely, M.K. 1997 Survey of soil chemical properties across a landscape in the Namib Desert. *J. Arid Environm.* 35: 29-38.

Adams, F. and Wemer, W. 1990. *The land issue in Namibia: an enquiry.* NISER, University of Namibia, Windhoek.

Adams, M.E. and Devitt, P. 1992 Grappling with land reform in Namibia. *Pastoral Development Network Paper.* 32a. ODI, London.

Adams, W.M. 1990 *Green development: environment and sustainability in the third world.* Routledge, London.

Adams, W.M. 1996 Irrigation, erosion and famine: visions of environmental change in Marakwet, Kenya. pp. 155-167 in Leach, M. and Meams, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Africare 1993 *Rural water supply maintenance in the Kunene Region, Republic of Namibia.* Unpublished report to the Africa Bureau of the United States Agency for International Development (USAID).

Agarwal, B. 1989 Rural women, poverty and natural resources: sustenance, sustainability and struggle for change. *Econ. and Pol. Weekly.* Oct. 28: 46-63.

Agricultural (Commercial) Land Reform Act 1995 *Government Gazette of the Republic of Namibia. No. 1040.* Office of the Prime Minister, Windhoek, Namibia.

Aharoni, B. and Ward, D. in press. A new predictive tool for identifying areas of desertification that combines Principal Components Analysis and Geographical Information Systems: a case study from Namibia. *Desertification Control Bull.*

Alexander, J. 1984 Early frontiers in southern Africa. pp. 12-23 in Hall, M., Avery, G., Avery, D.M., Wilson, M.L. and Humphreys, A.J.B. (eds.) *Frontiers: southern African archaeology today.* Cambridge Monographs in African Archaeology 10, BAR International Series 207.

Alexander, J.E. 1838 An expedition of discovery into the interior of Africa vol. II. *Africana collectanea.* C. Struik, Cape Town.

Andersson, C.J.1856 *Lake Ngami or explorations and discoveries during four years' wandering in the middle of South West Africa.* Hurst and Blackett, London.

Apollus, A., Kathena, J. and Tjiveze, H. 1997 Land degradation in Otjimbingwe and the surrounding commercial farms: an ecological and sociological investigation. In Ward, D.ed. *Land degradation in the pro-Namib.* Report of the Summer Desertification Project (DRFN) 1996 funded by USAID and SIDA.

Appadurai, A. 1989 Small-scale techniques and large-scale objectives. pp. 250-282 in Bardhan, B.ed. *Conversations between economists and anthopologists: methodological issues in measuring economic change in rural India.* Oxford University Press,Oxford.

Arnold, J.E.M. n.d. *Production of forest products in agricultural and common land systems: economic and policy issues.* A forest policy issues paper prepared for the Agricultural and Rural Development Dept., The World Bank.

Arnold, J.E.M. 1993 Management of forests as common property. *Commonwealth Forestry Review.* 72(3): 157-161.

Artivor, B. and Mwazi, R. 1995 Role of the UN, donor agencies and NGOs in drought and development. pp. 199-210 in Moorsom, R., Franz, J. and Mupotola, M. (eds.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Ashley, C. 1997 *Wildlife Integration for Livelihood Diversification (WILD) project plan.* Draft document.

Ashley, C. and Garland, E. 1994 Promoting community-based tourism development: why, what and how? *Research Discussion Paper.* 4. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C. and LaFranchi, C. 1997 Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management. *Research Discussion Paper.* 20. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C., Barnes, J. and Healy, T. 1994 Profits, equity, growth and sustainability: the potential role of wildlife enterprises in Caprivi and other communal areas of Namibia. *DEA Research Discussion Paper.* 2. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Ashley, C., Barnes, J., Brown, C. and Jones, B. 1997 Using resource economics for natural resource management: Namibia's experience. *Research Discussion Paper.* 16. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Auerbach, M.J. 1984 Stability, probability and the topology of food webs. pp. 413-436 in Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence.* Princeton University Press, Princeton.

Austin, M.P. and Williams, O.B. 1988 Influence of climate and community composition on the population demography of pasture species in semi-arid Australia. *Vegetatio.* 77: 43-49.

Austin, M.P., Williams, O.B. and Belbin, L. 1981 Grassland dynamics under sheep grazing in an Australian Mediterranean type climate. *Vegetation.* 47: 201-211.

Babiker, A.B. 1992 The role of rural industries in the arid and semi-arid areas of the Sudan. *Geojournal.* 8: 49-55.

Baker, L.M. and Mutijulu Community 1992 Comparing two views of the landscape: aboriginal traditional ecological knowledge and modern scientific knowledge. *Rangel. J.* 14(2): 174-189.

Baker, R.D. 1987 The diet of herbivores in the sheep rangelands. pp. 69-83 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Barnard, A. 1992 *Hunters and herders of southern Africa: a comparative ethnography of Khoisan peoples.* Cambridge University Press, Cambridge.

Barnes, D.L. 1990a A survey of grazed and ungrazed grassland in south-eastern Transvaal highveld 2. potential floristic composition and patterns of degradation. *J. Grassld. Soc. sth. Afr.* 7(4): 223-231.

Barnes, D.L. 1990b A survey of grazed and ungrazed grassland in south-eastern Transvaal highveld I. palatability, composition and grazing capacity. *J. Grassld. Soc. sth. Afr.* 7(4): 217-222.

Barnes, J.I. 1995 Current and potential use values for natural resources in some Namibian communal areas: a planning tool. *DEA Working Document.* Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Barnes, J.I. and de Jager, J.L.V. 1995 Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy. *Research Discussion Paper.* Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Barrett, S. 1989 On the over-grazing problem. *LEEC Paper* 89-07.

Barrow, E. 1990 Usufruct rights to trees: the role of Ekwar in dryland central Turkana, Kenya. *Hum. Ecol.* 18(2): 163-176.

Barrow, E. 1988 Trees and pastoralists: the case of the Pokot and Turkana. *Social Forestry Network Paper.* 6b. ODI, London.

Barrow, J. n.d. Schilderung des kupferschmelzens bei den Damaras. XXVIII Bd: 4. in Moritz, E. ed. *Die ältesten Reisberichte uber Deutsch-SüdwestAfrika. Mitterlungen aus den Deutschen Schutzgebien.*

Bayer, W., Metz, M., Sievers, J., Tapscott, C. and Vigne, P. 1991 *Sustainable livestock production in the less developed areas of Namibia: vol. 1, sector analysis and planning study.* GTZ, Berlin.

Becker, B. 1986 Wild plants for human nutrition in the Sahelian zone. *J. Arid Environm.* 11: 61-64.

Behnke, R. 1993 *Natural resource management in pastoral Africa.* Paper presented to the UNEP workshop on listening to the people: social aspects of dryland management, December 1993, Nairobi.

Behnke, R.H. 1985 Measuring the benefits of subsistence versus commercial livestock production in Africa. *Agric. Syst.* 162: 109-135.

Behnke, R.H., Scoones, I. and Kerven, C. (eds.) 1993 *Range ecology at disequilibrium: new models of natural variability and pastoral adaptation in African savannas.* ODI, IIED, Commonwealth Secretariat, London.

Beinart, W. 1996 Soil erosion, animals and pasture over the longer term: environmental destruction in southern Africa. pp. 54-72 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Bell, D. 1993 *Daughters of the dreaming.* Allen and Unwin, St. Leonard's, Australia.

Bell, R. 1987 Conservation with a human face: conflict and reconciliation in African land use planning. pp. 79-101 in Anderson, D. and Grove, R. (eds.) *Conservation in Africa: people, polices and practice.* Cambridge University Press, Cambridge.

Ben-Shahar, R. 1991 Successional patterns of woody plants in catchment areas in a semi-arid region. *Vegetatio.* 93: 19-27.

Benefice, E., Chevassus-Agnes, S. and Barral, H. 1984 Nutritional situation and seasonal variations for pastoralist populations of the Sahel (Senegalese Ferlo). *Ecol. Food and Nutr.* 14: 229-247.

Berge, G. and Hveem, B. 1992 L'utilisation des plantes sauvages: commentaires relatifs à la répartition de la population interrogée. Annexe 12 in *Report détape, plantes sauvages.* Projet de recherche SSE Environnement et Développement au Mali.

Bernard, H.R., Killworth, P., Kronenfield, D. and Sailer, L. 1984 The problem of informant accuracy: the validity of retrospective data. *Ann. Rev. Anthrop.* 13: 495-517.

Bester, F.V. 1995 Drought and rangeland management. pp. 91-104 in Moorsom, R., Franz, J. and Mupotola, M. eds. *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Bidinger, F.R. 1992 Utilization of plant genetic resources in crop breeding programmes. *Dinteria.* 23: 70-81.

Biesele, M. 1975 *Folklore and ritual of !Kung hunter-gatherers.* PhD thesis, Harvard University, Cambridge Massachusetts.

Biesele, M., Hubbard, D. and Ford, J. 1991 *Land issues in Nyae: a communal areas example in Namibia.* Draft report for the Nyae Development Foundation of Namibia.

Biesele, M., Murray, R.E., Bamard, A., Kennaugh, A. and Murray, E. 1984 *Morama and other plant foods of Kalahari: an applied ethnobotanical study.* Final project report, Alternative Plant Foods for Arid Regions.

Bion-Griffen, P. 1984 Forager resource and land use in the humid tropics: the Agta of northeastern Luzon, the Philippines. pp. 95-121 in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Biot, Y., Lambert, R. and Perkin, S. 1992 What's the problem? An essay on land degradation, science and development in Sub-Saharan Africa. *Discussion Paper.* DP 222. School of Development Studies, University of East Anglia.

Bishop, J., Cunningham, A.B., Pimbert, M., Scoones, I. and Terry, B. 1994 Beer and baskets: the economics of women's livelihoods in Ngamiland, Botswana. *The Hidden Harvest Project, Sustainable Agriculture Programme Research Series.* 3(1). International Institute for Environment and Development.

Bley, H. 1996 *Namibia under German rule.* Lit Verlag, Hamburg, Germany.

Boonzaier, E.A., Hoffman, M.T., Archer, F.M. and Smith, A.B. 1990 Communal land use and the 'tragedy of the commons': some problems and development perspectives with specific reference to the semi-arid regions of Southern Africa. *J. Grassld. Soc. sth. Afr.* 7(2): 77-80.

Borgerhoff Mulder, M. and Caro, T.M. 1985 The use of quantitative observational techniques in anthropology. *Curr Anthrop.* 26(3): 323-335.

Bosch, O.J.H. and Gauch, H.G. 1991 The use of degradation gradients for the assessment and ecological interpretation of range condition. *J. Grassld. Soc. sth. Afr.* 8: 138-145.

Bosch, O.J.H. and Janse van Rensburg, F.P. 1987 Ecological status of species on grazing gradients on the shallow soils of the Western Grassland Biome in South Africa. *J. Grassld. Soc. sth. Afr.* 4(4): 143-147.

Bosch, O.J.H. and Theunissen, J.D. 1992 Differences in the response of species on the degradation gradient in the semi-arid grasslands of southern Africa and the role of ecotypic variation. pp. 95-109 in Chapman, G.P. ed. *Desertified grasslands: their biology and management.* Academic Press, London.

Botelle, A. and Kowalski, K. 1995 *Changing resource use in Namibia's lower Kuiseb river valley: perceptions from the Topnaar.* Unpublished report for the Institute of Southern African Studies, University of Lesotho, and Social Sciences Division of the MRC, University of Namibia, Windhoek.

Botelle, A. and Rohde, R. 1995 *Those who live on the land: a socio-economic baseline survey for land use planning in the communal areas of Eastern Otjozondjupa.* Land Use Planning Series: report 1. Windhoek, Namibia.

Bourdieu, P. 1990 *The logic of practice.* Polity Press, Cambridge.

Braack, L. 1996 *Field guide to insects of the Kruger National Park.* Struik, Cape Town.

Bradley, P. and Dewees, P. 1993 Indigenous woodlands, agricultural production and household economy in the communal areas. pp. 63-137 in Bradley, P.N. and McNamara, K. (eds.) *Living with trees: policies for forestry management in Zimbabwe.* World Bank Technical Paper 210, World Bank, Washington, D.C.

Broch-Due, V., Garfield, E. and Langton, P. 1981 Women and pastoralist development: some research priorities for the social sciences. pp. 251-257 in Galaty, J.G., Aronson, D., Salzman, P.C. and Chouinard, A. (eds.) *The future of pastoral peoples.* Proceedings of a conference held in Nairobi, Kenya, 4-8 August 1980, International Development Research Centre, Canada.

Brockington, D. and Homewood, K. 1996 Wildlife, Pastoralists and Science: debates concerning Mkomazi Game Reserve, Tanzania. pp. 91-104 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Brokensha, D. and Riley, B.W. 1986 Changes in uses of plants in Mbeere, Kenya. *J. Arid Environm.* 11: 75-80.

Brokensha, D., Mwaniki, H.S.K. and Riley, B.W. 1972 Beekeeping in Embu District, Kenya. *Beeworld.* 53: 114-123.

Brown, C.J. 1993 Birds of the upper Huab River catchment, Cunene province. Appendix 6 in Jones, B.T.B.(ed.) *Report on the socioecological survey of the Huab catchment area, Cunene province, October 1992.* Directorate of Environmental Affairs, Ministry of Wildlife, Conservation and Tourism, Windhoek.

Brown, J.H., Reichman, O.J. and Davidson, D.W. 1979 Granivory in desert ecosystems. *Ann. Rev. Ecol. Syst.* 10: 201-227.

Brown, S. 1991 *A haven of tribalism? Reflections on ethnicity and politics in Okombahe - a 'Labour Reserve' in western Namibia.* Centre for African Studies, Edinburgh University.

Bryant, R.L. 1991 Putting politics first: the political ecology of sustainable development. *Gobal Ecol. and Biogeog. Letters.* 1: 164-166.

Burley, J. 1990 The conservation and use of plant resources in dry lands. pp. 199-218 in Goudie, A.S. (ed.) *Techniques for desert reclamation.* John Wiley and Sons Ltd., Chichester.

Büttner, C.J. 1879 The Berg Damara. *Cape Monthly Magazine.* XVIII: 285-294.

Campbell, A. 1986 The use of wild food plants, and drought in Botswana. *J. Arid Environm.* 11: 81-91.

Carney, J.A. 1988 Struggles over crop rights and labour within contract farming households on a Gambian irrigated rice project. *J. Peasant Studs.* 15(3): 334-349.

Carroll, C.R. and Janzen, D.H. 1973 Ecology of foraging by ants. *Ann. Rev. Ecol. Syst.* 231-256.

Carter, A.J. and O'Connor, T.G. 1990 A two-phase mosaic in a savanna grassland. *J. Vegn. Sci.* 2: 231-236.

Caughley, G. 1987 Ecological relationships. pp. 159-187 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Cavalli-Sforza, L.L., Menozzi, P. and Piazza, A. 1994 *The history and geography of human genes.* Princeton University Press, Princeton, New Jersey.

Central Statistics Office 1995 *Living in Namibia 1993/1994 study of household consumption and income (draft).* Central Statistics Office, Republic of Namibia National Planning Commmission.

Chambers, J.C. and Norton, B.E. 1993 Effects of grazing and drought on population dynamics of salt desert shrub species on Desert Experimental Range, Utah. *J. Arid Environm.* 24: 261-275.

Chambers, R. and Leach, M. 1989 Trees as savings and security for the rural poor. *World Development.* 17(3): 329-342.

Chapman, G.P. (ed.) 1992 *Desertified grasslands: their biology and management.* Academic Press, London.

Chapman, J. 1868 *Travels in the interior of South Africa, 1849-1863.* Balkema, Cape Town.

Clements, F.E. 1916 Plant succession: an analysis of the development of vegetation. *Carnegie Inst. Pubs.* 242: 1-512.

Cole, M.M. 1986 *The savannas: biogeography and geobotany.* Academic Press, London.

Collins, S.L. 1995 The measurement of stability in grasslands. *Tree.* 10(3): 95-96.

Connell, J.H. and Sousa, W.P. 1983 On the evidence needed to judge ecological stability or persistence. *Amer. Nat.* 121: 789-824.

Coppock, D.L. 1993 Vegetation and pastoral dynamics in the southern Ethiopian rangelands: implications for theory and management. pp. 42-61 in Behnke, R.H., Scoones, I. and Kerven, C. (eds.) *Range ecology at disequilibrium: new models of natural variability and pastoral adaptation in African savannas.* ODI, IIED, Commonwealth Secretariat, London.

Corbett, A. and Daniels, C. 1996 Legislation and policy affecting community-based resource management in Namibia. *SSD Research Report.* 26. Social Sciences Division, MRC, University of Namibia, Windhoek.

Costanza, R., Wainger, L., Folke, C. and Mäler, K-G. 1993 Modeling complex ecological economic systems: toward an evolutionary, dynamic understanding of people and nature. *Bioscience.* 43(8): 545-555.

Coughenour, M.B., Coppock, D.L. and Ellis, J.E. 1990 Herbaceous forage variability in an arid pastoral region of Kenya: importance of topographic and rainfall gradients. *J. Arid Environm.* 19: 147-159.

Coughenour, M.B., Ellis, J.E., Swift, D.M., Coppock, D.L., Galvin, K., McCabe, J.T. and Hart, T.C. 1985 Energy extraction and use in a nomadic pastoral ecosystem. *Science.* 230: 619-624.

Cousins, B. 1993 A political economy model of common property regimes and the case of grazing management in Zimbabwe. *Pastoral Development Network Paper.* 34b. ODI, London.

Cowling, R.M., Esler, K.J., Midgley, G.F. and Honig, M.A. 1994 Plant functional diversity, species diversity and climate in arid and semi-arid Southern Africa. *J. Arid Environm.* 27: 141-158.

Cowlishaw, G. and Davies, J.G. 1997 Flora of the Pro-Namib Swakop River catchment, Namibia: community classification and implications for desert vegetation sampling. *J. Arid Environm.* 36: 271-290.

Cox, J.R. 1984 Temperature, timing of precipitation and soil texture effects on germination, emergence and seedling survival of South African lovegrasses. *J. Sth. African Bot.* 50: 159-170.

Croom, E.M. Jnr. 1983 Documenting and evaluating herbal remedies. *Econ. Bot.* 37(1): 13-27.

Crosswhite, F.S. 1981 Desert plants, habitat and agriculture in relation to the major pattern of cultural differentiation in the O'odham people of the Sonoran Desert. *Desert Plants.* 3(2): 47-76.

Cunningham, A.B. 1988b Leaf production and utilization in *Hyphaene coriacea*: management guidelines for commercial harvesting. *S. Afr. J. Bot.* 54: 89-95.

Cunningham, A.B. 1996 People, park and plant use: recommendations for multiple-use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. *People and Plants Working Paper.* 4. People and Plants Initiative, Division of Ecological Sciences, UNESCO.

Cunningham, A.B. 1992 The role of ethnobotany and indigenous knowledge on conservation of plant genetic resources. *Dinteria.* 23: 119-131.

Cunningham, A.B. 1988a *Botswana basketry resources: resource management of plants supporting the Ngamiland basket industry, 1982-1988* Unpublished report, Botswanacraft Marketing Co. (Pty) Ltd, Gaborone.

Cunningham, A.B. and Milton, S. 1987 Effects of basket-making industry on Mokola palm and dye plants in northwestern Botswana. *Econ. Bot.* 41: 386-402.

Dahl, G. 1981 Production in pastoral societies.pp. 201-299 in Galaty, J.G., Aronson, D., Salzman, P.C. and Chouinard, A. (eds.) *The future of pastoral peoples.* Proceedings of a conference held in Nairobi, Kenya, 4-8 August 1980, International Development Research Centre, Canada.

Dahl, G. and Hjort, A. 1976 *Having herds.* Department of Social Anthropology, University of Stockholm.

Dahlberg, A. 1994 Contesting views and changing paradigms: the land degradation debate in Southern Africa. *Discussion Paper.* 6. Nordiska Afrikainstitutet, Uppsala, Sweden.

Danckwerts, J.E. and Stuart-Hill, G.C. 1988 The effect of severe drought and management after drought on the mortality and recovery of semi-arid grassveld. *J. Grassld. Soc. sth. Afr.* 5: 218-222.

Davies, A.G. and Richards, P. 1991 *Rain forest in Mende life: resources and subsistence strategies in rural communities around the Gola North forest reserve (Sierra Leone).* A report to ESCOR, ODA, London.

Davies, S. 1992 Green conditionality and food security: winners and losers from the greening of aid. *J. Intern Devt.* 4(2): 151-165.

DAWN 1985 Development crisis and alternative visions: third world women's perspectives. Christian Michelsen Inst., Bergen.

Dawson, W.R., Pinshow, B. (Convenors), Bartholomew, G.A., Seely, M.K., Shkolnik, A., Shoemaker, V.H. and Teeri, J.A. (Speakers) 1989 What's special about the physiological ecology of desert organisms? *J. Arid Environm.*17: 131-143.

De Klerk, J.C. 1947 Pastures of the southern Orange Free State, a century ago and today. *Fmg. S. Afr.* April: 347-354.

De Leeuw, P.N. and Tothill, J.C. 1990 The concept of carrying capacity in sub-Saharan Africa: myth or reality? *Pastoral Development Network Paper.* 29b.

de Ridder, N. and Wagenaar, K.T. 1986 Energy and protein balances in traditional livestock systems and ranching in eastern Botswana. *Agric. Syst.* 21: 1-16.

de Waal, A. 1989 Famine mortality: a case study of Darfur, Sudan 1984-5. *Popn. Studs.* 43: 5-24

Dean, W.R.J. and Macdonald, I.A.W. 1994 Historical changes in stocking rates of livestock as a measure of semi-arid and arid rangeland degradation in the Cape Province, South Africa. *J. Arid Environm.* 26: 281-298.

Dean, W.R.J. and Milton, S.J. 1991 Patch disturbances in arid grassy dunes: antelope, rodents and annual plants. *J. Arid Environm.* 20: 231-237.

Dean, W.R.J., du Plessis, M.A., Milton, S.J., Adams, N.J. and Siegfried, W.R. 1992 An association between a stem succulent (*Euphorbia damarana*) and a leaf succulent (*Aloe asperifolia*) in the Namib Desert. *J. Arid Environm.* 22: 67-72.

Dean, W.R.J., Hoffman, M.T., Meadows, M.E. and Milton, S.J. 1995 Desertification in the semi-arid Karoo, South Africa: review and reassessment. *J. Arid Environm.* 30: 247-264.

DeAngelis, D.L. and Waterhouse, J.C. 1987 Equilibrium and nonequilibrium concepts in ecological models. *Ecol. Monogr.* 57: 1-21.

deLucia, R. 1983 Defining the scope of wood fuel surveys. pp. 5-28 in FAO *Wood fuel surveys.* Forestry for local community development programme, FAO, Rome.

Denbow, J. and Wilmsen, E. 1983 Iron Age pastoral settlements in Botswana. *S. Afr. J. Sci.* 79: 405-408.

Denbow, J.R. and Wilmsen, E.N. 1986 Advent and course of pastoralism in the Kalahari. *Science.* 234: 1509-1515.

Dentlinger, U. 1977 The !Nara plant in the Topnaar Hottentot culture of Namibia: ethnobotanical clues to an 8,000 year-old tradition. *Munger Africana Library Notes.* 38: 3-39. Institute of Technology, California.

Devereux, S. 1996 Fuzzy entitlements and common property resources: struggles over rights to communal land in Namibia. *Working Paper.* 44. Institute of Development Studies, University of Sussex, Brighton.

Devereux, S. and Tapscott, C. 1995 Coping mechanisms of communal farmers in Namibia in response to drought. pp. 125-146 in Moorsom, R., Franz, J. and Mupotola, M.ed. *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Devereux, S., Rimmer, M., LeBeau, D. and Pendleton, W. 1993 The 1992/3 drought in Namibia: an evaluation of its socio-economic impact on affected households. *SSD Research Report.* 7.

Dewdney, R. 1996 *Policy factors and desertification: analysis and proposals.* Report for NAPCOD, Windhoek.

Dierks, K. 1992 *‖Khauxa!nas: growing to nationhood.* Longman, Namibia.

Draft Communal Lands Bill 1995 Government of the Republic of Namibia, Windhoek, Namibia.

Dregne, H.E. 1985 Aridity and land degradation. *Environment.* 27(8): 16, 18-20, 28-33.

DTA 1991 Proposals to the National conference on land reform, Windhoek, Namibia.

du Pisani, E. 1978 Dama settlement and subsistence along the Ugab Valley, South West Africa (Namibia). *Norvorsinge van die Nasionale Museum.* 4(1): 3-20.

du Pisani, E. 1983 Past and present plant utilization in Namaland and the lower Kuiseb River valley, South West Africa (Namibia). A preliminary report. *Khoisis.* 4: 1-19.

du Pisani, E. and Jacobson. L. 1985 Damara clay vessel from Gomatsarab, Damaraland, and its relevance for Dama ceramic studies. *S. Afr. Archaeol. Bull.* 40: 109-111.

du Plessis, W. 1992 In situ conservation in Namibia: the role of national parks and nature reserves. *Dinteria.* 23: 132-141.

Dublin, H.T. 1991 Dynamics of the Serengeti-Mara woodlands: an historic perspective. *Forest and Cons. Hist.* 35: 169-178.

Dublin, H.T., Sinclair, A.R.E. and McGlade, J. 1990 Elephants and fire as causes of multiple states in the Serengeti-Mara woodlands. *J. Animal Ecol.* 59: 1147-1164.

Dudziñski, M.L. and Arnold, G.W. 1973 Comparisons of diets of sheep and cattle grazing together on sown pastures on the southern Tablelands of New South Wales by principal components analysis. *Aust. J. Agric. Res.* 24: 899-912.

Dunn, E.J. 1931 *The Bushmen.* Griffen, London.

Eden, M.J. 1990 *Ecology and land management in Amazonia.* Belhaven Press, London.

EEAN 1994 *Rural appraisal of natural resources and awareness training for communities associated with new IMC boreholes in Kunene.* Unpublished report for IMC.

Eibl-Eibesfeldt, H. and Wiessner, P. 1984 Foreword. pp. xiii-xiv in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Eiseb, E., Giess, W. and Haacke, W.H.G. 1991 A preliminary list of Khoekhoe (Nama/Damara) plant names. *Dinteria.* 21: 17-29.

Eldridge, D.J., Westoby, M. and Stanley, R.J. 1990 Population dynamics of the perennial rangeland shrubs *Atriplex vesicaria*, *Maireana astrotricha* and *M. pyramidata* under grazing. *J. Appld. Ecol.* 27: 502-512.

Ellis, J.E. and Swift, D.M. 1988 Stability of African pastoral ecosystems: alternative paradigms and implications for development. *J. Range Mgmt.* 41: 450-459.

Ellis, J.E., Coughenour, M.B. and Swift, D.M. 1993 Climate variability, ecosystem stability, and the implications for range and livestock development. pp. 31-41 in Behnke, R.H., Scoones, I. and Kerven, C. (eds.) *Range ecology at disequilibrium: new models of natural variability and pastoral adaptation in African savannas.* ODI, IIED, Commonwealth Secretariat, London.

Elphick, R. 1977 *Kraal and castle: Khoikhoi and the founding of white South Africa.* Academic Press, New York.

Elton, C.S. 1958 (ed.) *The ecology of invasions by plants and animals.* Chapman and Hall, London.

Ensminger, J. (n.d.) Monetization of the Galole Orma economy: changes in the use of fuel and woodstock. pp. 124-140 in Barnes, C., Ensminger, J. and O'Keefe, P.O. (eds.) *Wood, energy and households: perspectives on rural Kenya.*

Erkkiliä, A. and Siiskonen, M. 1992 *Forestry in Namibia.* University of Joensuu, Finland.

Evers, Y. 1994b *Subsistence strategies and wild resource utilization: Pugu Forest Reserve, Tanzania.*MSc thesis, Anthropology Dept., University College London.

Evers, Y. 1994 Dealing with risk and uncertainty in Africa's drylands: the social dimensions of desertification. *Drylands Programme Issues Paper.* 48. IIED.

Fairhead, J. and Leach, M. 1996 Rethinking the forest-savanna mosaic: colonial science and its relics in West Africa. pp. 105-121 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Falconer, J. 1990 *The major significance of 'minor' forest products: the local use and value of forests in the West African humid forest zone.* FAO, Rome.

Falconer, J. and Arnold, M. 1989 *Household food security and forestry: an analysis of socioeconomic issues.* FAO, Rome.

FAO 1993 *Inter-agency MCARRD policy review mission to Namibia.* Main report prepared for the Government of the Republic of Namibia by the FAO, Rome.

FAO 1981 *Map of the fuelwood situation in the developing countries, with explanatory note.* FAO, Rome.

Felger, F. 1979 Ancient crops for the 21st century. In Ritchie, G.A. (ed.) *New agricultural crops. American Society for the Advancement of Science Symposium, 38.* Westview Press, Boulder, Colorado.

First, R. 1963 *South West Africa.* Penguin African Library, Harmonsworth, Middlesex.

FISA 1991 *Land reform and redistribution.* Proposals to the National conference on land reform, Windhoek, Namibia.

Fleuret, A. 1979 Methods for evaluation of the role of fruits and wild greens in Shambaa diet: a case study. *Medical Anthropology.* 3: 249-269.

Foran, B.D., Tainton, N.M. and Booysen, P de V. 1978 The development of a method for assessing veld condition in three grassveld types of Natal. *Proc. Grassld Soc. sth. Afr.* 13: 27-33.

Fourie, J.H., de Wet, N.J. and Page, J.J. 1987 Veld condition and trend in Kalahari duneveld under and extensive stock production system. *J. Grassld. Soc. sth. Afr.* 4: 48-54.

Fourie, L. 1926 Preliminary notes on certain customs of the Hei-‖om Bushmen. *Jl. S.W.A. Sci. Soc.* 1: 47-63.

Fowler, C.S. 1977 Ethnoecology. pp. 215-243 in Hardesty, D.L. (ed.) *Ecological anthropology.* John Wiley and Sons, London.

Fowler, N.L. 1986 Density-dependent regulation in a Texas grassland. *Ecology.* 67: 545-554.

Fox, F.W. 1938 Notes on the methods of preparation, composition and nutritional value of certain kaffir beers. *J. S. Afr. Chem. Inst.* 21: 39-54.

Fratkin, E. 1996 Traditional medicine and concepts of healing among Samburu pastoralists of Kenya. *J. Ethnobiol.* 16(1): 63-97.

Frost, P., Medina, E., Menaut, J.C., Solbrig, O., Swift, M. and Walker, B. 1986 Response of savannas to stress and disturbance. *Biol. Intern. (Special Issue).* 10.

Fry, R.C. 1995 Strategies for better water resource management and conservation: implications for industry. pp. 159-180 in Moorsom, R., Franz, J. and Mupotola, M. (ed.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Fuller, B.B. 1993 *Institutional appropriation and social change among agropastoralists in central Namibia 1916-1988.* Unpublished PhD dissertation, Boston Graduate School, Boston.

Fuls, E.R. 1992a Semi-arid rangelands: a resource under siege due to patch selective grazing. *J. Arid Environm.* 22: 191-193.

Fuls, E.R. 1992b Ecosystem modification created by patch over-grazing in a semi-arid grassland. *J. Arid Environm.* 23: 59-69.

Fuls, E.R. and Bosch, O.J.H. 1991 The influence of below-average rainfall on the vegetational traits of a patch-grazed semi-arid grassland. *J. Arid Environm.* 21: 13-20.

Gaillard, M.J., Birks, H.J.B., Emanuelsson, U. and Bergland, B.E. 1992 Modern pollen/land-use relationships as an aid in the reconstruction of past land-uses and cultural landscapes: an example from south Sweden. *Vegetation history and Archaeobotany.* 1: 3-17.

Galton, F. 1856 *Narrative of an explorer in tropical South Africa.* John Murray, London.

Galvin, K.A. 1990 Nutritional ecology of pastoralists in dry tropical Africa. *Amer. J. Hum. Biol.* 4: 209-221.

‖Garoëb, J. 1991 Address to the National Conference on Land Reform and the Land Question. Office of the Prime Minister, Windhoek, Namibia.

Gauch, H.G. 1982 *Multivariate analysis in community ecology.* Cambridge University Press, Cambridge.

Getahun, A. 1974 The role of wild plants in the native diet in Ethiopia. *Agro-Ecosystems.* 1: 45-56.

Ghazanfar, S.A. 1991 Vegetation structure and phytogeography of Jabal Shams, an arid mountain in Oman. *J. Biogeogr.* 18: 299-309.

Gibson, C.W.D. and Brown, V.K. 1992 Grazing and vegetation change: deflected or modified succession? *J. Appld. Ecol.* 29: 120-131.

Giess, W. 1971 A preliminary vegetation map of South West Namibia. *Dinteria.* 4: 1-114.

Giess, W. and Tinley, K.L. 1968 South West Africa. pp. 250-254 in Hedberg, I. and Hedberg, O. (eds.) *Conservation of vegetation in Africa south of the Sahara.* Acta Phytogeogr. Suec. 54, Uppsala.

Gilmore, M.R. 1977 *Uses of plants by the Indians of the Missouri River Region.* University of Nebraska Press, London.

Giorgis, D.W. 1995 Drought and sustainable development. pp. 227-243 in Moorsom, R., Franz, J. and Mupotola, M. (eds). *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Glover, P.E., Stewart, J. and Gwynne, M.D. 1966 Masai and Kipsigis notes on East African plants: part II - domestic uses of plants. *E. Afr. Agric. Forestry J.* October: 192-199.

Goldblatt, I. 1971 *South West Africa from the beginning of the 19th century.* Jta and Co. Ltd, Cape Town.

Goldschmidt, W. 1981 The failure of pastoral development projects in Africa. Galaty, J.G., Aronson, D., Saltzman, P.C. and Chouinard, A. (eds.) *The future of nomadic peoples.* International Development Research Centre, Ottawa.

Goldsmith, F.B., Harrison, C.M. and Morton, A.J. 1986 Description and analysis of vegetation. Moore, P.D. and Chapman, S.B. (eds.) *Methods in plant ecology.* Blackwell Scientific Publications, Oxford.

Gordon, R.J. 1984 The !Kung in Kalahari exchange: ethnohistorical perspective. pp. 95-124 in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Gordon, R.J. 1991 Vernacular law and the future of human rights in Namibia. *NISER Discussion Paper.* 11. Namibian Institute for Socio-economic Research (NISER), Windhoek, Namibia.

Gould, R.A. 1980 *Living Archaeology.* Cambridge University Press, Cambridge.

Grainger, A. 1992 Characterization and assessment of desertification processes. pp. 17-33 in Chapman, G.P. (ed.) *Desertified grasslands: their biology and management.* Academic Press, London.

Grandin, B. 1988 Wealth and dairy production: a case study from Maasailand. *Hum. Ecol.* 16: 1-21

Green, S.V. forthcoming. The Bushman as an entomologist: a preliminary survey of invertebrate utilization, folklore and folk systematics in the Ju |'hoansi of Namibia.

Griffen, G.F. and Friedel, M.H. 1985 Discontinuous change in central Australia: some implications of major ecological events for land management. *J. Arid Environm.* 9: 63-80.

Griffen, M., Carter, L.A. and Loutit, R. 1993a Checklist of mammals occurring in the Huab river area and surroundings, Damaraland. Appendix 6 in Jones, B.T.B. (ed.) *Report on the socioecological survey of the Huab catchment area, Cunene province, October 1992.* Directorate of Environmental Affairs, Ministry of Wildlife, Conservation and Tourism, Windhoek.

Griffen, M., Carter, L.A. and Loutit, R. 1993b Checklist of reptiles occurring in the Huab river area and surroundings, Damaraland. Appendix 6 in Jones, B.T.B. (ed.) *Report on the socioecological survey of the Huab catchment area, Cunene province, October 1992.* Directorate of Environmental Affairs, Ministry of Wildlife, Conservation and Tourism, Windhoek.

Grivetti, L.E. 1979 Kalahari agro-pastoral-hunter-gatherers: the Tswana example. *Ecol. Food Nutr.* 7: 235-256.

Grundy, I.M., Campbell, B.M., Balebereho, S., Cunliffe, R., Tafangenyasha, C., Fergusson, R. and Parry, D. 1993 Availability and use of trees in Mutanda Resettlement Areas, Zimbabwe. *Forest Ecol. and Managem.* 56: 243-266.

Günster, A. 1992 Aerial seed banks in the central Namib: distribution of serotinous plants in relation to climate and habitat. *J. Biogeog.* 19: 563-572.

Günster, A. 1994a Seed bank dynamics: longevity, viability and predation of seeds of serotinous plants in the central Namib Desert. *J. Arid Environm.* 28: 195-205.

Günster, A. 1994b Variability in life history parameters of four serotinous plants in the Namib Desert. *Vegetatio.* 114: 149-160.

Günster, A. 1994c Phenological niches of coexisting serotinous plants in the Namib Desert. *J. Tropical Ecol.* 10: 531-544.

Günster, A. 1995 Grass cover distribution in the central Namib: a rapid method to assess regional and local rainfall patterns of arid regions?. *J. Arid Environments.* 29: 107-114.

Gurirab, T. 1988 Preliminary notes on the process of land theft and the genesis of capitalist relations of production. pp. 314-323 in Wood, B. (ed.) *Namibia 1884-1984: readings on Namibia's history and society.* Namibia Support Committee, London.

Guy, R.D. 1972 The honey hunters of southern Africa. *Beeworld.* 53: 159-166.

Haacke, W.H.G. and Boois, J. 1991 *Khomai da ra. Grade 5.* Gamsberg Macmillan, Windhoek, Namibia.

Hadley, N.F. and Szarek, S.R. 1981 Productivity of desert ecosystems. *Bioscience.* 31(10): 747-753.

Hahn, C.H. 1928 Damaraland and the Berg Damaras. *Cape Monthly Magazine.* 218-130, 289-297.

Hamutenya, H. 1988 One century of imperialist occupation and anti-colonial resistance: an historical flashback. pp. 14-26 in Wood, B. (ed.) *Namibia 1884-1984: readings on Namibia's history and society.* Namibia Support Committee, London.

Hangula, L. 1995 Communal land reform in Namibia and the role of the traditional authorities. *SSD Discussion Paper.* 11. Social Sciences Division, MRC, University of Namibia, Windhoek.

Hardin, G. 1968 The tragedy of the commons. *Science.* 162: 1234-1248.

Harpending, H. and Jenkins, T. 1973 Genetic distance among southern African populations. pp. 177-199 in Crawford, M.H. and Workman, P.L. (eds.) *Methods and theories of anthropological genetics.* University of New Mexico Press, Albuquerque.

Harper, J.L. 1977 *Population biology of plants.* Academic Press, London.

Harris, D.R. 1977 Subsistence strategies across Torres Strait. pp. 421-459 in Allen, J., Golson, J. and Jones, R. (ed.) *Sunda and Sahel.*

Hartley, D. 1992 *Forest resource use and subsistence in Sierra Leone.* PhD thesis, Anthropology Dept., University College London.

Hartley, D. and Hunter, N. 1997 *Community wildlife management: turning theory into practice.* Paper prepared for the Department for International Development natural resources advisers' conference, Sparsholt College, Winchester, 6-10 July 1997.

Harvey, T.E.C. and Armitage, F.B. 1961 Some herbal remedies and observations on the Nyanga of Matabeleland. *Central Afr. J. Med.* 7(6): 193-207.

Hastings, A., Horn, C.L., Ellner, S., Turchin, P. and Godfray, H.C.J. 1993 Chaos in ecology: is Mother Nature a strange attractor? *Ann. Rev. Ecol. Syst.* 24: 1-33.

Hausman, A.J. 1982 The biocultural evolution of Khoisan populations of southern Africa. *Amer. J. Phys. Anthrop.* 58: 315-330.

Hecht, S. and Cockburn, A. 1989 *The fate of the forest: developers, destroyers and defenders of the Amazon.* Penguin, London.

Heinz, H.J. and Maguire, B. 1974 Ethnobotany of the !Ko Bushman: their ethnobotanical knowledge and plant lore. *Occasional Papers of the Botswana Society.* 1: 1-53.

Herskovitz, M.J. 1926 The cattle complex in Africa. *Amer. Anth.* 28.

Hill. M.O. 1973 Diversity and evenness: a unifying notation and its consequences. *Ecol.* 54: 427-432.

Hill, M.O. 1979a *DECORANA: a FORTRAN program for detrended correspondence analysis and reciprocal averaging.* Section of Ecology and Systematics, Cornell University, Ithaca, New York.

Hill, M.O. 1979b *TWINSPAN: a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes.* Cornell University, Ithaca, New York.

Hines, D.A. and Eckman, K. 1993 *Indigenous multipurpose trees of Tanzania: uses and economic benefits for people.* FAO, Rome.

Hitzeroth, H.W. 1976a On the identity of the stone-working Tjimba of South West Africa: a comparative multivariate anthropometric analysis. *Cimbebasia.* B 2(7).

Hitzeroth, H.W. 1976b On the identity of the stone-working Tjimba of South West Africa: a comparative study based on fingerprint pattern frequencies. *Cimbebasia.* B 2(7).

Hodgkinson, K.C., Ludlow, M.M., Mott, J.J. and Baruch, Z. 1989 Comparative responses of the savanna grasses *Cenchrus ciliaris* and *Themeda triandra* to defoliation. *Oecologia.* 79: 45-52.

Hodgson, D. (ed.) forthcoming for 1998 *Rethinking pastoralism in Africa: gender, culture and the myth of the patriarchal pastoralist.*

Hoernlé, A. 1923 South West Africa as a primitive culture area. *S. Afr. Geog. J.* 6: 14-28.

Hoffman, M.T. and Cowling, R.M. 1990 Vegetation change in the semi-arid eastern Karoo over the last 200 years: and expanding Karoo - fact or fiction? *S. Afr. J. Sci.* 86: 286-294.

Hoffman, M.T., Barr, G.D. and Cowling, R.M. 1990 Vegetation dynamics in the semi-arid eastern Karoo, South Africa: the effect of seasonal rainfall and competition on grass and shrub basal cover. *S. Afr. J. Sci.* 86: 462-463

Hogg, R. 1987 Settlement, pastoralism and the commons: the ideology and practice of irrigation development in northern Kenya. pp. 293-306 in Anderson, D. and Grove, R. (eds.) *Conservation in Africa: people, polices and practice.* Cambridge University Press, Cambridge.

Holling, C.S. 1973 Resilience and stability of ecological systems. *Ann. Rev. Ecol. Syst.* 4: 1-23.

Holling, C.S. 1986 The resilience of terrestrial ecosystems: local surprise or global change. pp. 292-317 in Clark, W.C. and Munn, R.E. (eds.) *Sustainable development of the biosphere.* Cambridge University Press, Cambridge.

Homewood, K. 1992 Development and ecology of Maasai pastoralist food and nutrition. *Ecol. Food Nutr.* 29: 61-80.

Homewood, K. 1994 Pastoralists, environment and development in East African rangelands. pp. 311-324 in Zaba, B. and Clarke, J. (eds.) *Environment and population change.* IUSSP. Ordina Editions, Belgium.

Homewood, K. and Lewis, J. 1987 Impact of drought on pastoral livestock in Baringo, Kenya 1983-85. *J. Appld. Ecol.* 24: 615-631.

Homewood, K. and Rodgers, W.A. 1987 Pastoralism, conservation and the overgrazing controversy. pp. 111-128 in Anderson, D. and Grove, R. (eds.) *Conservation in Africa: people, policies and practice.* Cambridge University Press, Cambridge.

Homewood, K.M. and Hurst, A.V. 1986 Comparative ecology of pastoralist livestock in Baringo, Kenya. *Pastoral Development Network Paper.* 21b. ODI, London.

Horowitz, M. 1981 Research priorities in pastoral societies: an agenda for the 1980s. pp. 61-88 in Galaty, J.G., Aronson, D., Salzman, P.C. and Chouinard, A. (eds.) *The future of pastoral peoples* Proceedings of a conference held in Nairobi, Kenya, 4-8 August 1980, International Development Research Centre, Canada.

Hurlbert, S.H. 1984 Pseudoreplication and the design of ecological field experiments. *Ecol. Monogr.* 54(2): 187-211.

Hurt, C.R. and Bosch, O.J.H. 1991 A comparison of some range condition assessment techniques used in southern African grasslands. *J. Grassld. Soc. sth. Afr.* 8: 131-137.

Hutchinson, P. 1995 The climatology of Namibia and its relevance to the drought situation. pp. 17-37 in Moorsom, R., Franz, J. and Mupotola, M. (ed.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Infoscience 1994 *Report on sustainable development in the Sesfontein/Khowarib Basin.* Infoscience, Windhoek.

Ingold, T. 1992 Comments. *Current Anth.* 33: 208-209.

Irle, J. 1907 *Die Herero: EinBeitrae zur Landes-, Volks-, und Missionskunde.* Bertelsmann, Gütersloh.

IUCN 1980 *The World Conservation Strategy.* International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme, World Wide Fund for Nature, Geneva.

Jacobson, K.M. 1997 Moisture and substrate stability determine VA-mycorrhizal fungal community distribution and structure in an arid grassland. *J. Arid Environm.* 35: 59-75.

Jacobson, L. 1976 A critical review of the Damaraland Culture. *Cimbebasia.* B 2(8): 203-208.

Jacobson, P.J. and Jacobson, K. 1995 Researchers with DRFN.

Jacobson, P.J., Jacobson, K.M. and Seely, M.K. 1995 *Ephemeral rivers and their catchments: sustaining people and development in western Namibia.* DRFN and SIDA, Windhoek, Namibia.

James, F.C. and McCulloch, C.E. 1990 Multivariate analysis in ecology and systematics: panacea or Pandora's box? *Annu. Rev. Ecol. Syst.* 21: 129-166.

Janse van Rensburg, F.P. and Bosch, O.J.H. 1990 Influence of habitat differences on the ecological grouping of grass species on a grazing gradient. *J. Grassld. Soc. sth. Afr.* 7: 11-15.

Jantsch, E. 1980 *The self-organising universe: scientific and human implications of the emerging paradigm of evolution.* Pergamon Press, Oxford.

Jennings, S.L. 1994 *Ruaha ecosystem wildlife management project (REWMP): village oral histories mini-project.* Unpublished report for REWMP and ODA.

Jensen, A.M. 1990 *Rural development project Owamboland, Namibia: environmental component.* LWF, Geneva.

Jobst, P. 1995 Botanical composition and productivity under different grazing pressures in northwestern Namibia. *Occasional Paper.* 2: 19-38. In *Summer desertification project December 1994 - January 1995* DRFN, Windhoek, Namibia.

Joekes, S. and Pointing, J. 1991 Women in pastoral societies in East and West Africa. *Drylands Programme Issues Paper.* 28. IIED.

Johns, T., Kokwaro, J.O. and Kimanani, E.K. 1989 Herbal remedies of the Luo of Siaya District, Kenya: establishing quantitative criteria for consensus. *Econ. Bot.* 44: 369-381.

Jones, B.T.B. 1992 *Preliminary report on the socio-ecological survey of the lower Kuiseb valley.* Unpublished report for the Environmental Planning Unit, MET, Windhoek.

Jones, B.T.B. 1993 *Report on the socioecological survey of the Huab catchment area, Cunene province, October 1992.* Directorate of Environmental Affairs, Ministry of Wildlife, Conservation and Tourism, Windhoek.

Jones, B.T.B. 1995 Wildlife management, utilization and tourism in communal areas: benefits to communities an improved resource management. *Research Discussion Paper.* 5. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Jones, B.T.B. 1997 Parks and resident peoples: linking Namibian protected areas with local communities. *Research Discussion Paper.* 24. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Jones, R.M. and Mott, J.J. 1980 Population dynamics in grazed pastures. *Tropical Grasslands.* 14: 218-224.

Joubert, D.F. 1997 Grazing gradients in the Highland Savanna vegetation of Namibia. *Dinteria.* 25: 69-86.

Jowkar, F., Horowitz, M.H., Naslund, C. and Horowitz, S. 1991 *Gender relations of pastoralist and agropastoralist production: a bibliography with annotations.* Prepared for UNIFEM and UNDP,

Institute of Development Anthropology, New York.

Jürgens, N. 1991 A new approach to the Namib Region 1: phytogeographical subdivision. *Vegetation.* 97: 21-38.

Jürgens, N. 1995 Unpublished research proposal.

Kabuye, C.H.S. 1986 Edible roots from wild plants in arid and semi-arid Kenya. *J. Arid Environm.* 11: 65-73.

Kajujaha-Matundu, O. 1994 *Economics of the environment.* Unpublished manuscript, DRFN, Windhoek.

Kakukuru, E.N. 1995 Current land use and local perspectives in the Kunene and Erongo Regions. *Occasional Paper.* 2: 79-86. *Summer desertification project December 1994 - January 1995.* DRFN, Windhoek, Namibia.

Kambatuku, J. 1996 Historical profiles of farms in former Damaraland: notes from the archival files. *Occasional Paper.* 4. Report prepared for DRFN, Windhoek.

Kambatuku, J.R. 1995 The effect of rangeland management on soil productivity: using plant germination and growth rates as a measure of soil productivity. *Occasional Paper.* 2: 39-54. *Summer desertification project December 1994 - January 1995.* DRFN, Windhoek, Namibia.

Kambatuku, J.R., Uariua-Kakujaha, K. and Abrams, M.M. 1995 The study in perspective: general introduction. *Occasional Paper.* 2: 2-5. *Summer desertification project December 1994 - January 1995.* DRFN, Windhoek, Namibia.

Karani, P.K. 1991 *Community forestry development in southern Namibia.* Unpublished report to the FAO (Project TPC/NAM/0155), FAO, Windhoek.

Katjavivi, P.H. 1988 *A history of resistance in Namibia.* UNESCO, Paris.

Kellner, K. and Bosch, O.J.H. 1992 The influence of patch formation in determining the stocking rate for South African grasslands. *J. Arid Environm.* 22: 99-105.

Kinahan, Jill 1989 Heinrich Vedder's sources for his account of the exploration of the Namib coast. *Cimbebasia.* 11: 33-39.

Kinahan, Jill 1990 The impenetrable shield: HMS Nautilis and the Namib Coast in the late 18th century. *Cimbebasia.* 12: 23-61.

Kinahan, John 1983 Walking to the rain: prehistoric nomads of the Brandberg. *SWA Annual.* :93-96.

Kinahan, John 1986 Settlement patterns and regional exchange: evidence from recent Iron Age sites on the Kavango River, north-eastern Namibia. *Cimbebasia.* B 3(4): 109-116.

Kinahan, John 1990 Four thousand years at the Spitzkoppe: changes in settlement and land use on the edge of the Namib desert. *Cimbebasia.* 12: 1-14.

Kinahan, John 1991 *Pastoral nomads of the central Namib Desert: the people history forgot.* Namibian Archaeological Trust and New Namibian Books, Windhoek, Namibia.

Kinahan, John 1993 The rise and fall of nomadic pastoralism in the central Namib Desert. pp. 372-385 in Shaw, T., Sinclair, P., Andali, B. and Okpoko, A. (ed.) *The archaeology of Africa.* Routledge, London.

Kisco, M., Simataa, L. and Munukayumbwa, S. 1997 Bush encroachment in the Pro-Namib. In Ward, D.ed. *Land degradation in the pro-Namib.*

Klintworth, H. 1949 Karoo may become complete desert. *The Farmer's Weekly.* Feb 2nd: 89-91.

Knappert, J. 1981 *Namibia: land and peoples, myths and fables.* E.J. Brill.

Knight, C. 1991 *Blood relations: menstruation and the origins of culture.* Yale University Press, New Haven and London.

Köhler, O. 1959 A study of Omaruru District South West Africa. *Ethnological Publications.* 43. Government Printer, Pretoria.

Kokwaro, J.O. 1983 An African knowledge of ethnosystematics and its application to traditional medicine with particular reference to the medicinal use of the fungus *Engleromyces goetzei. Bothalia.* 14(2): 237-243.

Kolberg, H., Giess, W., Müller, M.A.N. and Strohbach, B. 1992 List of Namibian plant species. *Dinteria.* 22: 1-21.

Konstant, T.L., Sullivan, S. and Cunningham, A.B. 1995 The effects of utilization by people and livestock on *Hyphaene petersiana* basketry resources in the palm savanna of north-central Namibia. *Econ. Bot.* 49(4): 345-356.

Krieke, E.H.P.M. 1991 Historical dynamics of traditional land tenure in Ovamboland. *NEPRU Working Paper.* pp. 545-565 in *Proceedings of the National Conference on Land Reform and the Land Question.* Windhoek, Namibia.

Krieke, E.H.P.M. 1995 The Ovambo agro-silvipastoral system: traditional land use and indigenous natural resource management in northcentral Namibia. *Forestry Publication.* 4. Ministry of Environment and Tourism, Windhoek.

LaFranchi, C. 1996 *Small-scale and subsistence use of natural resources in Namibian communal areas: estimating the value to livelihood of selected wild foods, medicinals, building and craft materials and fuelwoods.* Unpublished report for the World Wildlife Fund (US) and the Living in a Finite Environment (LIFE) Program, Windhoek, Namibia.

Lamprey, H.F. 1983 Pastoralism yesterday and today: the overgrazing problem. pp. 643-666 in Bourliere, F. (ed.) *Tropical savannas: ecosystems of the world, vol. 13.* Elsevier, Amsterdam.

Lane, C.R. and Swift, J. 1989 East African pastoralism: common land, common problems. *Drylands Programme Issues Paper.* 8. IIED.

Latz, P. 1995 *Bushfires and bushtucker: aboriginal plant use in Central Australia.* IAD Press, Alice Springs.

Lau, B. 1987 *Southern and central Namibia in Jonker Afrikaner's time.* Windhoek Archives Publication Series 8, National Archives, Windhoek, Namibia.

Lau, B. 1988 Pre-colonial Namibian historiography: what is to be done? pp. 90-101 in Wood, B. (ed.) *Namibia 1884-1984: readings on Namibia's history and society.* Namibia Support Committee, London.

Lau, B. 1979 *A critique of the historical sources and historiography relating to the 'Damaras' in pre-colonial Namibia.* Unpublished BA(Hons) dissertation, Dept. of History, University of Cape Town.

Le Houérou, H.N. 1984 Rain use efficiency: a unifying concept in arid-land ecology. *J. Arid Environm.* 7: 213-247.

Le Houérou, H.N. and Hoste, C.H. 1977 Rangeland production and annual rainfall relations in the Mediterranean Basin and in the African Sahelo-Sudanian zone. *J. Range Mgmt.* 30(3): 181-189.

Le Roux, P.J. 1971 *The common names and a few uses of the better known indigenous plants of South West Africa.* Bulletin 47, Dept. of Forestry, Government Printer: Pretoria.

Leach, L. and Mearns, R. 1996 Environmental change and policy: challenging received wisdom in Africa. pp. 1-33 in Leach, L. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Leach, M. and Meams, R. (eds.) 1996 *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Leader-Williams, N., Kayera, J.A. and Overton, G.L. 1995 *Community-based conservation in Tanzania.* Planning and Assessment for Wildlife Management (PAWM), Dept. of Wildofe, Dar es Salaam, Tanzania.

Lebzelter, V. 1934 *Eingeborenenkulturen in Südwest- und Südafrika.* Verlag Kal W. Hiersmann, Liepzig.

Lee, R.B. 1979 *The !Kung San: men, women and work in a foraging society.* Cambridge University Press, Cambridge.

Lee, S.G. and Felker, P. 1992 Influence of water/heat stress on flowering and fruiting of mesquite (*Prosopis glandulosa* var. *glandulosa*). *J. Arid Environm.* 23: 309-319.

Leithead, H.L. 1979 Measuring the growth of trees. *Rangelands.* 1(1): 29-30.

Leslie, P.W. and Fry, P.H. 1989 Extreme seasonality of births among nomadic Turkana pastoralists. *Amer. J. Phys. Anth.* 79: 103-115.

Lichtenstein, M.H.C. 1970 *Foundations of the Cape (and) about the Bechuanas. Being a history of the discovery and colonisation of southern Africa. Fragment of an unpublished manuscript written circa 1811 and a translation of Ueber der Beetjuanas originally published in 1807.* Translated and edited by D.H. Spohr. A.A. Balkema, Cape Town.

Little, P.D. 1985 Absentee herd-owners and part-time pastoralists: the political economy of resource use in northern Kenya. *Hum. Ecol.* 13(2): 131-151.

Little, P.D. and Brokensha, D.W. 1987 Local institutions, tenure and resource management in East Africa. pp. 193-209 in Anderson, D. and Grove, R. (eds.) *Conservation in Africa: people, polices and practice.* Cambridge University Press, Cambridge.

Longhurst, R. 1991 Dependency on forest and tree foods for food security. *Working Paper 181.* Swedish University of Agricultural Sciences, International Rural Development Centre, Uppsala.

Louw, G.N. and Seely, M.K. 1982 *Ecology of desert organisms.* Longman, London.

Loxton, R.F., Hunting and Associates 1974 *The natural resources of Damaraland.* Unpublished report undertaken for the Department of Bantu Administration and Development, Pretoria.

Loxton, Venn and Associates 1983 *Development strategy for Owamboland, Ontwikkelingstrategie vir Owambo.* Unpublished consultancy report, Windhoek.

Ludwig, J.A. and Reynolds, J.F. 1988 *Statistical ecology: a primer on methods and computing.* John Wiley and Sons, New York.

Ludwig, J.A. and Whitford, W.G. 1981 Short-term water and energy flow in arid ecosystems. pp. 271-299 in Goodall, D.W. and Perreira, R.A. (eds.) *Arid land ecosystems Vol. 2.* Cambridge University Press, Cambridge.

Mabbutt, J.A. 1952 The evolution of the middle Ugab Valley, Damaraland, SWA. *Trans. Roy. S. Afr.* 33(3): 333-365.

MacArthur, R.H. 1955 Fluctuations of animal populations and a measure of community stability. *Ecol.* 36: 533-536.

Mace, R. 1991 Overgrazing overstated. *Nature.* 349: 280-281.

Mackenzie, J. *Austral Africa. Losing it or ruling it. Being incidents and experiences in Bechuanaland, Cape Colony, and England.* 2 vols. Sampson, Low, Marston, Searle, and Rivington, London.

Maggs, G.L., Kolberg, H.H. and Hines, C.J.H. 1994 Botanical diversity in Namibia: an overview. *Strelitzia.* 1: 93-104.

Maiga, A. 1992 Production et cueillette des grains des graminées sauvages dans la zone du Gourma Malien. *Annexe no 12, Report d'etape, plantes sauvages. Projet de recherche SSE environnement et développement au Mali.*

Malaisse, F. and Parent, G. 1985 Edible vegetable products in the Zambezian woodland area: a nutritional and ecological approach. *Ecol. Food Nutr.* 18: 43-82.

Malan, J.S. 1973 Double descent among the Himba of South West Africa. *Cimbebasia.* B 2(3): 81-112.

Malan, J.S. 1974 The Herero-speaking peoples of Kaokoland. *Cimbebasia.* B 2: 113-129.

Malan, J.S. and Owen-Smith, G.L. 1974 The ethnobotany of Kaokoland. *Cimbebasia.* (B) 2(5): 131-178.

Marais, E. 1996 Omaungu in Namibia: *Imbrasia belina* (Saturniidae: Lepidoptera) as a commercial resource. Paper presented at the First Multidisciplinary Symposium on Phane (mopane caterpillars), Dept. of Biological Sciences and Kalahari Conservation Society, 18th June 1996.

Marais, E. 1996 Entomologist, National Museum of Namibia, Windhoek.

Marks, S. 1972 Khoisan resistance to the Dutch in the seventeenth and eighteenth centuries. *J. Afr. Hist.* 13(1): 55-80.

Marsh, A 1994 *Trees: threatened lifelines of northern Namibia, the people's perspective* Gamsberg Macmillan, Windhoek.

Marsh, A. n.d. Namibia: environmental degradation and the future. SIDA, Windhoek.

Marsh, A. and Seely, M. (eds.) 1992 *Oshanas: sustaining people, environment and development in Central Owambo, Namibia.* DRFN and SIDA, Windhoek.

Marshall, J. and Ritchie, C. 1984 *Where are the Ju /Wasi of Nyae Nyae? Changes in a Bushman society: 1958-1981.* Communications No. 9/84, Centre for Aftican Studies, University of Cape Town.

Marshall, L. 1976 *The !Kung of Nyae Nyae.* Harvard University Press, London.

Martens, J.C., Danckwerts, J.E., Stuart-Hill, G.C. and Aucamp, A.J. 1990 Use of multivariate techniques to identify vegetation units and monitor change on a livestock production system in a semi-arid savanna of the Eastern Cape. *J. Grassld. Soc. sth. Afr.* 7(3): 184-189.

Martin, G.J. 1995 *Ethnobotany: a methods manual.* Chapman and Hall, London.

Mauss, M. 1954 *The gift: forms and functions of exchange in archaic societies, trans. I. Cunnison.* Cohen and West, London.

May, P.H. 1991 Building institutions and markets for non-wood forest products from the Brazilian Amazon. *Unasylva.* 165(42): 9-16.

May, R.M. 1971 Stability in multi-species community models. *Mathematical Biosciences.* 12: 59-79.

May, R.M. 1972 Will a large complex system be stable? *Nature.* 238: 413-414.

May, R.M. 1977 Thresholds and breakpoints in ecosystems with a multiplicity of stable states. *Nature.* 269: 471-477.

Mbuende, K. 1986 *Namibia, the broken shield: anatomy of Imperialism and revolution.* Liber Förlag, Sweden.

McGregor, J. 1995 Gathered produce in Zimbabwe's communal areas changing resource availability and use. *Ecol. Food and Nutr.* 33: 163-193.

McNaughton, S.J. 1977 Diversity and stability of ecological communities: a comment on the role of empiricism in ecology. *Amer. Nat.* 111: 515-525.

Meams, R. 1996 When livestock are good for the environment. *IDS Working Paper.* 45.

Mendes, C. 1989 *Fight for the forest.* Latin American Bureau, London.

Menges, W. 1992 What is it worth to keep farming alive in Damaraland? 20th September. *Tempo Newspaper,* Windhoek.

MET 1992 The establishment of conservancies in Namibia: policy document. Appendix 1 in Jones, B.T.B. Wildlife management, utilization and tourism in communal areas: benefits to communities an improved resource management. *Research Discussion Paper.* 5. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Metcalfe, S. 1995 *Livestock, wildlife, and the forage commons. Prospects for rangelands reform in a semi-arid communal area of Zimbabwe.* Occasional Paper, Centre for Applied Social Sciences, University of Zimbabwe.

Miller, A.G., Morris, M. and Stuart-Smith, S. 1988 *Plants of Dhofar: the southern region of Oman traditional, economic and medicinal uses.* The Office of the Adviser for Conservation of the Environment, Diwan of Royal Court Sultanate of Oman.

Milton, S.J. and Hoffman, M.T. 1994 The application of state and transition models to rangeland research and management in arid succulent and semi-arid grassy Karoo, South Africa. *Afr. J. Range and Forage Sci.* 11(1): 18-26.

Ministry of Agriculture, Water and Rural Development 1991 *Analysis of plant material of SWA.* Unpublished data, Windhoek, Namibia.

Möller, P. 1974 translated and annotated by Rudner, I. and Rudner, J. *Journey in Africa through Angola, Ovampoland and Damaraland, 1895-1896.* C. Struik, Cape Town.

Monimart, M. 1989 Women in the fight against desertification. *Drylands Programme Issues Paper.* 12. IIED.

Moorsom, R. 1982 *Transforming a wasted land.* CIIR, London.

Morgan, W.T.W. 1981 Ethnobotany of the Turkana: use of plants by a pastoral people and their livestock in Kenya. *Econ. Bot.* 35: 96-130.

Morris, A.G. 1990 Khoikhoi origins. *The Phoenix.* 3: 8-13.

Mossop, E.E. (ed.) 1935 The journal of Hendrik Jacob Wikar (1779) and the journals of Jacobus Coetse Jansz (1760) and Willem van Reenen (1791). *Van Riebeeck Soc. J.* 15.

Mouton, D.P. 1995 Soil characteristics under different grazing regimes in northwestern Namibia. *Occasional Paper.* 2: 6-18. *Summer desertification project December 1994 - January 1995.* DRFN, Windhoek, Namibia.

Mubita, O. 1995 Drought effects on forests and woodlands. pp. 63-77 in Moorsom, R., Franz, J. and Mupotola, M. (eds.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Mueller-Dombois, D. and Ellenburg, H. 1974 *Aims and methods of vegetation ecology.* John Wiley and Sons, London.

Müller, M.A.N. 1984 *Grasses of South West Africa/Namibia.* Directorate of Agriculture and Forestry, Department of Agriculture and Nature Conservation, Windhoek.

Munukayumbwa, S., Simataa, L. and Kisco, M. 1997 Overgrazing near waterpoints in the Pro-Namib.in Ward, D.ed. *Land degradation in the pro-Namib.* Report of the Summer Desertification Project (DRFN) 1996 funded by USAID and SIDA.

Næraa, T., Devereux, S., Frayne, B. and Hamett, P. 1993 Coping with drought in Namibia: informal social security systems in Caprivi and Erongo, 1992. *NISER Research Report.* 12. NISER, Multidisciplinary Research Centre, University of Namibia, Windhoek.

Namibian Broadcasting Company 1992 *Dawn to dust.* A television documentary of drought in Damaraland.

National Planning Commission (NPC) 1991 *Population and housing census, preliminary report.*NPC, Central Statistics Office, Windhoek, Namibia.

NBRI 1996 *'Working list' of Namibian species.* Unpublished plant species list.

NEPRU 1992 Unofficial data printout of population returns by district 1970, 1981, 1981, 1991. National Economic and Planning Research Unit, Windhoek, Namibia.

NEPRU 1991a The water situation in the communal areas. pp. 149-170. *The proceedings of the National Conference on land reform and the land question.* Office of the Prime Minister, Windhoek, Namibia.

NEPRU 1991b Land tenure data. pp. 145-148. *The proceedings of the National Conference on land reform and the land question.* Office of the Prime Minister, Windhoek, Namibia.

Nevo, E. and Beiles, A. 1989 Genetic diversity in the desert: patterns and testable hypotheses. *J. Arid Environments.* 17: 241-244.

Nghitila, T.M. 1995 Selected soil flora and fauna as indicators of biotic integrity in northwestern Namibia rangelands. *Occasional Paper.* 2: 55-61. *Summer desertification project December 1994 - January 1995.* DRFN, Windhoek, Namibia.

Niamir, M. 1990 Herder's decision-making in natural resources management in arid and semi-arid Africa. *Community Forestry Note.* 4. FAO, Rome.

Nicholas, G.W. 1952 The answer to desert encroachment. *The Farmer's Weekly.* June 25th: 14-17.

NISER 1992 *Namibian household food security report* University of Namibia, Windhoek.

Noble, I.R. and Slatyer, R.O. 1980 The use of vital attributes to predict successional changes in plant communities subject to recurrent disturbances. *Vegetatio.* 43: 5-21.

Norbury, G.L., Norbury, D.C. and Oliver, A.J. 1994 Facultative behaviour in unpredictable environments: mobility of red kangaroos in arid Western Australia. *J. Animal Ecol.* 63: 410-418.

Nordenstam, B. 1974 The flora of the Brandberg. *Dinteria.* 2: 3-67.

Norušis, M.J./SPSS Inc. 1993 *SPSS for Windows: base system user's guide release 6.0.* SPSS, Chicago.

Noy-Meir, I. 1973 Desert ecosystems: environment and producers. *Ann. Rev. Ecol. Syst.* 4: 25-51.

Noy-Meir, I. 1975 Stability of grazing systems: an application of predator-prey graphs. *J. Ecol.* 63: 459-481.

Noy-Meir, I. 1979/1980 Structure and function of desert ecosystems. *Israel J. Bot.* 28: 1-19.

Noy-Meir, I. 1993 Compensating growth of grazed plants and its relevance to the use of rangelands. *Ecol. Appld.* 3: 32-34.

Ntenga, G.M. and Mugongo, B.T. 1991 Honey hunters and beekeepers: a study of traditional beekeeping in Babati District, Tanzania. *Working Paper.* 161. Swedish University of Agricultural Sciences, International Rural Development Centre, Uppsala.

Nurse, G.T., Lane, A.B. and Jenkins, T. 1976 Sero-genetic studies on the Dama of South West Africa. *Ann. Hum. Biol.* 3(1): 33-50.

O'Brien, E.M. 1988 Climatic correlates for species richness for woody 'edible' plants across southern Africa. *Monogr. Syst. Bot. Missouri Bot. Gard.* 25: 385-401.

O'Connell, J.F., Latz, P.K. and Barnett, P. 1983 Traditional and modern plant use among the Alyawara of Central Australia. *Econ. Bot.* 37(1): 80-109.

O'Connor, T.G. 1985 A synthesis of field experiments concerning the grass layer in the savanna regions of Southern Africa. *S. African National Science Programmes Report.* 114. CSIR, Pretoria.

O'Connor, T.G. 1991 Influence of rainfall and grazing on the compositional change of the herb layer of a sand veld savanna. *J. Grassld. Soc. sth. Afr.* 8(3): 103-113.

O'Connor, T.G. 1993 Influence of rainfall and grazing on the demography of some African savanna grasses: a matrix modelling approach. *J. Applied Ecol.* 30: 119-132.

O'Connor, T.G. 1994 Composition and population responses of an African savanna grassland to rainfall and grazing. *J. Appld. Ecol.* 31: 155-171.

O'Connor, T.G. and Pickett, G.A. 1992 The influence of grazing on seed production and seed banks of some African savanna grasslands. *J. Appld. Ecol.* 29: 247-260.

O'Connor, T.G. and Roux, P.W. 1995 Vegetation changes (1949-1971) in a semi-arid, grassy dwarf shrubland in the Karoo, South Africa: influence of rainfall variability and grazing by sheep. *J. Appld. Ecol.* 32: 6 12-626.

Oatham, M.P. 1997 Water relations of *Zygophyllum hamiense*, *Heliotropium kotschyi* and *Panicum turgidum* and their response to rangeland management techniques in Abu Dhabi. *J. Arid Environm.* 35: 95-110.

Oba, G. 1992 Ecological factors in land use conflicts, land administration and food insecurity in Turkana, Kenya. *Pastoral Development Network Paper.* 33a. ODI, London.

Oba, G. and Lusigi, W.J. 1987 An overview of drought strategies and land use in African pastoral systems. *Pastoral Development Network Paper.* 23a. ODI, London.

Odendaal Report 1964 *Report of the Commission of Enquiry into South West African Affairs 1962-1963.* The Government Printer, Pretoria.

Oduol, P.A., Felker, P., McKinley, C.R. and Meier, C.E. 1986 Variation among selected *Prosopis* families for pod sugar content and pod protein contents. *Forest Ecol. and Mgmt.* 16: 423-431.

Ogle, B.M. and Grivetti, L.E. 1985 Legacy of the chameleon: edible wild plants in the Kingdom of Swaziland, southern Africa. A cultural, ecological, nutritional study. Part II - demographics, species availability and dietary use, analysis by ecological zone. *Ecol. Food Nutr.* 17: 1-30.

Olsvig-Whittaker, L., Shachak, M. and Yair, A. 1983 Vegetation patterns related to environmental factors in a Negev Desert watershed. *Vegetatio.* 54: 153-165.

Ordinance Survey Map of the Republic of Namibia 1994 Survey Department, Windhoek, Namibia.

Orr, D.M. 1980 Effects of sheep grazing Astrebla grassland in central western Queensland II. effects of seasonal rainfall. *Australian J. Agric. Res.* 31: 807-820.

Owen-Smith, G. 1995 The evolution of community-based natural resource management in Namibia. pp. 135-142 in Leader-Williams, N., Kayera, J.A. and Overton, G.L. (eds.) *Community-based conservation in Tanzania.* Planning and Assessment for Wildlife Management (PAWM), Dept. of Wildlife, Dar es Salaam, Tanzania.

Oxfam Canada 1996 *Preliminary site surveys: Northern Region Livestock Development Project (NOLIDEP).* Unpublished Report for the Ministry of Agriculture, Water and Rural Development (MAWRD), Windhoek, Namibia.

Pager, H. 1973 Rock paintings in southern Africa showing bees and honey hunting. *Beeworld.* 54(2): 61-68.

Parkington, J.E. 1984 Soaqua and Bushmen: hunters and robbers. pp. 151-174 in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Pate, D. 1986 The effects of drought on Ngatatjara plant use: an evaluation of optimal foraging theory. *Hum. Ecol.* 14(1): 95-113.

Perkins, J.J. and Thomas, D.S.G. 1993 Spreading deserts or spatially confined environmental impacts? Land degradation and cattle ranching in the Kalahari desert of Botswana. *Land Degrad. Rehab.* 4: 179-194.

Peters, C.M., Gentry, A.H. and Mendelsohn, R. 1989 Valuation of an Amazonian rainforest. *Nature.* 339: 655-656.

Peters, C.R., O'Brien, E.M. and Box, E.O. 1984 Plant types and seasonality of wild-plant foods, Tanzania to southwestern Africa: resources for models of the natural environment. *J. Hum. Evol.* 13: 397-414.

Peterson, N. 1979 Territorial adaptations among desert hunter-gatherers: the !Kung and Australians compared. pp. 112-129 in Burnham, P. and Ellen, R.F. (eds.) *Social and ecological systems.* Association of Social Anthropologists Monograph 18, Academic Press, London.

Pimm, S.L. 1991 *The balance of nature?* University of Chicago Press, Chicago.

Poschen, P. and Eiche, G. 1986 Fuel and wood consumption surveys in developing countries: a proposal for an efficient low-cost method and the results of its application in eastern Ethiopia. *Resource Mgmt. and Optimization.* 4(1): 1-6.

Posey, D.A. 1984 Hierarchy and utility in a folk biology taxonomic system: patterns in classification of arthropods by the Kayapo Indians of Brazil. *J. Ethnobiol.* 4(2): 123-139.

Povinelli, E. 1990 Emiyenggal and Batjemal classifications, Cox Peninsula, Northern Territory: 'Figuring' continuity and contingency. *Australian Aboriginal Studs.* 2: 53-59.

Prance, G.T. 1991 What is ethnobotany today? *J. Ethnopharmacology.* 32: 209-216

Prance, G.T., Balée, W., Boom, B.M. and Carneiro, R.L. 1987 Quantitative ethnobotany and the case for conservation in Amazonia. *Cons. Biol.* 1(4): 296-310.

Pratt, D.J. and Gwynne, M.D. 1977 *Rangeland management and ecology in east Africa.* Centre for Development Research, Copenhagen and Scandinavian Institute of African Studies.

Prentice, I.C. and Werger, M.J.A. 1985 Clump spacing in a desert dwarf shrub community. *Vegetatio.* 63: 133-139.

Prigogine, I. 1989 The philosophy of instability. *Futures.* August: 396-400.

Quan, J., Barton, D. and Conroy, C. 1994a A preliminary assessment of the economic impact of desertification in Namibia. *DEA Research Discussion Paper.* 3. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Quan, J., Barton, D. and Conroy, C. 1994b The economic impact of desertification in communal and commercial areas of southern Namibia. *Excerpts from DEA Research Discussion Paper.* 3. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Quan, J., Barton, D. and Conroy, C. 1994c The economic impact of desertification in northen communal areas: Uukwaluudhi. *Excerpts from DEA Research Discussion Paper.* 3. Directorate of Environmental Affairs, Ministry of Environment, Windhoek, Namibia.

Queroz, J.S. 1993 Rangeland degradation in Botswana: myth or reality. *Pastoral Development Network Paper.* 35b. ODI, London.

Radcliffe-Brown, A.R. 1931 *The social organization of Australian Tribes.* Oceania Monographs 1, Macmillan, Melbourne.

Raikes, P. 1981 *Livestock development and policy in East Africa.* Centre for Development Research, Copenhagen, Scandinavian Institute of African Studies, Uppsala.

Ranger, T. 1988 Trends in African historiography and the tasks facing scholars of Namibia. pp. 41-44 in Wood, B. (ed.) *Namibia 1884-1984: readings on Namibia's history and society.* Namibia Support Committee, London.

Renvoize, S.A., Cope, T.A., Cook, F.E.M., Clayton, W.D. and Wickens, G.E. 1992 Distribution and utilization of grasses of arid and semi-arid regions. pp. 3-16 in Chapman, G.P. (ed.) *Desertified grasslands: their biology and management.* Academic Press, London.

Republic of Namibia 1991 *National conference on land reform and the land question: consensus document.* Office of the Prime Minister, Windhoek, Namibia.

Rethman, N.F.G., Beukes, B.H. and Malherbe, C.E. 1971 Influence on a north-eastern sandy highveld sward of winter utilization by sheep. *Proc. Grassld Soc. sth. Afr.* 6: 55-62.

Richards, P. 1985 *Indigenous agricultural revolution: ecology and food production in West Africa.* Unwin Hyman, London.

Richards, P. 1995 Farmer knowledge and plant genetic resource management. pp. 52-58 in Engels, J.N.N. (ed.) *In situ conservation and sustainable use of plant genetic resources for food and agriculture in developing countries: report of a DSE/ATSAF/IPGRI workshop 2-4 May 1995, Bonn Röttgen, Germany.* A joint publication of IPGRI, Rome, Italy and DES, Feldafing, Germany.

Richards, P. 1995 Cultivation: knowledge or performance? pp. 61-78 in Hobart, M. (ed.) *An anthropological critique of development: the growth of ignorance.* Routledge, London.

Riruako 1991 *The Hereros' view.* Paper presented to the National conference on land reform, Windhoek, Namibia.

Robertson, G. 1987 The environment of the Australian sheep rangelands. pp. 50-68 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Rodin, R.J. 1985 The ethnobotany of the KwaNyama Owambos. *Monogr. Syst. Bot. Missouri Bot. Gard.* 9.

Roe, E. 1995 Except-Africa: postscript to a special section on development narratives. *World Devt.* 23(6): 1065-1070.

Rohde, R.F. 1993 Afternoons in Damaraland: common land and common sense in one of Namibia's former 'Homelands'. *Occasional Papers.* 41. Centre of African Studies, Edinburgh University.

Rohde, R.F. 1994 Tinkering with chaos: towards a communal land tenure policy in former Damaraland. *SSD Discussion Paper.* 8. Social Sciences Division, MRC, University of Namibia, Windhoek.

Rohde, R.F. 1997a Looking into the past: interpretations of vegetation change in Western Namibia based on matched photography. *Dinteria.* 25: 121-149.

Rohde, R.F. 1997b *Nature, cattle thieves and various other midnight robbers: images of people, place and landscape in Damaraland, Namibia.* PhD thesis, Dept. Anthropology, University of Edinburgh.

Roux, P.W. 1980 Vegetation change in the Karoo region. *Karoo Agric.* 1(5): 15-16.

Rubenstein, D.I. 1989 Life history and social organisation in arid adapted ungulates. *J. Arid Environm.* 17: 145-156.

Rudner, J. 1979 The use of stone artefacts and pottery among the Khoisan peoples in historic and protohistoric times. *S. Afr. Archaeol. Bull.* 34: 3-17.

Russell, E.W. 1977 Foreword. pp. vii-viii in Pratt, D.J. and Gwynne, M.D. (eds). *Rangeland management and ecology in east Africa.* Centre for Development Research, Copenhagen and Scandinavian Institute of African Studies.

Rutherford, M.C. 1980 Annual plant production-precipitation relations in arid and semi-arid regions. *S. Afr. J. Sci.* 76: 53-56.

Safriel, U.N. 1987 The stability of the Negev desert ecosystems: why and how to investigate it. pp. 133-144 in Berkofsky, L. and Wartele, M.G. (eds.), Ranman and Littlefield, New Jersey, USA.

Safriel, U.N. 1989 What's special about desert ecology? Introduction. *J. Arid Environm.* 17: 125-130.

Sandelowsky, B. 1977 Mirabib: an archaeological study in the Namib. *Madoqua.* 10(4): 221-283.

Sandelowsky, B., van Rooyen, J.H. and Vogel, J.C. 1979 Early evidence for herders in the Namib. *S. Afr. Archaeol. Bull.* 34: 50-51.

Sandford, S. 1983 *Management of pastoral development in the third world.* John Wiley and Sons, Chichester.

Saunders, C. 1988 Towards the decolonisation of Namibian history: notes on some recent work in English. pp. 81-89 in Wood, B. (ed.) *Namibia 1884-1984: readings on Namibia's history and society.* Namibia Support Committee, London.

Schinz, H. 1891 *Deutsch-Südwest-Afrika. Forshungsreisen Durch Die Deutshen Schutzgebieten Gross-Nama und Hereroland, Nach deme Kunene dem Ngami-see und de Kalaxari. 1884-1887.* Oldenburg und Leipzig.

Schmidt, S. 1990 Ideological changes in Nama and Dama folktales. *D'un conte ...a l'autre: variabilité dans la littérature orale.* 2: 303-314.

Schmidt, S. 1986 The relations of Nama and Dama women to hunting. *Sprache und Geshichte in Afrika.* 7(1): 329-349.

Scholes, R.J. 1990 The regrowth of *Colophospermum mopane* following clearing. *J. Grassld. Soc. sth. Afr.* 7(3): 147-151.

Scholte, P.T. 1992 Leaf litter and *Acacia* pods as feed for livestock during the dry season in Acacia-Commiphora bushland, Kenya. *J. Arid Environm.* 22: 271-276.

Schreckenberg, K. 1994 *The role of indigenous tree products in the west African savanna with particular reference to the Bassila Region of Benin.* Unpublished manuscript.

Schrire, C. 1980 An enquiry into the evolutionary status and apparent identity of San hunter-gatherers. *Hum. Ecol.* 8: 9-32.

Schrire, C. (ed.) 1984a *Past and present in hunter gatherer society.* Academic Press Inc., London.

Schrire, C. 1984b Wild surmises on savage thoughts. pp. 1-25 in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Schrire, C. 1984c Interactions of past and present in Arnhem Land, northern Australia. pp. 67-93 in Schrire, C. (ed.) *Past and present in hunter gatherer society.* Academic Press Inc., London.

Schultz, L. 1907 *Aus Namaland und Kalahari.* Verlag von Gustav Fischer, Jena.

Scoones, I. 1996 Range management science and policy: politics, polemics and pasture in southern Africa. pp. 34-53 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Scoones, I. 1995 *Living with uncertainty: new directions in pastoral development in Africa.* IIED, London.

Seely, M.K. 1978 The Namib dune desert: an unusual ecosystem. *J. Arid Environm.* 1: 117-128.

Seely, M.K. and Louw, G.N. 1980 First approximation of the effects of rainfall on the ecology and energetics of a Namib dune ecosystem. *J. Arid Environm.* 3: 25-54.

Seely, M.K. and Jacobson, K.M. 1994 Guest Editorial. Desertification and Namibia: a perspective. *J. Afr. Zool.* 108: 21-36.

Seely, M.K., Hines, C. and Marsh, A.C. 1995 Effects of human activities on the Namibian environment as a factor in drought susceptibility. pp. 51-61 in Moorsom, R., Franz, J. and Mupotola, M. (ed.) *Coping with aridity: drought impacts and preparedness in Namibia.* Brandes & Apsel Verlag/NEPRU, Frankfurt.

Sen, A. 1981 *Poverty and famines: an essay on entitlement and deprivation.* Clarendon Press, Oxford.

Sen, A. 1984 *Resources, values and development.* Basil Blackwell, Oxford.

Serton, P. (ed.) 1954 The narrative and journal of Gerald McKiernan in South West Africa, 1874-1879. *Van Riebeeck Soc. J.* 35.

Shackleton, S.E. 1991 Autecological studies on grass species in southern Africa: a literature survey. *J. Grassld. Soc. sth. Afr.* 8: 114-120.

Shaffer, P. 1996 Beneath the poverty debate: some issues. *IDS Bulletin.* 27(1): 23-35.

Shaw, E.M. 1993 The basketwork of southern Africa. Part 2. Basketwork of the Khoisan and the Dama. *Annals of the South African Museum.* 102(8): 273-301.

Shepherd, G. 1992 *Managing Africa's dry tropical forests: a review of indigenous methods.* ODI Agricultural Occasional Paper 14.

Shepherd, N. and Caughley, G. 1987 Options for the management of kangaroos. pp. 188-219 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Silbauer, G.B. 1981 *Hunter and habitat in the Central Kalahari Desert.* Cambridge University Press, Cambridge.

Silvertown, J. Dodd, M., McConway, K., Crawley, M. and Potts, J. 1995 Species diversity and stability in grassland. *Tree.* 10(7): 287-288.

Simpson, E.H. 1949 Measurement of diversity. *Nature.* 163: 688.

Skarpe, C. 1990 Structure of the woody vegetation in disturbed and undisturbed arid savanna, Botswana. *Vegetatio.* 87: 11-18.

Skinner, T.E. 1981 Droughts in perspective. *Proc. Grassld Soc. sth. Afr.* 16: 13-16.

Slobodkin, L.B. 1989 *J. Arid Environm.* 17: 287-292.

Smilauer, P. 1992 *CANODRAW 3.00 user's guide.* Environmental Research Centre, University College London.

Solbrig, O. 1991 Savanna modelling for global change. *Biol. Intern. (Special Issue).* 24: 1-47.

Solway, J.S. and Lee, R.B. 1992 Foragers, genuine or spurious? Situating the Kalahari San in history. *Curr. Anthrop.* 33 supplement: 187-224.

Soroses, A., Lubbock, A., Nangolo, V. and Enjala, L. 1994 *Social and gender issues in agricultural and livestock production systems: a case study, Onepandaulo village, Uukwangula ward, Oshana Region, Northern communal areas, Namibia.* Unpublished draft report for FAO (Project TCP/NAM/4451), Windhoek.

Stafford-Smith, D.M. and Morton, S.R. 1990 A framework for the ecology of arid Australia. *J. Arid Environm.* 18: 255-278.

State Museum n.d. *The collection and preparation of grass seeds.* Leaflet for State Museum Ethnology Hall, Windhoek.

Stebbings, E.P. 1935 The encroaching Sahara. *Geog. J.* 86: 510.

Steyn, H.P. 1981 Nharo plant utilization: an overview. *Khoisis.* 1: 1-31.

Steyn, H.P. and du Pisani, E. 1984/1985 Grass-seeds, game and goats: an overview of Dama subsistence. *J. SWA Sci. Soc.* 39: 37-52.

Stiles, D. and Kassam, A. 1991 An ethno-botanical study of Gabra plant use in Marsabit District, Kenya. *J. East African Nat. Hist. Soc. and National Mus.* 81(198): 14-37.

Stott, P. 1994 Head of Dept., Geography Dept., School of Oriental and African Studies.

Strickland, S.S. 1982 Honey hunting by the Gurungs of Nepal. *Bee World.* 63(4): 153-161.

Strohbach, B.J. 1992 Loss of genetic diversity due to veld degradation: a case study in the northern Kalahari, Grootfontein district. *Dinteria.* 23: 102-115.

Sullivan, S. 1993a *The importance of indigenous woody species to rural subsistence in Namibia, Africa.* BSc dissertation, Dept. Anthropology, University College London.

Sullivan, S. 1993b *The utilization of, and impact on, indigenous woody species at Khowarib settlement, northern Damaraland, with particular reference to those used for potentially income-generating activities.* Unpublished report for the Royal Geographical Society, London.

Sullivan, S. 1995 *Local participation in community resource management initiatives: findings of interviews with individuals following the MET's socioecological survey meeting in Sesfontein, April 1994.* Unpublished document presented to B. Jones, Directorate of Environmental Affairs, MET, Windhoek.

Sullivan, S. 1996a The 'communalization' of former commercial farmland: perspectives from Damaraland and implications for land reform. *SSD Research Report.* 25. Social Sciences Division, MRC, University of Namibia, Windhoek.

Sullivan, S. 1996b Towards a non-equilibrium ecology: perspectives from an arid land. *J. Biogeog.* 23: 1-5.

Sullivan, S., Konstant, T.L. and Cunningham, A.B. 1995 The impact of utilization of palm products on the population structure of the Vegetable Ivory Palm (*Hyphaene petersiana*, Arecaceae) in north-central Namibia. *Econ. Bot.* 49(4): 357-370.

Sullivan, S. and Konstant, T.L. 1997 Human impacts on woody vegetation, and multivariate analysis: a case study based on data from Khowarib settlement, Kunene Region. *Dinteria.* 25: 87-120.

SWA Administration 1928 *Report of the Native Reserves Commission.*

Swift, J. 1977 Sahelian pastoralists: underdevelopment, desertification and famine. *Ann. Rev. Anthrop.* 6: 457-478.

Swift, J. 1996 Desertification: narratives, winners and losers. pp. 73-90 in Leach, M. and Mearns, R. (eds.) *The lie of the land: challenging received wisdom on the African environment.* The International African Institute, James Currey and Heinemann, London, Oxford and Portsmouth.

Tainton, N.M. and Booysen, P de V. 1963 The effects of management on apical bud development and seeding in *Themeda triandra*. *S. Afr. J. Agric. Sci.* 6: 21-30.

Tainton, N.M., Edwards, P.J. and Mentis, M.T. 1980 A revised method for assessing veld condition. *Proc. Grassld Soc. sth. Afr.* 15: 37-52.

Talle, A. 1987 Woman as heads of houses: the organisation of production and the role of women among the pastoral Maasai in Kenya. *Ethnos.* 52: 50-80.

Tanaka, J. 1976 Subsistence ecology of Central Kalahari San. pp. 98-119 in Lee, R.B. and DeVore, I. (eds.) *Kalahari hunter-gatherers: studies of the !Kung San and their neighbours.* Harvard University Press, London.

Tanaka, J. 1981 On residential patterns and livestock management among the pastoral Pokot. In Kipkorir, B.E., Soper, R.C. and Ssenyonga, J.W. (eds.) *Kerio valley, past, present and future.* Proceedings of a seminar held in Nairobi at the Institute of African Studies, University of Nairobi, Kenya.

Tapscott, C. 1990 The social economy of livestock production in the Ovambo Region. *Discussion Paper.* 4. Namibian Institute for Socio-economic Research (NISER), Windhoek, Namibia.

Tapscott, C. and Hangula, L. 1994 Fencing of communal range land in northern Namibia: social and ecological implications. *SSD Discussion Paper.* 6. Social Sciences Division, MRC, University of Namibia, Windhoek.

Ter Braak, C.J.F. 1986 Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. *Ecol.* 67(5): 1167-1179.

Ter Braak, C.J.F. 1987a The analysis of vegetation-environment relationships by CCA. *Vegetatio.* :69-77.

Ter Braak, C.J.F. 1987b Partial correspondence analysis. pp. 557-564 in Beck, H.H. (ed.) *Classification and related methods of data analysis.* Proceedings of IFCS Conference, June 1987, Amsterdam.

Ter Braak, C.J.F. 1987c *CANOCO: a FORTRAN progam for canonical community ordination by partial, detrended, canonical correspondence analysis, principal components analysis and redundancy analysis (version 2.1).* Institute of Applied Computer Science, Statistics Department, Wageningen.

Ter Braak, C.J.F. 1988 CANOCO: an extension of DECORANA to analyze species-environment relationships. *Vegetatio.* 75: 159-160.

Ter Braak, C.J.F. 1990 *Update notes: CANOCO version 3.1.* Agricultural Mathematics Group, Wageningen.

Ter Braak, C.J.F. 1991 *CANOCO 3.12.*

Terry, M.E. 1984 *Botswanacraft and Hambukushu basketry: the effects of a major marketing operation on a group of African people, their traditional craft and the natural resources.* Unpublished report, Botswanacraft Marketing Co. (Pty) Ltd, Gaborone.

Terry, M.E. 1987a *Mokola palm experimentation and extension activities in Ngamiland, CFDA.* Unpublished report, Botswanacraft Marketing Co. (Pty) Ltd, Gaborone.

Terry, M.E. 1987b *Final report for the handicraft development project of Ngamiland, Botswana.* Unpublished report, Botswanacraft Marketing Co. (Pty) Ltd, Gaborone.

Terry, M.B. and Cunningham, A.B. 1993 The impact of commercial marketing on the basketry of southern Africa. *J. Mus. Ethnography.* 4: 25-48.

Theron, E.P. and Booysen, P de V. 1966 Palatability of grasses. *Proc. Grassld Soc. sth. Afr.* 1: 110-120.

Thomas, D.S.G. and Middleton, N.J. 1994 *Desertification: exploding the myth.* John Wiley and Sons Ltd., Chichester.

Thompson, M., Warburton, M. and Hatley, T. 1986 *Uncertainty on a Himalayan scale.* Milton for Ethnographia Press, London.

Thrash, I., Nel, P.J., Theron, G.K. and Bothma, J. du P. 1991a The impact of the provision of water for game on the woody vegetation around a dam in the Kruger National Park. *Koedoe.* 34(2): 131-148.

Thrash, I., Nel, P.J., Theron, G.K. and Bothma, J. du P. 1991b The impact of the provision of water for game on the basal cover of the herbaceous vegetation around a dam in the Kruger National Park. *Koedoe.* 34(2): 121-130.

Thrash, I., Theron, G.K. and Bothma, J. du P. 1993 Herbivore dung deposit counts around drinking troughs in the Kruger National Park. *Koedoe.* 36(1): 87-93.

Tidmarsh, C.E.M. 1948 Conservation problems of the Karoo. *Fmg. S. Afr.* 23: 519-530.

Tindale, N.B. 1977 Adaptive significance of the Panara or grass seed culture of Australia. pp. 345-349 in Wright, R.V.S. (eds). *Stone tools as cultural markers: change evolution and complexity.* Prehistory and material culture series no. 12, Australian Institute of Aboriginal Studies, Canberra.

Trollope, W.S.W. 1990 Development of a technique for assessing veld condition in the Kruger National Park using key grass species. *J. Grassld. Soc. sth. Afr.* 7: 46-51.

Trollope, W.S.W., Trollope, L.A. and Bosch, O.J.H. 1990 Pasture management terminology in southern Africa. *J. Grassld. Soc. sth. Afr.* 7: 52-61.

Turner, S. 1996 Conservancies in Namibia: a model for successful common property resource management?. *SSD Discussion Paper.* 13. Social Sciences Division, MRC, University of Namibia, Windhoek.

Tyson, P.D. *Climatic change and variability in southern Africa.* Oxford University Press, Cape Town.

UDF 1991 *Documentation prepared and presented by the UDF to the National Land Conference on Land Reform and the Land Question, Windhoek.*

UNCOD 1977 *Round-up, plan of action and resolutions.* UN Conference on desertification, Nairobi, 29 August-9 September. United Nations, New York.

Union of South Africa 1918 *Report on the natives of South West Africa and their treatment by Germany.* His Majesty's Stationary Office, London.

Van den Eynden, V. Vernemmen, P. and Van Damme, P. 1992 *The ethnobotany of the Topnaar.* Universiteit Gent, Gent.

Van der Merwe, J.H. 1983 *National atlas of South West Africa (Namibia).* Directorate of Development Coordination, Windhoek, Namibia.

Van der Walt, J.J.A. 1974 A preliminary report on the genus *Commiphora* in South West Africa. *Madoqua.* Ser.1(8): 5-23.

Van Niekerk, J.P. and Wasserman, V.D. 1976 Important environmental factors influencing the natural distribution of *Schmidtia kalahariensis* and *Enneapogon cenchroides* in South West Africa. *Proc. Grassld Soc. sth. Afr.* 11: 37-41.

Van Rooyen, A. 1996 Desertification: a reality much closer to home than we would like to admit. *Griqua Gnus.* 253: 10-12.

Van Rooyen, N., Bezuidenhout, D., Theron, G.K. and Bothma, J. du P. 1990 Monitoring of the vegetation around artificial watering points (windmills) in the Kalahari Gemsbok National Park. *Koedoe.* 33: 63-88.

Van Rooyen, N., Bredenkamp, G.J. and Theron, G.K. 1991a Kalahari vegetation: veld condition, trends and ecological status of species. *Koedoe.* 34: 61-72.

Van Rooyen, N., Theron, G.K. and Bredenkamp, G.J. 1991b Long-term vegetation dynamics in the semi-arid Kalahari. *Koedoe.* 34: 91-92.

Van Rooyen, M.W., Grobbelaar, N., Theron, G.K. and van Rooyen, N. 1992 The ephemerals of Namaqualand: effect of germination date on development of three species. *J. Arid Environm.* 22: 51-66.

Van Rooyen, N., Bredenkamp, G.J., Theron, G.K., Bothma, J. du P. and Le Riche, E.A.N. 1994 Vegetational gradients around artificial watering points in the Kalahari Gemsbok National Park. *J. Arid Environm.* 26: 349-361.

Van Voorthuizen, E.G. 1976 The mopane tree. *Botswana Notes and Records.* 8: 223-230.

Van Warmelo, N.J. 1962 Notes on the Kaokoveld (South West Africa and its people). *Ethnological Publications.* 26. Dept. of Bantu Administration, Pretoria.

Vedder, H. 1923 *Die Bergdama 1. Teil.* L. Freiderichsen, Hamburg.

Vedder, H. 1928 The Berg Damara. pp. 38-78 in Vedder, H. (ed.) *The native tribes of South West Africa.* Cape Times Ltd, Cape Town.

Vedder, H. 1938 *South West Africa in early times.* Frank Cass and Co., London.

Veth, P.M. and Walsh, F.J. 1988 The concept of 'staple' plant foods in the Western Deset region of Western Australia. *Aust. Aboriginal Studs.* 2: 19-25.

Viereck, A. 1967 The Damaraland culture: a 'Later Stone Age' horizon in SWA. *J. of the SWA Sci. Soc.* 21: 13-31.

Viljoen, P.J. and Bothma, J. du P. 1990 The influence of desert-dwelling elephants on vegetation in the northern Namib Desert, SWA/Namibia. *J. Arid Environm.* 18: 85-96.

Von François, H. 1896 *Nama and Damara, Deutsch-Süd-West-Afrika.* Magdeburg, Baensch.

Von Koenen, E. *ca.* 1977 *Heil-und Giftpflanzen in Südwestafrika.* Akademischer Verlag, Windhoek.

Vorster, M. 1982 Development of the ecological index method for assessing veld condition in the Karoo. *Proc. Grassld Soc. sth. Afr.* 17: 84-89.

Wadley, L. 1979 Big elephant shelter and its role in the Holocene prehistory of central SWA. *Cimbebasia.* B 3(1): 1-76.

Walker, B.H. 1980 Stable production versus resilience: a grazing management conflict? *Proc. Grassld Soc. sth. Afr.* 15: 79-83.

Walker, B.H. and Noy-Meir, I. 1982 Aspects of stability and resilience of savanna ecosystems. pp. 556-590 in Huntley, B.J. and Walker, B.H. (eds.) *Ecology of tropical savannas. Ecological studies 42.* Springer-Verlag, New York.

Walker, B.H., Ludwig, D., Holling, C.S. and Peterman, R.M. 1981 Stability of semi-arid savanna grazing systems. *J.Ecol.* 69: 473-498.

Walker, H.F.B. 1917 *A doctor's diary in Damaraland.* Edward Arnold, London.

Waller, R. 1988 Emutai: crisis and response in Maasailand 1883-1902. in Johnson, D.H. and Anderson, D.M. (eds.) *The ecology of survival: case studies from northeast African history.* Lester Cook Academic Publishing, London.

Walsh, F. 1996 Central Land Council, Alice Springs, Australia.

Walter, H. 1939 Grassland, Savanne und Busch der arideren Teile Afrikas in ihrer ökologischen Bedingtheit. *Jb. Wiss. Bot.* 87: 750-760.

Walter, H. 1971 *Ecology of tropical and subtropical vegetation.* Oliver and Boyd, Edinburgh.

Walter, H. 1986 The Namib Desert. in Evenari, M., Noy-Meir, I. and Goodall, D.W. (eds.) *Ecosystems of the world: 12b hot deserts and arid shrublands.* Elsevier, Amsterdam.

Wandres, C. 1909 Über das Recht der Daman und Bergdaman. *Zeitschrift für Kolonialpolitik, Kolonialrecht und Kolonialwirtschaft.* 11(9): 648-686.

Ward, D. (ed.) 1997 *Land degradation in the pro-Namib.* Report of the Summer Desertification Project (DRFN) 1996 funded by USAID and SIDA.

Warren, A. and Agnew, C. 1988 An assessment of desertification and land degradation in arid and semi-arid areas. *Drylands Paper.* 2. Drylands Programme, IIED, London.

Waters-Bayer, A. 1985 Dairying by settled Fulani women in Central Nigeria and some implications for dairy development. *Pastoral Development Network Paper.* 20c. ODI, London.

Wehmeyer, A.S. 1986 *Edible wild plants of southern Africa: data on the nutrient contents of over 300 species.* Unpublished report, Pretoria.

Wellard, G. 1987 The effect of weather on soil moisture and plant growth in the arid zone. pp. 35-49 in Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia.* Cambridge University Press, Cambridge.

Wentzel, J.J., Bothma, J. du P. and van Rooyen, N. 1991 Characteristics of the herb layer in preferred grazing areas of six herbivore species in the south-eastern Kruger National Park. *Koedoe.* 34(1): 51-59.

Werger, M.J.A. 1978a Biogeographical division of southern Africa. pp. 145-170 in Werger, M.J.A. (ed.) *Biogeography and ecology of southern Africa.* Monogr. Biol. 31. Junk: the Hague.

Werger, M.J.A. 1978b The Karoo-Namib domain. pp. 231-199 in Werger, M.J.A. (ed.) *Biogeography and ecology of southern Africa.* Monogr. Biol. 31. Junk: the Hague.

Werner, W. 1991 A brief history of dispossession in Namibia. *National Conference on Land Reform and the Land Question.* Office of the Prime Minister, Windhoek, Namibia.

West, O. 1968 The possibility of using irrigated pastures for the rehabilitation of denuded grazing areas in the Rhodesian lowveld. *Proc. Grassld Soc. sth. Afr.* 3: 95-99.

Western, D. and Finch, V. 1986 Cattle and pastoralists: survival and production in arid lands. *Human Ecol.* 14(1): 77-94.

Westoby, M., Walker, B. and Noy-Meir, I. 1989 Opportunistic management for rangelands not at equilibrium. *J. Range Mgmt.* 42: 266-274.

White, F. 1983 *The vegetation of Africa. A descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa.* UNESCO, Paris.

White, R. 1992 *Livestock development and pastoral production on communal rangeland in Botswana.* Case study presented at workshop: new directions in African range management policy, Matopos, Zimbabwe, 13-17th January 1992, Commonwealth Secretariat.

Whitehead, A. 1990 Food crisis and gender conflict in the African countryside. pp. 54-67 in Berstein, H., Crow, B., Mackintosh, M. and Martin, C. (eds.) *The food question.* Earthscan Publications Ltd, London.

Whitford, W.G. 1978 Structure and seasonal activity of Chihuahuan Desert ant communities. *Insectes Sociaux.* 25: 79-88.

Wiens, J. 1984 On understanding a nonequilibrium world: myth and reality in community patterns and processes. pp. 439-457 in Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence.* Princeton University Press, Princeton.

Wild, R.G. and Mutebi, J. 1996 Conservation through community use of plant resources: establishing collaborative management at Bwindi Impenetrable and Mgahinga Gorilla National Parks, Uganda. *People and Plants Working Paper.* 5. People and Plants Initiative, Division of Ecological Sciences, UNESCO.

Williamson, J. 1956 *Useful plants of Malawi.* Government Printer, Zomba.

Wilmsen, E. 1989 *Land filled with flies: political economy of the Kalahari.* University of Chicago Press, Chicago.

Wilson, E.O. 1971 *The insect societies.* Belknap, Cambridge, Massachausetts.

Wilson, E.O. and Hölldobler, B. 1990 *The ants.* Springer, Berlin.

Wolf, A. 1983 Simplicity and universality in the transition to chaos. *Nature.* 305: 182-183.

Wolters, S. (ed.) 1994 *Proceedings of Namibia's national workshop to combat desertification. D*RFN, Windhoek.

WRAU 1992 *Drought Committee Report.* Welwitschia Regional Agricultural Union, 16th April 1992.

Yeaton 1990 *J. Arid Environm.* 18: 343-349.

Yellen, J.E. 1984 The integration of herding into prehistoric hunting and gathering economies. pp. 53-64 in Hall, M., Avery, G., Avery, D.M., Wilson, M.L. and Humphreys, A.J.B. (eds.) *Frontiers: southern African archaeology today.* Cambridge Monographs in African Archaeology 10, BAR International Series 207.

Appendices

- **Appendix 1.** List of Namibian plant species and families referred to in the text. Nomenclatural authorities follow NBRI (1996; see also Kolberg *et al*, 1992). Families and species are listed in alphabetical order for ease of reference. Naturalised species are marked with an asterix.

ACANTHACEAE

Ecbolium clarkei Hiern

Justicia platysepala (S.Moore) P.G.Mey.

Monechma cleomoides (S.Moore) C.B.Clarke

M. divaricatum (Nees) C.B.Clarke

M. genistifolium (Engl.) C.B.Clarke

M. australe (P.G.Mey.) Munday

M. genistifolium

Petalidium bracteatum Oberm.

P. *variabile* (Engl.) C.B.Clarke

AIZOACEAE

Gisekia africana (Lour.) Kuntze *africana*

Trianthema triquetra Rottler ex Willd.

AMARANTHACEAE

Amaranthus spp. L.

Calicorema capitata (Moq.) Hook. f.

Leucosphaera bainesii (Hook. f.) Gilg

APIACEAE

Phlyctidocarpa Cannon & Theobald

ARECACEAE

Hyphaene petersiana Klotzsch

ASCLEPIADACEAE

Hoodia cf. *currori* (Hook.) Decne. *currori*

Orthanthera albida Schinz

ASPHODELACEAE

Aloe spp. L.

ASTERACEAE

Antiphiona fragrans (Merxm.) Merxm.

Dicoma tomentosa Cass.

Geigeria alata (DC.) Benth. & Hook.f. ex Oliv. & Hiern

G. ornativa O. Hoffm. *Ornativa*

Helichrysum sp. Mill.

Pechuel-loeschea leubnitziae (Kuntze) O.Hoffm.

BALANITACEAE

Balanites welwitschii (Tiegh.) Exell & Mendonça

BIGNONIACEAE

Catophractes alexandri D.Don

BORAGINACEAE

Cordia gharaf (Forsskal) Ehrenb. ex Asch. (synonymous with *C. sinensis* Lam.)

Heliotropium cf. *hereroense* Schinz

Heliotropium sp. L.

BURSERACEAE

Commiphora anacardifolia Dinter & Engl.

C. cf. *glandulosa* Schinz

C. giessii J.J.A.van der Walt

C. glaucescens Engl.

C. krauseliana Heine

C. multijuga (Hiern) K.Schum

C. pyracanthoides/merkeri Engl.

C. saxicola Engl.

C. virgata Engl.

C. wildii Merxm.

CAPPARACEAE

Boscia albitrunca (Burch.) Gilg & Benedict

B. foetida Schinz *foetida*

Cadaba schroeppeli Suess.

Maerua juncea Pax *juncea*

M. schinzii Pax

COMBRETACEAE

Combretum apiculatum Sond. *apiculatum* Exell

C. imberbe Wawra

C. wattii Exell

Terminalia prunioides C.Lawson

CONVOLVULACEAE

Ipomea cf. *obscura* (L.) Ker.Gawl.

CUCURBITACEAE

Acanthosicyos horridus Welw. ex Hook.f.

Cucumis africanus L.F.

CYPERACEAE

Cyperus spp. L.

EBENACEAE

Euclea pseudebenus E.Mey. ex A. DC.

EUPHORBIACEAE

Chamaesyce glanduligera (Pax) Koutnik

C. inaequilatera (Sond.) Sojak

Croton gratissimus Burch. *Gratissimus*

Euphorbia guerichiana Pax

E. virosa Willd.

Ricinodendron rautanenii Schinz

*Ricinus communis** L.

Spirostachys africana Sond.

FABACEAE

Acacia cf. *erubescens/fleckii*

A. erioloba E.Mey.

A. fleckii Schinz

A. karroo Hayne

A. mellifera (Vahl) Benth *detinens* (Burch.) Brenan

A. montis-usti Merxm.& A.Schreib.

A. reficiens Wawra *reficiens*

A. robynsiana Merxm. & A.Schreib.

A. senegal (L.) Willd.

A. rostrata Brenan *tortilis* (Forssk.) Hayne *heteracantha* (Burch.) Brenan

Adenolobus garipensis (E. Mey.) Torre & Hillc.

A. pechuelii (Kuntze) Torre & Hillc.

Caeselpinia rubra (Engl.) Brenan

Colophospermum mopane (Kirk ex Benth.) Kirk ex J.Léonard

Cullen obtusifolia (DC.) C.H.Stirt.

Faidherbia albida (Delile) A.Chev.

Indigofera sp. L.

Mundulea sericea (Willd.) A. Chev.

*Prosopis glandulosa** Torr.

Rhynchosia sp. Lour.

Senna obtusifolia (L.) Irwin & Barneby

Sesbania cf. *sphaerosperma* Welw

GERANIACEAE

Monsonia senegalensis Guill. & Perr.

M. umbellata Harv.

LAMIACEAE

Acrotome sp. Benth.

Hemizygia floccosa Launert

LAMINARIACEAE

Laminaria schinzii Foslie

LORANTHACEAE

Plicosepalus kalachariensis (Schinz) Danser

MALVACEAE

Gossypium anomalum Wawra ex Wawra & Peyr. *Anomalum*

MORACEAE

Ficus sycomorus L.

MORINGACEAE

Moringa ovalifolia Dinter & A.Berger

MYROTHAMNACEAE

Myrothamnus flabellifolius Welw.

NYCTAGINACEAE

Boerhavia cf. *hereroensis/diffusa*

OLACACEAE

Ximenia americana L. *microphylla* var *microphylla* Welw. ex Oliv.

PEDALIACEAE

Harpagophytum procumbens (Burch.) DC. ex Meisn. *Procumbens*

Sesamothamnus guerichii (Engl.) E.A.Bruce

Sesamum rigidum Peyr. cf. *merenskyanum* Ihlenf. & Seidenst.

PERIPLOCACEAE

Curroria decidua Planch. ex Hook.f. & Benth.

POACEAE

Aristida adscensionis L.

A. cf. *effusa* Henrard *rhiniochloa* Hochst.

A. stipitata Hack.

Bothriochloa insculpta (A.Rich.) A.Camus

Cenchrus ciliaris L.

Chloris virgata Sw.

Dactyloctenium aegyptium (L.) Willd.

Danthoniopsis dinteri (Pilg.) C.E.Hubb.

D. ramosa (Stapf) Clayton

Digitaria eriantha Steud.

Enneapogon cenchroides (Roem. & Schult.) C.E.Hubb.

E. desvauxii Beauv.

Eragrostis cf. *annulata* Rendle ex Scott-Elliot

E. cf. *cylindriflora* Hochst.

E. echinochloidea Stapf

E. lehmanniana Nees

E. nindensis Ficalho & Hiern

E. superba Peyr.

E. trichophora Coss. & Durand

Heteropogon contortus (L.) Roem. & Schult.

Kaokochloa nigrirostris de Winter

Monelytrum luederitzianum Hack.

Panicum sp. L.

Schmidtia Steud. ex J.A.Schmidt

Setaria finita Launert

S. incrassata (Hochst.) Hack.

S. verticillata (L.) Beauv.

Sporobolus fimbriatus (Trin.) Nees

Stipagrostis cf. *damarensis* (Mez) De Winter

S. ciliata (Desf.) De Winter

S. gonatostachys (Pilg.) De Winter

S. hirtigluma (Trin. & Rupr.) De Winter *hirtigluma*

S. cf. *hirtigluma* (Trin. & Rupr.) De Winter *patula* (Hack.) De Winter

S. cf. *hochstetterana* (L.C.Beck ex Hack.) De Winter *secalina* (Henr.) De Winter

S. cf. *uniplumis* (Licht.) De Winter

S. obtusa (Delile) Nees

Themedra triandra Forrsk.

Tragus berteronianus Schult.

T. racemosus (L.) All.

Triraphis purpurea Hack.

Urochloa brachyura (Hack.) Stapf

PORTULACACEAE

Ceraria longipedunculata Merxm. & Podlech

RHAMNACEAE

Berchemia discolor (Klotzsch) Hemsl.

Ziziphus mucronata Willd.

RUBIACEAE

Amphiasma merenskyanum Bremek.

RUTACEAE

Thamnosma africana Engl.

Zanthoxylum ovatifoliolatum (Engl.) Finkelstein

SALVADORACEAE

Salvadora persica L.

SOLANACEAE

*Datura innoxia** Mill.

Lycium sp. L.

STERCULIACEAE

Hermannia modesta (Ehrenb.) Mast.

H. tigrensis Hochst. ex A.Rich.

Sterculia africana (Lour.) Fiori

TAMARICACEAE

Tamarix usneoides E.Mey. ex Bunge

TILIACEAE

Grewia bicolor C.Juss.

G. cf. *flava* DC.

G. tenax (Forssk.) Fiori

G. villosa Willd.

WELWITSCHIACEAE

Welwitschia mirabilis Hook. F.

ZYGOPHYLLACEAE

Tribulis terrestris L.

Zygophyllum simplex L.

- **Appendix 2.** Species recognised and used as 'sâi' or perfume by Damara women in north-west Namibia. The families and species are listed alphabetically. The variety of names recorded for several species reflects dialectical differences between Damara groupings associated prior to the colonial era with particular geographic areas of western and central Namibia.

ASTERACEAE

Antiphiona fragrans (Merxm.) Merxm.
!âusâ, **!âuhai.b**; **doeba!oa.b**, **doeba-oa-sâi**; **doeba!oahe** (in Van den Eynden *et al*, 1992: 64)
The dried ground leaves are used as a fragrant body powder in Sesfontein (see also Van den Eynden *et al*, 1992: 64) and along the Ugab River. It is a **sâi** plant but some Damara record that it is only used for medicinal purposes such as inhaling its strong smell to clear headaches and sinuses or consuming an extraction from the plant to treat chest pains and coughing.

Geigeria acaulis Benth. & Hook. F. ex Oliver & Hiern
|homexare; **‖habi.s**; **|game**; **≠oa.s** which means 'wind' and describes the fact that you can smell the **sâi** or perfume of this plant when the wind blows; *Geigeria* sp. is referred to as **!khoe ‖hawu** by the Nama (du Pisani, 1983: 8)
This species is slightly aromatic and the flowers can be used as **sâi**.

Geigeria alata (DC.) Benth. & Hook. F. ex Oliver & Hiern
|game or **tarare** (i.e. female) **|game**; **≠oa** (see *G. acaulis*)
The flowers are used for **sâi**.

Geigeria ornativa O. Hoffm.
|game or **dani** (i.e. honey) **|game**; **≠oa** (see *G. acaulis*); **≠gakarube**
This is considered a **sâi** plant throughout former Damaraland.

Helichrysum roseo-niveum Marloth & O. Hoffm.
!abi.s, !abise
Is considered a **sâi** plant.

Helichrysum tomentosulum (Klatt) Merxm. *aromaticum* (Dinter) Merxm.
!uru sâ.i, **!uru**; **!urue.b** (in Van den Eynden *et al*, 1992: 65)
The dry leaves and stem are used as **sâi** or perfume (see also Van den Eynden *et al*, 1992: 65).

Osteospermum microcarpum (Harvey) Norlindh *septentrionale* (Norlindh) Norlindh
saitsi≠ane (i.e. **sai** means 'it scratches', **tsi** means 'and', and **≠ane** is a 'red rash', i.e. this a scratchy plant); **≠hauta≠aebe** (**≠hauta** = always, **≠ae** = sticks)
Is a **sâi** plant.

Pechuel-loeschea leubnitziae (Kuntze) O. Hoffm.
known throughout former Damaraland as **autsi!khanne.b** (see also Eiseb *et al*, 1991: 18, 28; Van den Eynden *et al*, 1992: 28); Eiseb *et al* (1991: 18, 28) also record **auxan!khaa.b** as the Nama name and **au!khanne.b** or **ezimba.b** as Hai||om names for this species
The flowers are used in **sâi** although some Damara informants in settlements on the Ugab River do not consider it a **sâi** plant because it has a bitter smell.

BURSERACEAE

Commiphora giessii Van der Walt
ao-|âna.b, **ao-âna.b** (i.e. is considered a male (**ao**) or large form of *C. virgata* with which it shares similarities in appearance); **|aoa.b** (Van den Eynden *et al*, 1992: 67)
The seeds are used for **sâi**.

Commiphora glaucescens Engl.
|huu.b/s; **|awa-** (i.e. 'red') **|huu.b**; **ba-hai.s**; the sweet-smelling dried, rotten wood from this and other old trees is called **≠gae** or **≠ae.i**; the soft (**tsaura**) wood from inside **|huu.s** is called **mûnu**
The dried rotten wood called **≠gae** has a sweet aromatic scent and is used as a body perfume and baby powder particularly for boys. Van den Eynden *et al* (1992: 54, 86) also report this use, as well as of the powdery softwood known as **|ora.i**, for an unidentified species called **|hu.s**). Van den Eynden *et al* (1992: 86) report that the aromatic gum is mixed with oil or animal fat and used as a body perfume, but it is probable that this actually describes the use of resin from **herare**, i.e. *C. wildii*.

Commiphora multijuga (Hiern) Schumann
known throughout former Damaraland as **!gâua.b**; **tsans** also recorded along the Ugab River
The bark is used for perfume, either on its own or mixed with other aromatic plant substances. The gum is blended with animal fat as a fragrant body cosmetic used by Himba women in Kaokoveld among whom the name of this species, omuzumba, means 'perfume' (Malan and Owen-Smith, 1974: 152).

Commiphora virgata Engl.
|âna.s/n (recorded throughout former Damaraland and as *C. krauseliana* by Van den Eynden *et al*, 1992: 67); also called **anto.b** and **soba**
The bark and gum are used as **sâi** and often mixed with other **sâi** plants. The powdered bark is also used as body perfume by the Himba, particularly by women (Malan and Owen-Smith, 1974).

Commiphora wildii Merxm.
herare; **anto.b**; **tine.b/s**
The aromatic **haira** or gum of **herare** is pound into a powder and added as a **sâi** or perfume to animal fat (**≠gîna**) or bought lotions such as vaseline.

Commiphora sp.
!uri (i.e. white) **|huu.s**
This species is not as aromatic as *G. glaucescens* (i.e. **|awa- |huu.b/s**) but the rotting wood is considered to be **≠gae** and is used as **sâi**.

CAPPARACEAE

Cleome foliosa Hook F. *foliosa*
saida.b; **!khauro.b**; **sanana.b**; **≠hobo≠hobo**, **!hunihai.b** (**!huni** = yellow, i.e. the colour of the flowers); **sâhai.b** (**sâ** = perfume)
Can be used for **sâi** by drying and crushing the whole plant into a powder.

CYPERACEAE

Cyperus sp.
The bulbs/corms are called **!hare.s** and described as *C. rotundus* L. in Van den Eynden *et al*, 1992: 72); **|arebe.s** is used in dialects from further south (**|are.s** refers *to C. rotundus* in Eiseb *et al*, 1991: 26); the plant is considered a **|hom |ga.b** (**|ga.b** = a generic term for grasses) i.e. it forms a dense mat or lawn.
The corms are ground into a powder and used as **sâi** (also in Van den Eynden *et al*, 1992: 72) and are used as aromatic beads, necklaces of which may be sold. The aromatic roots of *C. longus* var. *tenuiflorus*, a large sedge found on the banks of the Kunene river, are plaited into necklaces by Himba women (Malan and Owen-Smith, 1974: 155: 156). A large root recorded as ondao or **!hare.s** is collected with other aromatic plants from the Kunene River by Herero women some of whom travel from Sesfontein, several hundred kms to the south, and return with these items for trading purposes.

EUPHORBIACEAE

Croton gratissimus Burchell *gratissimus*
!abubue, **!abubuse.b**; **(!)apupuue.b/s**, **(!)apu(ga)kuue.b/s**, **(!)apu(pe).b**, and the Hai//om **!apuro.b** recorded in Eiseb *et al* (1991: 22, 26); **‖game.b**
The roots and bark are dried and ground into a powder for use as **sâi**.

Spirostachys africana Sonder
âui.b and **âu-hai**; **âu-i.b** (Eiseb *et al*, 1991: 18, 29); **âui.b**, **âaue.b** (Van den Eynden *et al*, 1992: 54, 86); **oui.b** (Steyn and du Pisani, 1984/1985: 47)
The aromatic wood is made into beads (see also Van den Eynden *et al*, 1992: 86) which are often bought from Himba from Kaokoveld (who call them otupapa cf. Malan and Owen-Smith, 1974: 156). Pieces of the wood are burned as incense to bring a fragrant smell to the house or under clothes to perfume them. As such, it is known as a **|î-sâi**. The aromatic sap is described as having 'Damara power' which is why the wearing of beads from this wood is so popular.

FABACEAE

Acacia erioloba E. Meyer
‖gana.b/s (recorded throughout former Damaraland and among the Nama in du Pisani, 1983: 4; see also Eiseb *et al* 1991: 21, 25)
≠gae, i.e. fragrant rotten wood, from this tree is rubbed into rashes. A powder-like substance known as **'!hub'** is collected from between the stem and bark of rotten tree trunks and used as a cosmetic by women after mixing with animal fat (Schultze, 1907: 210; du Pisani, 1983: 3-4). This is possibly the same as **'!ub'** recorded as a powder from an unidentified species used as perfume in Van den Eynden *et al* (1992: 55). Schmidt (1986: 339) also records that among the Bondelswarts Nama of Warmbad, a root powder called **'!gu |gai'** was burnt for luck and,

because of its pleasant aroma, was frequently used as body perfume instead of buchu.

Acacia montis-usti Merxm.& A. Schreiber
nu-haib; **!ari.b**; **aru**
This is a **sâi** plant.

Acacia reficiens Wawra *reficiens*
!gû.b/s; **!guu.b/s** (Eiseb *et al*, 1991: 23, 25); **!go.s**; **!noe.s**
The seeds are used for **sâi**. **≠Gae**, i.e. aromatic dead wood, can be taken from this tree.

Adenolobus pechuelii (Kuntze) Torre & Hill C.
âi-hai.b (**âi** = liver); **aihai.b** referred to but unidentified in Van den Eynden *et al* (1992: 85) and its uses indicate that it is *A. pechuelii*; **dani |gamdi |a.b** (dani = honey)
The powdered bark is used as **sâi**.

Colophospermum mopane (Kirk ex Benth.) Kirk ex Leonard
known throughout the former Damaraland as **tsaurahai.b/s** (see also Eiseb *et al*, 1991: 21, 26; Van den Eynden *et al*, 1992: 68); **‖gai** (see also Eiseb *et al*, 1991: 21, 26); **!oeni.s** (Eiseb *et al*, 1991: 21, 26)
The ground pods of this species are used for **sâi**. **≠Gae** (aromatic rotten wood) can come from this species.

GERANIACEAE

Monsonia senegalensis Guill. & Perr.
surube bosu.i; **‖nurabe.s** (plant and seeds, i.e. **bosu.i**) and **gai** or large **bosu.i**; considered to be the male **raba.b** and **aore** (male) **bosui**; **raba** is recorded among the Nama in du Pisani (1983: 10); the plant and seeds are also called **‖nora**
Is considered a **sâi** or perfume plant.

Monsonia umbellata Harvey
Throughout Damaraland the seeds (and plant) are referred to as **bosu.i** or specifically **≠khari bosu.i**; **raba.b** is the name of the plant and this species is described as the female **(tarare) raba.b** due to its small size; Nama called it **raba** (du Pisani, 1983: 10) and Eiseb *et al* (1991: 19, 28) record the name **'harapa.b'** for *Monsonia* spp.; According to Rust (*in* du Pisani, 1983: 10) the Nama call the edible seeds which are collected from harvester ant nests **‖kuni.b**, the act of gathering as **'‖kunire'** and the orange seed from which the seed coat has been removed **'tsama.n'**. Van den Eynden *et al* (1992: 74) report that *Monsonia* sp. is called **harapab** or **rabab**, the seeds as **bosu.i** and the unripe seeds as **surube**.
M. umbellata is aromatic, and considered a **sâi** plant.

LAMIACEAE

Hemizygia floccosa Launert
|hai-hai.s (grey-plant), **≠hauta≠aebe**
The leaves and roots are collected, dried and pound into a powder for use as body perfume (also described in Steyn and du Pisani (1984/1985: 44) who refer to the perfume as **'saa.b'**).

LICHENES

Parmelia hottentotta (Thunb.) Ach.
|ui‖khao.b
Ground into a powder which is used by ≠Aonin along the !Kuiseb and in Sesfontein as a deodorant and perfume (Van den Eynden *et al*, 1992: 22, 61).

MORINGACEAE

Moringa ovalifolia Dinter & Berger
!khoe≠hanu.s; **sâi.s**; **!khoe≠khanu.s** and **‖khao.s** (in Eiseb *et al*, 1991: 22-23, 28)
The powdered bark is added to **sâi**.

PERIPLOCACEAE

Curroria decidua Planchon ex Hook. F. Benth.
|girihai.b (**|giri** means 'jackal', i.e. jackal plant; **|gaire** (jackal) **hai.b**; **≠hobo≠hobo.b**, the name referring to the taking or sucking of nectar by bees from its flowers; **girihai-i** (du Pisani, 1983: 7); **|hini.s** (Eiseb *et al*, 1991: 20, 26); **arihai.b** and **|hini.s** in Van den Eynden *et al* (1992: 78) who also refer to an unidentified plant called **|girehai.b** (p. 54) by the Kuiseb Topnaar whose medicinal uses indicate that it could be *C. decidua*; **pirihai.s** (**piri.n** = goats)
The bark can be used for **sâi**.

RUBIACEAE

Gardenia volkensii Schumann *spathulifolia* (Stapf & Hutch.) Verdc.
The fruit husks and kernels are collected by Himba and Herero women from the north of Kunene Region and traded throughout Kaokoveld and in Sesfontein for use as a body perfume. Herero women may travel from Sesfontein as far as the Kunene River to collect this and other perfume plants to trade within Sesfontein. The use of the bark and pips for body powder is also recorded in Malan and Owen-Smith (1974: 162).

RUTACEAE

Thamnosa africana Engl.
≠(k)hana.b (see also Van den Eynden *et al*, 1992: 81); **≠gana**, used by the Nama (du Pisani, 1983: 12); Eiseb *et al* (1991: 24, 27) records the name **≠khana.b** (and **≠khona.b**) for *Gnidia polycephala*, Thymelaceae
Is considered a **sâi** plant. The powdered plant parts of this species are often mixed with ground pods from *Colophospermum mopane*, Fabaceae. In Kaokoveld the roots and flowers are reported as ground into a neck perfume called otjizumba (Malan and Owen-Smith, 1974: 162).

Zanthoxylum ovatifoliolatum (Engl.) Finkelstein
nokoma, **ǀnoboheda**, **pepahai.s** (see also Van den Eynden *et al*, 1992: 81)
The dried fruits and seeds are ground into a body perfume, usually gained through trade with Himba from Kaokoveld (see also Malan and Owen-Smith, 1974: 162).

SCROPHULARIACEAE

Aptosimum angustifolium/lineare
ǀgame, **ǀgamero.s**, or specifically **tarare ǀgame**, i.e. female-**ǀgame**; **≠oa**
Described as smelling like **sâi**.

Aptosimum sp.
≠oa.s; **ǀgom-ǀgom**; **ǁgau ǀgora.s** (**ǁgau** = 'home', **ǀgora.s** = 'divide/separate')
Is a **sâi** plant.

STERCULIACEAE

Sterculia africana (Lour.) Fiori
hoe hanu, **!hoe.b**, **!khoe-hanu**, **khoenu**, **kaihai.s** (big tree) and **ǁkhaio** for the seeds and **koaro.s** for the fruit; **!uina.s** (see also du Pisani, 1983: 14); **huina** (Van den Eynden *et al*, 1992: 83); **≠guuge-amme.s**, **≠gauga-amme.s** (Eiseb *et al*, 1991: 29)
Is a **ǀî-sâi**, i.e. the bark is burnt for its aroma. **≠Gae**, i.e. aromatic rotten wood, comes from this tree.

Unidentified species

sâhetama ǀaubed, (**sâ** meaning perfume); **ǀgaube.b**; possibly the same as **ǀgâube.b** or **ǁgamme.b** recorded as the aromatic herb *Ocimum canum*, Lamiaceae by Eiseb *et al* (1991: 20, 21, 28).
The plant parts of **ǀgaubeb** are used or making perfume or **sâi**.

≠gama-hairogu, i.e. brown-plant
The fragrant roots of this plant are collected by Himba/Herero women, who call it okalui, from the Kunene River and traded in Sesfontein for perfume or **sâi**.

Additional aromatic plants recorded as used for perfume by the Himba of Kaokoveld to the north of the study area which, through trade, are likely to find their way into perfumes used by Damara women further south, are *Mikania sagittifera* Robinson, *Nicolasia felicioides* (Hiern) S. Moore and *Rennera limnophila* Merxm., all members of the Asteraceae family (Malan and Owen-Smith, 1974: 151).

- **Appendix 3.** Additional case study information, including migration histories, for the former commercial farms of southern Damaraland. Recorded in primarily October 1995.

1) Blaauport (≠Nu-!nabes) and Blaauport-pos (Dimab)

Like many of the former commercial farms in Damaraland, Blaauport is named after its previous European owner, Mr Andries Blaau. In the redistribution of these farms Blaauport was allocated to three brothers of a Nama/Damara-speaking family, Johannes, Gottard and Wilfred. Prior to this in 1971, this family from the old Fransfontein Reserve, had moved their livestock to new State-funded water installations at Springbokvlakte in the south of the Reserve near Khorixas. Due to overcrowding at Springbokvlakte, however, these brothers had actively been seeking an appropriate farm on which to have more exclusive rights for farming their livestock. After observing Blaauport Farm and hearing that no one had yet laid claim to it since the departure of Andries Blaau, they lodged their application to the appropriate Authorities at Khorixas (then Welwitschia) for permission to occupy the farm, and eventually moved there in November 1972.

At first the old farmhouse was divided between Gottard and Wilfred and their families, with Johannes building a separate house for his family some distance away. When Wilfred died in 1986 his wife Alfreda built a separate house approximately 150m away from the farmhouse where she currently lives with her new partner. Today the family's livestock wealth is spread relatively widely throughout southern Kunene Region. Apart from Blaauport the family retains official rights to several farms: Johannes, who became a very wealthy herder, bought the commercial farm of Blydskap near Kamanjab in Outjo District in 1992; Evelina, Gottard's sister, has cattle at Spitzkop pos near Fransfontein where they are herded by a labourer; Gottard's niece, Carolina and her husband who works as an electrician in Khorixas, have livestock at Moria Farm east of the Grootberg area; and Gottard and Anna-Marie's second and fourth living sons have livestock at Welkom Farm. This list is not exhaustive and the family may well have links elsewhere. In addition, Alfreda's elder children have herds elsewhere in former Damaraland. Alfreda's fourth child, Paulina, for example, who works at Welwitschia Junior School hostel in Khorixas, keeps goats at her sister-in-law's mother's farm (Anker in the north-east of the former 'homeland') where her elder brother works as herder.

Current occupiers and their herds

There are three households at Blaauport and one at Blaauport-pos:

1) The old farmhouse is inhabited by Gottard, his wife Anna-Marie, and a labourer Johannes, the 21-year-old nephew of Gottard who has been responsible for the day to day care of Gottard's livestock for 15 months. Various grand-children also spend periods of time in the care of Anna-Marie; in October 1995, the three-year-old daughter of Anna-Marie and Gottard's second living son, the five-year-old daughter of their fourth son, and the one-year-old great, great grand-son of Gottard's sister, were all staying at Blaauport. Gottard and Anna-Marie consider themselves to have exclusive rights, or rights of 'ownership', to the farmhouse.

Gottard has 99 cattle, roughly 200 goats, and 4 horses.

2) Alfreda, the 68 year old widow of Wilfred, lives with her partner, Oscar, and her nephew, Abraham, who is responsible for her's and Oscar's livestock. In May 1995 they were also paying a 25-year-old Herero labourer from Opuwo, to assist with herding. He disappeared in July, however, reportedly following a drunken brawl involving people at the neighbouring farm of Malansrust, and owing both Alfreda and Abraham money.

In May 1995, Alfreda and Oscar, together with Alfreda's four youngest children, had 164 goats of which 21 were pregnant and 59 were lambs. Oscar also had 7 cattle, of which 3 were adult cows, 2 were males and 2 were female calves. These are herded with Gottard's cattle. They also had 3 donkeys and kept chickens.

3) The third household consists of a family of relatively recent arrivals to Blaauport itself, although the female side of the family has long lived at Blaauport-pos (Dimab) and are considered to be part of the Dâureb[1] Damara ancestral 'nation' that have long-inhabited this area. It is these people who know the old Damara name of ≠Nu-!nabes for the area currently delimited as Blaauport Farm. The core of the household are Alwina Tanises (*née* !Gaoses) and her current partner Gabriel Somaëb. Various close relatives also reside here on a temporary to semi-permanent basis. Currently these include Alwina's fifth daughter Magrietha, previously a domestic-worker in Walvis Bay, and her two pre-school age children.

---

[1] After the Damara name of Dâures for the Brandberg.

Alwina and Gabriel have a small herd of goats and keep chickens.

4) Alwina's mother and several siblings continue to reside at Blaauport-pos (Dimab).

Additional sources of income and subsistence

All three households separately cultivate small gardens, irrigated mainly by hand and producing vegetables for home consumption. A wide range of vegetable crops was observed in these gardens, including maize, carrots, water-melons, pumpkins, tomatoes, onions, chilies, cabbages, beetroot and pomegranates. The indigenous succulent plant *Hoodia* cf. *currori* (**!khobas**), whose stems are eaten with relish as a snack food, is also planted in these gardens.

Dietary surveys conducted with households at Blaauport in both May and October 1995, using 24-hour dietary recall techniques and recording intended food consumption for the day of the survey, indicated that the bulk of the diet consisted of maize with goat or cow's milk, either fresh or curdled. Goat meat is eaten occasionally. Gathered plant foods eaten during the days of these surveys included the roasted seeds of *Monsonia umbellata* (**≠khari bosui**) and the fruits of *Euclea pseudebenus* (**tsawib**), *Cordia gharaf* (**‖khos**), and *Salvadora persica* (**xoris**). Wild fruits such as these were reported as often eaten by the labourers Johannes and Benjamin when in the field. The leaves and stems of *Myrothamnus flabellifolius* (**‖khootorotorosen**) was also consumed as tea by Johannes and Benjamin and by Alwina's household. In addition, both Alfreda's and Alwina's households make beer from grass seeds, largely *Stipagrostis* spp. (**sâun**), gathered from harvester ant nests. This may be consumed as a nutritious supplementary food. Alwina also distils liquor (**bâuga**) from this beer which she sells locally.

Migration history for Blaauport

1) Gottard and Anna-Marie from Fransfontein Reserve:

i. **1971**
moved to Springbokvlakte in the south of Fransfontein Reserve following the installation of State-funded water points to open up grazing and settlement opportunities in this previously sparsely populated area. After hearing that these water points were operational, they took the initiative to move; because it was on land that had remained communal throughout the commercialisation of the Damaraland area they did not have to ask permission to move from the Government authorities;

ii. **November 1972**
took up residence at Blaauport Farm after making the relevant applications to the Regional Authorities;

iii. **1980**
their cattle were moved through a Government drought-relief scheme to the eastern wetter areas (described as Tsumeb area) where they were taken care of by government labourers. They stayed in this area for approximately one year, during which time only one head of Gottard's cattle died;

iv. **1982**
the cattle were retrieved from Tsumeb area and taken by Gottard to Kromgat Farm near Fransfontein. This move was negotiated informally between Gottard and his nephew who had habitation rights to this farm. Gottard's herd was then herded with his nephew's cattle while Gottard and Anna-Marie remained at Blaauport with their goats. No monetary payment was made by Gottard in exchange for the right to 'rent' access to grazing resources at Kromgat, but his nephew would have benefitted from effective ownership over products such as milk from Gottard's cattle during this time;

v. **1984**
Gottard's cattle were returned to Blaauport after the above-average rains of 1984;

vi. ***ca.* 1987**
after two years of below-average rainfall, Gottard and Anna-Marie moved to Rockeys pos on Rockeys Farm with both their cattle and their goats. This pos was uninhabited due to problems with water availability and had previously been inhabited by Gottard's nephew prior to his move to Kromgat Farm (see above) following negotiations with the people already farming there. Both of these reasons enabled Gottard and Anna-Marie to move relatively easily to Rockeys Pos. As Gottard was working in Khorixas at this time, Anna-Marie was responsible for the bulk of the herding. To get around the problems of water availability at Rockeys pos, the larger cattle and goats would be taken to the Rockeys water point approximately 3kms away for water. Water for the young animals and the household was collected from here on foot. While they were based at Rockeys pos, Gottard and Anna-Marie locked the farmhouse at Blaauport in an effort to prevent anyone from moving in. Even so, they experienced the loss of considerable amounts of building material from the house, particularly corrugated iron from the roof;

vii. ***ca.* 1990**
Gottard and Anna-Marie returned with their livestock to Blaauport where they remained for the following 3-4 years;

viii. **November-December 1994**
when, in late 1994, it appeared that the rains would fail in the 1994/1995 season, Gottard organised the movement of his and his niece's (Carolina) cattle to Goedgenoeg Farm, south of Blaauport. This farm is not permanently occupied so was a focus for migration by farmers based further north. When they arrived at Goedgenoeg there were already two households there, belonging to a Herero farmer and to a Damara farmer who had moved from Olifantspad near Fransfontein. Gottard's nephew, Johannes, went with the cattle and was responsible for all herding tasks;

ix. **March 1995**
the cattle were returned by Johannes to Blaauport following the exceptionally good rains of early 1995. At present the availability of grazing and browse in the area is considered extremely good and Gottard has no plans for the movement of his livestock in the foreseeable future.

1a) Johannes, Gottard's brother:

i. **November 1972**
moved from Fransfontein Reserve to Blaauport Farm;

ii. **1980-1992**
it is likely that Johannes moved his livestock in a manner similar to that described for Gottard Hendriks, but as Johannes was unavailable for interview it has not been possible to reconstruct in detail this part of his migration history;

iii. **1992**
purchased the commercial farm Blydskap from its previous Afrikaans owner.

1b) Carolina, Gottard's niece:
Carolina's cattle are normally farmed at Moria Farm, east of the Grootberg. She employs Benjamin ǁHoabeb, a 38-year-old labourer originally from Nooidam near Windhoek, as a cattle-herder and he was responsible for all movements of her cattle following the drought years of the early 1990s. In May 1995 Carolina had 21 cattle herded with Gottard's herd, and a substantial goat herd which remained at Moria Farm. In addition, Benjamin, her labourer, owned several sheep and 1 cow;

i. **November-December 1994**
in response to the lack of grazing in the Grootberg area Carolina's cattle were moved with Gottard's to Goedgenoeg Farm, south of Blaauport;

ii. **March 1995**
Carolina's cattle accompanied Gottard's in their return to Blaauport Farm, following the good rains of early 1995. As she is related to Gottard, her use of grazing on 'his' farm was informally negotiated;

iii. **July 1995**
Benjamin returned with the cattle to Moria Farm.

2) Wilfred (deceased) and Alfreda:

i. **pre-1972**
moved with their livestock from Outjo area to Kaokokroon Farm, west of Khorixas, after applying to the Regional Authorities for a place to farm their livestock. During this time Wilfred was working as a brick-maker in Khorixas and Alfreda stayed at the farm;

ii. **1972**
because many people from Khorixas moved to Kaokokroon in the initial stages of implementation of the Odendaal plan, they joined Wilfred's brothers in the move to Blaauport Farm. Here they were mainly small-stock farmers with a few cattle which were herded with Gottard's. From 1972 Wilfred and Alfreda remained at Blaauport with their small stock until his death in 1986, following which she was joined by her current partner Oscar, and her nephew Abraham. Oscar's few cattle (see above) are herded with Gottard's larger herd so have probably followed the pattern of movement described above.

3) Alwina Tanises (*née* !Gaoses):

i. ***ca.* 1940s (?)**
Alwina's family moved from ≠Nu-!nabes area (i.e. Blaauport Farm) to the Ugab (!U≠gab) River in the north-west corner of the Okombahe Reserve. Alwina grew up in this area and married there. Together with her husband they had large numbers of livestock, including cattle.

ii. **1980**
After her husband died in the late 1970s their cattle were herded by her husband's brother, who was described by Alwina as not the most conscientious of herders. Some time after her husband's death

they consequently suffered severe stock theft, reportedly by Herero-speaking herders from Omatjette in the old neighbouring Reserve of Otjohorongo. She reported this incident to the police in Uis, and to the traditional councillors, both of whom declared they could do nothing because the cattle were unmarked and could not be officially identified as hers. This event led to her leaving the Ugab and joining her mother and the rest of her family who, in 1974, had moved to Blaauport-pos. Her mother's move from the Ugab had been stimulated by the opportunity, created by the redistribution of land following the Odendaal Commission, to return to her old home area. An added incentive for this move was the increased pressure on resources at the Ugab caused by the influx of the Aukeigas community in 1956, when their original home area of ǁkhaos[2] was appropriated as Daan Viljoen Game Park;

iii. **1992**
Alwina moved with her own dependants to Malansrust-pos following personal divisions between her and her siblings at Blaauport-pos;

iv. **May 1995**
due to problems with water supply at Malansrust-pos, Alwina moved with her dependants to Blaauport, following informal negotiations with Gottard at the old farmhouse.

2) Bankfontein and Bankfontein-pos 1 and 2

The pattern of settlement at Bankfontein Farm is slightly unusual, with only one household currently based at the old commercial farmhouse while the larger farm settlement has grown around one of the two farm-posts. This is due to problems with water supply at Bankfontein itself, although water availability at the more densely populated farm-post is also severely affected during drought years.

In 1974, Mr Martin Tsuseb, the elder brother of Simon Tsuseb and the cousin of Albert Tsuseb at Malansrust Farm, was given permission to farm at Bankfontein Farm. Martin's family were originally from the Khomas Hochland (|Khomas) reaches of the !Kuiseb River[3], his parents later working for commercial farmers in this area. Martin also worked a farm labourer at Ravenberg west and Ravenberg east Farms near Gross Barmen in Okahandja District. One of his stated reasons for applying for a farm in the Bantustan of Damaraland was because he was allowed to keep a maximum of only five cattle as a labourer on these farms. Before submitting his application for a farm he drove with his brother Simon to look around the farms that were available in the area near the Brandberg up to the Aba-Huab River catchment. By this time the farms further east in the Khorixas area had already been allocated to communal farmers. Martin owned cattle, goats, donkeys and horses when he moved to Bankfontein, most of which he bought at Gross Barmen with the exception of his goats which he inherited from his mother.

Martin was thus the first inhabitant of the old commercial farmhouse. He was then joined by Moses, the brother of Martin's wife, who also still farms at Bankfontein. Following problems with water availability at Bankfontein, Martin moved to Bankfontein-pos 1, where he still farms. Other farmers that arrived later in the 1970s farm at Bankfontein-pos 2.

Current occupiers and their herds

At present, there is one household at the old commercial farmhouse, one at Bankfontein-pos 1, and four at Bankfontein-pos 2.

Bankfontein farmhouse

1) Currently residing here is a 22-year-old labourer called Dawid Taku from Osona near Okahandja. He works as a herder for his uncle, Moses, the brother-in-law of the first communal farmer at Bankfontein, Martin Tsuseb. Moses is an ambulance driver who now works in Khorixas having previously worked in Okahandja. He comes by car to the farm on most weekends. Dawid has always lived with his aunt and uncle and is currently paid N$60/month as well as food rations to look after Moses' livestock.

At present Moses has 26 goats with 14 lambs, 3 donkeys and 23 chickens at Bankfontein. He and Dawid also have a small herd of cattle at Swartdam on Gainatseb Farm (see below).

Bankfontein-pos 1

2) Having been the first communal farmer at Bankfontein, and former inhabitant of the commercial farmhouse, Martin Tsuseb now lives at Bankfontein-pos 1 with his wife, his mother-in-law and his son. His herd consists of 22 cattle, roughly 40 old and 40 juvenile goats, 2 donkeys, 1 horse, 1

[2] Named after the abundant *Euphorbia virosa* in this area.
[3] At a place known as !Uri-!uwib.

mule and several chickens. One of his cows and 2 of his goats now belong to his niece as a wedding gift for her recent marriage, and these, together with her husband's 3 cattle and 20 goats, are herded with Martin's livestock.

Bankfontein-pos 2

3) Johanna and Stephanus Helongi (Damara- and Owambo-speaking Namibians respectively), together with her father, Simon, and her sister-in-law, Hendriede, approached Martin Tsuseb in 1976 with a view to moving to Bankfontein from the nearby Groenpor Farm. Following discussion, they were 'given' Bankfontein-pos 2 and moved here in the same year establishing separate households at Bankfontein-pos 2 (see below). Apart from herself and her husband, who is a roadworker and spends a considerable time away, she also prepares food for three elderly 'grandfathers': her father, who left Okonjera in Owambo as a young man and worked as a contract labourer on farms between Otavi and Outjo; her uncle Zagaria Somaeb from Groenpor Farm where she and her husband first moved when they started farming in the former Damaraland; and Zagaria's brother Max who has lived here for four years and previously worked as a builder in Kamanjab before farming at Anker. She is also currently caring for three of her brother's children and one small child of her own.

They have 46 goats with 36 young, 4 donkeys and 30 chickens.

4) Philippus Seibeb, an uncle of Johanna's, moved here in 1982 with his partner (now deceased) when he retired from work on the commercial farm of Otjidabi in Kamanjab area. He had 9 cattle when he left Otjidabi, which the farm-owners were complaining were too many to keep there. The government authorities directed him to Bankfontein as 'his family's farm'. Philippus grew up on Katjikanero Farm near Kamanjab where his family worked as labourers. He now lives on his own and cooks for himself, and is occasionally visited by his children who are in Khorixas.

Philippus has 7 cattle, 20 goats, purchased with his pension, and 15 lambs, 4 donkeys and 6 chickens.

5) Hendriede Seibes (*née* ǁHoeses) is married to Philippus Seibeb's nephew, and moved to Bankfontein-pos 2 in 1976 with Johanna and Stephanus Helongi. At present her 25-year-old son, Usiel ǁHoeses, and the 15-year-old brother of Usiel's girlfriend, Emmanuel Somaeb, stay with Hendriede and help with herding tasks.

She has 42 goats with 40 young, 3 donkeys, 36 chickens and many doves.

The cattle belonging to people at Bankfontein-pos 2 are herded in an aggregate herd of roughly 90 animals.

Alternative sources of subsistence and income

Each of the three settlement locations at Bankfontein has a garden, although the garden at Bankfontein-pos 2 is defunct at present due to water shortages. Both water availability and elephant damage are major constraints to productivity at this farm. Martin Tsuseb is a pensioner and the four elderly men at Bankfontein-pos 2 are pensioners, while Moses and Stephanus are civil servants. Dawid sells semi-precious stones collected from the farm.

Migration history for Bankfontein

1) Moses:

i. ***ca.* 1985-1990**
following discussions with Martin Tsuseb, who is related to Moses' wife, Moses arranged for his livestock to be farmed at Bankfontein. He subsequently moved his livestock to Bankfontein-pos 2 where his nephew Dawid Taku helped him with herding tasks;

ii. ***ca.* 1990-present**
Moses moved his livestock to the old Bankfontein farmhouse due to problems with water availability at Bankfontein-pos 2. Although the water situation at Bankfontein-pos 2 was worse, Bankfontein had its own problems due to the dam being broken, and this had already caused Martin Tsuseb to move to Bankfontein-pos 1;

iii. **May 1995**
Moses arranged for his cattle to move to Swaartdam, a farm-post of Gainatseb Farm, because two cows were stolen in 1994, reportedly by an inhabitant of a neighbouring farm who tried to sell them at a livestock auction at Onverwag on the Ugab River. They were recognised by Stephanus Helongi from Bankfontein-pos 2 and, after reporting the incident to the police, one was retrieved and the 16 remaining cattle, together with 5 cattle belonging to his nephew Dawid, were moved to Swartdam. Swartdam is where Moses' son Daniel, who is a civil servant in Khorixas, has farmed for the last six years, building on kinship-ties with family already there. Moses employs a labourer from Khorixas to

work with the cattle at Swartdam. His goats and other livestock remain at Bankfontein in the care of his nephew, Dawid Taku.

2) Martin Tsuseb:

i. **1974**
Martin moved into the Bankfontein farmhouse, following his resignation from labouring work at the Ravenberg Farms in Okahandja District;

ii. **1981**
Martin's cattle were moved with his brother Simon's to Gobabis District due to the early 1980s' drought (see notes above for Malansrust Farm);

iii. ***ca.* 1984**
Martin's cattle returned to Bankfontein;

iv. ***ca.* 1990**
Martin moved his household and livestock to Bankfontein-pos 1 due to problems with water availability at the Bankfontein farmhouse.

v. **1994**
due to the drought year's of the early 1990s Martin moved his cattle to Arbeid Adel Farm to the south-east of Bankfontein. He could see that there was good grazing there so he negotiated with the farmers (who were also originally from |Khomas area) to have access to it;

vi. ***ca.* March 1995**
the cattle returned to Bankfontein-pos.

3) Johanna and Stephanus Helongi, and the movements of the aggregate cattle herd from Bankfontein-pos 2:

i. **1975**
Johanna and Stephanus moved, with their cattle and goats, to Groenport Farm (=Groenvlei?) east of Bankfontein, where her uncle Zagaria Somaeb (her mother's brother) had lived since 1972. Before they began farming in Damaraland, Johanna was a domestic-worker on a farm in Outjo District known as |Gorab. The commercial farmers for whom they were working assisted them in their move by taking them to Khorixas and helping them apply to the relevant authorities. On seeing that Johanna's uncle, a farm-worker from Kamanjab area, had already received permission to farm at Groenpor, they were told they should move there. Previous to this, Johanna had never met her uncle. There were no other households farming at Groenpor at this time;

ii. **1976**
Johanna and Stephanus sought permission from Martin Tsuseb to move to Bankfontein because the rocky ground at Groenpor was unsuitable for livestock farming. After receiving permission to move from the appropriate government authorities, they became the first communal farmers to be based at Bankfontein-pos 2.

iii. ***ca.* early 1980s**
during the early 1980s' drought, their cattle were taken by government labourers to farms in Gobabis area. This was the first time their livestock were moved from Bankfontein since they started farming there;

iv. ***ca.* 1984**
cattle returned to Bankfontein-pos 2;

v. **1989**
again due to drought-induced lack of grazing, they organised for Stephanus' brother to take the cattle of Bankfontein-pos 2 to Oas (|Oas) Farm north of Bankfontein. This move was arranged informally through an Owambo farmer at Oas who is known to Stephanus. Johanna and Stephanus remained at Bankfontein-pos 2 to look after the goats;

vi. **1991**
the cattle were returned to Bankfontein-pos 2;

vii. **1994**
they moved the cattle of Bankfontein-pos 2 to Versteendewoud Farm where the government was distributing drought fodder and food aid. They remained here for roughly 4 months;

viii. **late 1994**
returned to Bankfontein-pos 2.

5) Hendriede Seibes
Hendriede accompanied Johanna and Stephanus in their move to Groenport and from Groenport

to Bankfontein-pos 2, and in later years her cattle have been herded with theirs. Her migration history will therefore not be related separately here.

4) Rietkuil (!Haoberos[4]) and Rietkuil-pos

A description of the current inhabitants of Rietkuil Farm and their livestock appears as Case Study 4.1 in Chapter 4 so only households inhabiting Rietkuil-pos are described here. The migration histories constructed for all of the farm's households are presented in this Appendix.

Rietkuil-pos

7) Emmanuel, who originally worked for the Omaruru municipality, received a permit to farm at Rietkuil-pos and has been here since the redistribution of land following Odendaal. Currently living with him are his mother, Fillipyne, his nephew, Gotlod, who has worked for Emmanuel for twelve years, a second labourer, Isaskar, and Emmanuel's brother's two children who are cared for by Fillipyne, their grand-mother.

Emmanuel has two goat kraals and keeps regular written notes on the status of his herd. In October 1995 he had a total of 130 mature goats with 37 lambs, as well as 2 cows, 1 donkey, and a number of chickens.

8) Willy, Emmanuel's son who works for Water Affairs in Khorixas, has his own house and kraal at Rietkuil-pos. His relative, Johannes, has been here since 1990 to herd Willy's livestock, together with Willy's wife's sister, Cornelia Somaes, and her son. Willy currently has 93 goats with 13 lambs, 1 cow and her calf, 2 donkeys and 10 chickens.

Migration history for Rietkuil

1) Justine Haraës (*née* !Nawases):

i. **pre-1982**
when Justine and her husband lived in Fransfontein and Khorixas their livestock were in the care of her mother at Smalruggens Farm, north of the Fransfontein Reserve;

ii. **1982**
Justine and her livestock moved from Smalruggens Farm to Rietkuil;

iii. **post-1982**
even though Justine wanted to move her livestock to other farms in drought years she has been unable to do so because of a lack of labour. She has suffered livestock losses as a consequence. Her livestock 'Owner's Record Card' indicates that her goat herd fell dramatically from 24 with 11 lambs in 1985/86 to only 4 in 1990, although her cattle showed increases from 4 with 3 calves to 19 with 12 calves in the same time period.

5) Alberta:

i. **1992**
due to the early 1990s' drought, Alberta moved her 6 cattle to be farmed near the Huab River. Unfortunately 5 of these animals died;

ii. **December 1994**
her remaining cow was returned to Rietkuil.

6) Kale and Magdalena:
On hearing that Justine was alone at Rietkuil Kale, Justine's brother-in-law, moved there with his livestock to join her.

i. **1992**
moved to Rietkuil, probably from Fransfontein area;

ii. **1993**
when Kale Haraëb died in 1993, his livestock were divided between family members at Fransfontein and Rotion-pos near Khorixas.

7) and 8) Emmanuel and Willy at Rietkuil-pos:
It was reported that Emmanuel's and Willy's livestock have never been removed from Rietkuil-pos in response to drought. Instead, they simply graze the goats further away in the hills on the farm.

---

[4] '!Hao' reportedly refers to the significance of social interaction around the evening cooking fire.

4) Driekrone and Driekrone-pos

Prior to Odendaal, Driekrone Farm belonged to a Mr Berger. Since then it has been uninhabited for many years due to its remote situation, and reportedly because of previous problems with elephant. In 1993, two families of Herero and Owambo herders moved here from east of Khorixas in response to drought. Driekrone-pos has been inhabited periodically in the past but there is no one currently farming there.

Current occupiers and their herds

There are two households at Driekrone, the heads of which spend varying amounts of time actually at Driekrone:

1) Wilfred has farmed his livestock here since 1993 and his household is based at the old commercial farmhouse. His wife, Tarenawa, is the half-sister of Gottlieb who farms at Malansrust, and the daughter of Tobias who is the second farmer at Driekrone. Two of Tobias' sister's grandsons also live here. Three labourers from Owambo take care of the daily herding tasks. These young men were employed by Wilfred following a trip he made to Owambo specifically to look for labourers. Two began working at Driekrone last year, while the third arrived in February 1995. Prior to these men, Wilfred employed a Kavango-speaking Namibian as a herder.

Wilfred currently has eight cows, 78 mature goats and an uncounted number of lambs, three donkeys, two horses, pigs and chickens.

2) Tobias, originally from Owambo, is head of the second household at Driekrone, based at the old commercial farmhouse. With him live his son, two Owambo-speaking labourers, and Tobias' great grandson.

Tobias has 16 cattle, 137 mature goats and 83 juvenile goats, seven donkeys and 20 chickens.

Migration history for Driekrone and Driekrone-pos

1) Wilfred and Tobias:
Wilfred and Tobias have managed their livestock together for many years.

i. ***ca.* early 1970s**
Wilfred and Tobias were farming at Lofdal Farm, west of Khorixas;

ii. ***ca.* 1980s**
they moved to Macaria Farm, south-east of Khorixas;

iii. **June 1993**
due to the early 1990s' drought, they decided to try and find a farm with better grazing for their livestock. After driving around farms in the region and seeing that Driekrone had good grazing and was unoccupied, they requested permission from the relevant authorities in Khorixas to move there. It is likely that the relationship between Wilfred's wife and Gottlieb who farms at Malansrust, also influenced their decision to look in this area.

There is currently no one occupying Driekrone-pos. This farm-post has, however, been the recipient of two herders, Ben and Leonard, in previous years:

3) Ben:

i. **1990**
moved here from Fransfontein due to the drought;

ii. **1992**
returned to Fransfontein.

4) Leonard:

i. **1994**
moved to Driekrone-pos with his large cattle herd from Outjo District due to the 1990s' drought;

ii. **1995**
returned to Outjo District following the good rains of early 1995.

- **Appendix 4.** Multivariate techniques used in floristic analysis of vegetation datasets.

TWINSPAN classification

TWINSPAN is a polythetic divisive classification technique which uses information on both species and samples (in this case, transects and quadrats) to successively divide ordinations of samples into a hierarchy of smaller and smaller groups based on indicator or strongly differential species and floristics (Hill, 1979b: i; Goldsmith et al, 1986: 494). In TWINSPAN the data are first ordinated by reciprocal averaging and the samples are divided or polarised through emphasizing the species that characterise extremes on the reciprocal averaging axes (Gauch, 1982: 201-2), and are therefore diagnostic of each level in the classification (Hill, 1979b: i).The values presented in the resulting two-way table are new values or 'pseudospecies' based on levels of abundance for each species in each sample (following the Braun-Blanquet scale), such that the synecological relations of the species are expressed as 'succinctly' as possible (Hill, 1979: 1). The amount of variance in the dataset that is accounted for by each division is represented by an eigenvalue, i.e. a number between 0 and 1 which is the fraction of the total variance in the species data that is explained by the current TWINSPAN division.

Ordination

Ordination techniques based on correspondence analysis or reciprocal averaging were used here. These assume a unimodal or Gaussian (i.e. bell-shaped) distribution for each species and simultaneously ordinate both the samples and species (Goldsmith *et al*, 1986: 507); the reduction of multi-dimensional data to a low-dimensional space (i.e. 2-3 dimensions or axes) is possible because other dimensions or axes are normally correlated with the most influential axes. The location of species and samples along these axes, therefore, is likely to reflect the underlying structure of the data (Gauch, 1982: 116). The strength of each axis in explaining the variance in the dataset is measured as an eigenvalue such that the higher the value, the more important the ordination axis (Ter Braak, 1987c: 39, 1990: 5).

Detrended Correspondence Analysis (DCA)

Detrended correspondence analysis (DCA) is a phytosociological ordination technique which constructs axes from vegetation data (Goldsmith *et al*, 1986: 504) and by using weighted averages for both samples and species facilitates assessment of the relationships between the two. The species scores which emerge from the ordination algorithm are parameters of unimodal responses, as estimated by the weighted total abundance of a species, in relation to the ordination axes (ter Braak, 1987c: 43-44) . A species score can be roughly considered, therefore, as the centre or 'optimum' of the curve for each species along these axes. DCA can be used to produce a spatial arrangement of samples and species along axes generated by the vegetation data such that their position reflects their similarity (Dudziñski and Arnold, 1973: 905; Goldsmith et al,

1986: 501-2; ter Braak, 1986: 1167). Relationships between community patterns and known environmental variables can thus be inferred to produce an ecological interpretation of community data, which can be tested using other methods. As such, DCA is an indirect gradient analysis method from which complex species-environment relationships can be explored and described in a qualitative manner (ter Braak, 1986: 1167).

Canonical Correspondence Analysis (CCA)

CCA is a constrained ordination technique developed by ter Braak and designed to directly relate sample composition to environmental variables. It is thus an extension of ordination techniques such as DCA, which extract continuous axes of variation from species abundance data which can then be interpreted indirectly in the light of data concerning known environmental variables (ter Braak, 1986: 1167). Canonical ordination such as CCA, combines both ordination and regression to produce a multivariate direct gradient analysis of the relationships between a number of species and environmental variables (ter Braak, 1986: 1167, 1987c: 1, 1988: 159). This is achieved using an iterative ordination algorithm to construct ordination axes as linear combinations of environmental variables which reveal, to the greatest possible extent, the common structure of both the samples-by-species and samples-by-environmental variables matrices (Gauch, 1982: 163; ter Braak, 1986: 1167, 1987a). Within this iterative algorithm, multiple regressions are carried out such that each time new sample scores are derived through ordination they are regressed on the environmental variables (ter Braak, 1987c: 4). The contribution of each specific environmental variable to the overall variance explained by the environmental data can be assessed statistically using forward selection of these variables.

- **Appendix 5.** Relative measures for density, basal area and dominance of (at least) the five highest ranked species by topographic category, substrate and distance from a settlement. Da/ha = density of species *a* by hectare, ba = basal area in cm^2, and dom = dominance in cm^2 (i.e. $density_a$ x $basal\ area_a$). N = the total number of plant individuals of $species_a$ in each category and R = the rank of $species_a$ for each category. Values are averages for transects in each sampling category. The five species with the highest ranks for each category are printed in bold; because the species ranks for the three measures (density, basal area and dominance) are not the same, more than five species are represented in each category and the measures for species with lower ranks included in the table where they are present in that category.

species	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R
	plains:																											
Acacia erioloba	6	0.37	9	3159.15	1	1168.89	5																					
Acacia tortilis	678	42.19	1	973.19	3	41058.89	1																					
Boscia albitrunca	6	0.37	9	1734.95	2	641.93	7																					
Boscia foetida	25	1.56	5	724.06	6	1129.53	6																					
Colophospermum mopane	385	23.96	2	921.41	4	22132.27	2																					
Maerua schinzii	48	2.99	4	732.19	5	1962.27	4																					
Salvadora persica	160	9.96	3	313.09	8	3118.35	3																					
	alluvial silts																											
Acacia tortilis	673	39.39	1	966.12	2	38655.47	1																					
Boscia albitrunca	4	0.23	9	585.16	6	134.59	7																					
Boscia foetida	21	1.23	6	675.78	4	831.19	5																					
Colophospermum mopane	43	2.52	3	2217.76	1	5588.76	2																					
Lycium sp. (SS160)	23	1.35	5	81.57	10	110.19	8																					
Maerua schinzii	38	2.22	4	873.78	3	1738.82	4																					
Pechuel-Loeschea leubnitziae	8	0.47	7	20.60	13	9.68	13																					
**Prosopis glandulosa*	1	0.59	12	607.07	5	358.17	6																					
Salvadora persica	113	6.62	2	387.76	7	2566.97	3																					
	distance (kms):																											
	0							0.5							5							10						
Acacia tortilis	235	22.29	1	1197.44	3	26690.94	1	198	59.96	1	849.35	4	50927.03	1	181	66.77	1	941.18	1	62842.59	1	59	28.45	1	513.11	5	14597.98	1
Boscia albitrunca															2	0.74	8	511.78	2	378.71	5	2	0.96	6	658.54	4	632.19	5
Boscia foetida	1	0.09	6	6.44	7	71.61	7	5	1.51	4	1097.11	3	1656.64	5	10	3.69	4	224.06	4	826.78	4	5	2.41	5	1278.70	2	3081.67	4
Colophospermum mopane	21	1.99	2	2717.18	1	5407.19	2	5	1.51	4	1735.36	1	2620.39	4	6	2.21	6	100.69	6	222.52	6	11	5.36	4	2638.34	1	13983.20	2
Lycium sp. (SS160)								9	2.73	3	163.63	6	446.71	6	14	5.16	3	28.82	9	148.71	7							
Maerua schinzii	2	0.19	5	2205.23	2	418.99	4	9	2.73	3	1664.98	2	4545.39	3	14	5.16	3	283.61	3	1453.43	3	13	6.27	3	756.74	3	4744.76	3
Pechuel-Loeschea leubnitziae	4	0.38	4	10.57	8	4.02	8	4	1.21	5					4	1.21	5											
**Prosopis glandulosa*	1	0.09	6	607.07	5	54.64	5																					
Salvadora persica	10	0.95	3	845.63	4	803.35	3	48	14.54	2	386.13	5	5614.33	2	5	11.44	2	196.15	5	2243.96	2	24	11.57	2	47.74	6	552.35	6
	sandy loams							distance (kms):																				
								0							0.5							8						
Acacia erioloba	4	3.82	5	4642.74	1	17735.27	2															4	5.72	4	4642.74	1	26556.47	2
Acacia tortilis	5	4.78	4	1925.30	3	9202.93	3								1	6.19	3	183.88	3	1138.24	3	4	5.72	4	2360.66	2	13502.98	3
Boscia albitrunca	2	1.91	6	4034.53	2	7705.95	4	2	8.34	2	4034.53	1	33647.98	2														
Boscia foetida	4	3.82	5	977.54	4	3734.20	6															4	5.72	4	977.54	4	5591.64	5
Colophospermum mopane	342	327.03	1	758.42	5	248746.59	1	118	492.16	1	739.88	2	364139.34	1	116	717.64	1	422.19	2	302980.43	1	108	154.52	1	1139.82	3	176124.99	1
Maerua juncea	1	0.96	7	6.16	8	5.91	8								1	6.19	3	6.16	4	38.13	4							
Maerua schinzii	10	9.56	3	194.16	6	1856.17	7								2	12.37	2	542.40	1	46709.49	2	8	11.45	3	107.09	6	1226.18	6
Salvadora persica	47	44.94	2	133.55	7	6001.74	5															47	67.24	2	133.55	5	8979.90	4

• Appendix 5 continued. (Da/ha = density of species *a* by hectare, ba = basal area in cm^2, dom = dominance in cm^2 (i.e. $density_a$ x $basal\ area_a$), N = the total number of plant individuals of $species_a$ in each category and R = the rank of $species_a$ for each category).

species	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R
	riverine: alluvial silts																											
Acacia erioloba	19	5.43	6	786.14	6	4268.74	6																					
Acacia tortilis	88	25.14	3	2017.07	2	**50709.14**	3																					
Boscia foetida	11	3.14	9	143.91	12	451.88	11																					
Colophospermum mopane	106	30.28	1	1692.22	3	**51240.42**	2																					
Combretum imberbe	7	1.99	11	1611.99	4	3207.86	7																					
Combretum wattii	24	6.86	5	1481.82	5	**10165.29**	4																					
Faidherbia albida	27	7.71	4	8007.11	1	**61734.82**	1																					
Maerua schinzii	10	2.86	10	660.04	8	1887.71	9																					
Pechuel-Loeschea leubnitziae	14	3.99	7	751.08	7	2996.81	8																					
Salvadora persica	105	29.99	2	148.13	12	**4442.42**	5																					
Tamarix usneoides	13	3.71	8	177.42	11	658.23	10																					
	distance (kms): 0.5							3							5							8						
Acacia erioloba								3	4.89	5	3803.31	1	**18598.19**	3	16	15.32	3	7345.42	2	**112531.83**	2							
Acacia tortilis	18	18.81	3	2015.73	3	**9458.42**	2	36	58.62	1	1658.15	3	**97200.00**	2	8	7.66	5	3944.04	3	30211.35	8	26	34.81	2	1922.05	2	**66906.56**	1
Boscia albitrunca																						1	1.34	9	249.84	6	**3680.14**	3
Boscia foetida																						11	14.73	4	143.91	6	2119.79	7
Colophospermum mopane	32	33.44	1	789.01	4	**26384.49**	3	34	55.37	2	3519.97	2	**194900.74**	1	3	2.87	7	3436.27	5	**9862.09**	5	37	5.35	1	652.42	4	**3490.45**	5
Combretum imberbe	4	4.18	8	2262.78	2	**9458.42**	4															3	4.16	7	744.28	3	3096.20	6
Combretum wattii	3	3.14	9	519.77	5	**1632.08**	5								21	20.10	2	1619.25	7	**32546.93**	3							
Faidherbia albida	7	7.32	5	5238.18	1	**38343.48**	1								15	14.36	4	9648.71	1	**138555.48**	1	5	6.69	5	6958.78	1	**46554.24**	2
Maerua schinzii	1	1.05	10	17.35	9	18.22	11	4	6.51	4	360.04	6	2343.86	6	1	0.96	8	3851.05	4	3697.01	7	4	5.35	6	322.95	5	1727.78	8
Pechuel-Loeschea leubnitziae	7	7.32	5	14.16	10	103.65	10								5	4.79	6	2070.34	6	**9916.93**	4	2	2.68	7	32.13	10	86.11	10
Salvadora persica	26	6.27	2	96.42	6	604.55	8	10	16.28	3	605.31	4	**9854.45**	4	51	48.82	1	84.59	8	4129.68	6	18	24.09	3	148.82	7	**3585.07**	4
Tamarix usneoides	10	10.45	4	63.16	7	660.02	7	3	4.89	5	558.29	5	**2730.04**	5														

- Appendix 5 continued. (Da/ha = density of species *a* by hectare, ba = basal area in cm^2, dom = dominance in cm^2 (i.e. $density_a$ x $basal\ area_a$), N = the total number of plant individuals of $species_a$ in each category and R = the rank of $species_a$ for each category).

species	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R
	mountain:																											
Adenolobus garipensis	4	1.51	20	399.42	5	603 12	12																					
Boscia albitrunca	4	1.21	21	1054.52	1	1275 97	9																					
Boscia foetida	72	21.73	3	69.25	17	1504.80	7																					
Catophractes alexandri	65	19.62	4	95 26	21	1869.00	6																					
Colophospermum mopane	128	38.64	2	695.04	2	26856.35	1																					
Commiphora anacardifolia	2	0.60	23	564.64	3	338.78	16																					
Commiphora multijuga	36	11.87	8	244.81	13	2905.89	4																					
Commiphora virgata	46	13.89	6	336.64	9	4675.93	3																					
Maerua schinzii	25	7.55	12	344.47	8	2600.75	5																					
Petalidium variabile	50	15.09	5	20.11	39	303.46	18																					
Terminalia prunioides	164	49.50	1	400.65	4	19832.18	2																					
	calcrete																											
Acacia reficiens	8	3.08	13	93.01	16	286.47	14																					
Acacia tortilis	38	14.61	5	114.44	12	1671.97	6																					
Boscia albitrunca	2	0.77	18	1854.81	1	1428.20	7																					
Boscia foetida	40	15.38	4	109.94	13	1690.88	5																					
Catophractes alexandri	23	8.85	7	42.55	19	376.57	12																					
Colophospermum mopane	58	22.31	1	1024.85	2	22864.40	1																					
Commiphora multijuga	5	1.92	16	204.64	9	392.91	10																					
Commiphora pyracanthoides	1	0.38	19	589.72	3	224.09	17																					
Commiphora saxicola	6	2.31	15	243.49	8	562.46	8																					
Commiphora virgata	35	13.46	6	403.57	4	5432.05	2																					
Commiphora wildii	3	1.15	17	294.61	7	338.80	13																					
FABACEAE	24	9.23	7	15.03	29	138.73	18																					
Heliotropium hereroensis	21	8.08	8	10.51	31	84.92	22																					
Maerua schinzii	20	7.69	9	338 98	6	2606.76	4																					
Monechma cleomoides	24	9.23	7	30.99	22	286.04	15																					
Monechma divaricatum	15	5.77	11	18 22	26	105.13	21																					
Monechma genistifolium subsp. #2	18	6.92	10	17.78	27	123.04	19																					
Petalidium variabile	50	19.23	2	20 11	25	386.72	10																					
Rynchosia sp.	12	4 62	12	9 67	32	44 68	26																					
Salvadora persica	3	1.15	17	345.85	5	397.73	9																					
Terminalia prunioides	43	16.54	3	183.75	10	3039.23	3																					
	distance (kms):																											
	0							0.5							3							5						
Acacia reficiens	4	2.87	6	100.69	8	288 98	7	1	1.00	11	12.57	13	12 57	14	1	5 39	8	198.58	4	1070 35	9	2	5.26	10	65 05	12	342 16	14
Acacia tortilis	31	22.27	2	97.68	9	2175.33	3	7	7 03	7	188.62	4	1326.00	4														
Boscia albitrunca	2	1.44	8	1854.81	1	2670.93	2																					
Boscia foetida	8	5.75	5	171.68	5	987.16	5	14	14.06	4	73.34	6	1031.16	6	4	21.59	5	23 89	11	515 79	12	14	36.82	4	135.84	6	5001.63	2
Catophractes alexandri	3	2.16	6	26.71	11	57 69	13	1	1 00	11	6.68	15	6 68	16	4	21.59	5	38.07	9	821 93	11	15	39.45	3	49.30	13	1944.89	4
Colophospermum mopane	33	23.71	1	1056.88	2	25058.62	1	25	25.1	1	982.58	1	24662.76	1														
Commiphora multijuga															2	10 79	7	236.76	2	2554.64	2	3	7.89	9	183.23	5	1445 68	9
Commiphora pyracanthoides																						1	2.63	11	589.72	1	1550 96	8
Commiphora saxicola															1	5.39	8	172.06	5	927 40	10	5	13.15	7	257.78	4	3389.81	3
Commiphora virgata															22	118.74	2	461.78	1	54831.76	1	13	34.19	5	305.06	3	10430.00	1
Commiphora wildii															1	5.39	8	227.01	3	1223 58	8	2	5.26	10	328.41	2	1727 44	6
FABACEAE															23	124.14	1	15 36	15	1906 79	6	1	2.63	11	7 55	18	19 86	18
Heliotropium hereroensis								3	3 01	9	12 34	14	37 14	12	8	43.18	4	9.49	16	409 78	13	10	26.29	6	10 78	17	283 41	15
Maerua schinzii	1	0.72	9	860.60	3	619 63	6	10	10 04	6	493.36	2	4953.33	2	4	21.59	5	96.44	8	2082.14	5	5	13.15	8	119 92	8	1576 95	7
Monechma cleomoides								2	2.01	10	4 71	16	9 47	15								22	57.85	1	33.38	14	1931.03	5
Monechma divaricatum								15	15.06	3	18.22	11	274 39	7														
Monechma genistifolium subsp. #2															18	97.15	3	17.78	14	1727 33	7							
Petalidium variabile								11	11.04	5	14.58	12	160 96	9	22	118.74	2	19 11	13	2269.12	3	17	44.70	2	24 99	15	1117 05	10
Rynchosia sp.	12	8.62	4	9 67	15	83.36	9																					
Salvadora persica								3	3 01	9	345.85	3	1041.01	5														
Terminalia prunioides	16	11.49	3	209.24	4	2404.17	4	21	21.09	2	177.99	5	3753.81	3	3	16 19	6	136.71	7	2213.33	4	3	7.89	9	135.08	7	1065 78	11

• Appendix 5 continued. (Da/ha = density of species *a* by hectare, ba = basal area in cm^2, dom = dominance in cm^2 (i.e. density$_a$ × basal area$_a$), N = the total number of plant individuals of species$_a$ in each category and R = the rank of species$_a$ for each category).

species	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R	N	Da/ha	R	ba	R	dom	R
	dolomite																											
Acanthaceae #1 (SS463)	14	19.21	8	42.95	23	825.07	12																					
Adenolobus garipensis	5	6.86	11	399.42	5	2740.02	7																					
Boscia albitrunca	2	2.74	14	254.23	10	696.59	14																					
Boscia foetida	26	5	5	161.37	13	806.85	13																					
Catophractes alexandri	42	57.63	3	124.13	14	7153.61	4																					
Ceraria longipedunculata	34	5	4	58.89	34	294.45	19																					
Colophospermum mopane	68	93.31	2	401.76	2	**37488.23**	2																					
Combretum apiculatum	17	23.33	6	213.27	11	4975.59	5																					
Commiphora anacardifolia	2	2.74	14	564.64	1	1547.11	10																					
Commiphora glaucescens	4	5.49	12	356.59	6	1957.68	9																					
Commiphora multijuga	25	34.31	5	259.25	9	**8894.87**	3																					
Commiphora pyracanthoides	8	10.98	10	285.55	8	3135.34	6																					
Commiphora saxicola	1	1.37	15	401.20	3	549.64	15																					
Curroria decidua	8	10.98	10	45.51	21	499.70	16																					
Grewia tenax	5	6.86	11	18.33	29	125.74	24																					
Heliotropium hereroensis	5	6.86	11	7.44	34	51.04	27																					
Leucosphaera bainesii	2	2.74	14	48.18	20	132.01	23																					
Maerua schinzii	5	6.86	11	366.46	5	2513.92	8																					
Sterculia africana	1	1.37	15	191.16	12	261.89	20																					
Terminalia prunioides	82	112.52	1	335.31	7	37729.08	1																					
	distance (kms):																											
	0.5							5							8							20						
Acanthaceae #1 (SS463)	4	8.5	9	7.50	18	63.75	13							10	53.42	4	57.12	8	3051.35	5								
Adenolobus garipensis	5	10.67	8	399.42	4	4261.81	5																					
Boscia albitrunca	1	2.13	12	304.84	6	649.31	11							1	5.34	8	203.61	5	1087.28	9								
Boscia foetida	14	29.87	5	262.73	7	7847.75	3	1	24.75	4	7.96	5	197.01	5	8	42.74	5	51.67	9	2208.38	6	3	34.06	7	32.05	16	1091.62	16
Catophractes alexandri	12	25.6	6	54.96	11	1406.98	9	16	396.04	1	238.63	2	94507.03	2								14	158.95	2	52.57	13	8356.00	7
Ceraria longipedunculata	23	49.07	3	56.78	10	2786.19	8															11	124.89	4	63.30	12	7905.54	8
Colophospermum mopane	25	53.33	2	715.82	1	**38174.68**	1							32	170.94	2	265.74	2	45425.60	2	11	124.89	4	83.69	9	**10452.04**	5
Combretum apiculatum	15	32	4	232.88	8	7452.16	4														2	22.71	8	66.19	11	1503.17	14
Commiphora anacardifolia																					2	22.71	8	564.64	1	**12822.97**	4
Commiphora glaucescens	4	8.5	9	356.59	5	3031.02	7																					
Commiphora multijuga	3	6.4	10	486.02	3	3110.53	6							11	58.76	3	206.53	4	12135.70	3	11	124.89	4	250.12	4	**31237.49**	1
Commiphora pyracanthoides								1	24.75	4	17.90	4	443.03	4	1	5.34	9	154.99	6	827.65	10	6	68.12	5	351.91	3	23972.11	2
Commiphora saxicola																					1	11.35	9	401.20	2	4553.62	9
Curroria decidua	1	2.13	12	4.16	20	8.86	20							7	37.39		51.42	10	1922.59	7								
Grewia tenax	1	2.13	12	8.04	16	17.13	19														4	45.41	6	20.9	18	949.07	17
Heliotropium hereroensis	1	2.13	12	10.18	17	21.68	18														4	45.41	6	6.76	22	306.97	21
Leucosphaera bainesii																					16	181.65	1	48.18	14	8751.90	6
Maerua schinzii								2	49.5	3	161.12	3	7975.44	3	3	16.03	6	503.34	1	8068.54	4						
Sterculia africana																					1	11.35	9	191.16	5	2169.67	12
Terminalia prunioides	26	55.47	1	487.28	2	27029.42	2	5	123.76	2	905.87	1	112110.47	1	39	208.33	1	223.18	3	46495.09	1	12	136.24	3	132.76	6	18087.22	3
	schist (0.5kms)																											
Acacia senegal	3	6.82	3	337.49	5	2301.68	5																					
Acacia tortilis	2	4.55	4	232.73	7	1058.92	7																					
Boscia foetida	6	13.65	2	598.74	3	8172.80	2																					
Ceraria longipedunculata	1	2.27	5	509.23	4	1155.95	6																					
Colophospermum mopane	2	4.55	4	1101.96	1	5013.92	3																					
Commiphora multijuga	6	13.65	2	218.15	8	2977.75	4																					
Commiphora virgata	1	2.27	5	336.17	6	763.11	8																					
Terminalia prunioides	39	88.71	1	777.15	2	68940.98	1																					

• **Appendix 6a and b.** Cover abundances by site for above-ground live biomass of each species, plant litter and bare ground for a. the 1995, and b. the 1996, growing seasons respectively. The figures for each site are the means for that site.

a. 1995.

species	site 1			site 2			site 3			site 4			site 5			site 6		
	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover
Grasses:																		
Aristida stipitata subsp. *stipitata*	0.13	(0.25)	(0.15)															
Cenchrus ciliaris													0.25	(0.08)	(0.07)	2.88	(0.63)	(0.58)
Dactyloctenium aegyptium													1.56	(0.47)	(0.42)			
Danthoniopsis dinteri													0.13	(0.04)	(0.04)			
Enneapogon cenchroides				0.06	(0.03)	(0.03)												
Enneapogon desvauxii										0.56	(0.53)	(0.41)						
Eragrostis annulata	5.75	(11.16)	(6.73)	172.88	(96.81)	(82.98)	94.75	(90.01)	(68.22)	0.56	(0.53)	(0.41)				5.50	(1.21)	(1.10)
Eragrostis cylindriflora	0.06	(0.12)	(0.07)	0.75	(0.40)	(0.36)	0.50	(0.48)	(0.35)				311.00	(93.3)	(83.97)	344.25	(75.74)	(68.85)
Eragrostis cf. *echinochloidea* (SS461)																2.75	(0.61)	(0.55)
Eragrostis cf. *nindensis*																0.13	(0.03)	(0.03)
Eragrostis cf. *superba*																0.25	(0.06)	(0.05)
Eragrostis sp. (SS275)													0.13	(0.04)	(0.04)			
Monelytrum leuderitzianum	0.38	(0.73)	(0.44)	1.25	(0.7)	(0.60)	4.88	(4.64)	(3.34)	27.25	(25.89)	(19.89)				7.25	(1.60)	(1.45)
Panicum sp.	0.13	(0.25)	(0.15)															
Setaria verticillata				0.56	(0.31)	(0.27)												
Stipagrostis hirtigluma subsp. *hirtigluma*	0.06	(0.12)	(0.07)	0.13	(0.07)	(0.06)				68.13	(64.72)	(49.73)						
Urochloa brachyura																0.06	(0.01)	(0.01)
Total:	**6.51**	**(12.63)**	**(7.61)**	**175.63**	**(98.95)**	**(84.3)**	**100.13**	**(95.13)**	**(71.91)**	**96.50**	**(91.67)**	**(70.44)**	**313.07**	**(93.93)**	**(84.54)**	**363.07**	**(79.89)**	**(72.61)**
Succulent forbs:																		
Chamaesyce glanduligera							0.13	(0.12)	(0.09)	0.13	(0.12)	(0.09)						
Chamaesyce inaequilatera							1.88	(1.79)	(1.35)				0.19	(0.06)	(0.05)			
Gisekia africana	7.00	(13.58)	(8.19)	0.06	(0.03)	(0.03)				0.06	(0.06)	(0.04)						
Trianthema triquetra	14.69	(28.50)	(17.19)							3.89	(3.70)	(2.84)						
Zygophyllum simplex	17.75	(34.44)	(20.77)	1.44	(0.81)	(0.69)	2.13	(2.02)	(1.53)	4.38	(4.16)	(3.20)						
Total:	**39.44**	**(76.52)**	**(46.15)**	**1.50**	**(0.84)**	**(0.72)**	**4.14**	**(3.93)**	**(2.97)**	**8.46**	**(8.04)**	**(6.17)**	**0.19**	**(0.06)**	**(0.05)**	**0.00**	**(0.00)**	**(0.00)**

• Appendix 6a continued.

species	site 1			site 2			site 3			site 4			site 5			site 6		
	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover
Other forbs:																		
Amaranthus sp.	0.06	(0.12)	(0.07)	0.25	(0.14)	(0.12)	0.94	(0.89)	(0.68)									
Cucumis africana																1.63	(0.36)	(0.33)
Geigaria alata																4.13	(0.91)	(0.83)
Heliotropium sp. (SS168)													7.38	(2.21)	(1.99)			
Hermannia modesta							0.06	(0.06)	(0.04)				0.38	(0.11)	(0.10)			
Hermannia tigrensis				0.69	(0.39)	(0.33)				0.25	(0.24)	(0.18)						
Indigofera sp. #1	0.13	(0.25)	(0.15)															
Indigofera sp. #2 (SS277)													11.60	(3.48)	(3.13)	1.13	(0.25)	(0.23)
Ipomea obscura													2.94	(0.88)	(0.24)			
Sesbania sphaerosperma																67.13	(14.77)	(13.43)
Tribulus terrestris	5.31	(9.95)	(6.21)							0.19	(0.18)	(0.14)						
Total:	**5.50**	(10.32)	(6.43)	**0.94**	(0.53)	(0.45)	**1.00**	(0.95)	(0.72)	**0.44**	(0.42)	(0.32)	**22.30**	(6.68)	(5.46)	**74.02**	(16.29)	(14.82)
Dwarf shrubs:																		
Monechma divaricatum													3.25	(0.98)	(0.88)	17.00	(3.74)	(3.40)
Total:	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**3.25**	(0.98)	(0.88)	**17.00**	(3.74)	(3.40)
Seedlings of woody species:																		
Acacia tortilis				0.81	(0.10)	(0.39)	0.06	(0.06)	(0.04)				0.19	(0.06)	(0.05)			
Colophospermum mopane										0.06	(0.06)	(0.04)						
Total:	**0.00**	(0.00)	(0.00)	**0.81**	(0.10)	(0.39)	**0.06**	(0.06)	(0.04)	**0.06**	(0.06)	(0.04)	**0.19**	(0.06)	(0.05)	**0.00**	(0.00)	(0.00)
Fungi:																		
Podaxis pistillaris	0.13	(0.25)	(0.15)															
Total:	**0.13**	(0.25)	(0.15)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)	**0.00**	(0.00)	(0.00)
Plant litter	16.40		(19.19)	24.30		(11.66)	24.10		(17.35)	17.90		(13.07)	30.80		(8.32)	33.00		(6.60)
Bare ground	17.50		(20.48)	4.30		(2.06)	9.80		(7.06)	13.10		(9.56)	2.90		(0.78)	0.00		(0.00)

• Appendix 6b.

b. 1996.

species	site 1			site 2			site 3			site 4			site 5			site 6		
	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover	total pin strikes	% biomass	% total cover
Grasses:																		
Poaceae (SS460)													0.14	(1.33)	(0.20)			
Total:	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.14**	**(1.33)**	**(0.20)**	**0.00**	**(0.00)**	**(0.00)**
Succulent forbs:																		
Chamaesyce inaequilatera													0.07	(0.67)	(0.10)			
Zygophyllum simplex	0.58	(100.00)	(1.12)	2.19	(100.00)	(3.22)	0.19	(100.00)	(0.26)	6.25	(100.00)	(9.31)						
Total:	**0.58**	**(100.00)**	**(1.12)**	**2.19**	**(100.00)**	**(3.22)**	**0.19**	**(100.00)**	**(0.26)**	**6.25**	**(100.00)**	**(9.31)**	**0.07**	**(0.67)**	**(0.10)**	**0.00**	**(0.00)**	**(0.00)**
Other forbs:																		
Asteraceae (SS459)													0.14	(1.33)	(0.20)			
Boerhavia cf. *hereroensis/diffusa* (SS159, SS170)													2.89	(27.48)	(4.10)			
Heliotropium sp. (SS168)													0.29	(2.76)	(0.41)			
Indigofera sp. #2 (SS277)													0.71	(6.75)	(1.01)			
Ipomea obscura													0.64	(6.09)	(0.91)			
Tribulus terrestris													0.07	(0.67)	(0.10)			
Total:	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**4.74**	**(45.08)**	**(6.73)**	**0.00**	**(0.00)**	**(0.00)**
Dwarf shrubs:																		
Monechma divaricatum													5.50	(52.31)	(7.81)	5.25	(100.00)	(0.32)
Total:	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**5.50**	**(52.31)**	**(7.81)**	**5.25**	**(100.00**	**(0.32)**
Seedlings of woody species:																		
Boscia foetida													0.07	(0.67)	(0.10)			
Total:	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.00**	**(0.00)**	**(0.00)**	**0.07**	**(0.67)**	**(0.10)**	**0.00**	**(0.00)**	**(0.00)**
Plant litter	18.33		(35.38)	41.38		(60.83)	20.63		(28.68)	28.88		(43.03)	29.71		(42.19)	1565.00		(93.90)
Bare ground	32.83		(63.36)	24.25		(35.65)	51.38		(71.42)	32.13		(47.87)	30.43		(43.21)	47.00		(2.82)

Annexe 1
Database of Damara ethnobotany

Preamble

This catalogue of ethnobotanical information with relevance to Damara farmers in north-west Namibia is intended as a source of reference material providing underlying detail to the plant resources referred to in the main body of the thesis. It is based primarily on original field data collected through the following:

- interviews at households in Khowarib in (1992), Sesfontein and at settlements on the Ugab River (1994) (52 interviews in total);

- extensive small-group discussion at repeat-visits to 12 households who participated in a wider survey concerned with monitoring household use of natural resources. In this case, 228 fieldcards prepared from plant specimens collected by the author were used as the basis for discussion. The Damara 'nation' to which respondents described themselves as belonging was recorded to try and elucidate dialectical and use differences; in many cases this is specified alongside information on names and uses of plants listed in this database (see Map 1.1 in the main text of the thesis);

- finally, ethnobotanical information was recorded opportunistically during collecting trips with Damara resource-users.

For each species in the catalogue the Damara name is listed followed by uses for food, medicine, perfume, livestock forage and 'other' including household utensils, building materials and firewood. Each category is supported by literature references for Nama/Damara people where these could be found. This is followed by plant names and uses recorded for Herero/Himba herders who live in close proximity with the Damara in north-west Namibia. Literature references to the use of the species in drylands elsewhere are then recorded. Information from the literature on the names and uses of particular plant species are referred to in the present tense throughout but fieldwork is needed to verify whether or not these practices are enacted in contemporary settings.

For ease of reference within Namibia and South Africa, each species is numbered according to 'Prodromus einer Flora von Südwestafrika' (FSWA) and the Botanic Research Institute of Pretoria (BRI). This is followed by the author's collection number (i.e. SS0332) for specimens which were deposited with the herbarium collection at the National Botanical

Research Institute (NBRI) in Windhoek, Namibia. Naturalised species are marked with an asterix. Families and species are listed alphabetically, again for ease of reference.

Note on orthography

The Damara names for species recorded during this study are written as transcribed by my field assistant from Sesfontein, Suro Ganuses. As such, the orthography may not be as detailed as elsewhere (cf. Olpp, n.d.; Eiseb *et al*, 1991). Similarly, complications are introduced by dialectical differences related to the geographical location and ancestral lineage of individuals. Consequently, Damara-speaking people from different areas may use and hold substantially different names and knowledge relating to natural resources. Given these constraints, every effort has been made to notate Damara names and uses of plants as faithfully as possible.

As in the thesis this Annexe uses the standardised orthography such that clicks are represented by symbols as follows:

| = dental click

‖ = lateral click

! = palatal click

≠ = alveolar click

Long vowels are represented with a double vowel rather than a macron above a single vowel letter so that ≠**h**$\bar{a}$ becomes ≠**haa** (see Eiseb *et al*, 1991: 17). Tone is not marked.

The suffixes 's' and 'b' 'n' denote feminine, masculine and plural nouns respectively. These are demarcated from the main stem of the noun with a full-stop. The same plant can, in many cases, be referred to with different suffixes, depending on the part of the plant referred to. Generally, the whole plant is given the masculine ending, whereas fruits or other plant parts are given the feminine or masculine endings depending on their shape: round fruits, for example, are female while long, thin fruits are male. Heinz and Maguire (1974: 9) similarly note for the !K$\bar{o}$ San in Namibia and Botswana that the sex of the plant or of a plant part depends on its shape: relative stoutness is a female attribute and slenderness is a male attribute.

ACANTHACEAE

Blepharis cf. *obmitrara* C.B.Clarke
FSWA: 1300 BRI: 7973 Author's coll. no. SS0314
Ao |**game** (recorded from Purros Damara in Sesfontein). **'Ao'** means 'male', i.e. it is considered a male |**game** plant.

The Himba of Kaokoveld refer to this species as onyainya or ojikokotwa and report that it is

browsed by small stock (Malan and Owen-Smith, 1974: 149).

B. gigantea Oberm.
FSWA: 1300 BRI: 7980 Author's coll. no. SS0454
Kai |game (recorded in Sesfontein).
Recognised as a fodder plant (recorded along the Ugab). The bees take nectar from the flowers of this species (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein) and ostrich eat this plant (recorded from ‖Khaoa-a Damara in Sesfontein).

B. grossa (Nees) T.Anderson
FSWA: 1300 BRI: 7980 Author's coll. no. SS0216
Is a (**kai**) **|game.s** (recorded throughout former Damaraland); **|ami** (= ostrich) **|game** (recorded from Dâureb Damara at ‖Gaisoas and Gudipos on the Ugab River).
Goats and sheep eat this species during drought (recorded from |Khomani Damara at Rietkuil farm) and ostrich eat it (recorded from Tsoaxau and Dâureb Damara at ‖Gaisoas, Ugab).

Ecbolium clarkei Hiern
FSWA: 1300 BRI: 8048 Author's coll. no. SS0003, SS0400
|Hom |hom (recorded from Dâureb Damara at Gudipos, Ugab River), i.e. the name refers to sucking the nectar out of the flowers.
This plant is browsed by goats (recorded from Dâureb Damara at Gudipos, Ugab River) although Purros Damara in Sesfontein state that if goats eat this plant it makes their milk taste 'bad'.

Omutikaiko, i.e. tree (muti) not there (kaiko) (recorded from Herero and Purros Damara in Sesfontein); otjipembati otjinene recorded in Malan and Owen-Smith (1974: 149) who report that this species is browsed by livestock in Kaokoveld.

Monechma cf. *divaricatum* (Nees) C.B.Clarke
FSWA: 1300 BRI: 8094 Author's coll. no. SS0184
≠Naada (recorded from Purros Damara in Sesfontein); **‖gabi.s** (recorded from ≠Ao-Dama, Rietkuil Farm).
Browsed by goats (recorded from ≠Ao-Dama, Rietkuil Farm) and bees take nectar from this plant (recorded from Purros Damara in Sesfontein).

M. cleomoides (S.Moore) C.B.Clarke
FSWA: 1300 BRI: 8094 Author's coll. no. SS0080
|Homexare; **|hom** = shiny, i.e. the name describes the oiliness of the leaves (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).
Goats eat (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

M. genistifolium (Engl.) C.B.Clarke
FSWA: 1300 BRI: 8094 Author's coll. no. SS0396
|Homexarebe (recorded from ‖Khaoa-a, Purros (originally !Oe-≠gaa) Damara in Sesfontein, and Dâureb Damara at ‖Gaisoas, Ugab River); **|gom |gom** (recorded from Dâureb Damara at Gudipos, Ugab River).
Can eat the nectar (recorded from Dâureb Damara at Gudipos, Ugab River) and goats browse (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).
This plant, like SS0397 (*Petalidium* sp., Acanthaceae) is used in ritual enacted at the death of a child. **‖Gau-ao.s** is the name used by ‖Khaoa-a and !Narenin Damara for a woman whose child has died. The whole body of the woman is washed and she then hides (**anasen**) under a blanket and sits in the smoke of a fire in which parts of this plant are burned (sometimes with **|âna.s** (*Commiphora virgata*, Burseraceae) and elephant dung or **≠hoaxau**). An axe warmed on the fire is also placed (**‖go**) on the woman's stomach as part of this ritual. The whole process is called **‖gaub** (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Monechma sp. Hochst.
FSWA: 1300 BRI: 8094
Van den Eynden *et al* (1992: 61) record that this is known as '**blomhai.n**' in Sesfontein ('**blom**'

is the Afrikaans word for flower).
A decoction from the roots is drunk to relieve body pains (Van den Eynden *et al*, 1992: 61).

Petalidium bracteatum Oberm.
FSWA: 1300 BRI: 7934 Author's coll. no. S0406
|Gom |gom (Recorded from Purros (originally !Oe-≠gaa) and ‖Khaoa-a Damara in Sesfontein, and from Dâureb Damara at Gudipos, Ugab River); **!hakabi** (recorded from ‖Khaoa-a Damara in Sesfontein).
The nectar can be eaten (recorded from Dâureb Damara at Gudipos, Ugab River) and honey bees take nectar from this plant (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).
Goats eat (recorded from Dâureb Damara at Gudipos, Ugab River).
P. cf. *engleranum* (Schinz) C.B.Clarke
FSWA: 1300 BRI: 7934 Author's coll. no. SS0011, SS0269?
‖Ona.n (recorded in Sesfontein; this name is also reported as the Hai‖om term for a similar dwarf-shrub *Leucosphaera bainesii* (Hook. F.) Gilg, Amaranthaceae, in Eiseb *et al* (1991: 21, 23, 28)). **‖Ona.n** seems to be a generic term ('ethnogenus') for *Petalidium* spp. utilised as livestock forage (see below).
This is an important fodder for goats (recorded in Sesfontein).

The Himba call this plant otjingenge (Malan and Owen-Smith, 1974: 149) and describe it as dry season stock feed.

P. coccineum S.Moore
FSWA: 1300 BRI: 7934 Author's coll. no. SS0022
‖Khona.s (recorded along the Ugab).
This is an important fodder for goats (recorded along the Ugab).

P. halimoides (Nees) S.Moore
FSWA: 1300 BRI: 7934 Author's coll. no. SS0307
!Na hai.b (recorded in Sesfontein).
A decoction from the root is drunk to treat stomach pains and diarrhoea (recorded in Sesfontein).

Malan and Owen-Smith (1974: 149) report that the roots of an unidentified *Petalidium* sp. known locally by the Himba as otjipembati (also a name for *P. rossmannianum*) are chewed and the sap swallowed for nausea, and an extract from the root bark is applied to wounds. This specis is eaten by livestock in Kaokoveld (Malan and Owen-Smith, 1974: 149).

P. rossmannianum P.G.Mey.
FSWA: 1300 BRI: 7934 Author's coll. no. SS0350
‖Ona.n (recorded in Sesfontein; see notes above for *P.* cf. *engleranum*).
This is an important fodder for goats (recorded in Sesfontein).

Is called ojipembati or otjingongwe by the Himba of Kaokoveld and is used as a dry season stock feed (Malan and Owen-Smith, 1974: 149).

Petalidium sp. Nees
FSWA: 1300 BRI: 7934
Ao ‖ona.n (recorded in Sesfontein); '**ao**' means 'male' and '**‖ona.n**' is the name of plant, i.e. male **‖ona.n**. Refers to fact that it has black bark and larger leaves than other *Petalidium* spp. which are known generically as **‖ona.n**.
This is an important fodder for goats (recorded in Sesfontein).

Petalidium sp. Nees
FSWA: 1300 BRI: 7934 Author's coll. no. SS0397, SS0415
|Homexare, **‖gauhai.b** (recorded from ‖khaoa-a Damara in Sesfontein); **‖gabi** (recorded from Dâureb Damara in Sesfontein); **≠naada** (recorded from Purros Damara in Sesfontein); **‖ona.s**

(recorded fromTsoaxau Damara at ǁGaisoas, and Dâureb Damara, Ugab River, who state that there are different types of **ǁona.s** in different areas and that this one is green when wet). Goats eat (recorded from Dâureb Damara in Sesfontein, Tsoaxau Damara at ǁGaisoas, and Dâureb Damara, Ugab River).

Bees take nectar from this plant (recorded from Purros Damara in Sesfontein).
This plant is used in **ǁgaub** rituals enacted at the death of a child (see notes above for *Monechma genistifolium*).

Ruellia diversifolia S.Moore
FSWA: 1300 BRI: 7965 Author's coll. no. SS0016, SS0243, SS0302,

ǁHui.b and **|hom** **|hom** or **|gom** **|gom** (recorded in Sesfontein); **|gom** **|gom** and **!hakabi** described as !Narenin names (recorded from ǁKhaoa-a Damara in Sesfontein); **|gom** **|gommehai.b** (Van den Eynden *et al*, 1992: 61). '**|Hom** **|hom**' refers to the action of sucking nectar out of the flowers.
The nectar is eaten as a snack while in the field (recorded in Sesfontein) and bees take the nectar from this plant for honey (recorded from ǁKhaoa-a Damara in Sesfontein).

AIZOACEAE

Gisekia africana (Lour.) Kuntze *africana*
FSWA: 270 BRI: 2382 Author's coll. no. SS0087, SS0115, SS0256

Toabe.b and **|habe.b** (SS0087) (recorded in Sesfontein); **oara** (recorded for SS0115 from Purros Damara in Sesfontein); **|âtsi** **|âbe** recorded for SS0256 (**kai** **|âtsi** **|âbe** = *Sesuvium sesuvioides*, Aizoaceae) (recorded from Dâure.b Damara at Gudipos on the Ugab River).
'**Toabe.b**' means 'no power or uses'; an equivalent Damara word is '**≠habusa**'. '**|Habe.b**' itself has no meaning. There is a hill near the road between Kamanjab and Outjo which is known as '**|habe.b ≠ho.b**'; '**≠ho.b**' means 'to hide' and, as '**|habe.b**' is abundant on this mountain, the name refers to '**|habe.b** hiding' on the mountain.
The seeds are collected in combination with **sâu.n** (seeds of *Stipagrostis* spp. grasses) from harvester ant nests and eaten; it is described as 'food for **≠goburun**', i.e. harvester ants (recorded for SS0256 from Purros Damara in Sesfontein).
Goats eat (recorded from Purros Damara in Sesfontein).

The Herero name is ombuija (recorded for SS0256 from Purros Damara in Sesfontein).

Limeum argute-carinatum Wawra & Peyr.
FSWA: 270 BRI: 2376
!Uru (recorded from Purros Damara in Sesfontein).

Mollugo cerviana (L.) Ser. ex DC.
FSWA: 270 BRI: 2387 Author's coll. no. SS0077, SS0147

Dom hai.b or voice-plant (recorded from |Khomani Damara at Malansrust farm); **!uru** (recorded in Sesfontein, e.g. by Purros Damara).
Ash from this plant is placed on the throat to cure sore throats (recorded from |Khomani Damara at Malansrust farm).
Goats eat this plant.

Sesuvium sesuvioides (Fenzl) Verdc.
FSWA: 270 BRI: 2394 Author's coll. no. SS0075

(**Kai**) **|âbe** (recorded in Sesfontein); **kai** **|âtsi** **|âbe** (recorded from Dâureb Damara at Gudipos on the Ugab River).

Tetragonia schenckii (Schinz) Engl.
FSWA: 270 BRI: 2403

≠Khoe-hai.n (du Pisani, 1983: 12); **≠khoe.s** (also refers to *Salsola* spp., Eiseb *et al*, 1991: 24, 29)

The dry wood is an important source of firewood in the former Namaland (du Pisani, 1983: 12).

Trianthema triquetra Rottler ex Willd.
FSWA: 270 BRI: 2395 Author's coll. no. SS0014, SS237
≠Nurusoâ.b, **≠nurusoâ |âgeame** (recorded in Sesfontein, e.g. from ‖khaoa-a, Namib |!Naren, Purros (incl. originally !Oe-≠gaa), and Dâureb Damara); an unidentified species called **≠nurusôa.i** is referred to as utilised in Van den Eynden *et al* (1992: 87) (see below); **|âtsi |âbe** (Dâureb Damara at Gudipos, Ugab River).
'**≠Nurusoâ**' is the name of the black seeds (**≠nu** = black). '**≠Nurusoâ |âgeame**' refers to the fact that it is seen as being very similar in appearance to **|âgeame**, i.e. *Zygophyllum simplex* L., Zygophyllaceae, to the point of being a 'type' of **|âgeame**.

The seeds are eaten with different types of porridge, mainly as seasoning rather than a staple food (recorded from ‖khaoa-a, Purros (incl. originally !Oe-≠gaa) and Dâureb Damara in Sesfontein, and Dâureb Damara at Gudipos, Ugab River, and also recorded by Van den Eynden *et al*, 1992: 87). They are eaten without preparation or are pounded first. Timotheus Ganuseb claims that 'it tastes better than salt'.

The Herero call this species onona (plant) and oruandjero (the food from plant) (recorded in Sesfontein and from Purros Damara) and also eat the seeds as a seasoning for milky porridge.

AMARANTHACEAE

Amaranthus spp. L.
FSWA: 330 BRI: 2299 Author's coll. no. SS0062, SS0194, SS0235
‖Hâube.s |b, **‖gâube.s |b** (recorded throughout former Damaraland), **≠aube** recorded from ‖khaoa-a Damara in Sesfontein; **|hai** (= grey) **‖gâube.b** recorded from ‖Khaoa-a and Purros (originally !Oe-≠gaa) Damara from Sesfontein; **‖gâube.b**, **≠khaube.b** = *Amaranthus* sp. (Eiseb *et al*, 1991: 21, 25); Tsoaxau Damara at ‖Gaisoas, Ugab River, state that **‖hâube.s** refers to plants that grow where people live, e.g. in kitchen gardens, and that **|horo.b** is the same type of plant when it grows wild in the field or **!garo.b**.
The leaves are eaten throughout former Damaraland and can be sundried and rehydrated for later consumption. **‖Hâube.s** seems to be a generic term used to describe a range of *Amaranthus* spp.; cultivars have also been introduced into Sesfontein by Owambo immigrants to the area. Leaves of **≠khaube.b**, identified by Van den Eynden *et al* (1992: 61) as *Amaranthus dinteri* Schinz subsp. *dinteri*, are recorded as cooked and eaten in Sesfontein. Goats eat this plant (recorded from ≠Ao-Dama, Rietkuil Farm).

The Hereo name is omunandi (recorded for SS0361 by Purros Damara in Sesfontein and in Malan and Owen-Smith, 1974: 149) or ombowa (yozondu) (Kajujaha-Matundu, 1994).
Among the Himba the leaves and stems are boiled in water and eaten as a relish with meat and maize or dried and pressed into cakes called 'omavanda' which are stored for later use (Malan and Owen-Smith, 1974: 149). This food is regarded as a delicacy and omavanda are traded in Kaokoveld.
The plant is browsed by cattle (Malan and Owen-Smith, 1974: 149).

The leaves of *Amaranthus* spp. are eaten wherever they occur and are now added to commercial products in South Africa such as 'Green Gold' tinned 'Marog with Curry'. Uses as a gathered food include: the leaves of *Amaranthus* sp. are eaten by Dobe-area !Kung in Botswana (Lee, 1979: 167), the leaves of *A. thunbergii* and three other *Amaranthus* species are eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148) and several *Amaranthus* spp. are consumed as relish by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 46). The leaves of a number of *Amaranthus* spp. are consumed by Maasai and Kipsigis in east Africa (Glover *et al*, 1966: 192) and throughout Ethiopia (Getahun, 1974: 49). In North America the seeds and leaves of *Amaranthus* spp. were consumed by the Hiach-eD O'odham of the Sonoran Desert (Crosswhite, 1981: 53).

Arthraerua leubnitziae (Kuntze) Schinz
FSWA:330 BRI: 2320
|Haisari.s (Eiseb *et al*, 1991: 20, 25); **sari.s** (recorded among the ≠Aonin of the !Kuiseb by Van den Eynden *et al*, 1992: 23).
A decoction of the roots is drunk by the ≠Aonin of the !Kuiseb River to 'ease tremblings' (Van den Eynden *et al*, 1992: 23).

Calicorema capitata (Moq.) Hook. f.
FSWA: 330 BRI: 2325 Author's coll. no. SS0034
Dairu (recorded in Sesfontein).
'**Dairu**' comes from '**dai**' meaning 'milk'.
The roots can be added to **sâu.n** beer (i.e. beer made from *Stipagrostis* spp. grass seeds) as a fermentation agent (recorded in Sesfontein)

The Herero name for this plant is ongaradi (recorded in Sesfontein; Malan and Owen-Smith, 1974: 149).
In Sesfontein it was recorded that beer and wine used to be made by Herero from the roots of this plant which were prepared by scraping clean, chopping and drying in the sun, and then added to water with honey or sugar.
Considered by Herero herders in Sesfontein to be an important forage species, especially in the dry season, for both small and large stock, and is reportedly one of the most nutritional forage plants. Recorded by Malan and Owen-Smith (1974: 149) as eaten by livestock in areas considered heavily grazed in western Kaokoveld, with speculation as to whether this is 'by choice or necessity', i.e. due to perceived environmental degradation in this area.

Leucosphaera bainesii (Hook. f.) Gilg
FSWA: 330 BRI: 2313 Author's coll. no. SS0308
‖Oona (recorded from Purros Damara in Sesfontein).
Bees take nectar from this plant (recorded from Purros Damara in Sesfontein).

Otjigenge (recorded from Purros Damara in Sesfontein); otjingenge is recorded for *Petalidium coccineum*, Acanthaceae, in Malan and Owen-Smith (1974: 149) who record the name otjivetjombanje (sputum (= otjive) of the jackal (= ombandje), i.e. due to the similarity between the infloresence and white scaly bark of this plant and hairballs regurgitated by jackals), for *L. bainesii*.

An extract of the root is applied by Himba to wounds or as a warm compress for swelling and consider this plant an important dry season stock feed (Malan and Owen-Smith, 1974: 149-150).

AMARYLLIDACEAE

FSWA: 1500 Author's coll. no. 0032
Gânao (recorded from Dâureb Damara in Sesfontein). This name seems to be a generic term applied to lilies.
!Noa.b (porcupines) eat (recorded from Dâureb Damara in Sesfontein).

Crinum/*Nerine* sp.
FSWA: 1500 BRI: 1189 Author's coll. no. SS0032
Gânau.n, **gânau.s** (flower) (recorded in Sesfontein).
The flowers are eaten by goats and the bulbs are eaten by baboons.

ANACARDIACEAE

Rhus undulata Jacq.
FSWA: 740 BRI: 4594
!Kuni (Coates-Palgrave, 1991: 491)
This shrub bears edible berries consumed by the Nama (Schultze, 1907 in du Pisani, 1983: 14).

Coates-Palgrave states that 'the Hottentots' use a decoction of the leaves of this species for postparturient problems and chew the leaves for chest colds.

*Schinus molle** L.
FSWA: 740 Author's coll. no. S0284
Pepahai.s (recorded at farms along the Aba-Huab River; this name was also recorded for *Zanthoxylum ovatifoliatum*, Rutaceae).

APIACEAE

Peucedanum upingtoniae (Schinz) Drude
FSWA: 1030 BRI: 6116
The tuber of this plant is eaten by the Nama (Schultze, 1907 in du Pisani, 1983: 14).

APOCYNACEAE

Pachypodium lealii Welw.
FSWA: 1120 BRI: 6681 Author's coll. No SS0112
|Khîni.s (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein); **gunu** (recorded from ǁkhaoa-a Damara in Sesfontein); called **gowa.s** (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River).
An extraction from the leaves is poured into the ears for earache (recorded from Purros Damara in Sesfontein).
Bees often make hives in the fat base of the trunk of this tree (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein). The wood can be used for carving utensils such as buckets or **ǁhoe.s** (recorded from ǁkhaoa-a Damara in Sesfontein). If you stick something in the stem 'it cries'; you can't drink water from the stem because it's very bitter (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River).

The Herero name is ohaanga (recorded from Purros Damara in Sesfontein); ohwanga (Malan and Owen-Smith, 1974: 150).
Sap from the pith of the trunk is applied to inflammed wounds on people and livestock and is used as eardrops (Malan and Owen-Smith, 1974: 159).The Tjimba are reported to make water troughs to poison birds from the wood of this tree (Malan and Owen-Smith, 1974: 150).

APONOGETONACEAE

Aponogeton cf. *desertorum* Zeyh. ex Spreng.
FSWA: 1430 BRI: 65
Possibly **ǁana.b** (recorded from Dâure.b Damara from ǁGaisoas on the Ugab River); **ǁgana.b/s/i** (Eiseb *et al*, 1991: 21, 25).
Dâure.b Damara from ǁGaisoas on the Ugab River report that the red root of **ǁana**, found near water during the rain season to the west of the Brandberg, is eaten like a potato. Du Pisani (1983: 6) records that when the leaves turn yellow the Nama harvest the bulb of this freshwater rain season hydrophyte. These are then peeled and either cooked in water or roasted and mashed with milk. They can also be stored and consumed as an emergency food.

ARECACEAE

Hyphaene petersiana Klotzsch
FSWA: 1610 BRI: 553
!Uni.s/b (recorded in Sesfontein and Khowarib and in Van den Eynden *et al*, 1992: 62); **!unihai.s**, **!unia.s** (Eiseb *et al*, 1991: 22, 27).
The sweet, fibrous mesocarp of the fruit is eaten, especially by children (recorded in Sesfontein, Khowarib and in Van den Eynden *et al*, 1992: 62).

Baskets are woven from the leaves, and may be sold (recorded in Sesfontein and Khowarib and in Van den Eynden *et al*, 1992: 62) and the kernels, i.e. Vegetable Ivory, are carved and sold (throughout the former Damaraland). The young leaves soaked in water or with **|noma.s** bark can be used to colour baskets (recorded from Purros Damara in Sesfontein).

The young bushy tree is called omavere and the mature stemmed individuals are called omurunga by the ovaHimba (Giess, 1966: 107); Malan and Owen-Smith (1974: 150) record the names omurunga (= tree), omarungu (= fruit) and omarusu (= sap).
The fruits are eaten, and the trunk sap used for making an alcoholic beverage (Malan and Owen-Smith, 1974: 150).
Like in the *Hyphaene* palm savanna of Owambo, north-central Namibia (cf. Rodin, 1985; Konstant *et al*, 1995; Sullivan *et al*, 1995), this species has a number of uses among the Himba of Kaokoveld: a variety of baskets, known as ovimbara, are woven from the leaves, the leaf fibre is used for twine, the leaf petioles or stalks are used for bows and stirring sticks and joined twin fruits are used as dolls and dressed by girls in ways which represent different stages in a girl's life (Malan and Owen-Smith, 1974: 150).

The fruits are consumed wherever they occur in north and north-west Namibia (Giess, 1966: 107).The fruit and plam heart (apical meristem) is eaten, the latter with particular relish, by !Kung San (Marshall, 1976: 119), and Lee (1979: 160, 167) describes the fruits of *H. benguellensis* as a major food species for the Dobe !Kung as well as the occasional consumption of *Hyphaene* sp. palm-hearts.The leaves of *Hyphaene* spp. are used wherever they occur for basketry, the sap is collected for the production of a nutritious alchoholic beverage (cf. Moll, 1972: 631 for Tongaland, Natal).

H. compressa is an important multipurpose species and forage resource in the ekwar system of range management of the Turkana (Barrow, 1990: 170). It is an important source of construction material for the Gabra of north Kenya and the fruits are eaten (Stiles and Kassam, 1991: 22). The fruits of *H. ventricosa* Kirk and *H. coriacea* Gaertn. are described as among the most important plant foods for Turkana and Samburu pastoralists respectively in Becker (1986: 63).

ASCLEPIADACEAE

Ceropegia sp. L.
FSWA: 1140 BRI: 6874
The potato-like tubers are eaten by the Nama (Schultze, 1907 in du Pisani, 1983: 14).

Fockea angustifolia K. Schum.
FSWA: 1140 BRI: 6914
≠Hawa.s, **!na-≠hawa.b**, **nodoma** (recorded in Sesfontein, e.g. from Purros Damara); **‖hawa.s**, **‖haba.s** (recorded along the Ugab); **≠hawa.b**, **≠hapa.b** (du Pisani, 1983: 8; Eiseb *et al*, 1991: 24, 27; Van den Eynden *et al*, 1992: 63); **≠haga.b/s**, **!gawo.b** (Eiseb *et al*, 1991: 23-24, 27)
The tuber, referred to as 'Damara potato' is eaten after roasting (recorded in Sesfontein and Ugab, and in Van den Eynden *et al*, 1992: 63). It occurs in Kamanjab and Twyfelfontein areas. The young tuber can be eaten raw (Giess, 1966: 66) and water from inside the tuber can be drunk (recorded along the Ugab and among the Nama in du Pisani, 1983: 8). Du Pisani (1983: 8) also records that the Nama use the tuber as an ingredient for beer, and that it was cut into pieces, put into lime water to prevent it from disintegrating, and eaten as jam.
A decoction from the root (of SS0307) is drunk for stomach pains and diarrhoea.
The milky latex from the tuber of a creeping plant referred to as **≠hawa-!khore.s** is recorded in Vedder (1923: 63) as obtained from the San and used as arrow poison.

The Herero names otjipwiya and otjimbuya are used for *F. multiflora* (Malan and Owen-Smith, 1974: 150).
The milky latex of *F. multiflora* is a stong intestinal poison and is used, sometimes in powdered form, by the Himba to poison predators by placing in carcasses, and also known to have been used against humans (Malan and Owen-Smith, 1974: 150).

Gomphocarpus cf. *filiformis* (E. Mey.) Dietr.
FSWA: 1140 BRI: 6791 Author's coll. no. SS0377
tsîtsî (i.e. mimics the sound made when sneezing) (recorded from ≠Ao-Dama, Rietkuil Farm).
A powder from the plant is inhaled as snuff to clear nose (recorded from ≠Ao-Dama, Rietkuil Farm).

Hoodia cf. *currori* (Hook.) Decne. *currori*
FSWA: 1140 BRI: 6878 Author's coll. no. SS0050
Known throughout former Damaraland as **!khoba.b/s** or **!khowa.b** (see also Eiseb *et al* 1991: 23, 27; Van den Eynden *et al*, 1992: 63)
The stems of *Hoodia* spp. are eaten throughout the arid western parts of Namibia after removal of the spines, especially after rain when it is more juicy and less bitter (see also Schultze, 1907: 202; Giess, 1966: 67; du Pisani (1978: 15) who record the consumption of the 'fruits' of **!khoba.s**; du Pisani, 1983: 9; Steyn and du Pisani, 1984/1985: 44; and Van den Eynden *et al*, 1992: 63). The flowers are also eaten (recorded in Sesfontein and from Dâureb Damara at ǁGaisoas, Ugab River and ≠Ao-Dama, Rietkuil Farm). Like *Trichocaulon pedicellatum*, pieces of the stem are added by the Kuiseb Topnaar to sugarwater to make a refreshing drink (Van den Eynden *et al*, 1992: 25).
The stems are eaten throughout former Damaraland for a variety of ailments including stomach disorders (and by the Nama and Kusieb Topnaar in du Pisani (1983: 9) and Van den Eynden *et al* (1992: 25) respectively), coughs and to reduce high blood pressure (cf. Van den Eynden *et al*, 1992: 25). Juice from the stems is used to relieve eye irritations (recorded in Sesfontein, e.g. from ǁKhaoa-a Damara, and Khowarib and from the Kuiseb Topnaar in Van den Eynden *et al*, 1992: 25). In the Tses area of Namaland pregnant women eat stems to prevent new-born babies from having a dry mouth which is considered as indication that they are ill (Budack, 1965: 110 in du Pisani, 1983: 9).

The Herero name otjinkandue was recorded from Purros Damara in Sesfontein and otjinove is recorded as the name for *H. parviflora* in Malan and Owen-Smith (1974: 151).
The sap of *H. parviflora* is reported as poisonous but only stong enough to be effective in the hunting of jackals (Malan and Owen-Smith, 1974: 151).

Lavrania marlothii (N.E.Br.) Bruyns
FSWA: 1140 BRI: 6879
|Goai-i and **|goa.b** are recorded as names for *Trichocaulon officinale*, Asclepiadaceae, by the Nama and *T. pedicellatum* by the Kuiseb Topnaar in du Pisani (1983: 12) and Eiseb *et al* (1991: 20, 29), and Van den Eynden *et al* (1992: 27) respectively.
The succulent stems of *T. officinale* and *T. pedicellatum* are consumed by the Nama and Kuiseb Topnaar, and are added by the latter to sugarwater to make a refreshing drink (du Pisani, 1983: 12; Van den Eynden *et al*, 1992: 27).
The eating of stems is considered by the Kuiseb Topnaar to lower high blood pressure, cure colds, relieve stomach pains and indigestion and the flesh applied to eyes relieves soreness (Van den Eynden *et al*, 1992: 25, 27).

Orthanthera albida Schinz
FSWA: 1140 BRI: 6862 Author's coll. no. SS0392
|Haurutabe.s (recorded in throughout former Damaraland); **|ari.b** (Van den Eynden *et al*, 1992: 25, 63); **|harudawe.b** used for *Asclepias buchenaviana* in Eiseb *et al* (1991: 20, 25) and is possibly a creeping plant referred to at Rietkuil farm as **|harube** which has green fruits with brown stripes, containing milk or '**da.i**' when young and filled with seeds with hairs when ripe.
The pods are eaten raw, mainly as a snack food by children (recorded in Sesfontein, e.g. from ǁKhaoa-a, Namib |!Naren, Dâureb, Purros (incl. originally !Oe-≠gaa) Damara and in Steyn and du Pisani (1984|1985: 45) and Van den Eynden *et al* (1992: 25, 63) and the flowers are eaten raw (Steyn and du Pisani, 1984|1985: 45). The Kuiseb Topnaar add the root to beer to improve its flavour (Van den Eynden *et al*, 1992: 25).
Van den Eynden *et al* (1992: 25) report that the Kuiseb Topnaar make a decoction from, or chew, the stems and/or roots to treat stomach pains, and make a decoction from the ground seeds for kidney and/or back pain.
The pods are considered good fodder for goats (recorded in Sesfontein).
The stems are used by the Kuiseb Topnaar for teeth-cleaning (Van den Eynden *et al*, 1992:

25).

The Herero name orunavi was recorded in Sesfontein; donkeys reportedly eat the pods.

The Nharo add the dried and crushed root of *O. jasminiflora* (Decne) Schinz to home-brewed beer to increase its potency (Steyn, 1981: 16).

Pergularia daemia (Forssk.) Chiov. *leiocarpa* (K.Schum.) H. Huber
FSWA: 1140 BRI: 6917 Author's coll. no. SS0133, SS0203
Dai-!gui.b, **dai-!gubi.b**, **'opklim'** (recorded in Sesfontein); **dai |namib** (recorded from Dâureb Damara at Gudipos, Ugab River); **!gubi.b** (recorded from ≠Ao-Dama, Rietkuil Farm); **!gubi.b**, **!guwi.b**, **dai-!gubi.b**, **|gutama ‖o.b** (recorded for *P. daemia* var. *daemia* and var. *leiocarpa* in Van den Eynden *et al*, 1992: 25, 64); **!guwi.b** and **!gubi.b** are recorded for *Pentarrhinum insipidum* E. Meyer, and **|guutama ‖oo.b** or **|giitama ‖oo.b** are recorded for *Asclepias fruticosus* L. (Eiseb *et al*, 1991: 21, 23, 27, 28)

'Dai' means 'milk' and refers to the milky latex of the fruits.

An extraction of the root is taken for hard coughs (1 spoon at morning and at night) (recorded from ≠Ao-Dama, Rietkuil Farm). Van den Eynden *et al* (1992: 25, 64) record that in Sesfontein the ground root is introduced into incisions in the back to treat backpain and that among the Kuiseb Topnaar a decoction of the roots is drunk to treat symptoms of venereal disease and a powder from the roasted roots or leaves is applied to wounds.

This plant is eaten by goats (recorded in Sesfontein).

The Topnaar Kuiseb add the latex from this plant to water to poison animals (Van den Eynden *et al*, 1992: 25).

The Nharo take an extract of the root of *P. daemia* var. *daemia* for pains in the lower abdomen and bladder associated with venereal disease (Steyn, 1981: 17).

The stalk and leaf of *P. daemia* are eaten by the |Gwi and ‖Gana San (Tanaka, 1976: 118) and the leaves of *Pergularia* spp. are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249). The starchy roots are eaten in Ethiopia (Getahun, 1974: 55.)

ASPARAGACEAE

Protasparagus denudatus (Kunth) Oberm.
FSWA: 1470 BRI: 1113
The Nama name for this plant is recorded as **|hoabe.b** by du Pisani (1983: 6); Eiseb *et al* (1991: 19-20, 28) record the names **|hoape.b** and **tuu(tsi) |hoape.b** for *Protasaparagus* sp. and **|hoape.b** is also a general term for freshwater algae.

The Nama use this plant to treat flesh burns (Dentlinger, 1977: 35).
The Nama of Tses would throw the green stems into the fire to halt continuous rain (du Pisani, 1983: 6).

Among the Himba orukanunambura i.e. take away (= -kanuna) the rain (= ombura) refers to *Protasparagus* cf. *cooperi* (Baker) Oberm. (Malan and Owen-Smith, 1974: 158); i.e. it is believed that if this plant is removed following its appearance after the first warm weather of spring, the rains will be delayed (Malan and Owen-Smith, 1974: 158).

ASPHODELACEAE

Aloe dichotoma Masson
FSWA: 1470 BRI: 1026
The Nama name is **‖gara.s/b** (du Pisani, 1983: 6; Eiseb *et al*, 1991: 21, 25; Van den Eynden et al, 1992: 42).

A decoction from the scraped root was used by the Nama to treat asthma (du Pisani, 1983: 6) and by the Kuiseb Topnaar top treat symptoms of TB (Van den Eynden *et al*, 1992: 42). The porous inner fibre of the trunk was used as a cooling material by the Nama; sometimes the whole trunk was cut out and the whole plant used as a cooler (du Pisani, 1983: 6).

Aloe spp. *(A. hereroensis* Engler & *A. asperifolia* A.L.Berger)
FSWA:1470 BRI:1026

Known throughout former Damaraland variously as **gore.b**, **kore.b**, **aukore.b**, **‖gore.s** **!gore.b**; **aukore.b** or **augore.b** (recorded from ‖Khaoa-a Damara from Sesfontein and for *A. hereroensis* in du Pisani (1983: 6) and Van den Eynden *et al* (1992: 75); **aore** (= male) **koreb** (recorded from Purros Damara in Sesfontein); **gorep** (Steyn and du Pisani, 1984|1985: 47); **‖gore.s** recorded for *A. asperifolia* and **kore.b** as a general term for *Aloe* spp. in Eiseb *et al* (1991: 19, 21, 25).

'**Au**' and '**k/goreb**' both mean 'bitter' so the name literally emphasises the bitterness of the plant.

Throughout former Damaraland the leaves are used for a variety of medicinal purposes: they are squeezed and the liquid used as a body wash to improve general health, and decoctions from the leaves are drunk to bring back appetite and relieve stomach disorders including pains and constipation, to relieve coughing and chest pains (cf. Van den Eynden *et al*, 1992: 75) and to reduce high blood pressure. The decoction is made by taking a piece of the leaf, boiling in a cup with water and taking 2 spoons of the extract 3 times a day. It is claimed that 'in one day you are better' but that if you drink a whole cup of this extract you will immediately get diarrhoea. Du Pisani (1983: 6) also reports that Nama women with suckling young would rub their breasts with the juice from the leaves, using its bitter taste to shorten the weaning period. Van den Eynden *et al* (1992: 42) record the following medicinal uses of *A. asperifolia* among the Kuiseb Topnaar: a decoction of the leaves was drunk to treat symptoms of arterosclerosis, kidney problems, asthma, epilepsy, colds and to indice afterbirth and the leaves are chewed or a decoction drunk to relieve chest pains. The leaves of *Aloe* spp. are also highly valued as a medicine for livestock and its use is included in advice to farmers from the Veterinary Service. Disorders treated using an extraction from the leaves include diarrhoea or constipation, to induce afterbirth (cf. Van den Eynden *et al*, 1992: 42) and as a medicine against animal parasites (cf. du Pisani, 1993: 6). Van den Eynden *et al* (1992: 42) also report that among the Kuiseb Topnaar it is given to donkeys who have eaten poisonous plants and a leaf is added to the drinking water of chickens if they display disease symptoms of paralysis and falling over, while in Sesfontein a decoction of leaves is given to apparently rabid dogs (p. 75).

Otjindombo = a general Herero term for *Aloe* spp. occurring in Kaokveld (Malan and Owen-Smith, 1974: 157-158; see also Kajujaha-Matundu, 1994 for the eastern Herero).

The Himba mix the sap of *Aloe* spp. with warm water and drink as a remedy for chest or stomach pains and to treat symptoms of gonorrhea (Malan and Owen-Smith, 1974: 157-158).

The flowers of *Aloe* spp. are consumed by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 46). Decoctions of the pounded roots and stem of *Aloe* spp. are administered by Luo herbalists of east Kenya as a treatment for stomach problems (Johns *et al*, 1990: 378). An extract of the roots of *A. secundiflora* Engl. is administered as an enema by Samburu pastoralists in the treatment of TB and the sap is used as eyedrops (Fratkin, 1996: 74, 76).

Aloe is a medically important genera (Croom, 1983: 18) whose curative powers have been used in the Americas, Asia and Africa with the earliest use as an anti-inflammatory agent recorded for the 4th century B.C. (Bruce, 1975: 57). Several South African species are known to have purgative properties and the use in folk-medicine of decoctions from *Aloe* to treat tuberculosis, colds and stomach problems, and of preparations applied externally for a variety of skin complaints, is widespread, not only in Africa, but also in Asia and the Americas (Bruce, 1975: 58). In terms of its chemical structure, polyuronide material in aloe leaf-pulp is effective in the treatment of wounds, burns and abrasions and the yellow leaf-sap contains purgative and anti-bacterial agents (Bruce, 1975: 59, 63-65)

ASTERACEAE

FSWA:1390 Author's coll. no. SS0220

Kai |game (**kai** = big, **|game** = a prickly plant) (recorded from Purros (originally !Oe-≠ga) Damara in Sesfontein); **!uru.s** (recorded from ‖Khaoa-a Damara in Sesfontein).

The Herero name ombango was recorded from Purros Damara in Sesfontein.

Antiphiona fragrans (Merxm.) Merxm.

FSWA: 1390 BRI: 9065 Author's coll. no. SS0354

!Âusâ (recorded from Purros (originally !Oe-≠gaa) Damara from Sesfontein); **!âuhai.b** (recorded from Purros Damara in Sesfontein); **doeba!oa.b** (recorded from Dâureb Damara in Sesfontein), **doeba!oahe** (Van den Eynden *et al*, 1992: 64); **doeba-oa-sâi** (recorded fromTsoaxau Damara at ‖Gaisoas, Dâureb Damara, Ugab River).

'**!Au**' is the name for rock dassies (hyrax) and '**sâ**' means '**sâi**' or perfume.

This aromatic plant is inhaled to clear headaches and sinuses, e.g. by taking as snuff (by Purros (originally !Oe-≠gaa) Damara from Sesfontein; also recorded fromTsoaxau Damara at ‖Gaisoas, Ugab River). A decoction from the whole plant is given to donkeys which are coughing (recorded from Dâureb Damara in Sesfontein) and a decoction from the whole plant is drunk to relieve chest pains and coughing (recorded from Dâureb Damara at ‖Gaisoas, Ugab River and in Van den Eynden *et al*, 1992: 64).

The dried ground leaves are used as a fragrant body powder in Sesfontein, e.g. (recorded from Dâureb Damara in Sesfontein, Dâureb Damara, Ugab River; also recorded in Van den Eynden *et al*, 1992: 64). It is a **sâi** plant but is only used for medicinal purposes (recorded fromTsoaxau Damara at ‖Gaisoas, Ugab River).

Eaten by rock hyraxes or **!âu.n** (recorded from Purros Damara in Sesfontein).The smell is so beautiful (**îxa**) that it will hold you to a place, i.e. you will keep going back to it.

The Herero name it omubango was recorded from Purros Damara in Sesfontein (also for *Helichrysum roseo-niveum*, Asteraceae); otjindundu (Malan and Owen-Smith, 1974: 151). 'Browsed to some extent by large and small stock' (Malan and Owen-Smith, 1974: 151).

Aspilia eenii S.Moore

FSWA: 1390 BRI: 9195

Referred to by the Kuiseb Topnaar as **damadawi.b** (Van den Eynden *et al*, 1992: 27).

'**Dama**' refers to the Damara and '**dawi.b**' is the name for *Tamarix usneoides*, Tamaricaceae.

The root is added to milk to induce curdling (Van den Eynden, 1992: 27).

Blumea decurrens (Vahl) Merxm.

FSWA: 1390 BRI: 8939

Referred to by the Kuiseb Topnaar as **tunu.b** (Van den Eynden *et al*, 1992: 27); **sapube.b** (Eiseb *et al*, 1991: 19, 25).

Van den Eynden *et al* (1992: 27) record that this species is used by the Kuiseb Topnaar for a variety of medicinal purposes: a decoction of the leaves and/or roots relieves stomach pains; a body wash from the plant parts treats acne; the leaves are put into shoes to relieve painful feet.

The stalks are used as thatch by the Kuiseb Topnaar (Van den Eynden *et al*, 1992: 27).

The Himba call this plant otjindundu, otjindumba (Malan and Owen-Smith, 1974: 151).

Goats will eat this shrub when other browse is scarce but it taints the milk and meat if consumed excessively (Malan and Owen-Smith, 1974: 151).

Herders as cattle-posts sometimes sleep on this and other shrubs after placing on the ground and covering with a skin (Malan and Owen-Smith, 1974: 151).

Dicoma tomentosa Cass.

FSWA: 1390 BRI: 9501 Author's coll. no. SS0019, SS0291

Known throughout Damaraland as **sore.b/s**; Eiseb *et al* (1991: 18-19, 26) record this name and **guu!uru.s** for *D. capensis* Less.and du Pisani (1983: 7) records the Nama name **gun-!uru** for this species.

'**Sore.b**' means the 'sun' and the plant is called this because the flowers are round and golden like the sun.
A decoction of stems, flowers and leaves is drunk for coughs and colds; it's a very commonly used medicine. To prepare, the plant parts are pounded and boiled in water and when cool this decoction is put in a bottle and three spoonfuls are taken daily or just after a coughing fit. Drinking a whole cupful of this fluid does not cause observable harmful effects. Du Pisani (1983: 7) records that in Namaland the green leaves and roots of *D. capensis* are boiled into a decoction which is drunk for colds and fevers.
Goats eat recorded from ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm).

Steyn (1981: 11) records that a decoction of the leaves and roots of *D. schinzii* O. Hoffm. is taken by the Nharo for colds and headaches. In oshiWambo the plant is called okalupulupu and isadded to water and is used to treat symptoms of malaria and is given to livestock to treat abdominal pains (Marsh, 1994: 4, 26).

Emilia marlothiana (O.Hoffm.) C. Jeffrey
FSWA: 1390 BRI: 9411 Author's coll. no. SS0127
≠na≠ara (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River); known by the Kuiseb Topnaar as **!ga!gau.b** (Van den Eynden *et al*, 1992: 29).
The root is added by Kuiseb Topnaar to home-brewed corn beer after wrapping in a cloth, putting in the sun and crushing ((Van den Eynden *et al*, 1992: 29).

The Herero name ekurukaze (i.e. grandmother) was recorded from Purros Damara in Sesfontein.

Gazenia spp. Gaerth.
FSWA:1390 BRI: 9434
Schultze (1907 in du Pisani, 1983: 14) records the Nama name **!gobo‖na.s** for this species.
The Nama are recorded as eating the flowers of *D. capensis* raw or with boiling, salted milk (Schultze, 1907 in du Pisani, 1983: 14).

Geigeria acaulis Benth. & Hook.f. ex Oliv. & Hiern
FSWA: 1390 BRI: 9090 Author's coll. no. SS0233
|Homexare (recorded in Sefontein, e.g. by ‖Khaoa-a Damara); **‖habi.s** or the Afrikaans 'waterpokies' (used by ≠Ao Damara at Rietkuil farm on the Aba- Huab); **|game** (recorded from ‖khaoa-a Damara in Sesfontein); *Geigeria* sp. called **!khoe ‖hawu** by the Nama and vermeerbos in Afrikaans (du Pisani, 1983: 8); **≠oa.s** Dâureb Damara, Ugab River.
'**|Homexare**' means 'it brings you luck', i.e. in the past, if you were very poor or were unlucky in finding food in the field when you were out collecting, you would smear a leaf of this plant onto the centre of your forehead to bring you luck. It is described as 'a medicine plant because it brings you luck', (recorded from Christophine |Awo.s of Sesfontein).
This plant is roasted and pound, added to animal fat or bought vaseline and smeared onto boils (recorded from ≠Ao Damara at Rietkuil farm on the Aba-Huab).
It is slightly aromatic and is considered a '**sâi**' or perfume plant (recorded in Sesfontein, e.g. from ‖Khaoa-a Damara), and the flowers can be used as **sâi** (Dâureb Damara, Ugab River).
The bark from a *Geigaria* sp. considered poisonous burns easily so is used to kindle fires by Nama in the Berseba area (Du Pisani, 1983: 8).
It is woolly, i.e. **!abi.s**.

The Herero name okaputi was recorded in Sesfontein and okapuite is recorded as *Geigeria* sp. in Kajujaha-Matundu (1994); ojeja (recorded from Purros Damara in Sesfontein).
Ashes from the burned plant are mixed with fat and spread on circumcision wounds of boys to promote healing (recorded in Sesfontein).

G. alata (DC.) Benth. & Hook.f. ex Oliv. & Hiern
FSWA:1390 BRI:9090 Author's coll. no.SS0198
|Game (recorded in Sesfontein, e.g. from ‖khaoa-a and Purros (originally !Oe-≠gaa) Damara);

tarare (i.e. female) **|game** recorded from ‖Khaoa-a Damara in Sesfontein; **≠oa**, meaning 'wind', is used by Purros, Dâureb and ‖Khaoa-a Damara from Sesfontein, Tsoaxau Damara at ‖Gaisoas and Dâureb Damara, Ugab River.
The flowers are used for '**sâ.i**' or perfume.
This is described as a bitter plant, i.e. if the goats eat it you can't eat the offal (**!na-xu.n**) because it's bitter ('**au**').

G. ornativa O. Hoffm. *ornativa*
FSWA: 1390 BRI: 9090 Author's coll. no. SS0196a
|Game (recorded at Palm farm), **dani** (= honey) **|game** (recorded from ‖Khaoa-a, Namib/!Naren and Purros (incl. originally !Oe-≠gaa) Damara in Sesfontein); also called **≠oa** (see *G. alata* above) (recorded in Sesfontein and from Dâure.b Damara from ‖Gaisoas and Gudipos on the Ugab River, who stated that this plant is not **|game.s**); **≠gakarube** (recorded from |Khomani Damara at Malansrust);
This is a '**sâ.i**' or perfume plant (recorded from ‖Khaoa-a, Namib/!Naren Damara in Sesfontein, and from Dâure.b Damara from ‖Gaisoas and Gudipos on the Ugab River).
Goats eat (recorded from Purros Damara in Sesfontein).
Bees take nectar from the yellow flowers of this plant (recorded from ‖Khaoa-a Damara from Sesfontein).
The ash is used as circumcism medicine by Hereros in the same way as they use okaputi (recorded from Dâureb Damara at Gudipos, Ugab River).

Helichrysum roseo-niveum Marloth & O.Hoffm.
FSWA: 1390 BRI: 9006 Author's coll. no. SS0258
!Abi.s; **!abise** (recorded in Sesfontein, e.g. from ‖khaoa-a and Purros (incl. originally !Oe-≠gaa) Damara). '**!Abise**' is used to describe a plant that is covered with woolly hairs, as *is H. roseo-niveum*.
Is considered a '**sâi**' or perfume plant.
The woolly hairs on the plant can be used as cotton wool (recorded in Sesfontein, e.g. from ‖khaoa-a Damara).

The Herero name omubango was recorded from Purros Damara in Sesfontein.

H. tomentosulum (Klatt) Merxm. *tomentosulum*
FSWA: 1390 BRI: 9006 Author's coll. no. SS0137?
!Uru.s (recorded throughout former Damaraland).

The Himba refer to this plant as ongwambundu and use it as a substitute for thatch (Malan and Owen-Smith, 1974: 151).

H. . tomentosulum (Klatt) Merxm. *aromaticum* (Dinter) Merxm.
FSWA: 1390 BRI: 9006 Author's coll. no. SS0316
!Uru sâ.i (recorded in Sesfontein) **!uru** (recorded from Dâure.b Damara from ‖Gaisoas and Gudipos on the Ugab River); **!uri**, i.e. white (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab; **!urue.b** (Van den Eynden *et al*, 1992: 65)
'**!Uru**' refers to the single flowers clustered on the capitulum or flower-head characteristic of the Asteraceae. There is reportedly a second very similar '**!uru**' which is not aromatic, i.e. is possibly *H. tomentosulum* subsp. *tomentosulum* (see above). '**Sâi**' refers to the use of this '**!uru**' as perfume.

A decoction from the pounded stem is drunk for general health and strength; as it is not bitter a lot can be drunk at one time (recorded from |Khomani Damara at Malansrust farm).
The dry leaves and stem are used as '**sâi**' or perfume (recorded in Sesfontein, from |Khomani Damara at Malansrust farm, from Tsoaxau Damara at ‖Gaisoas and Dâureb Damara at Gudipos on the Ugab River, from ≠Ao-Dama at Rietkuil Farm, and in Van den Eynden *et al*, 1992: 65).

This springy plant used to be used for sleeping on after covering with a skin (recorded from Dâure.b Damara from ‖Gaisoas on the Ugab River).

Helichrysum sp. Mill.
FSWA: 1390 BRI: 9006
!Uru (used by |Khomani Damara at Bankfontein Farm on the Aba-Huab).
The plant parts are used to make tea (recorded from |Khomani Damara at Bankfontein Farm on the Aba-Huab).

Hirpicium gorterioides (Oliv. & Hiern) Rossler
FSWA: 1390 BRI: 9435 Author's coll. no. SS0091
≠Aeda (**≠ae** = sticky) recorded from ‖Khaoa-a Damara in Sesfontein; **oara** (recorded from Purros Damara in Sesfontein); **!goare!horo** (**!goare** = zebra, **!horo** = ankle) (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River); **tarare** (= female) **≠oa.s** (recorded from Dâureb Damara at Gudipos, Ugab River).
This plant grows where there are lots of zebra and they eat it (recorded from Dâure.b Damara from ‖Gaisoas on the Ugab River).

Kleinia longiflora DC.
FSWA: 1390 BRI: 9411
The Kuiseb Topnaar drink a decoction of the stems to relieve headache and toothache (Van den Eynden *et al*, 1992: 28).

The Herero refer to this plant as orukwasena; an extract of the plant parts is drunk or administered rectally to treat stomach/intestinal ailments (Malan and Owen-Smith, 1974: 151).

Launaea intybacea (Jacq.) Beauv.
FSWA: 1390 BRI: 9593 Author's coll. no. SS0219
Damara from Sesfontein describe this as a **dai-haib** or 'milk-plant' because when given to goats it helps them to produce milk (recorded in Sesfontein).

Osteospermum microcarpum (Harvey) Norl. *Septentrionale* (T.Norl.) T.Norl.
FSWA: 1390 BRI: 9427 Author's coll. no. SS0221
Saitsi≠ane, **sai** means 'it scratches', **tsi** means 'and', and **≠ane** is a 'red rash', i.e. this a scratchy plant (recorded from |Khomani Damara at Malansrust farm); **≠hauta≠aebe** (**≠hauta** = always, **≠ae** = sticks) (recorded from Dâure.b Damara from ‖Gaisoas on the Ugab River).
This i a **sâ.i**, i.e. perfume plant (recorded from Purros Damara in Sesfontein) and bees take nectar from this plant (recorded from Dâure.b Damara from ‖Gaisoas on the Ugab River).
The Herero name of ekurukaze (i.e. grandmother) was recorded from Purros Damara in Sesfontein.

Othonna furcata (Lindl.) Druce
FSWA: 1390 BRI: 9420
Du Pisani (1983: 10) records the Nama names for this species as **|nunu.s**, **≠gu.s**.
Resin from this plant, which is common towards the coast, was fashioned by the Nama of Berseba into small beads after mixing with charcoal (Schultze, 1907: 252 in du Pisani, 1983: 11).

Pechuel-loeschea leubnitziae (Kuntze) O.Hoffm.
FSWA: 1390 BRI: 8943 Author's coll. no. SS0252, SS0336
Known throughout former Damaraland as **autsi!khanne.b** (see also Eiseb *et al*, 1991: 18, 28; Van den Eynden, 1992: 28); **!ababue** (recorded from Purros, ‖Khaoa-a (‖Hoes) Damara in Sesfontein); Eiseb *et al* (1991: 18, 28) also record **auxan!khaa.b** as the Nama name and **au!khanne.b** or **ezimba.b** as Hai‖om names for this species.
'Au' means 'bitter', and is so-called because if goats eat it they produce bitter milk and meat. **'!Khanne.b'** is the name of the plant.

The leaves are placed on insect bites to relieve itching and promote healing (recorded in Sesfontein) and the leaves are pounded and soaked in water which is then used to wash the body or as a poultice to cure and relieve rashes and itchiness (recorded along the Ugab, e.g. by Tsoaxau Damara at ‖Gaisoas, Ugab River, from Purros Damara in Sesfontein, and from ≠Ao-

Dama, Rietkuil Farm). A decoction from the roots or leaves is used to treat colds and coughs (recorded from Purros (incl. originally !Oe-≠gaa) and Dâureb Damara in Sesfontein) and high blood pressure (recorded from |Khomani Damara at Malansrust Farm). Steam is inhaled from plants soaked in water to treat colds (Dâureb Damara at Gudipos, Ugab River). Van den Eynden *et al* (1992: 28) record a variety of medicinal uses for this herb by the Kuiseb Topnaar including: the leaves are used to treat measles, sores and to disinfect wounds; an extract of the leaves is drunk to treat gonorrhoea, stomach pains, fever, colds and aches and pains; an extract of the root is taken to treat symptoms of TB; the vapour from leaves soaked and boiled in water is inhaled to clear colds and, through exposure to this vapour, relieve skin disorders; and the warmed leaves are used as a poultice to relieve painful feet and headaches.

The flowers are used in **'sâ.i'**, i.e. perfume (recorded in Sesfontein and along the Ugab), although Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos, Ugab River state that they do not consider it a **sâi** plant because it has a bitter smell.

The plant is kept in houses or burned on the fire as a mosquito repellent (recorded in Sesfontein and recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos, Ugab River).

The Herero names omudumba, omuntumba were recorded from Purros Damara at Sesfontein and otjindumba, omundumba in Malan and Owen-Smith (1974: 151).
An extract from the root is drunk to treat gonorrhoea or applied externally to treat venereal and other skin disorders and mange in livestock (Malan and Owen-Smith, 1974: 151).
Finely ground root chips which are burnt black and mixed with fat are smeared on the neck and under traditional necklaces by Himba, Zemba and Hakaona men (Malan and Owen-Smith, 1974: 151).

This herb is known in oshiWambo as 'lizimba' and the leaves are used as a remedy for constipation and externally for eye, ear and nose problems (Marsh, 1994: 26).

Pegolettia cf. *senegalensis* Cass.
FSWA: 1390 BRI: 9073 Author's coll. no. SS0352
≠Khari ≠khana.b, i.e 'small' **≠khana.b** or *Thamnosma africana*, Rutaceae (recorded from Purros Damara from Sesfontein).

Senecio alliariifolius O.Hoffm.
FSWA: 1390 BRI: 9411
The plant is used by the Nama as a broom (Dentlinger, 1977).

BALANITACEAE

Balanites welwitschii (Tiegh.) Exell & Mendonça
FSWA: 660 BRI: 3980 Author's coll. no. SS0051
!O!o.s (recorded from Purros Damara in Sesfontein).

The Herero name omubanmeje was recorded from Purros Damara in Sesfontein; omumbamenye (from shoot = umba, the springbok = omenye) recorded in Malan and Owen-Smith (1974: 151).
The branches are used by Himba to fence gardens as the sharp spines keep out wild animals. The wood, which produces an acrid smoke when burnt, is preferred for smoking out aggressive bees (Malan and Owen-Smith, 1974: 151).

The ground bark of *B. aegyptiaca* (L.) Del. is mixed with salt and lick to treat coughs by the Luo of east Kenya (Johns *et al*, 1990: 379). The resinous gum of *Balanites* sp. (lowwai) is used by Samburu pastoralists for a variety of medicinal purposes: it is boiled in water and drunk with milk to treat bronchitis and pneumonia; it is placed in eyes and then washed out in the treatment of eye irritations; the heated gum is applied to wounds and burns (Fratkin, 1996: 74, 76, 77). The bark of *Balanites* sp. (lowwai) is also drunk as a decoction to treat symptoms of malaria and the ground leaves of *Balanites* sp. (sarai) are applied to infected eyes on livestock (Fratkin, 1996: 77, 81). The fruits/seeds of *B. aegyptiaca* and *B. scillin*, and the leaves of *B.*

gillettii Cuf. are eaten in Ethiopia (Getahun, 1974: 50) and the fruits of *B. aegyptiaca* are eaten by the Gabra of north Kenya (Stiles and Kassam, 1991: 23) and is considered one of the most important plant foods of Ferlo pastoralists of Senegal (Becker, 1986: 63).

BIGNONIACEAE

Catophractes alexandri D.Don
FSWA: 1280 BRI: 7723 Author's coll. no. SS0049
Known throughout former Damaraland **as !gawa.s/b**, **!gaba.s/b** (see also du Pisani, 1983: 7; Eiseb *et al*, 1991: 22, 26; Van den Eynden *et al*, 65); **!huu-ai!huri.b** (Eiseb *et al*, 1991: 22, 26).

A decoction from the root is used to treat children with diarrhoea (1 teaspoon is taken 3 times a day, for 3-4 days) (recorded from ǁkhaoa-a Damara in Sesfontein). At Palm farm it was recorded that a decoction from the bark is used to treat stomach pain and of the leaves and stems/leaves for coughs (the latter was also recorded from Purros, Namib/!Naren, and ǁKhaoa-a Damara in Sesfontein). The bark is chewed or made into a decoction drunk for indigestion after eating meat (can drink a little 3 times a day for 2-3 days) (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River, ǀKhomani Damara, Malansrust Farm). Du Pisani (1983: 7) recorded the use of pounded root in Namaland to treat the former ailment while Van den Eynden *et al* (1992: 66) records the use of the latter treatment in Sesfontein or alternatively of chewing the bark to treat colds. It was reported that the bark of the red young stem can be chewed frequently with no ill effects. The smoke inhaled from burning the leaves on the fire helps ease headaches (recorded from ǁKhaoa-a Damara in Sesfontein).

This species provides good livestock fodder.

If you steal meat that someone else has cooked, putting **!gawas** leaves on the meat will stop you from getting boils; similarly, adding the leaves to meat before it is cooked will help cure boils that you already have. Boils thought to be related to 'talking too much' (recorded from Dâureb Damara at Gudipos, Ugab River).

The Herero name omukaravize was recorded in Sesfontein, and in Malan and Owen-Smith (1974: 151); omukaraize (recorded from Purros Damara in Sesfontein).
In Kaokoveld, this species is browsed by large and small stock, the twigs are used as toy cattle as part of a learning game and the branches are used for sacred fire-sticks (Malan and Owen-Smith, 1974: 151).

BORAGINACEAE

Cordia gharaf (Forsskal) Ehrenb. ex Asch. (synonymous with *C. sinensis* Lam.)
FSWA: 1200 BRI: 7038 Author's coll. no. SS0036, SS0045, SS0078,
Throughout former Damaraland two names are recorded for this species which are considered to represent two distinct plants i.e. **ǁkho.s** (see also Van den Eynden *et al*, 1992: 66; **ǁkhoo.s** recorded as *Grewia avellana* and *G. villosa* (Tiliaceae) in Eiseb *et al*, 1991: 22, 27) and **ǀai.s**; **ǀae.s** (Van den Eynden *et al*, 1992: 66).
The fruits are eaten throughout former Damaraland (see also Steyn and du Pisani, 1984 ǀ1985: 44; Van den Eynden *et al*, 1992: 66).
The fruits and leaves browsed by goats (recorded from Dâure.b Damara from ǁGaisoas on the Ugab River).

ǁKhoo.s wood is used for '≠**gou.b**', i.e. winnowing bowls, which are marketed to toursists for approx. N$18-20 each (recorded in Khowarib). The gum from the sticky **ǀai.s** fruits is used as glue, even to the extent of this being the primary form of paste used by children in the school at Sesfontein. The branches are used for bows (recorded along the Ugab) and **ǁkhoo.s** is sometimes used for building poles (recorded at Palm farm).

ǁKhoo.s and **ǀai.s** are perceived as completely different species. Recognised features of each include the following:

- **ǁkho.s**: smaller fruits without sticky gum in the fruit, much smaller leaves (cf. SS0036,

SS0078);

- **|ai.s**: larger fruits with conspicuously sticky gum, much larger and more leathery leaves, and described as causing stomach ache if too much is eaten (cf. SS0045, SS0242).

‖Kho.s, **|ai.s**, **|noma.s** (*Ficus sycomorus*, Moraceae) and **sabibe.s** (*Grewia villosa*, Tiliaceae) are perceived as being similar. Stated that the green, moist stems smell the same, and this feature is used as an aid to identification.

The Herero names owozeba = SS0036 and omakwaha = SS0045 were recorded from Dâureb Damara at Gudipos on the Ugab River); omusepa (plant), ozosepa (fruits) (Malan and Owen-Smith, 1974: 157).

The fruits are eaten by Himba in Kaokoveld and small stock browse the leaves (Malan and Owen-Smith, 1974: 157). The wood is used for bows and toothbrushes (Malan and Owen-Smith, 1974: 157).

The fruit of Cordia *sinensis* Lam. is considered a major source of food for Turkana and Samburu pastoralists by Becker (1986: 63). Turkana and Gabra of north Kenya pastoralists gather relatively large quantities of fruits of *C. sinensis* (Morgan, 1981: 101; Stiles and Kassam, 1991: 23) and this species is an important forage resource for the Turkana (Barrow, 1990: 171). The fruits of *C. rothii* Roem. & Schultes are eaten by Maasai pastoralists (Glover *et al*, 1966: 192) and of *Cordia* spp. are eaten in Ethiopia (Getahun, 1974: 51).It is considered to be of 'very important' ritual significance among the Gabra (Stiles and Kassam, 1991: 23). The root is eaten raw by the Pokot (Kabuye, 1986: 68). The gum of *C. sinensis* is boiled in water and drunk with milk to treat bronchitis and pneumonia by Samburu pastoralists and limbs are set using branches of this species (Fratkin, 1996: 74, 76).

Heliotropium albiflorum Engl.
FSWA: 1200 BRI: 7052
Totosu (recorded from Purros Damara in Sesfontein).

H. cf. *hereroense* Schinz
FSWA: 1200 BRI: 7052 Author's coll. no. SS0398, SS0409
!uru.b (recorded from Dâureb Damara at ‖Gaisoas, Ugab River); **≠haabe.s** (recorded from |Khomani Damara at Malansrust Farm).
The root is chewed for stomach pain (recorded from |Khomani Damara, Malansrust Farm).
Goats and cattle eat (recorded from |Khomani Damara, Malansrust Farm).
Can use this plant as bedding (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

The Herero name omumbwanda is recorded in Malan and Owen-Smith (1974: 157) who state that the berries (ozombwanda) are eaten by the Himba and that this species is browsed by livestock.

The roots of *H. steudneri* Vatke are consumed as an extract (children) or chewed directly (adults) for liver pains (Steyn, 1981: 11).

H. albohispidum Bak. is used medicinally by the Gabra of north Kenya (Stiles and Kassam, 1991: 23) and a wash of *H. steudneri* is used by Samburu pastoralists to get rid of fleas on livestock (Fratkin, 1996: 81).

- H. *ciliatum* Kaplan
FSWA: 1200 BRI: 7052 Author's coll. no. SS0096
≠Aeda (recorded from ‖Khaoa-a Damara in Sesfontein); **≠hauda≠aebe** and **‖hui.b** (recorded from Purros Damara from Sesfontein); **!uru.b** (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).
'**≠Ae**' means 'sticky' and describes the stickiness of this plant.

H. ovalifolium Forssk.
FSWA: 1190 BRI: 7052 Author's coll. no. SS0044
In Sesfontein this plant is referred to as **|ao-‖hare.n**, or **!hawise/!habise** (e.g. by ‖Khaoa-a Damara), or **!uru.b** (recorded from Purros (originally !Oe-≠gaa) Damara).

'|**Ao**' means 'snake' and '‖**hare.n**' means 'flower', so it is literally 'snake-flower' and is so-called because of the linear inflorescence which unfurls like a snake.

The Herero name orujara, which means it stays on the ground (also recorded for *Boerhavia* cf. *hereroensis /diffusa*, Nyctaginaceae) was recorded from Purros Damara in Sesfontein.

H. tubulosum E. Meyer ex DC.
FSWA: 1190 BRI: 7052 Author's coll. no. SS0098
|**Hai-hai.s** (recorded in Sesfontein and from Dâureb Damara at Gudipos, Ugab River); **!âuhai.b** (**!âu** = rock dassie) (recorded from Purros Damara in Sesfontein); |**henda.s** is recorded as the Nama name in Eiseb *et al* (1991: 20, 27).

'|**Hai**' means grey and refers to the grey appearance of the plant.

Goats eat this plant (recorded from ‖Khaoa-a Damara in Sesfontein and Dâureb Damara at Gudipos, Ugab River) and it is also eaten by **!âu**, i.e. rock dassies (recorded from Purros Damara in Sesfontein).

Heliotropium sp. L.
FSWA: 1200 BRI: 7052 Author's coll. no. SS0168
!Uru.b (recorded from ‖Khaoa-a, Namib/!Naren and Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Trichodesma africanum (L.) Lehm.
FSWA: 1200 BRI: 7056 Author's coll. no. SS0100
≠Hauta≠aebe.b (recorded from Purros Damara at Sesfontein and at Palm farm); **≠aebe** (recorded from Namib/!Naren Damara in Sesfontein); (**≠auba≠aebe** recorded for *Boerhavia* sp. in Sesfontein); **saida**, i.e. causes the skin to itch when you touch it (recorded from Dâure.b Damara at Gudipos on the Ugab River).

'**≠Ae**' means 'sticky' and describes the stickiness of this plant.

Goats eat this species (recorded from Dâureb Damara at Palm farm and |Khomani Damara at Rietkuil farm).

BURSERACEAE

Commiphora anacardifolia Dinter & Engl.
FSWA: 700 BRI: 4151
!Khoebe.b (recorded in Sesfontein, e.g. from Purros (originally !Oe-≠gaa) Damara, and in Khowarib); **!khoe-anu.b** (recorded in Sesfontein); (Eiseb *et al* (1991: 22, 23, 28) record the name **!khoe≠khanu.s** (and ‖**khao.s**) for *Moringa ovalifolia*).

The wood of this species is soft and easy to work and is used to make '**≠gou.b**', i.e. winnowing bowls, buckets (‖**hoe.s**) and was used for 3-legged storage pots (recorded in Sesfontein, e.g. by ‖khaoa-a Damara).

The Herero name is omutuya (Malan and Owen-Smith, 1974: 152) and the wood is used by the Himba for carving household utensils in Kaokoland (Malan and Owen-Smith, 1974: 152).

C. crenato-serrata Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0039
Anto.b (recorded in Sesfontein, e.g. from ‖khaoa-a, Namib/!Naren, Purros (incl. originally !Oe-≠gaa) Damara and in Khowarib); this is also the name of an unidentified species in Van den Eynden *et al* (1992: 86) but the description of the plant does not match this *Commiphora*; **tenne** and |**oohai.s** are Dâureb Damara names for this species recorded along the Ugab River; **tine.s** (recorded from Dâureb Damara at Gudipos, Ugab River); Eiseb *et al* (1991: 19, 26) refer to this species as **sukurikanne.b**.

The young root, which contains moisture, can be dug up and pieces eaten raw (described by Tsôaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos, Ugab River). Similarly, the root of an unidentified *Commiphora* sp. is chewed by the Nharo as a source of water (Story, 1950 in Steyn, 1981: 26) and the roots of several east African commiphoras are chewed by Maasai, Kipsigis and Boran as a source of water or gum (Glover *et al*, 1966: 192; Kabuye, 1986: 68). ≠**Nû** ǀ**giru.s**, i.e. edible caterpillars (*Usta wallengrenii*, Saturniidae) grow on this species.

The wood is used for carving (Van den Eynden *et al*, 1992: 86).

The Herero name omuhanga was recorded from Purros Damara in Sesfontein and in Malan and Owen-Smith (1974: 152). This species has special symbolic significance among the Himba and Herero in marriage, initiation and funeral ceremonies (Malan and Owen-Smith, 1974: 152).

C. giessii J.J.A.van der Walt
FSWA: 700 BRI: 4151 Author's coll. no. SS0057, SS0359

Ao-ǀ**âna.b** (recorded from ǁkhaoa-a and Purros Damara in Sesfontein); **ao-âna.b** (recorded in Sesfontein, e.g. by Purros Damara (incl. originally !Oe-≠gaa) Damara); ǀ**aoa.b** (Van den Eynden *et al*, 1992: 67).

'**Ao**' means 'male' and this name thus refers to *C. giessi* as a male ǀ**ana.s**, i.e. *C. virgata*.

Edible '**ǀgiru.s**' or caterpillars (Saturniidae, *Usta Wallengrenii*) are abundant on this species in the rainy season.

The seeds are used for **sâi** (perfume) in Sesfontein (recorded from ǁKhaoa-a Damara, ≠Ao-Dama, Rietkuil Farm.).

The twigs are used as firesticks, i.e. a hole is made in the stem, dried donkey dung is placed in the hole and friction is used to light fires (recorded from ǁkhaoa-a and Purros (originally !Oe-≠gaa) Damara in Sesfontein; see also Van den Eynden *et al*, 1992: 67).

The Herero name toro was recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

C. glaucescens Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0105, SS0420?, SS0444

ǀ**Huu.b** (recorded in Khowarib and Sesfontein); ǀ**awa-**ǀ**huu.b** = 'red' ǀ**huu.b/s** (used by Purros, Dâureb (SS0420), and ǁKhaoa-a Damara from Sesfontein, and Dâureb Damara at ǁGaisoas, Ugab River); **ba-hai.s** (recorded from Namib/!Naren Damara in Sesfontein); the sweet-smelling dried, rotten wood from this and other old trees is called ≠**gae** or ≠**ae.i** (recorded in Sesfontein and from ≠Ao-Damara at Rietkuil farm); the soft (**tsaura**) wood from inside ǀ**huu.s** is called **mûnu** (≠Ao-Damara at Rietkuil farm).

The roots can be eaten.

The ≠**gae** or fragrant rotten wood which comes primarily from this species is chewed for infant teething probles and mouth ulcers (recorded in Sesfontein and along the Ugab River). When added to the bark from a tree called **!nu.s** (described as not a thorn tree) it forms an effective medicine for burns and these added to a powder from the dried insect ≠**hubina** (*Mylabris oculata*, Coleoptera: Meloidae or blister beetle) is applied externally to treat vaginal thrush (recorded from ≠Ao-Damara at Rietkuil farm). The bark is pounded into a powder which is made into a decoction and drunk for chest pains (recorded from ǁKhaoa-a Damara in Sesfontein) and a decoction of the soft wood (ǀ**ora.i**) or of the root is drunk to relieve post-natal pains and for intestinal problems (see also Van den Eynden *et al*, 1992: 86).

The dried rotten wood called '≠**gae**' has a sweet aromatic scent and is used as a body perfume and baby powder particularly for boys (recorded throughout Damaraland). Van den Eynden *et al* (1992: 54, 86) also report this use, as well as of the powdery softwood known as 'ǀ**ora.i**', for an unidentified species called ǀ**hu.s**). Van den Eynden *et al* (1992: 86) report that the aromatic gum is mixed with oil or animal fat and used as a body perfume, but it is possible that this may actually describe the use of resin from **herare**, i.e. *C. wildii.*

The wood is carved into ≠**gou.b** (i.e. winnowing bowls), ǁ**hoe.s** (i.e. buckets) and spoons (recorded along the Ugab, e.g. by Dâureb Damara at ǁGaisoas and by ǁKhaoa-a Damara in Sesfontein). The root and trunk bark are used to make a red dye for tanning animal skins (recorded from Dâureb Damara at Sesfontein and at ǁGaisoas, Ugab River, and by ǁKhaoa-a

and Namib/!Naren Damara in Sesfontein). The soft wood called **mûnu** is good for lighting fires with sparks from flint (recorded from ≠Ao-Damara at Rietkuil farm).

The Herero and Himba use the names omutungi (tree) and ozondowa (fruit) (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 152).

The fruits are eaten by the Himba of Kaokoveld, the leaves are browsed by small stock and the soft wood is a favoured timber for carving household utensils (Malan and Owen-Smith, 1974: 152).

C. krauseliana Heine
FSWA: 700 BRI: 4151 Author's coll. no. SS0347, SS0450
Eu (recorded from Purros (incl. originally !Oe-≠gaa), ǁKhaoa-a, Namib/!Naren, and Dâureb Damara in Sesfontein); Van den Eynden *et al* (1992: 67) report that in Sesfontein this species is called **|ana.s** but it is likely that they are actually referring to *C. virgata* which is common around Sesfontein.

The seeds are opened and the soft inner parts eaten (recorded from Purros (incl. originally !Oe-≠gaa), and ǁKhaoa-a Damara in Sesfontein) as described by Steyn and du Pisani (1984/1985: 44) who state that 'This is the only *Commiphora* sp. known of which the seeds are eaten by natives. As in almonds, the putamen is cracked open to expose the seed'.
The dry seeds are used as beads (Steyn and du Pisani, 1984|1985: 44).

C. multijuga (Hiern) K.Schum
FSWA: 700 BRI: 4151 Author's coll. no. SS0158
!Gâua.b (recorded in Sesfontein, e.g. from ǁkhaoa-a and Dâureb Purros (incl. originally !Oe-≠gaa) Damara, in Khowarib, and from Tsoaxau and Dâureb Damara at ǁGaisoas, Ugab River); **tsans** (recorded from Dâureb Damara at Gudipos, Ugab River).

|Giru.s, i.e. *Usta wallengrenii*, Saturniidae, caterpillars grow on this species (recorded from ǁkhaoa-a Damara in Sesfontein).

The bark is used for perfume, either on its own or mixed with other aromatic plant substances (recorded in Sesfontein). The gum is blended with fat as a fragrant body cosmetic used by Himba women (Malan and Owen-Smith, 1974: 152).

Is browsed by goats (recorded in Sesfontein, e.g. by Dâureb Damara).
The wood is used to carve '**≠gou.b**', i.e. winnowing bowls, buckets or '**ǁhoe.s**', pipes and spoons (recorded in Sesfontein, e.g. from ǁkhaoa-a and Purros (originally !Oe-≠gaa) Damara, and in Khowarib, and by Dâureb Damara at ǁGaisoas, Ugab River). The bark is used as a red leather tanning agent (recorded in Khowarib).
This species is called omuzumba by Herero and Himba (recorded in Sesfontein and by Malan and Owen-Smith, 1974: 152). The leaves are browsed by small stock and the twigs are used as toothbrushes (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 152).
Commiphora multijuga is one of four tree species (including *C. crenato-serrata*) with special significance for marriage, initiation and funeral ceremonies (Malan and Owen-Smith, 1974: 152).

C. pyracanthoides Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0079
|Inî.b/s (recorded from Purros and Dâureb Damara in Sesfontein, and in Khowarib); **|iini.b** (Eiseb *et al*, 1991: 26); **|huu.s** (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos, Ugab River)

≠Gae, i.e. fragrant rotten wood, comes from this plant (recorded from Tsoaxau Damara at ǁGaisoas, and Dâureb Damara, Ugab River) and is rubbed onto rashes, e.g. for small babies.

This species is a fodder plant for goats (recorded from Dâureb Damara in Sesfontein).
The bark is used as a red tanning agent and the wood is used for carving utensils such as **≠gou.b**, **ǁhoe.s** and **ǁgoa.s**, i.e. winnowing bowls, buckets and spoons (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos, Ugab River).

The Herero name for this species is omukange (Malan and Owen-Smith, 1974: 152).
Small forms called 'omboo' have edible roots (Malan and Owen-Smith, 1974: 152); similarly, 'tubers' from this species are eaten by the |Gwi and ǁGana San (Tanaka, 1976: 118).
An extract from the bark is used to treat gallsickness in calves, the gum is boiled in water to form a lather which can be used to wash clothes and an extract from the bark is used as a hair straightener(Malan and Owen-Smith, 1974: 152).

C. pyracanthoides/merkeri Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0411

Edible '**|giru.s**' or caterpillars (Saturniidae, *Usta Wallengrenii*) are abundant on this species in rainy season.

The Herero name omunangui was recorded from Purros Damara in Sesfontein; onangwi is recorded for *C. merkeri* Engl. in Malan and Owen-Smith (1974: 152).

C. *saxicola* Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0055

ǁGâi (recorded in Sesfontein, e.g. from Purros (originally !Oe-≠gaa) Damara); **≠gauga-ame**, described as a !Narenin name, and **po-e**, described as a Nama term, recorded from ǁkhaoa-a and Namib/!Naren Damara in Sesfontein; **≠gauga-ame.s** (recorded from ≠Ao-Dama, Rietkuil Farm); **ani** (= bird)**ǁhan** (recorded from ǁKhaoa-a Damara in Sesfontein); **|oohai.s** or **tines** (means to pick up) (recorded fromTsoaxau Damara at ǁGaisoas, Ugab River); **tine.s** recorded from Dâureb Damara at Gudipos, Ugab River, who state that **tine.s** is different from, but similar to, **|oohai.s**; **tine.s** (plant) and **po-e** (seeds) (recorded from Dâureb Damara at ǁGaisoas, Ugab River).
The fruits are eaten when they become red (recorded from ǁkhaoa-a, Namib/!Naren Damara in Sesfontein, Tsoaxau Damara at ǁGaisoas, and Dâureb Damara, Ugab River, and in Steyn and du Pisani, 1984/1985: 44). The stem can be consumed for its thirst-quenching properties (it contains 'too much sweet water') (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River, and for the Topnaar by Dentlinger, 1977: 35). **|Giru.s** caterpillars (Saturniidae, *Usta wallengrenii*) are abundant on this species in the rainy season.
This is taken as medicine for tonsils (recorded from ǁKhaoa-a Damara in Sesfontein).
Goats eat (recorded from ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm).

The Herero name omubiri was recorded from Purros Damara in Sesfontein)

An extract from the leaves contains the most promising anti-tumor properties of all the southern African plants analysed so far (National Chemical Research Laboratory, CSIR in Van der Walt, 1974: 20).

Commiphora cf. *tenuipetiolata* Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0445

Po-e (recorded from Namib/!Naren Damara in Sesfontein); **!uri |huu.s** (recorded from Dâureb Damara in Sesfontein).

The fruits are eaten (recorded from Namib/!Naren Damara in Sesfontein and in Steyn and du Pisani, 1984/1985: 44).

The wood is used to make-'**≠gou.b**', i.e. winnowing bowls (recorded from Dâureb Damara in Sesfontein and in Steyn and du Pisani, 1984/1985: 44).

The Herero name omungorua was recorded in Sesfontein; Malan and Owen-Smith (1974: 152) record the names omongorwa and omuhangorwa for *C. angolensis*.
The fruits and leaves are good fodder (recorded in Sesfontein).The bark is used by Herero for softening and tanning leather. It is rubbed on the inside of the animal skin after pounding and mixing with water (recorded in Sesfontein).
When the man who is responsible for looking after the holy fire dies, a branch from this species is cut and placed next to the holy fire to indicate his death (recorded in Sesfontein).
If you cut a branch and replant it, it will grow (recorded in Sesfontein).

The fruits of *Commiphora* spp. are eaten in Ethiopia (Getahun, 1974: 51).

C. virgata Engl.
FSWA: 700 BRI: 4151 Author's coll. no. SS0059
|âna.s/n (recorded throughout former Damaraland and as *C. krauseliana* by Van den Eynden *et al*, 1992: 67); also called **anto.b** by |Khomani Damara, Malansrust Farm and Tsoaxau Damara at ǁGaisoas, Ugab River; **soba** (recorded from ≠Ao-Dama, Rietkuil Farm).

Haira or gum can be eaten from this species (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River); similarly, the resin is eaten from *Commiphora* spp. by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148). Edible '**|giru.s**' or caterpillars (Saturniidae, *Usta Wallengrenii*) are abundant on this species in the rainy season.

Used for a variety of medicinal purposes throughout former Damaraland: a decoction of the leaves, bark and stem is taken for coughs and colds, general strength and good health, restoring maternal health after child-birth, stomach disorders and for hearts and chest pain. It's very strong and bitter so a spoonful is taken at midday and night (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River). Water in which plant parts have been soaked is used for washing to promote good health (recorded in Sesfontein) and is used for washing the body of women after childbirth (recorded from Namib/!Naren in Sesfontein). If somebody has died when a woman has just borne a baby she is washed in water in which this plant has been soaked for good luck (recorded from ǁkhaoa-a Damara in Sesfontein, Dâureb Damara at Gudipos, Ugab River). Van den Eynden *et al* (1992: 67) report that a decoction of this species is used to treat coughs, palpitations and chest pains, and the plant is thought to bring luck.

The gum is used as **sâi** like **herare**, i.e. *C. wildii* (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River). The bark is used for **sâi** (recorded from Dâureb Damara in Sesfontein and ≠Ao-Dama at Rietkuil Farm) and often mixed with other **sâi** plants (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River). The powdered bark is also used as body perfume by Himba women (Malan and Owen-Smith, 1974), often in a mix including the species 'otjindundu' and 'omone' (recorded in Sesfontein).

Goats eat (recorded from ≠Ao-Dama at Rietkuil Farm) and the wood from this species is used for making '**ǁhoe.s**' or buckets (recorded along the Ugab).

The Herero name for this species is omumbara (recorded in Sesfontein by Herero and Purros Damara, and by Malan and Owen-Smith, 1974: 152).

This species is recorded as host to a large edible caterpillar called 'oruwowo' (Malan and Owen-Smith, 1974: 152).

Root, bark or twigs are chewed, sometimes after cooking, to aid digestion after eating too much meat (recorded in Sesfontein).The leaves are browsed by livestock and the twigs are used as toothbrushes (Malan and Owen-Smith, 1974: 152).

The roots of *C. africana* (A. Rich). Engl. are added to 'various concoctions' to treat gastrointestinal problems by Luo herbalists in east Kenya (Johns *et al*, 1990: 379). Cold water in which the bark of a *Commiphora* sp. (l-ampurrorri) has been soaked is drunk by Samburu pastoralists to treat stomach upsets and a tea of *C. africana* is drunk for diarrhoea ('children's stomach'), and a decoction of *Commiphora* sp. (loitokutok) bark is drunk to treat hepatitis; the stewed bark and leaves of *Commiphora* sp. (l-teroi), to which milk has been added, are applied as a poultice to relieve swelling; a decoction of the bark of *Commiphora* spp. (l-maim and l-teroi) is drunk in the treatment of polio (Fratkin, 1996: 75-77). *Commiphora* spp. are used for a variety of purposes by Gabra pastoralists in north Kenya including: *Commiphora* spp., particularly *C. africana*, are important in the production of objects of material culture, *C. myrrha* (Nees) Engl. is used medicinally and ritually and *C. boiviniana* Engl. and *C. habessinica* (O. Berg) Engl. produce minor food items (Stiles and Kassam, 1991: 23, 31).

C. wildii Merxm.
FSWA: 700 BRI: 4151 Author's coll. no. SS0056
Herare (recorded in Sesfontein); recorded as **anto.b** by Dâureb Damara in Sesfontein and as **tine.b** by Dâureb Damara at Gudipos, Ugab River.

Edible '**|giru.s**' or caterpillars (Saturniidae, *Usta Wallengrenii*) are abundant on this species in rainy season.

The aromatic **'haira'** or gum of **herare** is pound into a powder and added as a **'sâ.i'** or perfume to fat (**≠gîna**) or bought body creams such as vaseline (recorded in Sesfontein, e.g. from ǁkhaoa-a, Ṋamib/!Naren, Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Goats eat (recorded from Dâureb Damara in Sesfontein).
The stems are chewed for moisture when herding (recorded in Sesfontein).

Two Herero names were recorded; omuwonga (recorded in Sesfontein) and omuhatji (recorded from Purros Damara in Sesfontein).

The fruits are described by Herero as edible, but they're mostly eaten by birds (recorded in Sesfontein).

Commiphora sp. Jacq.
FSWA: 700 BRI: 4151 Author's coll. no.
!Uri (white) |huu.s = is not as aromatic but the rotting wood is ≠gae and is used as sâi (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River).

Goats eat and the wood is used for carving utensils (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River).

CAPPARACEAE

Boscia albitrunca (Burch.) Gilg & Benedict
FSWA: 470 BRI: 3106 Author's coll. no. SS0118
Commonly known as **|huni.b/s** (see also du Pisani, 1978: 15, 1983: 6; Eiseb *et al*, 1991: 20, 25; Van den Eynden *et al*, 1992: 69); also referred to as **ǁowo |huni.b** or **ǁopo |huni.b** (Eiseb *et al*, 1991: 20, 25).

The fruits are eaten throughout former Damaraland especially from August to October (cf. Steyn and du Pisani, 1984/1985: 44) and a drink can be made out of the juicy fruits (recorded in Sesfontein and by Van den Eynden *et al*, 1992: 69). The dried root-bark is pounded and boiled with water as a coffee substitute (recorded in Sesfontein, and from Dâureb Damara at Gudipos, Ugab River; also in du Pisani, 1978: 15, 1983: 6; Steyn and du Pisani, 1984/1985: 44). A cold drink can also be made from the roots, sap and water, and is known by its otjiHerero name, 'omburunga' (recorded in Sesfontein). The fruits soaked in water are poured over bread dough to give it flavour (du Pisani, 1983: 6). The Nama are recorded as using the fruits for beer brewing (du Pisani, 1983: 6).

Washing in water in which the leaves have soaked, together with those of **|ânas** (*Commiphora virgata*, Burseraceae) is considered to bring good fortune (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River) and a decoction of the leaves is dripped into the ears to relieve earache by the Kuiseb River Topnaar (Van den Eynden *et al*, 1992: 32).
The flowers, leaves and seeds are considered good fodder for goats (recorded throughout former Damaraland).
The wood is recorded in Sesfontein as providing good straight building poles.

The following Herero names have been recorded for this species omutendereti, epembati (recorded in Sesfontein); omungwindi, omurembwe and omutendereti (Malan and Owen-Smith, 1974: 154); omunguindi (Kajujaha- Matundu, 1994).

The fruits eaten and soaked in water with honey or sugar make a sweet non-alcoholic, or slightly alcoholic, drink (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 154). Small pieces of bark may also be added (recorded in Sesfontein). When food is scarce, the roots are pounded, dried and ground into a fine powder which is mixed with grain foods and cooked into a porridge (Malan and Owen-Smith, 1974: 154). Root used to separate cream and promote beer fermentation (Malan and Owen-Smith, 1974: 154).

Fruit and leaves provide good browse (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 154), and donkeys eat the bark (Sesfontein).

The roots can be used to make milk pails (recorded in Sesfontein) and is used to separate cream and promote beer fermentation (Malan and Owen-Smith, 1974: 154).

The fruit is eaten by the Nharo (Steyn, 1981: 9 and Story, 1950 in Steyn, 1981: 26).The fruits are eaten raw (and sometimes roasted?) by the !Koo San (Heinz and Maguire, 1974: 41), the fruits and leaves are eaten by the |Gwi and ‖Gana San (Tanaka, 1976: 117), and the fruits are eaten by !Kung San (Marshall, 1976: 113; Lee, 1979: 160). The fruit and root of this species are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148) and the fruit of *B. octandra* (Hochst. ex Hamta) Schwfth ex Radik. is eaten in Ethiopia (Getahun, 1974: 51). The flowers and leaves of *Boscia* spp. are consumed by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 47).The fruit of *B. coriacea* Pax is consumed by Turkana pastoralists (Morgan, 1981: 101) and the fruit of this species is considered among the most important food species for Turkana (Becker, 1986: 63). The fruit of *B. senegalensis* (Pers.) Lam. ex Poir. is considered among the most important foods for Senegalese Ferlo (Becker, 1986: 63) and has a high incidence of use among Malian pastoralists, particularly Tamasheq (Berge and Hveem, 1992: 13).

The boiled roots are added to milk and consumed by Samburu pastoralists in the treatment of malaria (Fratkin, 1996: 78).

B. foetida Schinz *foetida*

FSWA: 470 BRI: 3106 Author's coll. no. SS0116, SS0356

Xaube.s (recorded throughout former Damaraland; see also du Pisani 1983: 6; Eiseb *et al*, 1991: 20, 25); **xaube |huni.s** (recorded from |Khomani Damara at Malansrust Farm and in Eiseb *et al*, 1991: 20, 25; Van den Eynden *et al*, 1992: 69).

'**Xaube.s**' means 'bad smell' (smells like dung) and refers to smell of this species, as does the specific name '*foetida*'.

The fruits are eaten, especially by children in field (recorded throughout former Damaraland). Fruits are also recorded as eaten in Namaland (du Pisani, 1983: 6) and by the Kuiseb Topnaar (Dentlinger, 1977: 35). The roots are consumed in times of scarcity (as described by Purros Damara in Sesfontein) and are added to **sâu.n** beer as a fermenting agent (recorded from ‖Khaoa-a Damara in Sesfontein).

A decoction made from the leaves or any plant part, after pounding, acts as a laxative for constipation and stomach pain and twigs can be chewed for the same reason (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein, at the farm Palm and from Tsoaxau and Dâure.b Damara at ‖Gaisoas and Gudipos, Ugab River). Half a cup is consumed at a time upto 3 times a day, and it's reported to act quickly. A decoction of the leaves is also drunk to treat coughs (recorded from ‖Khaoa-a Damara in Sesfontein). |Khomani Damara at Malansrust farm pound and cook the stem and leaves in water and put a drop of this extraction into ears for earache, upto 3 times a day (also recorded from ‖Khaoa-a, Namib/!Naren and Dâure.b Damara in Sesfontein), and wash the body in a wash of this extract to 'rid you of unlucky things if you've been away for a long time'. A decoction is also drunk to treat coughs (recorded along the Ugab). Van den Eynden *et al* (1992: 69) record the use in Sesfontein of a decoction of the leaves and twigs to relieve stomach pain and cold symptoms, while the Topnaar of the Kuiseb use the same preparation to bathe sore ears and eyes (p. 32).

The leaves, fruits and tips of young branches are excellent forage for goats (recorded throughout the former Damaraland).

The Herero name is otjinautoni (recorded in Sesfontein and by Malan and Owen-Smith, 1974: 154); large forms are referred to as omungwindi, i.e. the same name as *B. albitrunca* (Malan and Owen-Smith, 1974: 154).

Malan and Owen-Smith (1974: 154) record that the fruits are eaten (also recorded in Sesfontein) and can be made into a non-alcoholic drink. When alternative food is scarce, roots can be ground into a flour which is added to available grain and cooked into a porridge. The roots can also be used to separate cream and promote beer fermentation.

The twigs are boiled into a decoction to treat coughs and colds (recorded in Sesfontein).Fruits and leaves are important browse (Malan and Owen-Smith, 1974: 154).Roots used to separate cream (Malan and Owen-Smith, 1974). Roots promote beer fermentation (Malan and Owen-Smith, 1974).

The fruit of *B. foetida* subsp. *rehmanniana* is eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148).

B. microphylla Oliv.
FSWA: 470 BRI: 3106 Author's coll. no. SS0378
Seen as indistinguishable from *Boscia foetida* and called **xaube.s** (recorded from ǁKhaoa-a, Dâureb Damara in Sesfontein, Tsoaxau and Dâureb Damara on the Ugab River).

The fruits are eaten (recorded from Dâureb Damara at ǁGaisoas, Ugab River, and in Sesfontein).

An extraction o f the leaves is poured into the ears to treat earache (cf. *B. foetida*) (recorded from ǁKhaoa-a Damara in Sesfontein) and a decoction of the leaves is drunk for stomach pain (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River).

Cadaba schroeppeli Suess.
FSWA: 470 BRI: 3109 Author's coll. no. SS0155
ǁGoberue (**ǁgob** means crooked and refers to the crooked shape of this species) (recorded from Dâureb Damara at ǁGaisoas, Ugab River); **ǁGabi** recorded from ǁKhaoa-a Damara, but this is alternatively described as a short plant. Recorded as **xaube.s** by ǁKhaoa-a, Dâureb, Namib/!Naren and Purros Damara in Sesfontein due to its close similarity with *Boscia foetida*.
Fodder for goats (recorded from Dâureb Damara at ǁGaisoas, Ugab River).

The Herero name of okahuno kondo was recorded in Sesfontein

Capparis hereroensis Schinz
FSWA: 470 BRI: 3101
Siru.b (Van den Eynden *et al*, 1992: 33).

The fruits are eaten by Kuiseb Topnaar (Van den Eynden *et al*, 1992: 33).

Cleome angustifolia Forsskal *diandra* (Burch.) Kers
FSWA: 470 BRI: 3082 Author's coll. no. SS0124
Tuhorabe (**tu** means rain) (recorded from ǁKhaoa-a Damara in Sesfontein); **≠hobo≠hobo**, **!hunihai.b** (**!huni** = yellow, i.e. the colour of the flowers) (recorded from Purros Damara in Sesfontein); **xamhai.b** (**xam** = lion) (recorded from Dâure.b Damara from ǁGaisoas on the Ugab River).
This plant makes a bad smell when burned and is put on the fire to keep lions away (recorded from Dâure.b Damara at ǁGaisoas on the Ugab River).

Chewed by traditional healers (not others) to make them strong/powerful (recorded from ǁKhaoa-a Damara in Sesfontein).

C. foliosa Hook. f. *foliosa*
FSWA: 470 BRI: 3082 Author's coll. no. SS0042, SS0083, SS0274
Saida.b (recorded from ǁKhaoa-a Damara in Sesfontein), **!khauro.b** (recorded in Sesfontein); **sanana.b** (recorded from Purros Damara at Sesfontein, Tsoaxau Damara at ǁGaisoas, Ugab River and Dâureb Damara from Gudipos, Ugab River); Dâure.b Damara from ǁGaisoas state that this name refers to SS0083, i.e. a tall-growing herb while **|homexarebe** is the name of SS0042 which is a short herb with oily hairs (**|hom** = oil)); **≠hobo≠hobo**, **!hunihai.b** (**!huni** = yellow, i.e. the colour of the flowers) (recorded from Purros Damara in Sesfontein); **sâhai.b** (**sâ** = perfume) (recorded from Namib/!Naren and Purros (originally !Oe-≠gaa) Damara in Sesfontein).

'**Sa**' means 'sticky' and the name refers to the fact that the plant is sticky to touch.

Can be used for '**sâ.i**' by drying and crushing the whole plant into a powder, and is recognised as a '**sâ-haib**' or perfume-plant (recorded from ǁKhaoa-a and Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Goats eat this plant (recorded in Sesfontein, e.g. by Purros (incl. originally !Oe-≠gaa) Damara, and from Tsoaxau and Dâure.b Damara at ǁGaisoas and Gudipos, Ugab River).

The Herero name of okaberehi was recorded from Purros Damara in Sesfontein.

C. gynandra L.

FSWA: 470 BRI: 3082 Author's coll. no. SS0152

!Khauro.b (used by Purros Damara in Sesfontein); **≠hobo≠hobo**, **!hunihai.b** (**!huni** = yellow, i.e. the colour of the flowers) (recorded from Purros Damara in Sesfontein); **goma |horo.b**, **gomabe.b** (Eiseb *et al*, 1991: 18, 26), i.e. **|horo.b** refers to spinach cf. *Amaranthus* sp. and is a reference to the knowledge that the leaves of this species are edible, although Damara people strongly prefer not to eat them.

Described as a **sâ-hai.b** or perfume plant by Purros Damara in Sesfontein.

Fodder for goats and sheep (recorded in Sesfontein).

The Herero name ekurukaze was recorded from Purros Damara in Sesfontein and ombowa is recorded in Malan and Owen-Smith (1974: 154).

Stem and leaves are eaten by the Himba of Kaokoveld as relish and may be dried into cakes or omavanda for future use (Malan and Owen-Smith, 1974: 154). Similarly, the leaves are eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249) by Maasai and Kipsigis (Glover *et al*, 1966: 192) and in Ethiopia (Getahun, 1974: 50).and the leaves of *Cleome* spp. are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 46). The consumption of leaves as a vegetable is believed to be good for stomach problems by Luo of east Kenya (Johns *et al*, 1990: 379).

Cleome sp. L.

FSWA: 470 BRI: 3082

ari-‖gaube.b/s (recorded in Sesfontein), '**ari**' means 'dog' and '**‖gaube.s**' is *Amaranthus thunbergii*, i.e. a plant which is eaten as spinach, so the name describes a '**‖gaubes** that is not eaten by humans'.

Maerua juncea Pax *juncea*

FSWA: 470 BRI: 3082 Author's coll. no. SS0367

|Aohai.b, i.e. snake (**|ao**) plant (**hai.b**), recorded from Purros Damara in Sesfontein. Eiseb *et al* (1991: 20, 28) report that this species is called **|aohai.b**, **|ao!uwu.b** or **|ao!ubu.b**.

The fruits are eaten along Ugab River (Steyn and du Pisani, 1984/1985: 45).

A decoction from the stem is drunk for heart problems such as palpitations (**|hara**) and diarrhoea (half a cup drunk in the morning and evening for 3 days) (recorded from Purros Damara in Sesfontein). Also used in Sesfontein as used as an unspecified medicine for goats.

The Herero name is omupangambura which means to doctor (-panga) the rain (-ombura), and refers to the belief (although not commonly practised) that burning the tendrils of this plant can halt rain during floods(Malan and Owen-Smith, 1974: 154).

M. schinzii Pax

FSWA: 470 BRI: 3082 Author's coll. no. SS0038, SS0069, SS0120, SS0353, SS0360

Korada.b (recorded throughout former Damaraland and in Eiseb *et al*, 1991: 18, 28); **koratsab** (recorded from Dâureb Damara at ‖Gaisoas and Gudipos, Ugab River, and ≠Ao-Dama at Rietkuil Farm.); **‖goberue** (recorded by a ‖Khao-a Damara in Sesfontein); **goarda.b** (Eiseb *et al*, 1991: 18, 28; Van den Eynden *et al*, 1992: 70)

The young pods are sweet inside and can be eaten (recorded from Tsoaxau and Dâureb Damara at ‖Gaisoas and Gudipos on the Ugab River, ‖Khaoa-a Damara in Sesfontein).

A decoction from the pounded leaves is drunk to treat coughs (recorded from Purros, and Namib/!Naren Damara in Sesfontein), used to wash sore or infected eyes (both uses recorded in Sesfontein, e.g. by Purros (originally !Oe-≠gaa) and ‖Khaoa-a Damara from Sesfontein). Boils, especially on the head, are treated with a powder of the dried leaves (recorded along the !Ugab, e.g. by Dâureb Damara at Gudipos). A big handful (**kai garase**) of the leaves is used for these preparations and half a cup of the decoction can be drunk 2 to 3 times a day (recorded from Purros Damara in Sesfontein). A decoction from the roots is poured into ear to relieve ear-

ache (recorded in Khowarib and from ǁKhaoa-a, Dâureb, Namib/!Naren, Purros (originally !Oe-≠gaà) Damara in Sesfontein). The root is also used to treat bladder pain (recorded from Purros (originally !Oe-≠gaa) Damara from Sesfontein). A decoction from the roots is also considered to be an important medicine for men should they become sick after sleeping with menstruating women. It is believed that sleeping with a menstruating woman has the power to kill a men through causing a sickness in the abdomen and bleeding from the mouth, nose and penis; **korada.b** medicine cleanses the man by acting as a diuretic (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River). A body wash with the leaves is good for general health and when someone dies (recorded from ≠Ao-Dama at Rietkuil Farm, |Khomani Damara, Malansrust Farm). Van den Eynden *et al* (1992) record the use of a leaf decoction to treat coughs and the use of a root decoction to treat earache in Sesfontein (p. 70), and the use of a body-wash from the leaves to treat skin disorders such as acne and fevers by the ≠Aonin along the !Kuiseb (p.34).

Leaves and pods are good fodder for goats (recorded throughout former Damaraland).

A decoction of the leaves is used as a substitute for soap by the !Kuiseb ≠Aonin (Van den Eynden *et al*, 1992: 34).

A Herero tradition is reportedly that you shouldn't sit under this tree because it's a medicine tree (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River).

The Herero name is etengu (recorded from Herero and Purros Damara in Sesfontein and by Malan and Owen-Smith, 1974: 154); also omutengu and omuhaseviwa (recorded in Sesfontein).

'Omuhaseviwa' means 'don't sit in the shade' of this tree as there is a superstition that a person must not sit in the shade of this species without first cutting a branch from a mopane (*Colophospermum mopane*) tree and hanging it from one of the *M. schinzii* branches. This may be related to the observation that 'etengu' seedlings often grow in association with mopane trees, this being thought to prevent giraffe from eating their bark as they are observed to do (recorded in Sesfontein).

Browsed by both small and large stock (Malan and Owen-Smith, 1974: 154).

The leaves are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249) as are the leaves of *M. angolensis* DC. by Bemba and Lamda peoples of southern Shaba, Congo (Malaisse and Parent, 1985: 50). The fruits of *M. edulis* (Gilg & Bened.) De Wolf are eaten by Kipsigis children and the roots are pounded and used in soup (Glover *et al*, 1966: 192), and the fruit of *M. subcordata* are eaten by Turkana pastoralists (Morgan, 1981: 101) while the root is recorded as a famine food in semi-arid east Africa (Kabuye, 1986: 69). The chewed leaves *of M. triphylla* A. Rich. are placed on wounds by Samburu healers (Fratkin, 1996: 77).

CELASTRACEAE

Maytenus senegalensis (Lam.) Exell

FSWA: 770 BRI: 4626 Author's coll. no. SS0379

Called **pepahai.s** by ǁKhaoa-a Damara in Sesfontein; recorded as **|hoe.b** by Dâureb Damara in Sesfontein but this name is usually given to a type of thorn tree; **|hurube** (**|huru** means brackish and refers to the taste of the fruits) (recorded fromTsoaxau Damara at ǁGaisoas, Ugab River); **!goo!goo.b**, **!oo!oo.b** (Eiseb *et al*, 1991: 23, 28)

The seeds are eaten after rubbing (**!nobo**) the skins off; it grows at !Aoǁaexas (recorded fromTsoaxau Damara at ǁGaisoas, Ugab River).

The Herero name is omutungavimbara, so-called because the spines are used for weaving (-tunga) basketware dishes (ovimbara) (Malan and Owen-Smith, 1974: 154).

The roots are cooked as a vegetable with meat broth by the Maasai (Glover *et al*, 1966: 192) and the fruit/seeds of *Maytenus* spp. are eaten in Ethiopia (Getahun, 1974: 52). A soup of the roots is drunk by Samburu pastoralists for the treatment of muscular-skeletal aches (Fratkin, 1996: 77).

CHENOPODIACEAE

Suaeda plumosa Aellen
FSWA: 320 BRI: 2261 Author's coll. no. SS0323
≠**Au.b** (recorded along the !Ugab River where this species is common).

This species is browsed by livestock.

COMBRETACEAE

Combretum apiculatum Sond. *apiculatum* Exell
FSWA: 990 BRI: 5538
≠**o.n** (recorded at Khowarib); **!gari-hai.s** (recorded by Purros Damara from Sesfontein) Eiseb *et al* (1991: 24, 27) record the name ≠**oo.b/s** for *C. apiculatum* subsp. *apiculatum.*
'**!Gari**' means 'hard' and refers to the fact that branches of this species are extremely difficult to break.
Browsed by livestock (recorded in Sesfontein).

Malan and Owen-Smith (1974: 154) record the Herero name of omumbute for this species: the ground dry leaves are applied by Himba as a powder to the umbilical cord after childbirth; an extract from the bark is used as a leather tanning agent.

The gum is eaten by !Kung San (Story, 1958 in Marshall, 1976: 122; Lee, 1979: 162) and the resin is eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148).

C. imberbe Wawra
FSWA: 990 BRI: 5538 Author's coll. no. SS0294
Known throughout former Damaraland as **!haa.s/b** (see also du Pisani, 1978: 15; Eiseb *et al*, 1991: 23, 26; Van den Eynden *et al,* 1992: 70).

A decoction of leaves and/or bark is widely used as a treatment for coughs and colds, and chest pains (see also Van den Eynden *et al,* 1992: 70) (but |Khomani Damara at Rietkuil farm and Tsoaxau Damara at ǁGaisoas, Ugab River, state that its effectiveness is compromised if you smoke or drink alcohol) and similarly for stomach disorders (recorded in Sesfontein). A wash of the pounded leaves added to cold water is used to bathe sore eyes (recorded from ǁKhaoa-a Damara in Sesfontein).

The leaves are good browse (recorded in Sesfontein, Tsoaxau and Dâureb Damara at ǁGaisoas, Ugab River, and ≠Ao-Dama, Rietkuil Farm).

The leaves and bark used as a green leather tanning agent by crushing, adding water and smearing onto inside of animal skins (recorded in Sesfontein, Khowarib and fromTsoaxau and Dâure.b Damara at ǁGaisoas, Ugab River and by Steyn and du Pisani, 1984/1985: 44). Steyn and du Pisani (1984/1985: 44) also describe this tree as providing good firewood and building poles.

The Herero name is omumborombonga (recorded in Sesfontein and in Hahn, 1928: 225; Malan and Owen-Smith, 1974: 154); Hahn also reports the name 'tate mukururume' i.e. meaning 'grandfather' or 'first parent'.
smoke from the burning leaves is used to relieve coughs and colds (Coates-Palgrave, 1991: 670).

The wood is a good all-purpose firewood (Malan and Owen-Smith, 1974: 154).
In Kaokoland, this is one of 4 species (including *Commiphora angolensis* and *C. multijuga*) with significance for Himba/Herero ceremonies such as funerals (Malan and Owen-Smith, 1974: 154).

The gum is eaten by !Kung San (Story, 1958 in Marshall, 1976: 122; Lee, 1979: 162). The resin is eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148). The roots of

C. aculeatum Vent. are soaked overnight, added to milk, and consumed by Samburu pastoralists for the treatment of muscular-skeletal aches and gonorrhoea, and the boiled roots are taken for polio (Fratkin, 1996: 77-78).

C. wattii Exell

FSWA: 990 BRI: 5538 Author's coll. no. SS0183a

≠**Nabi** (= dove) **hai.s** (recorded from Dâureb Damara at ‖Gaisoas, Ugab River); recognised as 'a type of **ǀhaa.b**, i.e. *C. imberbe* (recorded from ‖Khaoa-a, Purros (incl. originally !Oe-≠gaa) Damara in Sesfontein).

Browsed by goats (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein). The wood is very hard and used to make axe handles The wood is suitable for making knobkieries (recorded from Purros Damara in Sesfontein). Rock hyraxes eat this species (recorded from Purros Damara in Sesfontein), as do doves (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

The Herero name omutapati was recorded from Purros Damara in Sesfontein and in Malan and Owen-Smith (1974: 155)

The wood is suitable for making knobkieries (Malan and Owen-Smith, 1974: 155) and is a preferred species by the Himba for housebuilding at Purros (Jacobsohn, 1988: 80).

Terminalia prunioides C.Lawson

FSWA: 990 BRI: 5544 Author's coll. no. SS0089

≠**Khee(r)a.s** (recorded throughout former Damaraland and by Eiseb *et al*, 1991: 24, 29; Van den Eynden *et al*, 1992: 70); ‖**gaetahuo** (recorded in Sesfontein, e.g. by ‖khaoa-a, Purros Damara in Sesfontein) and ‖**gaetab** (recorded in Sesfontein and along the Ugab); these names refer to how you easily get hooked on the thorns, i.e. '‖**gae**' means 'hook'.

The exudate is consumed as a snack food (recorded in Sesfontein and Khowarib). The seeds are roasted, ground and used like coffee, i.e. boiled and milk and sugar added (recorded from Tsoaxau Damara at ‖Gaisoas and Dâureb Damara, Ugab River, ǀKhomani Damara, Malansrust Farm). The seeds and seed coat can be eaten raw (Dâureb Damara at Gudipos, Ugab River, Steyn and du Pisani, 1984/1985: 45). The leaves are added to tea (Van den Eynden *et al*, 1992: 70).

A decoction from plant parts, especially the bark is drunk to treat stomach disorders such as diarrhoea, especially for children, (1 teaspoon taken twice a day for 3 to 4 days) (recorded from Purros (incl. originally !Oe-≠gaa) and ‖Khaoa-a Damara in Sesfontein). Bark twine is tied tightly around the belly of a pregnant woman in the belief that this will help prevent miscarrying (recorded in Sesfontein, e.g. from ‖khaoa-a Damara in Sesfontein). The bark is heated and placed as a poultice on injuries to reduce swelling (recorded in Khowarib). The root is pounded and cooked for cough mixture and to treat chest pains and coughs (recorded in Sesfontein, e.g. from ‖Khaoa-a Damara, and along the Aba-Huab) or is chewed or drunk as a decoction to treat colds (Van den Eynden *et al*, 1992: 70). The bark twine is worn around the neck to prevent neck pain. ≠**Gae** from this tree is rubbed onto rashes, e.g. for babies (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River).

≠**Gae**, i.e. fragrant rotten wood, comes from this plant (recorded from Tsoaxau Damara at ‖Gaisoas, Dâureb Damara at Gudipos, Ugab River, ≠Ao-Dama at Rietkuil Farm; ‖Khaoa-a Damara in Sesfontein).

Throughout former Damaraland the pods and leaves of this common species provide important livestock fodder.

The wood is used for knobkierries, which can also be sold (recorded in Khowarib) and the wood is an important firewood (see also Steyn and du Pisani, 1984/1985: 45; Van den Eynden *et al*, 1992: 70).

The Herero name is omuhama (recorded in Sesfontein, from Purros Damara in Sesfontein, from Dâureb Damara at Gudipos, Ugab River and in Malan and Owen-Smith, 1974: 155).

The young twigs are boiled in water and drunk by Himba as 'tea' (Malan and Owen-Smith, 1974: 155). Bark, cooked or uncooked, is chewed to aid digestion and for stomach cramps (recorded in Sesfontein), and Malan and Owen-Smith (1974: 155) additionally record this use in the treatment of sore throats. The spines are made into necklaces worn at night to keep the

neck straight when sleeping (recorded in Sesfontein).
The fruit and leaves are browsed by small and large stock (Malan and Owen-Smith, 1974: 155).

When a child is sick the father must cut a branch and tie it horizontally above the hut door. He then puts a pot of meat in front of the door and he and the child's mother stand on either side of the pot with the mother nearest the door. The lid is removed from the pot and the child is passed back and forth over the pot so that it is bathed in the steam. The whole process is called 'ongaripira', and requires the 'omuhama' branch for its special healing powers (recorded in Sesfontein). When a girl menstruates for the first time, a long branch, preferably with fruit, is wound around the ceremonial shelter and gifts are brought to her and hung on its spines (Malan and Owen-Smith, 1974: 155).

The Nharo eat gum produced by *Terminalia sericea* Burchell ex DC. (Steyn, 1981: 19). The gum of *T. prunioides* is eaten by Dobe-area !Kung (Lee, 1979: 162), as is that of *T. sericea* is eaten (Story, 1958 in Marshall, 1976: 122; Lee, 1979: 162).

CONVOLVULACACEAE

FSWA: 1160 Author's coll. no. SS0355
≠Nabi-hai.s, meaning 'dove-plant', recorded from Purros Damara from Sesfontein.

Bonamia schizantha (Hallier f.) A.Meeuse
FSWA: 1160 BRI: 6979 Author's coll. no. SS0295
Sorobe (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

This plant provides fodder for goats and cattle (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Ipomea cf. *obscura* (L.) Ker.Gawl.
FSWA: 1160 BRI: 7003 Author's coll. no. SS0278, SS0456
The Herero name of orujava was recorded from Purros Damara in Sesfontein.

CUCURBITACEAE

Acanthosicyos horridus Welw. ex Hook.f.
FSWA: 940 BRI: 8590
!Nara.b/s (recorded in Sesfontein and in du Pisani, 1983: 4; Eiseb *et al*, 1991: 23, 25; Van den Eynden *et al*, 1992: 34)

The fruit of this species has been utilised as a subsistence item in the Central Namib for at least 8,000 years (Dentlinger, 1977: 3) and is well-known as the staple plant food of the Topnaar or ≠Aonin of the Kuiseb valley who are referred to derogatively by the Nama as '!Naranin' for this reason (see Schultze, 1907: 199-200; Giess, 1966: 107; Dentlinger, 1977; Pfeifer, 1979: 159; du Pisani, 1983: 4-5; Van den Eynden *et al*, 1992: 35 for descriptions of harvesting and preparation of the fruits for consumption). It appears that the ≠Aonin formerly recognised hereditary tenure rights to !nara patches (Schapera, 1930: 291 in Dentlinger, 1977: 29). In Sesfontein it was recorded that the flesh of fruits are/were eaten after having been collected into a bucket, churned, thrown to dry on the ground for approx. 3 days, after which the dried 'cake' (or **≠goa-garibe.b** in Dentlinger, 1977: 28 and du Pisani, 1983: 5) is rolled up and is ready to eat. This product is described in Sesfontein as 'it's Topnaar cattle', i.e. it is regarded highly as a substitute for cattle milk. The roasted seeds are also eaten; earlier this century they were exported from Walvis Bay to Cape Town where they were eaten like nuts and used by bakers and confectioners (Giess, 1966: 107) and in the 1970s there was a thriving commercial trade in these pips in Swakopmund and from there to Cape Town (Dentlinger, 1977: 18). The root is also recorded as added to beer to aid fermentation (Von Gerard, 1912: 233).

The roots are made into a decoction for kidney and stomach pains (recorded by Purros Damara in Sesfontein and along the Ugab from where it was stated that you have to travel far to find it, and also in du Pisani, 1983: 5). Roots, described as '**aore !nara !noma.b**' (**aore** = male,

!noma.b = roots), are taken for 'men's illness'. Versfeld and Britten (1916: 234) also recorded that the stems were used medicinally and necklaces made from the seeds are believed to help chest colds (Dentlinger, 1977: 34). Among the Kuiseb Topnaar eating the fresh fruit is considered to relieve stomach pains, chewing or drinking a decoction of the roots is considered a 'life elixir' and used to treat diseases of the internal organs such as venereal disease, stomach pains, nausea, kidney problems and chest pains, and the crushed root mixed with fat is smeared on wounds to promote healing (Van den Eynden *et al*, 1992: 37).

Oil of the seeds was used by the Kuiseb Topnaar as a skin moisturiser (Moritz, 1970: 7; Dentlinger, 1977: 28). The seeds are considered to be aphrodisiac (Ross, 1971: 175), the odour of a ripe melon is considered to cause milk to congeal (Von Gerard, 1912: 233), and the value of the plant is denoted by special praise songs or **gare-tsanati** (Moritz, 1975, and Budack, 1977 in du Pisani, 1983: 5).

Citrullus ecirrhosus Cogn.
FSWA: 940 BRI: 8598

Tsama.s/b (recorded in Sesfontein and in Van den Eynden *et al*, 1992: 37); **tsama.b** recorded as a general term for the elongated melons of *Citrillus* spp. in Eiseb *et al* (1991: 26).

The melons are eaten, often by adding to porridge (recorded in Sesfontein), the seeds are roasted and eaten (Van den Eynden *et al*, 1992: 38) and **tsama.s** generally can be buried under the fire at night to bake and the liquid drunk when they have been dug out the following morning (Hildesheim, 1986: 333).

C. ecirrhosus or the desert tsamma are poisonous when consumed raw (Giess, 1966: 107).

C. lanatus (Thunb.) Matsum. & Nakai
FSWA: 940 BRI: 8598

Tsama.b/s, **|otsama.b** (du Pisani, 1983: 7); **au(se)tsama.s** (Eiseb *et al*, 1991: 18, 26).

The melons were eaten in the past by the Nama (Schultz, 1907; du Pisani, 1983) and the fruits are recorded as eaten raw or cooked by Damara along the Ugab River (Steyn and du Pisani, 1984/1985: 44).

A decoction of the pounded root is given by the Nama to goat and sheep ewes to help with expellation of the afterbirth (du Pisani, 1983: 7).

The San consume the flesh of this melon as a source of water (Giess, 1966: 107) and the Nharo eat the flesh of the melon either raw or roasted and the seeds are eaten after roasting and pounding (Steyn, 1981: 10). *Citrullus* spp. melons, including *C. lanatus*, are also eaten for their moisture and sugar by the !Kung, |Gwi and ‖Gana San (Marshall, 1976: 120; Tanaka, 1976: 117; Lee, 1979: 167).

The fruit of *C. lunatus* (Thunb.) Mansf. and the root of *C. colocyntinis* (L.) Schrad. are eaten in Ethiopia (Getahun, 1974: 52, 55).

The fruits are eaten by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25).

Coccinia cf. *sessilifolia* (Sond.) Cogn.
FSWA: 940 BRI: 628

|Ha.s, **|kiros** (fruits) (recorded along the Ugab); **|aa.n** (recorded at Khowarib); **|haa.b** (plant), **|gairo.b** (fruit) = *C. sessilifolia* (Eiseb *et al*, 1991: 20, 26); **|ha.b** = *Coccinia* sp. (in Van den Eynden *et al*, 1992: 71).

The fruits are eaten (recorded in Khowarib and along the Ugab). Van den Eynden *et al* (1992: 71) record that the tuberous rootstock is eaten in Sesfontein.

Eaten by livestock (recorded in Khowarib).

It is described as growing like a creeper on trees. The fruits are likened to grapes.

The Herero name is otjimaka; the fruits are eaten raw and the tubers are roasted and eaten (Malan and Owen-Smith, 1974: 155).

The Nharo eat the fruits (Bleek, 1928 in Steyn, 1981: 23). The fruits or cucumbers and tubers of this species and *C. rehmannii* Cogn. are eaten by the !Kung San of Nyae Nyae (Marshall, 1976: 109-110, 118). Lee (1979: 164, 167) records the consumption of tubers of *C. rehmannii* as a major food resource, and of 2 unidentified *Coccinia* species, and of the cucumbers of *C. sessilifolia* by Dobe-area !Kung. The roasted tuber of *C. rehmannii* is also eaten by the !Koo, |Gwi and ‖Gana San (Heinz and Maguire, 1974: 41; Tanaka, 1976: 117).

The fruit of *C. rehmannii* is eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148) and those of *C. adoensis* (A. Rich.) Cogn. are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 47).

The fruit of *C. grandis* (L.) Voigt and the starchy root of *C. abyssinica* W & A are eaten in Ethiopia (Getahun, 1974: 52, 55).

Dactyliandra welwitschii Hook.f.
FSWA: 940 BRI: 8563 Author's coll. no. SS0187, SS0204
Sorobe (recorded in Sesfontein) This is also the name recorded for *Solanum incanum;* the two species have superficially similar fruits.
Browsed by livestock (recorded in Sesfontein).

Trochomeria macrocarpa (Sond.) Hook.f. *vitifolia* (Hook.f.) R.R. & A.Fern
FSWA: 940 BRI: 608
Called '**|hai-i**' by the Nama (du Pisani, 1983: 12).
The root-fibre is roasted and eaten in Namaland (du Pisani, 1983: 12).
An extract prepared from boiling the root (?) in water is taken to treat diarrhoea in Namaland (du Pisani, 1983: 12).

Ohona, also the name of *Corallocarpus welwitshii* (Naudin) Hook. F., Cucurbitaceae, is recorded as the Herero name in Malan and Owen-Smith (1974: 155).
For this species and *C. welwitschii* the tuberous roots are roasted and eaten by the Himba, the stems and leaves are cooked in water or milk and eaten and the fruits are eaten cooked or raw (Malan and Owen-Smith, 1974: 155).
The stem and leaves are relished by livestock (Malan and Owen-Smith, 1974: 155).

CYPERACEAE

Cyperus marginatus Thunb.
FSWA: 1650 BRI: 459 Author's coll. no. SS0321
|Haru.s/b (recorded in Sesfontein and along the Ugab, and in Van den Eynden *et al*, 1992: 71, and as the name for *Juncus rigidus* Desf., Juncaceae, and *Scirpus dioecus* (Kunth) Boeck. in du Pisani, 1983: 9); the Nama name **!khowobe.s** is recorded in Haacke (1982) and **!khowobe.s** or **!khopobe.s** in Eiseb *et al* (1991: 23, 26).
Portions of the root material are warmed and then placed as a poultice around the throat of someone with a sore-throat or mumps (recorded from ≠Ao-Dama, Rietkuil Farm).
|Haru.b is a favoured house-building material among the Nama who go to a place called **|narab di ‖gams** near Sesfontein to collect it (recorded in Sesfontein). The stalks are used for making mats (Haacke, 1982), making baskets for storing plant foods (Steyn and du Pisani, 1984 |1985: 44) and as thatch (Van den Eynden *et al*, 1992: 38, 71). Du Pisani (1983: 9-11) records the use of *Juncus rigidus* and *Scirpus dioecus* by the Nama in woven mats used to cover huts known as **|haru-omti** (i.e. **|haru**-homes) (following Schultze 1907; Büttner, 1976 (1884)).

Where this plant grows it is considered to indicate that there is water close to the surface which you will be able to reach by digging with a digging stick.

Ondeka is the Herero name which refers to *Scirpus dioecus*; in Kaokoveld, this species is grazed by cattle and 'A Herero superstition holds that elephants will be attracted to the spring if

this grass (*sic*) is pulled out (Malan and Owen-Smith, 1974: 156).

Cyperus sp. L.

FSWA: 1650 BRI: 459

!Ha.n (recorded in Sesfontein and in du Pisani, 1983: 7); **!kha.n** (recorded along the Ugab); **!hann** are described as edible underground bulbs in Vedder (1923: 67-71); Steyn and du Pisani (1984/1985: 39-40) following Dinter (1912: 7) describe **!hann** as *C. edulis* but, according to Kohlberg *et al* (1992) this species does not occur in Namibia; **!han.i** is used for *C. esculentus* in Eiseb *et al* (1991: 23, 26); **!hanni**, **uintjie** (Van den Eynden *et al*, 1992: 72).

The bulbs are eaten like potatoes (recorded in Sesfontein and along the Ugab) and when consumed raw are good for quenching thirst (recorded in Sesfontein). The Nama consume the bulbs either raw or roasted and the roasted and pound bulbs are used as a coffee substitute (du Pisani, 1983: 7). The Kuiseb Topnaar believe it to be an excellent food for pregnant women (Budack, 1965: 110). Steyn and du Pisani (1984/1985: 44) and Van den Eynden *et al* (1992: 72) report that bulbs of *Cyperus* sp. are eaten by Damara along the Ugab and in Sesfontein respectively. The edible bulbs/corms of *C. fulgens* C.B. Clarke are represented in the archaeological remains at Big Elephant Shelter in the Erongo Mountains (Wadley, 1979: 28).

!Kha.n is said to be very common at **Au kai ǁkhais** near Windhoek.

The Herero names are oseu (plant), ozoseu (bulbs) for *C. fulgens* G.B. Clarke (Malan and Owen-Smith, 1974: 105). The nut-like bulbs are eaten by the Himba and this species is grazed by livestock (Malan and Owen-Smith, 1974: 105).

Giess (1966: 105) describes the collection of *Cyperus* bulbs by women in the centre of Windhoek after the rain season of 1966. The bulbs of *C. fulgens* (n!anni) are eaten by the Nharo either roasted or raw (Steyn, 1981: 11).The bulbs of *Cyperus* sp. near *C. fulgens* are eaten by the !Kung (Marshall, 1976: 110) and Lee (1979: 164) records the consumption of bulbs from *C. fulgens* and *C. rotundus* by Dobe-area !Kung.

The stem of *C. esculentus* and the root of *C. papyrus* L. are eaten by Bemba and Lamda peoples of southern Shaba, Congo (Malaisse and Parent, 1985: 48).The bulbs of *C. esculentus* are eaten in Ethiopia (Getahun, 1974: 55), and those of *C. blysmoides* Hochst. are eaten by Boran children (Kabuye, 1986: 72).

The bulbs of *C. bulbosus* and *Cyperus* sp. are an important source of food for Martujarra Aborigines in Western Australia and large quantities can be stored for about two years (Veth and Walsh, 1988: 22, 25; see also O'Connell, 1983: 84-85).

Cyperus sp. L.

FSWA: 1650 BRI: 459 Author's coll. no. SS0254, SS0265

The bulbs/corms are called **!hare.s** (recorded in Sesfontein and Ugab and described as *C. rotundus* L. in Van den Eynden *et al*, 1992: 72); **ǀarebe.s** is used in dialects from further south (**ǀare.s** refers to *C. rotundus* in Eiseb *et al*, 1991: 26); the plant is considered a **ǀhom ǀgâ.b**, i.e. it forms a dense mat or lawn.

The corms are burned and the smoke inhaled to relieve headaches and a little of the corm is eaten or drunk as a decoction to relieve stomach pain (recorded along the Ugab and in Sesfontein).

The corms are ground into a powder and used as **'sâi'**, i.e. perfume (recorded in Sesfontein and along the Ugab, and in Van den Eynden *et al*, 1992: 72) and are used as aromatic beads, necklaces of which may be sold (recorded throughout former Damaraland). The aromatic roots of *C. longus* L. var. *tenuiflorus* (Rottb.) Kük, a large sedge found on the banks of the Kunene river, are plaited into necklaces by Himba women (Malan and Owen-Smith, 1974: 155: 156).

The Herero name ondao was recorded in Sesfontein for the large sedge-like aromatic root/corm collected from the Kunene River, by a Herero woman from Sesfontein, and brought back to Sesfontein for trading purposes, and was recognised as **!hare.s** by Damara in Sesfontein; onenge is used for *C. longus* var. *tenuiflorus* in Malan and Owen-Smith (1974:

155). This species is grazed by livestock.

DRACANACEAE

Sansevieria aethiopica Thunb.
FSWA: 1470 BRI: 1110
'The Berg-Damaras and Bushmen use it for twine and, for example, make snares of it' (Hahn, 1928: 296).

The Herero name is ongwehe (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 149); onguebe (identified as *S. pearsonii* N.E. Br. in Hahn (1928: 296) who records the name ongwehe-okaandja for *S. cabrifolia* (which, according to Kolberg *et al*, (1992) is not listed for Namibia).
The roots promote separation of milk (Malan and Owen-Smith, 1974: 149).
Hahn (1928: 296) records that *Sansevieria* spp. 'contains a great deal of fibre, and would make excellent cordage'. In Sesfontein it was recorded that the leaves are used for rope/twine and that Himba make clothing from them. The roots are used when separating butterfat for body ointment (Malan and Owen-Smith, 1974: 149).

The Nharo also use the leaf fibres, from which the flesh has been scraped off, to make ropes (Steyn, 1981: 18; see also Bleek, 1928 and Story, 1950 in Steyn, 1981: 24-25). The fibre of *S. scabrifolia* is used for rope and the juicy rhizome is a source of water and the gum is eaten by !Kung San (Story, 1958 in Marshall, 1976: 123). The root is also consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249) and the flowers of *Sansevieria* spp. are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 46). The fibre of *S. robusta* (N.E. Br.) Jake is an important construction material for the Gabra of norh Kenya (Stiles and Kassam, 1991: 22). *Sansevieria* spp. are used medicinally by Samburu pastoralists: juice from the warmed leaves of *S. robusta* is drunk to relieve muscular-skeletal aches, while the boiled roots are mixed with sheep fat and administered as an enema in the treatment of gonorrhoea and for problems with passing urine for women; similarly, the boiled root of *Sansevieria* sp. (lauragi) which is added to milk is drunk to treat muscular-skeletal aches and for problems with passing urine (Fratkin, 1996: 77-79).

EBENACEAE

Diospyros lycioides Desf. *lycioides*
FSWA: 1070 BRI: 6406
Referred to as ≠**hari** by the Nama (du Pisani, 1983: 7).
In the Gibeon area the roasted red seeds were used as a coffee substitute (du Pisani, 1983: 7).
The wood was used by Nama in the manufacture of bridle bits (du Pisani, 1983: 7).

The Herero name is omundumbiri; toothbrushes are made by the Himba from the twigs and roots (Malan and Owen-Smith, 1974: 156).

Euclea pseudebenus E.Mey. ex A. DC.
FSWA: 1070 BRI: 6404 Author's coll. no. SS0286
Known throughout former Damaraland as **tsabi.b/s**, **tsawi.b/s** (see also du Pisani, 1983: 7; Eiseb *et al*, 1991: 20, 27; Van den Eynden *et al*, 1992: 72).
The fruits are eaten but are bitter (**au**) (recorded in Sesfontein, e.g. from ǁKhaoa-a, Namib/!Naren and Purros Damara, and along the Ugab, e.g. by Dâureb Damara at ǁGaisoas and Gudipos).

The Nama are recorded as feeding ripe fruits to fowl as it is considered to harden egg shells (du Pisani, 1983: 8). The leave s and fruit are reportedly relished by livestock in the Kuiseb (Van den Eynden *et al*, 1992: 38).
The twigs of this species are used for teeth-cleaning; it makes the mouth red (recorded in

Sesfontein, e.g. from ǁKhaoa-a and Purros Damara). The seeds are used as beads (recorded from ≠Ao-Damara at Rietkuil farm). The heartwood is hard and is used to make spoons or tumi and pipes (recorded in Sesfontein, e.g. from ǁKhaoa-a and Dâureb Damara, in Khowarib, from Dâureb Damara at ǁGaisoas and Gudipos, Ugab River, and by Van den Eynden *et al*, 1992: 38, 72). Observed as a roofing material at farms on the Aba-Huab and recorded as used for construction purposes by ǀKhomani Damara, Malansrust Farm, and by the Kuiseb Topnaar (see du Pisani, 1983: 7; Van den Eynden *et al*, 1992: 38, 72). Twigs from this species were observed packed into the inner framework of a well (Von Koenen, 1964: 121) and Dâureb Damara at ǁGaisoas, Ugab River, state that it is used to cover water containers as it doesn't make the water bitter. The straight sticks used to be used by Nama children in a popular game called '**ǁara.b**' and for whipsticks (du Pisani, 1983: 7-8). This species is also used for firewood (du Pisani, 1983: 7; Van den Eynden *et al*, 1992: 38, 72).

Jackals eat the fruit (recorded from Namib/!Naren Damara in Sesfontein and Tsoaxau Damara at ǁGaisoas on the Ugab River) as do birds (recorded from Dâureb Damara in Sesfontein). Water occurs where **tsawi.s** grows so that is where boreholes are drilled (recorded from ≠Ao-Dama, Rietkuil Farm).

The Herero name is omuzema; the twigs are used as toothbrushes and stirring sticks by The Himba (Malan and Owen-Smith, 1974: 156)

The fruits of *Euclea* spp. are eaten in Ethiopia (Getahun, 1974: 52). The pounded and boiled roots of *E. divinorum* Hiern. are administered in concoctions to treat venereal disease by Luo herbalists in east Kenya (Johns *et al*, 1990: 379) and for 'congested blood vessels around the stomach' and malaria by Samburu pastoralists (Fratkin, 1996: 75, 77).

EUPHORBIACEAE

Chamaesyce glanduligera (Pax) Koutnik
FSWA: 670 BRI: 4498 Author's coll. no. SS0126, SS0202
dai ǀgame.b (recorded in Sesfontein); **!uruhai.s** (recorded from Purros Damara in Sesfontein).
'**Dai**' means 'milk', referring to the plant's milky latex, and '**ǀgame.b**' is the name of the plant. '**ǀGame**' is also the name of *Geigaria ornativa,* Asteraceae.
Fresh or sun-dried leaves are pounded into a paste and introduced into incisions on the chest to induce breast milk, the milky latex in plant seen as representing the healthy production of breast milk (recorded in Sesfontein, e.g. by ǁKhaoa-a and Namib/!Naren Damara).
Goats eat (recorded from ǁKhaoa-a Damara in Sesfontein).

C. inaequilatera (Sond.) Sojak
FSWA: 670 BRI: 4498 Author's coll. no. SS0099
Also referred to by Purros and ǁKhaoa-a Damara from Sesfontein as '**dai-hai.s**' (see *C. glanduligera*) and **dai ǀnamib** by Dâure.b Damara from ǁGaisoas on the Ugab River; **daitsi!hui.b** (recorded from ≠Ao-Dama, Rietkuil Farm).
The plant is roasted and applied to burns (recorded from ≠Ao-Dama, Rietkuil Farm).
Goats eat (ǁKhaoa-a and Purros Damara from Sesfontein).

The Nharo dry, pound, and mix the leaves of this plant with tobacco, and the mixture is smoked in a pipe shared between a man and the woman he is pursuing in the beief that the smoke from this plant will 'soften her heart' (Steyn, 1981: 12).

Croton gratissimus Burch. *gratissimus*
FSWA: 670 BRI: 4348 Author's coll. no. SS0025, SS0369
!Abubue (recorded in Sesfontein from Dâureb and Namib/!Naren Damara); **!abubuse.b** (recorded from Dâureb Damara at ǁGaisoas and Gudipos, Ugab River); **(!)apupuue.b/s**, **(!)apu(ga)kuue.b/s**, **(!)apu(pe).b**, and the Haiǁom **!apuro.b** in Eiseb *et al* (1991: 22, 26); **ǁgame.b** (recorded from ≠Ao-Dama, Rietkuil Farm).

Used to treat coughs (recorded from Purros Damara in Sesfontein).

The roots and bark are dried and ground into a powder for use as **sâi** (recorded from Dâureb Damara at ǁGaisoas, Ugab River, and from ≠Ao-Dama, Rietkuil Farm).

The Herero name is omumbango; small stock browse the leaves of this plant in Kaokoveld and knobkieries and walking sticks are carved by Himba from the stems(recorded in Malan and Owen-Smith, 1974: 156).

The leaves are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148). The aromatic roots of *C. dichogamus* Pax are added to stew by the Maasai (Kabuye, 1986: 70). A decoction of the bark of *C. megalocarpus* Hutch. is taken by Samburu pastoralists to treat coughs and colds; the roots of *C. dichogamus* to treat 'chest congestion believed due to poisonous substances and a tea of the bark of this species is drunk to treat stomach upsets (Fratkin, 1996: 74, 75).

Euphorbia damarana L.C.Leach
FSWA: 670 BRI: 4498
ǁHao.s (recorded in Sesfontein); **gui.b/s** (recorded throughout former Damaraland); **kui.b** (Eiseb *et al*, 1991: 19, 27); **kauimp**; '**Kui.b**' and '**kauimp**' are described as 'Namib Damara' and 'Damara Damara' dialects respectively.
The latex used to be used as poison for poisoning water-holes and thereby catching animal wildlife (recorded in Sesfontein). Bees take nectar from this species (recorded from Dâureb Damara at ǁGaisoas, Ugab River).
Known to be eaten by rhino and kudu.

The Herero name is otjihavara (recorded from Purros Damara in Sesfontein); otjiharava, otjintine (recorded from Herero in Sesfontein).

E. guerichiana Pax
FSWA: 670 BRI: 4498

The berries are eaten and may be stored for later use (Steyn and du Pisani, 1984/1985: 44).

The Herero names for this species are omupondororwa, omupondoriro; in Kaokoveld the leaves are browsed by small stock and dry branches used for firesticks known as ozongune (Malan and Owen-Smith, 1974: 156).

E. subsalsa Hiern *fluvialis* Leach
FSWA: 670 BRI: 4498

The Herero name is ohahi (recorded in Sesfontein and by Malan and Owen-Smith, 1974: 156).
A powder from the plant, prepared by burning thorns of a branch, drying it in the sun, and then pounding, is smeared into tattoos at site of pain for pain relief (recorded in Sesfontein).
A powerful intestinal poison can be extracted from this plant and either used on its own or with the sap of *Fockea multiflora* or the root sap of *Adenium boehmianum* and used as a blood toxin on arrow heads (Malan and Owen-Smith, 1974: 156).

E. virosa Willd.
FSWA: 670 BRI: 4498
ǁkhao.s/b (recorded in Sesfontein and in Eiseb *et al*, 1991: 22, 27).
'**ǁKhao**' means 'very strong', e.g. can be used to described very alcoholic beer (in the sense of 'what's your poison?'). This is a reference to the poisonous nature of this plant.
The latex was used in the past as an arrow-head poison (recorded in Sesfontein). Steyn and du Pisani (1984/1985: 46-47) describe the heating of the latex from *Euphorbia* sp. called **ǁkhao.b** over a fire until it thickened and was applied to arrow-heads, sometimes with the addition of the juice of *Aloe* sp. (**gorep**) and the sap of *Spirostachys africana* (**oui.b**). The latex of **ǁkhao.b** was also used to poison waterholes which were then called **tsowe.s**. The seeds are used as beads for necklaces which are increasingly sold as curios to tourists (recorded in Sesfontein).
Known to be very poisonous but eaten by rhino and kudu.

The Herero name is eyao; in Kaokoveld the latex is used to poison small predators such as

jackals and hyenas and is sometimes mixed with the sap of *Adenium boehmianum* as an arrow-head poison (Malan and Owen-Smith, 1974: 156).

Samburu pastoralists use *Euphorbia* spp. for a variety of medicinal purposes: the sap of *Euphorbia* sp. (l-paraa) is placed on wounds and the stewed leaves are consumed to treat symptoms of malaria; stems of *E. heterochroma* Pax which have been burned to remove the white latex are consumed in a fat soup in the treatment of gonorrhoea; a soup from latex tapped from the trunk of *E. candelabrum* Kotschy, added to water and ox meat and boiled in an ox bladder, is drunk by Samburu women to induce vomiting and reverse a condition of barrenness (Fratkin, 1996: 77-79).

*Ricinus communis** L.
FSWA: 670 BRI: 4424
Known throughout former Damaraland as **|hera** (**|khera.s** in Van den Eynden *et al*, 1992: 72); the seeds are referred to as **munu** (recorded in Sesfontein).
Ricinus seeds are strongly purgative and very toxic, and have general medicinal uses in former Damaraland. Van den Eynden *et al* (1992: 39-40, 74) record that they are ground, boiled and rubbed onto swollen cheeks in cases of toothache or mumps and the affected area then covered by a warm *Ricinus* leaf and a compress, and the roasted and ground seeds or a leaf poultice are applied to burns, wounds, skin disorders, painful knees, breasts or throat.

This species grows throughout Africa and is widely used as a purgative (Kokwaro, 1983: 239). Kipsigis women extract oil from the seeds for use as body lotion (Glover *et al*, 1966: 198). Luo herbalists of east Kenya advise chewing the roots or taking a decoction of the roots or leaves 'to facilitate expulsion of the placenta or to hasten parturition' (Johns *et al*, 1990: 380).

Spirostachys africana Sond.
FSWA: 670 BRI: 4478
Âui.b and **âu-hai.b** (recorded throughout former Damaraland); **âu-i.b** (Eiseb *et al*, 1991: 18, 29); **âui.b**, **âaue.b** (Van den Eynden *et al*, 1992: 54, 86); **oui.b** (Steyn and du Pisani, 1984/1985: 47 after Vedder).

'**Au**' means 'bitter' and '**hai.b**' means 'tree', i.e. 'bitter tree'.

A decoction from ground root or wood is drunk when cool for hard coughs with chest pains (recorded throughout former Damaraland) and stomach disorders (recorded in Sesfontein) (Van den Eynden *et al* (1992: 86) also describe these uses).

S. africana is a '**sâi**' or perfume plant. The aromatic wood is made into beads (see also Van den Eynden *et al*, 1992: 86) which are often bought from Himba from Kaokoveld (who call them otupapa cf. Malan and Owen-Smith, 1974: 156). Pieces of the wood are burned as incense to bring a fragrant smell to the house or under clothes to perfume them (recorded in Sesfontein). As such, it is known as an **|î-sâ.i**. The aromatic sap is thought to have 'Damara power' which is why the wearing of beads from this wood is so popular.

The wood is used for carving (Van den Eynden *et al*, 1992: 86).

The Herero name for this species is orupapa (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 156). Among the Himba the dry or dead wood is used as a medicine for headaches (recorded in Sesfontein).

The resin is consumed by by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).

FABACEAE

Author's coll. no. SS0259

!Hona (recorded from Purros (incl. originally !Oe-≠gaa), ‖Khaoa-a, and Dâureb Damara from Sesfontein).
Used to make tea (recorded from Purros (incl. originally !Oe-≠gaa), ‖Khaoa-a and Dâureb Damara from Sesfontein), and the root is added for the taste to milk (recorded from ‖Khaoa-a Damara in Sesfontein).

Acacia cf. *erubescens/fleckii*
FSWA: 580 BRI: 3446 Author's coll. no. SS0414
Ana (recorded from Purros (originally !Oe-≠gaa) Damara from Sesfontein).

A. erioloba E.Mey.
FSWA: 600 BRI: 3446 Author's coll. no. SS0320
‖Gana.b/s (recorded throughout former Damaraland and among the Nama in du Pisani, 1983: 4; see also Eiseb *et al* 1991: 21, 25).

Du Pisani (1983: 3-4) records that the exudate is eaten and the pulp from the pods may sometimes be eaten by children (as recorded for the Kuiseb Topnaar in Dentlinger, 1977: 34). A powder from the plant parts is introduced into incisions (**|gore.s**) on pregnant women who start bleeding, to prevent miscarrying (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein). Inhalation of the smoke from burned pods is considered good for general health and pods are applied to swelling. The gum is dissolved in boiling water which is by the Kuiseb Topnaar drunk to relieve coughs, colds and symptoms of TB (Van den Eynden *et al*, 1992: 45).

A powder-like substance known as '**!hub**' is collected from between the stem and bark of rotten tree trunks and used as a cosmetic by women after mixing with animal fat (Schultze, 1907: 210; du Pisani, 1983: 3-4). This is possibly the same as '**!ub**' recorded as a powder from an unidentified species used as perfume in Van den Eynden *et al* (1992: 55). Hildesheim (1986: 339) also records that among the Bondelswarts Nama of Warmbad, a root powder called '**!gu |gai**' was burnt for luck and, because of its pleasant aroma, was frequently used as body perfume instead of buchu. Tsoaxau Damara at ‖Gaisoas, Ugab River, record that **≠gae**, i.e. fragrant rotten wood, from this tree is rubbed into rashes on small babies and overweight women (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River).

Considered good fodder for livestock, especially the leaves but the pods are also eaten.
Among the Nama, the dry wood is considered to make a good firewood which burns slowly and provides excellent coals, and the wood (which is termite resistant and hard cf. Van den Eynden *et al*, 1992: 45) is also used for construction purposes and to make knobkieries (du Pisani, 1983: 3-4). Du Pisani (1983: 4) also states that the green bark is used as a tanning agent for leather, the thorns were used in a children's game called **‖abi** which involved the imitation of adult warriors (cf. Schultze, 1907: 359) and the root bark was used in the manufacture of flutes when suitable reeds were unavailable (cf. Breyer-Brandwijk, 1962).

Recorded Herero names for this species are otumbuende (recorded in Sesfontein); omumbonde, omuhiviriko (Hahn, 1928: 229); and omumbonde (Malan and Owen-Smith, 1974: 158).

According to Hahn (1928: 225) 'omuhiviriko' means 'the praiseworthy'.

The pods and seedlings are eaten by small-stock in Kaokoveld and the branches are used by the Himba for fencing and firewood (Malan and Owen-Smith, 1974: 158).

The gum is eaten by !Kung, |Gwi and ‖Gana San (Story, 1958 in Marshall, 1976: 121; Tanaka, 1976: 117; Lee, 1979: 162).

A. erubescens Welw. ex Oliv.
FSWA: 600 BRI: 3446
!Uri!huni (recorded in Sesfontein and along Ugab); **|uri!gune** (recorded in Khowarib); **!goro.s/b** - said to occur towards Purros, i.e. north-west of Sesfontein; **duube.s** (Eiseb *et al*, 1991: 18, 25, these authors use the names **!uri!gonne.s** and **!uri!gonno.s** to describe *A. fleckii*); **!uria!gonnes** is described as having white gum which is not sweet but can be eaten if cooked with sugar (recorded from Dâureb Damara at Gudipos, Ugab River).
'**!Uri**' means 'white', '**gonne.s** (etc)' is the name of the tree.
The exudate is eaten but called '**!habu-haira**' or 'bee-gum' i.e. to describe its not very sweet taste.

The Herero name is omungongomwi; the exudate is eaten by the Himba and described as sweet-tasting (Malan and Owen-Smith, 1974: 158). The seed pods are consumed by small stock in Kaokoveld, building poles and kraal fencing materials are taken from this species, and

branches are cut for walking sticks (Malan and Owen-Smith, 1974: 158).

The gum is eaten by the |Gwi, ‖Gana and !Kung San (Tanaka, 1976: 117; Lee, 1979: 162).The resin is eaten by the Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148).

A. hebeclada DC.
FSWA: 600 BRI: 3446
!goo.s; **‖ganni-amme !goo.s** (Eiseb *et al*, 1991: 23, 25).
The seeds are recorded as eaten by the Nama, either roasted or ground (Schultze, 1907 in du Pisani, 1983: 14).

The Herero name for this species is otjimbuku (Malan and Owen-Smith, 1974: 158). The Himba take the ground root bark added to porridge to treat a stomach complaint, the symptom of which is the passing of bloodstained stools (Malan and Owen-Smith, 1974: 159). Small stock eat the seed pods and branches used for fencing (Malan and Owen-Smith, 1974: 159).

The gum of *A.* cf. *hebeclada* is eaten by Dobe area !Kung (Lee, 1979: 162).

A. karroo Hayne
FSWA: 600 BRI: 3446 Author's coll. no. SS0390?
‖Hu.s (recorded along the Ugab); **‖khuub** (du Pisani, 1983: 4); **‖kuu.s** (Eiseb *et al*, 1991: 22, 25); SS0390 recorded as **‖gana** by Purros (originally !Oe-≠gaa) Damara in Sesfontein.

The exudate is eaten (recorded in Sesfontein and along the Ugab and in du Pisani, 1983: 4) but is considered not sweet like '**du-haira**', i.e. *Acacia senegal*(?) and *Acacia mellifera* subsp. *detinens*. The gum can be stored in a ground form for long periods of time (du Pisani, 1983: 4).

The leaves of **‖gana** (recorded for SS0390, usually the name of *A. erioloba*) are used to bathe sore eyes (recorded from Purros (originally !Oe-≠gaa) Damara from Sesfontein).

Du Pisani (1983: 4) records that in Namaland the green bark is used as a red-brown leather dye, walking sticks and fish traps are made from the roots and the tree constitutes an important source of firewood, and in the Berseba area, branches are used for hut frames.

The gum is eaten by Dobe area !Kung (Lee, 1979: 162). Coates-Palgrave (1991: 241-2) states that *A. karroo* produces a clear golden or red gum which is edible; this resin is recorded as consumed by Tswana-speaking Tlokwa of south-east Botswana, who also consume bark from this species (Grivetti, 1979: 148).

A. mellifera (Vahl) Benth *detinens* (Burch.) Brenan
FSWA: 600 BRI: 3446
!Noe.s (recorded at Khowarib, Tsoaxau Damara at ‖Gaisoas on the Ugab River, ≠Ao-Dama, Rietkuil Farm, and |Khomani Damara, Malansrust Farm); **!noe.s** and **≠gare.s** (Eiseb *et al*, 1991: 24-25); produces **du-haira**, i.e. sweet-gum (recorded in Sesfontein, Khowarib and along Ugab); **!noe.s** pods are described as thin and straw-coloured (recorded from Dâureb Damara at Gudipos, Ugab River). **!Noe.s** refers to the fact that if you are too hasty and try to hurry (= **!noesa**) through these trees the thorns will hold you back. This species is also described as 'devastatingly thorny' in Coates-Palgrave (1991: 244), and the specific name '*detinens*' assigned by Burchell describes the fact that it holds you back.

The exudate is eaten, especially in Ugab area (see also Steyn and du Pisani, 1984/1985: 44) but also recorded in Sesfontein, Khowarib, and from ≠Ao-Dama at Rietkuil Farm. Tsoaxau Damara at ‖Gaisoas on the Ugab River say that **haira** comes from **!noe.s** and do not record this name for *A. reficiens* which they say is **!gû.s** and does not produce **haira** (see below); Dâureb Damara at Gudipos on the Ugab River say that **!noes** produces sweet haira. The bark of **≠nu!noe.s** (?) is used to make milk 'taste nice' (recorded from Purros Damara in Sesfontein).

The root is pounded and boiled in water and the exudate drunk by young Nama men in Tses and Namaland to treat venereal disease (du Pisani, 1983: 4).

This is a useful livestock fodder (cf. ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm) and kraals are made with branches of this species (|Khomani Damara, Malansrust Farm)

which is similarly used by the Nama for the construction of animal enclosures and as firewood (du Pisani, 1983: 4).

The Herero name is omusaona and in Kaokoveld the Himba use debarked pieces of root to promote the curdling of milk (this is considered the finest milk-souring agent) and considered this to be the best fencing material to protect gardens from animals(Malan and Owen-Smith, 1974: 159).

The Nharo eat the sweet-tasting gum (Steyn, 1981: 7) and the gum is eaten by |Gwi, ‖Gana and Dobe-area !Kung San (Tanaka, 1976: 117; Lee, 1979: 162). The resin, leaves and ash are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148).

A. montis-usti Merxm.& A.Schreib.
FSWA: 600 BRI: 3446 Author's coll. no. SS0287
Nu-haib (recorded along the Aba-Huab and Ugab Rivers where this species is common); **!ari.b** (recorded from Dâureb Damara at Gudipos, Ugab River); **aru** (recorded from ‖Khaoa-a Damara in Sesfontein).

The roasted seeds can be eaten (recorded from Dâureb Damara at Gudipos, Ugab River). The bark can be used as a fermenting agent in beer brewing (recorded from ‖Khaoa-a Damara in Sesfontein).

Sâi is made from this species (recorded from Purros Damara in Sesfontein)
Goats eat, especially the pods (recorded from Dâureb Damara at Gudipos, Ugab River) and the straight, upright branches are commonly used for building poles along the Aba-Huab and Ugab Rivers. The nectar of this plant is considered to produce good honey.

The Herero name of okangondo was recorded from Purros Damara in Sesfontein.

A. nebrownii Burtt Davy
FSWA: 600 BRI: 3446
|Khanu.s, **|nuwi.b**, **|nupi.b** (Eiseb *et al*, 1991: 21, 25).

Orupunguya is the Herero name; the branches are used for fences by the Himba of Kaokoveld (Malan and Owen-Smith, 1974: 159).

A. reficiens Wawra *reficiens*
FSWA: 600 BRI: 3446 Author's coll. no. SS0298
!Gû.b/s (recorded from Tsoaxau and Dâureb Damara on the Ugab River, and in Khowarib); **!guu.b/s** (Eiseb *et al*, 1991: 23, 25); **!go.s** (recorded from ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm); **!noe.s** (recorded from ‖Khaoa-a, Dâureb, Purros (incl. originally !Oe-≠gaa) Damara in Sesfontein).

The exudate is eaten (recorded from ‖Khaoa-a, Dâureb, Purros Damara in Sesfontein, ≠Ao Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm and Dâureb Damara at ‖Gaisoas, Ugab River, who state that it is not sweet) and in Steyn and du Pisani, 1984/1985: 44, but Tsoaxau Damara at ‖Gaisoas on the Ugab River state that the **haira** from **!gû.s** is not eaten). (**du-haira** is very sweet and comes from a tree with white pods (recorded from Dâureb Damara at ‖Gaisoas, Ugab River)).The inner fibre or **|a.b** from the bark is used as a milk curdling agent (recorded from Tsoaxau Damara at ‖Gaisoas on the Ugab River).

A decoction of the roots is given to children to treat diarrhoea. A decoction of the bark fibre (**|âb**) is drunk (3 cups/day) to treat colds and coughs (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

The seeds are used for **sâi** (recorded from ‖Khaoa-a Damara in Sesfontein). **≠Gae**, i.e. aromatic dead wood, is taken from this tree (recorded from ≠Ao-Dama, Rietkuil Farm).

This species provides good fodder for goats who eat the leaves and pods (recorded throughout former Damaraland).

Is used for firewood (recorded from |Khomani Damara, Malansrust Farm).

The Herero name is omungondo (Malan and Owen-Smith, 1974: 159; Kajujaha-Matundu, 1994); possibly orupunguya (recorded in Sesfontein) which is stated as *A. nebrownii* (Malan and Owen-Smith, 1974: 159.
The bark is used by Himba to promote curdling of milk and the roots are used to make a decoction which is drunk for stomach pains and given to women after childbirth (Malan and Owen-Smith, 1974: 159). The leaves and pods are eaten by small stock and the branches are used for fencing (Malan and Owen-Smith, 1974: 159).

A. robynsiana Merxm. & A.Schreib.
FSWA: 600 BRI: 3446
!Nue.b and **lue** recorded in Sesfontein.
The name **lue** refers to the swaying motion of this tall and spindly-looking species in the wind (recorded from ‖Khaoa-a Damara from Sesfontein).

A. senegal (L.) Willd. *Rostrata* Brenan
FSWA: 600 BRI: 3446 Author's coll. no. SS0297
Nu.b (recorded in Khowarib and Sesfontein); **tu.n** (recorded in Khowarib); **!noe.s** (used in Khorixas area); **!go.b** (used by Purros Damara in Sesfontein); **!ari.b** (recorded from Tsoaxau Damara at ‖Gaisoas on the Ugab River); ≠**nuu** (= black) **!noe.s** (recorded from ≠Ao-Dama, Rietkuil Farm); **!uri!gonne.s** (recorded from |Khomani Damara, Malansrust Farm, who state that this tree has a white bark and sweet **haira**; there are two species which look like **!noe.s** and it is the one which looks like **!noe.s** which has sweet gum); **duus.s** and **nuu.s** (Eiseb *et al*, 1991: 18, 25)

The exudate is eaten (recorded from ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm). Hahn (1928: 296) considered that 'The gum of the common mimosa, which, as an article of trade, is known under the name of gum-arabic, is very plentiful here and in other parts of the country, and could be collected by the Berg-Damaras and sold to the trading establishments'.
This species is a valued fodder for goats (recorded throughout former Damaraland).
The branches are used as building poles (recorded from Tsoaxau Damara at ‖Gaisoas on the Ugab River).

The Herero name is omuryangava; the leaves and pods are eaten by small stock in Kaokoland and the branches are used for fencing (Malan and Owen-Smith, 1974: 159).

A decoction of the bark of *A. senegal* is drunk by Samburu pastoralists in the treatment of stomach upsets, to promote abortion and expellation of the placenta, and for pain following abortion by Samburu pastoralists (Fratkin, 1996: 74, 79).

A. sieberiana DC. *Woodii* (Burtt Davy) Keay & Brenan
FSWA: 600 BRI: 3446

The Herero name is omunyere; in Kakoveld the pods are eaten by small stock and the branches are used for fencing (Malan and Owen-Smith, 1974: 159).

A. tortilis (Forssk.) Hayne *heteracantha* (Burch.) Brenan
FSWA: 600 BRI: 3446
Known throughout former Damaraland |**nara.b/s** (see also in Eiseb *et al*, 1991: 21, 25; Van den Eynden *et al*, 1992: 75)); |**nubi**‖**huu.s** was recorded as the |Khomani Damara name by Tsoaxau Damara at ‖Gaisoas, Ugab River.

The pods are eaten, either as a snack or pounded and cooked into a porridge, preferably with milk, and may be collected, dried and stored for later use (recorded in Sesfontein and in Van den Eynden *et al*, 1992: 76). The exudate is eaten (recorded in Sesfontein, Khowarib and in Van den Eynden *et al*, 1992: 76).

The roots are cooked and eaten for lower back pain (recorded in Sesfontein). A decoction from the stems is drunk for chest pain (recorded from Dâureb Damara at Gudipos on the Ugab

River).
The pods and leaves are important sources of fodder throughout Damaraland but particularly around Sesfontein (see also Van den Eynden *et al*, 1992: 76).

Used as firewood in Sesfontein but produces a lot of smoke (see also Van den Eynden *et al*, 1992: 76).

Easily attacked by termites or 'goms'.

The Herero name is omunjarava (recorded in Sesfontein) which means 'carrying pods for goats and cattle'; or omungondo (Malan and Owen-Smith, 1974: 159).

In Kaokoveld the fallen pods are considered especially important for small stock (Malan and Owen-Smith, 1974: 159). Branches used for fencing (Malan and Owen-Smith, 1974: 159).

The gum is eaten by Dobe-area !Kung (Lee, 1979: 162). The resin, bark and leaves are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 148).

The bark and resin of several east African *Acacia* spp. are also eaten by Maasai as are the young green pods of *A. drepanolobium* Sjöstedt (Glover *et al*, 1966: 193). The pods but not the seeds are dried and ground into a flour which is consumed by the Turkana (Morgan, 1981: 101). *A. tortilis* is an extremely important multipurpose species among the Gabra of north Kenya and the seedless pods are consumed 'as a famine food' (Stiles and Kassam, 1991: 25, 31). A decoction of the bark is used in the treatment of polio (nkurotet) by Samburu pastoralists (Fratkin, 1996: 78). Samburu pastoralists use preparations from *Acacia* spp. to treat a variety of ailments: the bark of *A. nilotica* (L.) Del. is taken as a soup (or as a cold infusion for nausea), and the roots of *A. hockii* de Wild. as a tea, in the treatment of an 'upset stomach'; the former preparation is also used for the treatment of hepatitis (ndis); he roots of *A. nilotica* are burned in the ritual cures of loibonok diviners; the bark of *A. nubiaca* Benth. is soaked in water for 12 hours and the water drunk for menstrual problems ('women's stomach') and in treatment of the liver (eminyua), hepatitis, gonorrhea, and is applied to the site of muscular-skeletal aches; the bark or chewed leaves of *A. nilotica* are applied to burns; polio is treated with a decoction of the bark of *A. nubiaca*; livestock are bathed in water in which the bark of *A. nubiaca* has soaked in the treatment of trypanosomiasis (Fratkin, 1996: 74-80).

Green and dry seeds of *Acacia* spp. are eaten by Alyawara Aborigines in north Australia and Martujarra Aborigines in Western Australia, and *Acacia* spp. are also sources of edible gum and nectar and support edible insect galls and witchetty grubs (O'Connell, 1983: 85-86; Veth and Walsh, 1988: 25). Salves from the plant parts of *Acacia* spp. are used for the treatment of colds and chest infections (O'Connell, 1983: 97)

Adenolobus garipensis (E. Mey.) Torre & Hillc.
FSWA: 590 BRI: 3528 Author's coll. No. SS0070
Hantu (recorded from Dâure.b Damara in Sesfontein), **|hantu** (recorded from ‖khaoa-a and Namib/!Naren Damara in Sesfontein), **|hantsu** (all recorded from Daureb Damara); **|hantsu** (recorded from Tsoaxau and Dâure.b Damara at ‖Gaisoas and Gudipos, Ugab River, and ≠Ao-Dama, Rietkuil Farm who also refer to it as **≠gao-hai.b** (heart-plant) due to its heart-shaped leaves and its sympathetic medicinal use to prevent heart problems); **|khentsu.b** recorded from |Khomani Damara at Rietkuil farm; **|hairu** (from **|hai** = grey) recorded from Purros Damara at Sesfontein.

A decoction from the pounded leaves or root is drunk to relieve coughs (Daureb Damara at the farm settlement of Palm). |Khomani Damara at Rietkuil farm report that a decoction of the leaves and twigs is drunk for heart medicine and that beads made from the stems are worn as necklaces for the same reason (recorded from ≠Ao-Dama, Rietkuil Farm).

Goats eat (Namib/!Naren and Dâure.b Damara in Sesfontein).
The branches are used for building material (recorded from Daureb Damara along Aba-Huab, Tsoaxau and Dâure.b Damara at ‖Gaisoas, Ugab River).

The Herero name is omukandakanda, which refers to the swaying motion of this plant (recorded from Purros Damara in Sesfontein and in Malan and Owen-Smith, 1974: 153).
Browsed by large and small stock in Kaokoveld (Malan and Owen-Smith, 1974: 153).

A. pechuelii (Kuntze) Torre & Hillc.
FSWA: 590 BRI: 3528 Author's coll. no. SS0121
Âi-hai.b (**âi** = liver) (recorded in Sesfontein, e.g. by ǁKhaoa-a, Namib/!Naren and Purros (originally !Oe-≠gaa) Damara and from Dâure.b Damara at ǁGaisoas and Gudipos on the Ugab River); **aihai.b** referred to but unidentified in Van den Eynden *et al* (1992: 85) and uses indicate that it is *A. pechuelii*; **dani** |**gamdi** |**a.b** (**dani** = honey) recorded from Purros Damara in Sesfontein.

A decoction of a small portion of the root is consumed (1 spoonful 2 to 3 times a day) for the treatment of liver complaints (recorded from Dâureb Damara at Gudipos, Ugab River and in Sesfontein; see also Dentlinger, 1977: 35; Van den Eynden *et al*, 1992: 85) or introduced into incisions for the same reason (recorded from Dâure.b Damara from ǁGaisoas on the Ugab River).

The powdered bark is used as **sâ.i** or perfume.

Is a fodder plant (recorded in Sesfontein).

The pounded roots are used to colour dressed skins red (Steyn and du Pisani, 1984/1985: 44).

The Herero name omujawaouitji (ouitji = sugar |honey) was recorded from Purros Damara in Sesfontein.

Albizia anthelmintica (A.Rich.) Brongn.
FSWA: 580 BRI: 3443
Aru.b (du Pisani, 1983: 5; Eiseb *et al*, 1991: 18, 25).

The exudate is eaten by the Nama who also obtain building poles from this species (du Pisani, 1983: 5).

The Herero name omuryandjima, meaning 'food' (okurya) 'of the baboon' (ondjima), is recorded in Malan and Owen-Smith (1974: 159) who state that the pods are eaten by small stock in Kaokoveld.

The wood is added to milk and consumed in the treatment of intestinal worms (and for livestock), the roots and bark are drunk as a tea in the treatment of malaria, the boiled root, bark and leaves are mixed with sheep fat and administered as an enema, or consumed with milk, in the treatment of gonorrhoea by Samburu pastoralists (Fratkin, 1996: 75, 78-79, 81).

Caeselpinia rubra (Engl.) Brenan
FSWA: 600 BRI: 3559 Author's coll. no. SS0427?
au-a-uri (recorded in Sesfontein, e.g. by ǁKhaoa-a and Purros Damara); **auauroi** (Van den Eynden, 1992: 67).
'**Au**' means 'bitter' and '**uri**' is a reference to lice as the aromatic powder from this plant is believed to encourage lice/fleas if it is thrown onto blankets and they are not washed frequently.

The seeds are consumed as a medicine for sore throats accompanied by a lost voice or are pound into a powder and placed on burns or boils (recorded in Sesfontein). A powder from the leaves is put on boils on a child's head (recorded from ǁKhaoa-a Damara in Sesfontein).
The powdered seeds and leaves are used as a '**sâi**', i.e. body perfume (recorded in Sesfontein, e.g. from Purros and ǁKhaoa-a Damara in Sesfontein, and in Van den Eynden *et al*, 1992: 68).

Colophospermum mopane (Kirk ex Benth.) Kirk ex J.Léonard
FSWA: 600 BRI: 3490
Known throughout the former Damaraland as **tsaurahai.b/s** (see also Eiseb *et al*, 1991: 21, 26; Van den Eynden *et al*, 1992: 68); ǁ**gai.s** (recorded at farm settlements along the Aba-Huab River and in Eiseb *et al*, 1991: 21, 26); **!oeni.s** (Eiseb *et al*, 1991: 21, 26)

'**Tsaura**' means soft', and '**hai.s**' means plant/tree, i.e. 'soft-tree'.
Dried secretions on mopane leaves, produced by a species of aphid (Hemiptera: Psyllidae, *Retroacizzia mopani*) and containing sugar and gum, are eaten with relish. They are called '**name.b/n**' and referred to in English as 'Damara chips' (recorded throughout former Damaraland, see also Steyn and du Pisani, 1984/1985: 44; Van den Eynden *et al*, 1992: 68).

This species was recorded as used throughout former Damaraland for a variety of medicinal

purposes: the leaves or bark are boiled into a decoction which is drunk for stomach pain, nausea and diarrhoea; the leaves are chewed for stomach-ache; a poultice or wash is made from the leaves for colds and coughs and for headaches or eye-pains; the dried leaves are pounded into a powder which is sprinkle on cuts and wounds such as burns (see also Van den Eynden *et al*, 1992: 68). When prepared as a decoction to treat stomach pain or coughs a handful of leaves are boiled in a cup and the whole contents of the cup drunk; this procedure is repeated twice in a day.

The ground pods of this species are used for **sâi** (recorded from ≠Ao-Dama, Rietkuil Farm) and can be mixed with plant parts of *Thamnosma africana*, Rutaceae, for **sâ.i** (recorded from |Khomani Damara at Rietkuil farm). **≠Gae** (aromatic rotten wood) can come from this species (recorded from ≠Ao-Dama, Rietkuil Farm).

The leaves and pods are generally considered as important sources of forage.

This species yields the most desirable firewood in north-west Namibia and also produces good building poles (cf. Steyn and du Pisani, 1984/1985: 40) and bark fibre used for construction purposes. The bark and roots are used as an orange/red leather tanning agent (recorded in Sesfontein and Khowarib). Leaves can be used for rolling cigarettes and the wood is made into spoons and pipes (recorded in Khowarib). This species is host to edible caterpillars (**|hoobe |giru.s**, i.e. Lepidoptera: Saturniidae, *Imbrasia imbelina*) which form an important food when available. The pods can be used for beads (recorded from ≠Ao-Dama, Rietkuil Farm). The twigs are used for teeth-cleaning (Van den Eynden *et al*, 1992: 68).

On a seed collecting trip to |Giribes plains (north-west of Sesfontein) mopane leaves and tobacco were placed in an offering to the ancestors at two significant places as a sign of respect and to ensure safe passage through these ancestral lands. This was with a family who originally came from Purros area. Mopane leaves were used due to the significance or 'power' of this species as a medicine.

The Herero name is omutati (Malan and Owen-Smith, 1974: 153).

The 'omungu' caterpillar or mopane worm which occurs on mopane is regarded as a delicacy by Herero peoples and consumed in large quantities when available in the late summer (Malan and Owen-Smith, 1974: 153). The edible caterpillar ombwakarumbu also occurs on this species (Malan, 1974).

A decoction from the leaves is drunk for stomach disorders, especially caused from eating too much meat (recorded in Sesfontein). The leaf is thought to have disinfectant properties and an ability to stop excessive bleeding; leaves are placed on open wounds, sometimes following chewing to allow the coarse white fibres which remain to absorb blood and promote clotting (Malan and Owen-Smith, 1974: 153).

Browsed by both small and large stock but usually only in small quantities (described in Sesfontein and in Malan and Owen-Smith, 1974: 153).

This is the most important source of poles and bark fibre for building in Kaokoveld, branches from this species are used for ceremonial structures and in the sacred fire, and this species is also used for carving water troughs while young flexible branches are made into waist bands for young girls (Malan and Owen-Smith, 1974: 153).

In Owambo 'omusati' is used as medicine to treat vomiting (Marsh, 1994: 26).

In the former eastern Transvaal an extract of the bark is used to treat syphilis and in applications for sore eyes (Watt and Breyer Brandwyk, 1962, in van Voorthuizen, 1976: 223)

Crotalaria sp.L.

FSWA: 600 BRI: 3669 Author's coll. no. SS0068

≠Hara-≠khara; **≠ha≠ara** (recorded from Dâure.b Damara at ǁGaisoas on Ugab River); **ǁnâǁgara** recorded from |Khomani Damara at Rietkuil farm who state that '**ǁnâ**' means 'horn and **ǁgara** or **≠nara** is the sound made by the seeds in the seedpod when shaken; **sanana.b** (recorded from Dâureb Damara at Gudipos on the Ugab River).

This species is a source of goat fodder (recorded from Dâure.b Damara at ǁGaisoas and Gudipos on Ugab River), although ≠Ao-Dama, Rietkuil Farm, believe that the seeds are harmful to cattle.

If these seeds are collected and accidently eaten with **sâu.n** (seeds of *Stipagrostis* spp.,

Poaceae) or **bosu** (seeds of *Monsonia* spp., Geraniaceae) they will cause you to vomit (recorded from Dâure.b Damara at ǁGaisoas on Ugab River).

The Herero name otijaturaza was recorded from Purros Damara in Sesfontein.

The outer layer of the root of *C. incana* L. is chewed by Samburu pastoralists to treat colds and coughs (Fratkin, 1996: 74).

Cullen obtusifolia (DC.) C.H.Stirt.
FSWA: 600 BRI: 3703 Author's coll. no. SS0162? (= *Rhyncosia*)
!Hona.b (recorded fromTsoaxau Damara at ǁGaisoas, Ugab River, from Namib/!Naren in Sesfontein, and in Van den Eynden *et al*, 1992: 74).

The sweet-smelling leaves and flowers are added to tea, and are said to whet the appetite, and the roots are used as a curdling agent for milk and to make it 'delicious' (recorded fromTsoaxau Damara at ǁGaisoas, Ugab River, from Namib/!Naren in Sesfontein and in Van den Eynden *et al*, 1992: 74).

The Kuiseb Topnaar drink an extraction of the plant in water or milk to relief stomach and post-natal pains, and this is also given to livestock after parturition (Van den Eynden *et al*, 1992: 40).

This is a fodder plant (recorded in Sesfontein).

Dichrostachys cinerea (L.) Wight & Arn. *africana* Brenan and Brummitt
FSWA: 600 BRI: 3452 Author's coll. no. SS0251
ǀHoe.b (recorded in Sesfontein, from ≠Ao-Dama, Rietkuil Farm, and ǀKhomani Damara, Malansrust Farm); **ǀgoe** (recorded from Dâureb Damara in Sesfontein); **ǀgo(w)e.s**, **ǀgo(p)e.s**, **ǀgoe.s** (Eiseb *et al*, 1991: 20, 26); described as family with **!noe.s**, i.e. *Acacia mellifera*, Fabaceae, by ǁKhaoa-a Damara in Sesfontein; **!nobotixara≠uuhe**, i.e. food (**≠uuhe**) of **!nobos** or francolins which eat the seeds (recorded from Purros Damara in Sesfontein)

The small stems and leaves are cooked, pounded into a powder and put on to boils (recorded from ≠Ao-Dama, Rietkuil Farm).

An important fodder (recorded from Dâureb Damara in Sesfontein, ≠Ao-Dama, Rietkuil Farm, and ǀKhomani Damara, Malansrust Farm). It is considered that if goats eat the pods they will produce a lot of milk (recorded in Sesfontein).

The hard stems can be used for making smoking pipes (recorded from Purros Damara in Sesfontein).

The Herero name omuranguari was recorded from Purros Damara in Sesfontein.

Steyn (1981: 11) reports that the Nharo set metal traps set in these trees to catch duikers which are described as frequenting this species.

Gum from this tree is eaten by the ǀGwi, ǁGana and Dobe-area !Kung San (Tanaka, 1976: 118; Lee, 1979: 162) and the resin is also eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).

Faidherbia albida (Delile) A.Chev.
FSWA: 600 BRI: 3446 Author's coll. no. SS0324
Known throughout Damaraland as **ana.s** (see also du Pisani, 1978: 14, 1983: 3; Van den Eynden *et al*, 1992: 44); **ao-ana.b** (recorded in Khowarib); **anahai.s** (Eiseb *et al*, 1991: 18, 25)

'**Ao-ana.b**' means 'male-**ana.b**'.

The pods can be eaten after removing the seeds (recorded along the Ugab, from ≠Ao-Dama, Rietkuil Farm, and in Steyn and du Pisani (1984/1985: 44) who state that when water is drunk afterwards this gives a feeling of fullness). The pulp in the pods may sometimes by eaten by Nama children (du Pisani, 1983: 3).

Hahn in 1928 described the pods as 'an excellent food for oxen, small cattle and horses' (p. 229). The leaves and particularly the pods continue to provide important fodder throughout the north-west of Namibia and especially in dry season, when the pods are often collected in sackfuls (or carloads) as livestock feed. Also described for the Kuiseb Topnaar (Van den

Eynden *et al*, 1992: 44).

The wood is recorded as used to make '≠**gou.b**' or winnowing bowls, and plates (du Pisani, 1978: 14, also recorded among the Nama in du Pisani, 1983: 3; see also Schultze, 1907: 200). The dry wood and bark were observed as an important building materials used by Damara farmers along the Ugab (du Pisani, 1978: 6). Among the Nama, the dry wood provides firewood and is used in the construction of hut frames, the green wood for inner framework and the bark provides roof material for huts and when green is used as a tanning agent for leather (du Pisani, 1983: 3).

The Herero name is omwe and, again, the Himba consider the pods and leaves to be an imprtant source of fodder, especially in the dry season (Malan and Owen-Smith, 1974: 158).

Indigofera sp. L.

FSWA: 600 BRI: 3702 Author's coll. no. SS0074, SS0407

!Hona.b (recorded from ‖Khaoa-a Damara in Sesfontein).

The roots are used as a milk curdling agent (recorded from ‖Khaoa-a Damara in Sesfontein; see *Cullen obtusifolia* above).

Indigofera sp. L.

FSWA: 600 BRI: 3702 Author's coll. no. SS0300 (& SS0095?)

!Ganikie (used by Purros Damara from Sesfontein).

The seeds are collected from harvester ant nests and eaten. In nests at |Giribes plains, north-west of Sesfontein, they are mixed with grass seeds from *Stipagrostis* spp. (**|hoe sâu** and **!garibe sâu**) and *Kaokochloa nigrirostris* (**≠haa**).

Indigofera sp. L.

FSWA: 600 BRI: 3702

Oara (used by !Nara Damara from Sesfontein).

The name of this plant refers to the scratchiness of its leaves.

Described as a '**dani-hai.b**' or 'honey-plant', i.e. bees are observed to gather nectar from this plant for the production of honey (recorded in Sesfontein).

Mimosa pigra L.

FSWA: 600 BRI: 3449 Author's coll. no. SS0387

!Goo.s (described as 'family' with **!noe.s**, **!urigonne.s** and **!gû.s**; recorded from Dâureb Damara at Gudipos, Ugab River).

The seeds and pods are used for **sâi** (recorded from Purros Damara in Sesfontein).

Steenbok (**!airi.s**) eat (recorded from Purros Damara in Sesfontein). The leaves are sensitive to touch (recorded from Dâureb Damara at Gudipos, Ugab River).

The Herero name okaruzu was recorded from Purros Damara in Sesfontein; omutiyahoni, i.e. tree (omuti) of shyness (ohoni), so-called because the leaflets close when touched (recorded in Malan and Owen-Smith, 1974: 159).

The Himba believe this tree to have the power to make a crocodile release its prey by throwing leaves and twigs of this plant in the water (recorded in Malan and Owen-Smith, 1974: 159).

Parkinsonia africana Sond.

FSWA: 600 BRI: 3551 Author's coll. no. SS0032, SS0033, SS0090

!Khâ.b/s (recorded throughout former Damaraland); **!khaa.s** = *P. africana*, *Acacia haematoxylon*, *Prosopis glandulosa* (Eiseb *et al*, 1991: 23, 28; du Pisani, 1983: 11).

The seeds are roasted, pounded, boiled in water and drunk as coffee (recorded throughout Damaraland; see also Steyn and du Pisani, 1984/1985: 45; and also among the Kuiseb Topnaar, Van den Eynden *et al*, 1992: 31 after Dentlinger, 1977: 35).

A decoction from leaves and young stems is drunk for coughs (recorded in Sesfontein, and Tsoaxau Damara at ‖Gaisoas and Dâureb Damara from Gudipos, both on the Ugab River). One cup of this is drunk 2 to 4 times a day. It is reportedly ineffective for smokers and you

shouldn't drink this medicine it if it boils over into the fire (recorded from Tsoaxau Damara at ǁGaisoas, Ugab). Dâure.b Damara from ǁGaisoas on the Ugab River use a decoction from the roots and young stems to treat coughing in dogs (not people) by pouring the liquid into their mouth twice a day until they are better. Dentlinger (1977: 35) records that the leaves are used as medicine by the Kuiseb Topnaar but does not indicate for which ailment.

Recorded throughout Damaraland as a good fodder plant for goats.

The roots are used for a leather tanning agent (recorded in Khowarib). Provides good firewood (Tsoaxau Damara at ǁGaisoas, Ugab). The wood is used by the Nama for pipes beacuse it does not crack when hot (du Pisani, 1983: 11) and as firewood by Damara settled along the Ugab River (Steyn and du Pisani, 1984/1985: 45).

The Herero name ehuu (was recorded in Sesfontein)

*Prosopis glandulosa** Torr.

FSWA: 600 BRI: 3454 Author's coll. no. SS0322

≠Hon ǀnara.b, **≠khen ǀnara.s**, **ǀara.s** and **Johanneshai.s/b** (recorded along the Ugab); **johannehai.b** (recorded from Purros (incl. originally !Oe-≠gaa) and ǁKhaoa-a Damara from Sesfontein); **Joanisoro** (recorded from Namib/!Naren and Dâureb Damara in Sesfontein); **ǀhube.s** (recorded in Sesfontein); **ǀnara.b/s** (Eiseb *et al*, 1991: 23, 28; Van den Eynden *et al*, 1992: 47); **!khaa.s**, **≠khonhai.s** (Eiseb *et al*, 1991: 23, 28).

'**≠Hon**' and '**≠khen**' mean 'sweet' and '**ǀnara.b**' is the name of *Acacia tortilis* to which the pods of *P. glandulosa* are considered similar, i.e. sweet **ǀnara.b**.

Seed pods are eaten (recorded in Sesfontein, e.g. from Purros (incl. originally !Oe-≠gaa), ǁKhaoa-a Damara from Sesfontein, and along the Ugab, and in Steyn and du Pisani (1984/1985: 45), and by the Kuiseb Topnaar in Van den Eynden *et al*, 1992: 48).

Is an important forage species (recorded in Sesfontein and along the Ugab River).

Prosopis spp. provide an important source of forage for livestock and the pods were a major source of food for indigenous inhabitants of the arid west of North America (Felger, 1979) including the O'odham peoples of the Sonoran Desert (Crosswhite, 1981: 53, 56, 58, 64).

Rhynchosia sp. Lour.

FSWA: 600 BRI: 3897 Author's coll. no. SS0162

Recorded as **!hona.b** (cf. *Cullen obtusifolia* above) by Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos along the Ugab, as **kai** (= large) **!hona.b** by Dâure.b Damara at ǁGaisaos on the Ugab; ≠Ao-Dama, Rietkuil Farm, say it looks like **!hona.b** but it isn't this plant; **ǀhoro.s** (Namib/!Naren and Purros (originally !Oe-≠gaa) Damara in Sesfontein).

In the rain season the leaves are used for tea (recorded from Dâure.b Damara at ǁGaisaos and Gudipos on the Ugab River). Leaves eaten as a relish (recorded from Namib/!Naren and Purros (originally !Oe-≠gaa) Damara in Sesfontein).

Goats relish this dwarf shrub in the rain season (recorded from Dâure.b Damara at ǁGaisaos on the Ugab).

The Herero name omubango was recorded from Purros Damara in Sesfontein.

Senna italica Mill.

FSWA: 600 BRI: 3536 Author's coll. no. SS0255

!Haa ≠haa.b (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein); **!naa≠khawa.b** recorded from Purros Damara in Sesfontein and Van den Eynden *et al* (1992: 87) record this name for an unidentified species whose uses in Sesfontein match the uses recorded here for this species.

The leaves are taken as a decoction for stomach pain and the roots are pound and taken as a decoction to treat the symptoms of gonorrhea (recorded from Purros Damara in Sesfontein). Van den Eynden *et al* (1992: 87) record that a decoction of the stems is drunk to relieve stomach pains.

Malan and Owen-Smith (1974: 153) record the Herero name orutanga and state that the Himba

drink an extract of the roots of *S. italica* subsp. *arachoides* (Burchell) Lock to relieve stomach pains (Malan and Owen-Smith, 1974: 253).

An extract of the roots is drunk by the Nharo for stomach and liver ailments (Steyn, 1981: 9). Decoctions of the leaves and roots of *Senna* spp. comprise the most important herbal remedies for gastrointestinal disorders including constipation administered by Luo herbalists in east Kenya or are eaten as a potherb (Johns *et al*, 1990: 374, 379). *Senna* spp. are similarly used throughout East Africa and elsewhere in Africa, in South America, the Caribbean, and the Philippines (see references in Johns *et al*, 1990: 375). The stewed leaves of *Senna* sp. (*Cassia longiracemosa* Vatke) are consumed in the treatment of malaria by Samburu pastoralists (Fratkin, 1996: 78).

The leaves of *Senna* sp. (*Cassia obtusifolia* L.) are among the most important plant foods of the Senegalese Ferlo (Becker, 1986: 63).

Senna? sp. (*Cassia venusta*) is an important source of insect galls and witchetty grubs for Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25) and by (O'Connell, 1983: 95).

Sesbania cf. *sphaerosperma* Welw
FSWA: 600 BRI: 3747 Author's coll. no. SS0064, SS0345?

Nana-tu, refers to both red and black seeds (cf. SS0345 and SS0064) (recorded from Tsoaxau and Dâureb Damara on the Ugab River, and Dâureb Damara in Sesfontein); **(ǀ)horobakie**, refers only to red seeds, cf. SS0064 (both names recorded in Sesfontein by ǁKhaoa-a, Namib/!Naren and Purros (incl. originally !Oe-≠gaa) Damara).

The roasted seeds (of both SS0064 and SS0345) are ground and drunk as 'Damara coffee', preferably with '**dani.b**', i.e. honey (recorded throughout former Damaraland and by Van den Eynden *et al*, 1992: 74).

This species provides good fodder for goats (recorded from ǁKhaoa-a Damara in Sesfontein, Tsoaxau and Dâureb Damara on the Ugab River).

The seeds are used to make beads where found throughout former Damaraland.

The Herero name ozuhebe was recorded for SS0345 by Purros Damara in Sesfontein.

Tephrosia dregeana E. Mey. *dregeana*
FSWA: 600 BRI: 3718

ǀHena ǀhab (recorded among the Kuiseb Topnaar by Van den Eynden *et al*, 1992: 41).

Among the Kuiseb Topnaar the roots are used as a milk curdling agent (Dentlinger, 1977: 35; Van den Eynden *et al*, 1992: 41).

Tylosema esculentum (Burch.) A.Schreib.
FSWA: 590 BRI: 3528

ǁNâu.s (Eiseb *et al*, 1991: 21, 29).

The Herero names are as follows: omumbanyu (aerial plant parts), otjipiva/otjipiya (tuber), ozombanyu (seeds) (Malan and Owen Smith, 1974: 153).

The large tuber is eaten by the Himba roasted (portions of which can be stored) or as a thirst quencher when raw. The beans are also eaten (Malan and Owen Smith, 1974: 153).

The leaves are eaten raw and the seeds and roots are roasted and eaten by the Nharo (Steyn, 1981: 20) and the seeds ('nuts') are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).

T. fassoglense (Schweinf.) Torre & Hillc.
FSWA: 590 BRI: 3528

The Herero names and uses are as for *T. esculentum* above. Otjipiva also recorded (Malan, 1974).

Luo herbalists of east Kenya administer a decoction of the roots to treat constipation and gastrointestinal problems (Johns *et al*, 1990: 380).

Vigna cf. *frutescens* A. Rich. *Frutescens frutescens*
FSWA: 600 BRI: 3905 Author's coll. no. S0317, cf. SS0104 = *Otoptera*
!Gae sururu.s (recorded in Sesfontein).
'**!Gae sururu.s**' means 'dark **sururu.s**', '**sururu.s**' being another plant which this species is perceived as being in the same 'family' with. It is considered to look dark when the sun shines on it.
This plant is considered to share family characteristics with **‖horo.s** (with red edible seeds) and **sururu.s**.

It is a minor food source for Gabra pastoralists of north Kenya (Stiles and Kassam, 1991: 26).

The root of *Vigna* sp. (*V. lanceolata*) is eaten by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25) and Alyawara Aborigines in north Australia (O'Connell, 1983: 84).

GERANIACEAE

Monsonia senegalensis Guill. & Perr.
FSWA: 640BRI: 3925 Author's coll. no. SS0148, SS0292
Surube bosu.i (recorded from ‖Khaoa-a, Namib/!Naren and ‖Khaoa-a Damara from Sesfontein); **‖nurabe.s** (plant and **bosu.i** or seeds) and **gai** or large **bosu.i** (recorded from Dâureb Damara at Palm and Gudipos, Ugab River, and in Sesfontein e.g. by Purros Damara); considered to be the male **raba.b** (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River) and **aore** (= male) **bosui** (recorded from ≠Ao-Dama, Rietkuil Farm); **raba** (recorded among the Nama in du Pisani, 1983: 10); the plant and seeds are also called **‖nora** (recorded from Dâure.b Damara from ‖Gaisoas and Gudipos on the Ugab River and by ‖Khaoa-a Damara in Sesfontein).
'**Surube**' and '**gai**' refers to the large size of the seeds (**bosu.i**) compared to *Monsonia umbellata*.

Seeds of this species and *M. umbellata* (see below) are collected from harvester ant nests ande eaten as snacks, usually roasted beforehand, or pound into a flour and cooked as porridge, often with other flours (recorded throughout former Damaraland). (When you pound the seeds of this **raba.b** they do not 'clean' as well as *M. umbellata* seeds (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River); they are very hard (recorded from Dâure.b Damara from ‖Gaisoas on the Ugab River)). Also recorded for the Kuiseb Topnaar who add leaves to tea and use seeds for beer brewing (Dentlinger, 1977: 35).

Is aromatic and, like *M. umbellata* is considered a '**sâi**' or perfume plant.

M. umbellata Harv.
FSWA: 640 BRI: 3925 Author's coll. no. SS0134
Throughout Damaraland *Monsonia umbellata* seeds (and plant) are referred to as **bosu.i** or specifically **≠khari bosu.i**, or 'small **bosu.i**, to distinguish them from *M. senegalensis* (see above); **raba.b** is the name of the plant and this species is described as the female (**tarare**) **raba.b** due to its small size relative to *M. senegalensis* (recorded from Tsoaxau Damara at ‖Gaisoas, and Dâureb Damara at Gudipos, on the Ugab River, ≠Ao-Dama, Rietkuil Farm); Nama called it **raba** (du Pisani, 1983: 10) and Eiseb *et al* (1991: 19, 28) record the name '**harapa.b**' for *Monsonia* spp.; According to Rust (1969: 255 in du Pisani, 1983: 10) the Nama call the seeds which have been collected from harvester ant nests '**‖kuni.b**', the act of gathering as '**‖kunire**' and the orange seed from which the seed coat has been removed '**tsama.n**'. Van den Eynden *et al* (1992: 74) report that *Monsonia* sp. is called **harapab** or **rabab**, the seeds as **bosu.i** and the unripe seeds as **surube**.

Throughout former Damaraland seeds are collected from harvester ant nests and eaten as snacks or pounded and cooked into a porridge with water and/or milk, and sometimes fat

and/or milk. They are also often added in smaller quantities to other flours such as maize-flour to add flavour, sometimes after roasting or soaking in water. The seeds can be stored for long periods of time (for references to food uses of **bosu.i** see Rust, 1969, in du Pisani, 1983: 10; du Pisani, 1978: 14 for the use of unidentified 'red seeds' called **bosu.i**; du Pisani, 1983: 10; Steyn and du Pisani, 1984/1985: 45; Van den Eynden *et al*, 1992: 74). The seeds are also used to make 'Damara beer' and sometimes added to **sâu.n** beer made from grass seeds of *Stipagrostis* spp. (see also du Pisani, 1983: 10). Leaves, stems and flowers are brewed into tea (recorded throughout former Damaraland and in du Pisani, 1983: 10, Steyn and du Pisani, 1984/1985: 45, Van den Eynden *et al*, 1992: 74) and roasted and ground seeds may be added to tea or coffee (Van den Eynden *et al*, 1992: 74). Du Pisani (1983: 10) also records that among the Nama small cakes used to be made from mashed **tsama.n** (*Citrillus lanatus*, Cucurbitaceae) porridge and milk and the leaves are used to flavour milk. The scraped root is recorded as used to thicken fresh milk (Schultz, 1907; Giess, 1966; Hoff 1981 in du Pisani, 1983: 10).

Monsonia umbellata is aromatic, and considered a **'sâi'** or perfume plant.

The Herero names ondami, omurondji and etendera (= a type of ondami?) were recorded in Sesfontein).

An extract of *Monsonia* spp. (*M. glauca* Knuth and *M. burkei*?) was known as an effective Cape remedy against chronic dysentery (MacOwen, 1897: 596-598).

Pelargonium sp. L'Hér. ex Aiton

FSWA: 640 BRI: 3928

|Ami≠ai.b (Schultze, 1907 in du Pisani, 1983: 14):

The edible subterranean plant parts eaten by Nama (Schultze 1907 in du Pisani, 1983: 14).

Sarcocaulon cf. *marlothii* Engl.

FSWA: 640 BRI: 3926 Author's coll. no. SS0054

Sora.b (recorded from ‖Khaoa-a, Purros and Dâureb Damara in Sesfontein), also used for *Ceraria longipedunculata*, Portulacaceae. **Sora.b** describes sliding the waxy bark off the stems (recorded from ‖Khaoa-a Damara in Sesfontein); **‖nora** (i.e. to press, referring to its use to plug holes in utensils) (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

The waxy bark is used to fix holes in utensils, often after melting or making more malleable using fire. For example, its use like this is said to add decoration to pipes and it is pressed (**‖nora**) into holes in **≠gou.b** and **!nubu≠gou.b**, i.e. big buckets like **‖hoe.s** used for beer (recorded from ‖Khaoa-a, Purros, Dâureb Damara in Sesfontein, and Dâureb Damara at ‖Gaisoas, Ugab River).

HYACINTHACEAE

Dipcadi cf. *bakeranum* Bolus

FSWA: 1470 BRI: 1084 Author's coll. no. SS0123

Gânao (recorded in Sesfontein, e.g. from ‖Khaoa-a Damara).

Baboons and porcupines (**!hoa.b**) eat the bulb (recorded in Sesfontein).

The small bulbs of *D. crispum* Baker and *D. marlothii* Engl. are eaten raw or roasted by the Nharo (Steyn, 1981: 11); and Bleek (1928 in Steyn, 1981: 23) records the same information for *D. glaucum* (Burchell ex Ker Gawler). Baker and Story (1958 in Steyn, 1981: 26) states that *Dipcadi* sp. produces edible bulbs.

The small, onion-like bulbs of *Dipcadi* spp. cf. *glaucum* and *longifolium* are eaten by the !Koo San; the former are roasted and the latter are eaten raw, as are the leaves (Heinz and Maguire, 1974: 41). The bulbs of *D. marlothii* and *D. viride* are eaten infrequently by the |Gwi and ‖Gana San (Tanaka, 1976: 118); the bulbs of *Dipcadi* spp. and leaves of *D. glaucum* are eaten by the !Kung San (Marshall, 1976: 110, 121) and Lee (1979: 164, 167) reports the consumption of

bulbs from several *Dipcadi* species by the Dobe-area !Kung, as well as of the leaves from *D. glaucum*.

Dipcadi sp. Medik.

FSWA: 1470 BRI: 1089 Author's coll. no. SS0109b

Gânao (recorded in Sesfontein, e.g. by Dâureb Damara).

Baboons and porcupines (**!hoa.b**) eat the bulb (recorded in Sesfontein). See notes above.

Scilla sp. L.

FSWA: 1470 BRI: Author's coll. no. SS0060

Gânao (recorded from Dâureb Damara in Sesfontein).

!Noa.b (porcupines) eat (recorded from Dâureb Damara in Sesfontein).

The Nharo eat the roasted roots of a *Scilla* sp. called ǁa-bi (Bleek, 1928 in Steyn, 1981: 23).The bulbs and raw leaves of *Scilla* sp. are staple foods among the !Koo San (Heinz and Maguire, 1974: 41) and the bulbs and stalks of *Scilla* spp. are eaten by the ǀGwi, ǁGana and Dobe-area !Kung San (Tanaka, 1976: 117; Lee, 1979: 164).

IRIDACEAE

Lapeirousia spp. Pourr.

FSWA: 1550 BRI: 1314

The edible corms of *L. rivularis* H.E. Wannt. are represented in Big Elephant Shelter in the Erongo Mountains (Wadley, 1979: 28) (nb. this species does not occur in Kunene according to Pat Craven's species list).

Onduvi is the term for *Lapeirousia* sp. in Malan and Owen-Smith (1974: 157).
The small tubers are eaten by the Himba Malan and Owen-Smith (1974: 163).

The Nharo eat the roasted bulbs of *L. littoralis* Baker subsp. cf. *caudata* (Schinz) Goldblatt (Steyn, 1981: 15). The edible corms of *L. schimperi* (Ash. & Klatt) Milne-Redh. and *L. odoratissima* Baker are eaten by the !Kung San (Marshall, 1976: 111), and those of *L. coerulea* Schinz and *Lapeirousia* sp. are eaten by Dobe-area !Kung (Lee, 1979: 164).

LAMIACEAE

Acrotome sp. Benth. ex Endl.

FSWA: 1230 BRI: 7236 Author's coll. no. SS0197

Oumahai.b (recorded from Purros Damara in Sesfontein); **ǀnai ǀgâs** (giraffe-grass) (recorded from Namib/!Naren Damara in Sesfontein).

'**Ouma**' means 'old lady' or 'grandmother' in Afrikaans and '**hai.b**' means plant. So-called as clustered flowers and hairy bracts of the inflorescence is thought to look like the white hair of an old lady.

Donkeys eat this plant (recorded from Namib/!Naren in Sesfontein) and the flowers are sprinkled onto blankets and plants kept in houses as a mosquito repellent (recorded in Sesfontein from Purros Damara).

Hemizygia floccosa Launert

FSWA: 1230 BRI: 7365 Author's coll. no. SS0101, SS0217

ǀHai-hai.s (grey-plant), **≠hauta≠aebe** (recorded from Purros Damara in Sesfontein); **ǀhai-hais** (recorded from ≠Ao-Dama, Rietkuil Farm).

'**ǀHai**' means grey and refers to the grey appearance of the plant.

This plant is a '**sâi**' or perfume plant and the leaves and roots are collected (often when collecting food items such as **bosu.i** or *Monsonia umbellata* (Geraniaceae) seeds), dried and ground into a powder for use as a body perfume (recorded from ≠Ao-Dama, Rietkuil Farm) (also described in Steyn and du Pisani (1984/1985: 44) who refer to the perfume as '**saa.b**').

Mentha longifolia (L.) L. *wissii* (Launert) Codd
FSWA: 1230 BRI: 7328
Referred to as '**christamine**' or '**te-haib**' ('**te**' means 'tea') in Sesfontein, and as '**kruisement**' by the Nama (du Pisani, 1983; 9).

This plant is cultivated in kitchen gardens and used to flavour tea (also recorded among the Nama and the Kuiseb Topnaar (du Pisani, 1983: 9).

The leaves of *Mentha* spp. are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).

Ocimum americanum L. *americanum*
FSWA: 1230
‖Game.b (du Pisani, 1983: 10).
The green leaves are used by the Nama to flavour tea throughout the Berseba and Tses areas (du Pisani, 1983: 10).

The Nharo use this (aromatic?) herb for 'toilet and ceremonial purposes' (Bleek, 1928 in (Steyn, 1981: 24).

The leaves (and roots) are used by Maasai and Kipsigis to make tea (Glover *et al*, 1966: 192). The leaves of *Ocimum* spp. are administered by Luo herbalists of east Kenya as decoctions or chewed raw to treat gastrointestinal disorders and are similarly used throughout Africa and Asia (see references in Johns *et al*, 1990: 374-375). Leaves of *O. suave* Willd. are placed in houses as a mosquito repellant (Johns *et al*, 1990: 380).

LAMINARIACEAE

Laminaria schinzii Foslie
Hurib!gûi.b; **‖gam-!gûi.b**, **huri-‖hai.n** and **‖ha.b** (du Pisani, 1983: 7); **huri‖hâa.b/i** (Eiseb *et al*, 1991: 19) and **huri‖ha.b**, **huri‖hâ.b** and **‖gam |gûi.b** (Van den Eynden *et al*, 1992: 21, 60) identified as *Ecklonia maxima*, i.e. seaweed.

'**Huri.b**' means 'sea', referring to where the plant ('**hai.n**') comes from (i.e. seaweed), and '**!gûi.b**' means 'intestine', referring to the appearance of the plant.

A commonly used medicine for healing burns or sores (**|habi.s**). Is prepared by roasting and pounding into a powder which is placed on to the affected area and said to be especially useful for children. This type of use was recorded in both Sesfontein and settlements along the !Ugab, and in Sesfontein and by the ≠Aonin of the !Kuiseb by Van den Eynden *et al* (1992: 21, 60). Schultze in 1907 (p. 213) mentions the use of a powder from seaweed for the treatment of venereal disease, and du Pisani (1983: 7) records its preparation in Berseba as an ointment through the mixing of dried, pounded and cooked stems, collected from Luderitz, with animal fat.

LICHENES

Parmelia hottentotta (Thunb.) Ach.
|Ui‖khao.b.
Van den Eynden *et al* (1992: 22, 61) record that this lichen is prepared by the ≠Aonin of the Kuiseb as a decoction which is drunk to cure coughs and relieve stomach and chest pains. It is also ground into a powder which is used by ≠Aonin along the !Kuiseb and in Sesfontein as a deodorant and perfume (Van den Eynden *et al*, 1992: 22, 61).

LOASACEAE

Kissenia capensis Endl.
FSWA: 930 BRI: 5388 Author's coll. no. SS0333
≠Aetabe, i.e. sticky plant (recorded from Dâureb Damara at ǁGaisoas, Ugab River); **≠aebe** (recorded from Dâureb Damara at Gudipos, Ugab River).

LORANTHACEAE

Plicosepalus kalachariensis (Schinz) Danser
FSWA: 220 BRI: 2074 Author's coll. no. SS0109
Dai !gu.b, recorded in Sesfontein; **dai!hui.b** (recorded from ǁKhaoa-a Damara in Sesfontein); **|naradai!hui.b**, i.e. **dai!hui.b** (= a hemiparasite) which grows on **|nara.s** or *Acacia tortilis*, Fabaceae (recorded from Purros (incl. originally !Oe-≠gaa) and ǁKhaoa-a Damara in Sesfontein); **mai!hui.b** (i.e. with male suffix, see *Tapinanthus oleifolius* below) (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos on the Ugab River, and is said to be a ≠Ao-Dama name); **haitsui.b** from Dâureb Damara at Gudipos, Ugab River and stated as the Dâureb Damara name); **hai!gui.b** (recorded from ≠Ao-Dama, Rietkuil Farm).

'**Dai**' means 'milk', and refers to the nectar which is sucked out of the flower.

The stems are dried, pounded and cooked and then added to sugar and milk 'like cocoa' (recorded from Dâureb Damara at Gudipos, Ugab River). Nectar is sucked out of the flower as a snack when in the field (reported in Sesfontein).

A decoction of the stems is used to treat gonorrhea; half a cup is drunk twice or three times a day and in one day it is reported to relieve symptoms such as the burning sensation when passing urine (recorded from Purros Damara in Sesfontein).
The leaves are considered good fodder for goats (recorded throughout former Damaraland)
This hemi-parasite is seen as an 'illness' of the tree it's growing on (recorded from Dâureb Damara at Gudipos, Ugab River).

Tapinanthus oleifolius (Wendl.) Danser
FSWA: 220 BRI: 2074 Author's coll. no. SS0001, SS0331
Hai-!hui.b/s (recorded in Sesfontein and along the !Ugab, and by ≠Ao-Dama, Rietkuil Farm); **dai** (= milk) **!hui.b** (recorded from ǁKhaoa-a, Dâureb, Namib/!Naren, and Purros (incl. originally !Oe-≠gaa) Damara in Sesfontein); **mai-!kui.s** (i.e. feminine suffix, see *Plicosepalus kalachariensis* above) (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos on the Ugab River and stated as a ≠Ao-Dama name); **haitsui.b** (recorded from Dâureb Damara at ǁGaisoas and Gudipos, Ugab River); **hai!khui.s/i** and **mâi!khui.s** are recorded as *T. oleifolius*, *Viscum capense* or *V. rotundifolium*, i.e. any mistletoe, in Eiseb *et al* (1991: 19, 29-30).

'**Hai-!hui.b/s**' means 'grows from the tree', i.e. refers to the parasitic life-form of this species.

The stems are dried, pounded and cooked and then added to sugar and milk 'like cocoa' (recorded from Dâureb Damara at Gudipos, Ugab River). As with *Plicosepalus kalachariensis*, nectar is sucked from the flowers when in the field (recorded in Sesfontein and along the Ugab). The fruits are eaten by children when in the field (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos on the Ugab River, and by ≠Ao-Dama at Rietkuil Farm); and Steyn and du Pisani (1984/1985: 45) also record that the fruits are eaten both fresh and dried.

As for *P. kalahariensis* above, a decoction of the stems is used to treat gonorrhea; half a cup is drunk twice or three times a day and in one day it is reported to relieve symptoms such as the burning sensation when passing urine (recorded from Purros Damara in Sesfontein).

Browsed by goats and is considered particularly good fodder for young goats who are fed with this in the kraals (recorded from Tsoaxau and Dâureb Damara at ǁGaisoas on the Ugab River).

This hemi-parasite is seen as an 'illness' of the tree it's growing on (recorded from Dâureb Damara at Gudipos, Ugab River) It is considered to dry out the trunks of the tree on which they

are growing; wax insects are also described as growing on this species (recorded from Dâureb Damara at ǁGaisoas, Ugab River).

The Herero name is oviraura (recorded in Sesfontein; otjiraura in Malan and Owen-Smith, 1974: 158)
A decoction from branches and leaves is drunk by Herero to treat gonorrhoea (recorded in Sesfontein) and an extract from the leaves is used by the ovaHimba in north-west Kunene to aid cattle in expeling the after-birth (the hemi-parasites *Odontella welwitschii* and *Plicosepalus undulatus* are used in the same way) (Malan and Owen-Smith, 1974: 158).

The fruits have a sticky gum that can be used as a glue substitute and has been recorded as used as a bird-lime in Owambo (Rodin, 1985).

MALVACEAE

Gossypium anomalum Wawra ex Wawra & Peyr. *anomalum*
FSWA: 820 BRI: 5020 Author's coll. no. SS0065
Dani ǀhamdi-a (**dani** = honey, **ǀhamdi** = very sweet) (recorded from Purros Damara in Sesfontein); **!garo.b**, i.e. field **!abise**, i.e. so-called because this plant has cotton-wool (**!abise**) inside the pods (it is related to the commercial cotton plant) (recorded from Tsoaxau Damara at ǁGaisoas and Dâureb Damara at Gudipos on the Ugab River, ǀKhomani Damara, Malansrust Farm).
Du Pisani (1983: 8) reports that the 'Dama' living along the lower Kuiseb valley use the pounded root of this plant to curdle milk.
Goats eat (recorded from ǀKhomani Damara, Malansrust Farm).
The cotton is used as wick in lighters and for cotton-wool (recorded from Tsoaxau Damara at ǁGaisoas on the Ugab River). Bees make sweet honey from the nectar of this plant (recorded from Purros Damara in Sesfontein).

The Herero name omujava outji (outji = sugar) was recorded from Purros Damara in Sesfontein.

Seeds of *G. hopii* were dried and eaten, or pounded into a flour with Mesquite (*Prosopis velutina*) beans, by the Akimel O'odham of the Sonoran Desert (Crosswhite, 1981: 65).

MESEMBRYANTHEMACEAE

Brownanthus kuntzei (Schinz) Ihlenf. & Bittrich
FSWA: 275 BRI: 2405
≠**Nugu.b** (recorded along the Ugab); ≠**naugu.b** (Van den Eynden *et al*, 1992: 44).
A decoction from the roots is drunk for indigestion and intestinal disorders (recorded along the Ugab). Van den Eynden *et al* (1992: 44) similarly record that this succulent bush is used by the Kuiseb Topnaar for a variety of medicinal purposes: a decoction from the stems relieves stomach pain, indigestion and constipation and whets the appetite; exposing the chest to the vapour obtained by boiling plant parts in water is effective in treating colds, flu and fever; and a decoction from the stems is given to livestock if the stomach is inflated or they have worms (tapeworm).

MONTINIACEAE

Montinia caryophyllacea Thunb.
FSWA: 540 BRI: 3238
≠**Niina.b** and ≠**niio.b** used by Damara and Nama respectively (Eiseb *et al*, 1991: 28).
The hollowed branches were used for pipe stems (Dentlinger, 1977: 35).

The Herero name is omutete; the Himba treat open wounds on people and animals with an extract from the bark of this tree, beads cut from the bark are worn around the waist by young Herero and Himba children and are associated with the social stage preceding puberty, and the hollowed branches are used as narrow pipes (Malan and Owen-Smith, 1974: 159).

MORACEAE

Ficus cordata Thunb. *cordata*

FSWA: 160 BRI: 1961 Author's coll. no. SS0399

|**Nomtabe.s**, recorded in Sesfontein; ‖**ui**, recorded in Sesfontein, e.g. by ‖Khaoa-a, Namib/!Naren, Dâureb and Purros (incl. originally !Oe-≠gaa) Damara (also for *F. ilicina*), and in Khowarib; ‖**ui.s** is *F. ilicina* according to Eiseb *et al* (1991: 27).

The fruits are edible but small (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

Used for leather dye or '**baa**' in Sesfontein. *F. ilicina* is also recorded as used for leather dye by the Herero in Kaokoland (Malan and Owen-Smith, 1974).

The Herero name is omumkumbwa or omumbaha (Malan and Owen-Smith, 1974: 160).'Ombaha' refers to the bark of the tree which is used as a leather dye, and by which any tree used for this purpose can be referred (Malan and Owen-Smith, 1974: 160).

The leaves and fruits are eaten by livestock in Kaokoveld (Malan and Owen-Smith, 1974: 160).

F. ilicina (Sonder) Miq.

FSWA: 160 BRI: 1961 Author's coll. no. SS0370

‖**Uui.b** (recorded in Sesfontein); referred to as **!garob** |**nomas**, i.e. field |**nomas** (*Ficus sycomorus*, see below) by Tsoaxau and Dâureb Damara at ‖Gaisoas, Ugab River; called ‖**ui.s** (Damara), ‖**noma.s** (Nama) and ‖**gau.s** in Eiseb *et al*, 1991: 27)

The fruits are edible but small (recorded from Dâureb Damara at ‖Gaisoas, Ugab River).

F. sycomorus L.

FSWA: 160 BRI: 1961 Author's coll. no. SS0332

Widely known as |**noma.s** (see also du Pisani, 1978: 15, 1983: 8; Eiseb *et al*, 1991: 21; Van den Eynden *et al*, 1992: 76).

'|**Noma.s**' means 'hot tongue'.

The fruits (figs) are eaten wherever this tree is found in north-west Namibia, either fresh or dried, or pounded and eaten like a porridge with milk (see also Jacobson, 1991: 10; Steyn and du Pisani, 1984/1985: 44). They are also widely consumed by the Nama of southern Namibia who often eat them with other gathered foods such as !nara (*Acanthosicyos horridus*, Cucurbitaceae) and sometimes cook the dried fruits and use as a coffee substitute (du Pisani, 1978: 15; 1983: 8). The fruits can also be boiled and made into a jam (also recorded by Steyn and du Pisani, 1984/1985: 44; Van den Eynden *et al*, 1992: 76).

Goats browse the leaves (recorded from ≠Ao-Dama, Rietkuil Farm).

The bark is widely used to make a red leather dye for tanning livestock skins and can also be used to dye *Hyphaene petersiana* leaves used in basketry.

The Herero name is omukuyu (tree), omakuyu (fruit) (recorded in Sesfontein (also omukuju/omakuju) and see Malan and Owen-Smith, 1974: 160)

The fruits are eaten (recorded in Sesfontein, Malan and Owen-Smith, 1974).

In Kaokoveld the leaves are browsed by goats and the bark is used as a leather dye but is regarded as poor quality (Malan and Owen-Smith, 1974).

Ficus sycomorus is one of several indigenous figs providing edible fruits consumed by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 49). The fruits are also eaten by Maasai and Kipsigis (Glover *et al*, 1966: 193) and the fruits of this and other *Ficus* spp. are eaten in Ethiopia (Getahun, 1974: 51-52).

The fruit of *Ficus* sp. (*F. platypoda*) is eaten by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25).

MORINGACEAE

Moringa ovalifolia Dinter & A.Berger
FSWA: 500 BRI: 3128
!Khoe≠hanu.s (recorded in Sesfontein); **sâi.s** (used by Purros (originally !Oe-≠gaa) Damara in Sesfontein); **!khoe≠khanu.s** and **‖khao.s** (Eiseb *et al*, 1991: 22-23, 28).
The roots of young individuals can be roasted and eaten (as described by Purros Damara from Sesfontein).
It is considered a '**sâi**' or perfume plant, and the powdered bark is added to '**sâi**', i.e. body perfume (recorded in Sesfontein).

The Herero name is omukuva; the raw roots are eaten by herdboys while at remote cattle posts, but only when alternative foods are scarce (Malan and Owen-Smith, 1974: 160).

MYROTHAMNACEAE

Myrothamnus flabellifolius Welw.
FSWA: 510 BRI: 3282 Author's coll. no. SS0046
‖Khootorotorosen (when green), **!hotorotorosen** (when dry, **!ho** means grasp and refers to the plant being clasped together) (recorded throughout former Damaraland); **!hotorobasen** (recorded from ‖khaoa-a Damara in Sesfontein); **totosen** (Dâureb Damara at ‖Gaisoas, Ugab River); **!khotorotorosen**, **!khotortorsen**, **totosen**, **!kho≠go≠gosen** (Van den Eynden *et al*, 1992: 76); **!khooto(r)oto(r)osen.ni**, **!khootortorsen.ni**, **to(r)oto(r)osen.ni**, **!khoo≠goo≠goosen.ni** (Eiseb *et al*, 1991: 23, 28).
Tea is commonly made from the leaves and small branches (also recorded for Sesfontein in Van den Eynden *et al*, 1992: 76).
Goats reportedly eat it when green (recorded from |Khomani Damara, Malansrust Farm).

The Herero name is ohandukaze (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 160); ekurukaxe (recorded from Purros Damara in Sesfontein).
This herb is also made into a tea drunk commonly by Herero and less so by Himba (Malan and Owen-Smith, 1974: 160).

NYCTAGINACEAE

Boerhavia L.
FSWA: 250 BRI: 2349 Author's coll. no. SS0206, SS0250
≠Auba ≠aebe (recorded in Sesfontein).
'**≠Auba**' means 'it won't fall out' and '**≠aebe**' refers to the plant's stickiness (**≠ae** = sticky). The name refers to the plant's usefulness in plugging up holes in liquid-carrying vessels such as buckets or calabashes.
The roots of *B. diffusa* are recorded as chewed or cooked and eaten to treat stomach and intestinal complaints (Koenen, 1977).
The plant is scrunched up and used for plugging holes in liquid-carrying vessels. As demonstrated in Sesfontein, its stickiness promotes water-tightness.

The Herero name okaharaova refers to an unidentified *Boerhavia* or *Commicarpus* sp.; the Himba boil the runners of 'okaharaova' to make a coffee-like drink consumed with goat-milk and sugar (Malan and Owen-Smith, 1974: 160).

The tap root of *Boerhavia diffusa* L. is eaten by Alyawara Aborigines in north Australia (O'Connell, 1983: 84).

B. cf. hereroensis/diffusa
FSWA: 250 BRI: 2349 Author's coll. no. SS0159
!Hona (recorded from Purros Damara in Sesfontein).
Eaten by ostriches (recorded from Purros Damara in Sesfontein).

The Herero name orujara was recorded from Purros Damara in Sesfontein.
Phaeoptilum spinosum Radlk.
FSWA: 250 BRI: 2351 Author's coll. no. SS0052
‖Ari.b/s (recorded from Tsoaxau and Dâure.b Damara at ‖Gaisoas, Ugab and by |Khomani Damara at Rietkuil farm); **‖ari.s** (**‖khawi.s**? Giess) = *P. spinosum* and/or *Grewia flavescens* var *olukondae* in Eiseb *et al* (1991: 21, 28); **|hoe.b** recorded from ‖Khaoa-a, Namib/!Naren and Purros (originally !Oe-≠gaa) Damara in Sesfontein; **gubi |hans** (**gubi** = sheepskin, **|hans** = mat/blanket) recorded from Purros Damara in Sesfontein, also for *Lycium* sp., Solanaceae; **!on** (recorded from Dâure.b Damara from ‖Gaisoas and Gudipos on the Ugab River), is also considered a male **‖ari** (recorded from Dâure.b Damara from Gudipos on the Ugab River).

At settlements on the !Ugab it was recorded that the roots are pounded, cooked and a decoction from them drunk to relieve diarrhoea. Du Pisani (1983: 12) describes the similar use in the former Namaland of a plant referred to as '**ao-‖ari.b**' or 'male' **‖ari.b**, interpreted here as being *P. spinosum*, the roots of which are pounded and boiled in water and the extract used to treat children for stomach disorders and convulsions.
Browsed by livestock.

It was reported that if you make a fire from this species the whole family will die one by one (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab) and that when it has new (red) flowers you can't look at it for a long time because it will make your eyes red and sore (recorded from |Khomani Damara at Rietkuil farm). Purros (originally !Oe-≠gaa) Damara from Sesfontein say that it is a **!garihai.s**, i.e. hard to break. Ostrich eat this plant (recorded from Dâureb Damara at Gudipos on the Ugab River).

The Herero name okahono(ka)ondu was recorded from Purros Damara in Sesfontein and for *Lycium* sp., Solanaceae.

OLACACEAE

Ximenia americana L. *microphylla microphylla* Welw. ex Oliv.
FSWA: 190 BRI: 2129 Author's coll. no. SS0253
Known throughout former Damaraland as **≠ero.s/n** or **≠eero.s**; also spelt as **≠eero.s**, **≠iiro.s** and **≠ooro.s** in Eiseb *et al*, (1991: 24, 30), and **≠ero.s** in Van den Eynden *et al* (1992: 76).

'**≠Ero**' means sour; is similar to '**au**' meaning 'bitter', and refers to the sourness of the fruits.The fruits are widely eaten (also recorded by Van den Eynden *et al*, 1992: 76), and the seeds soaked in water produce a sweet tasting drink (recorded in Sesfontein). The seeds are used to make a coffee-like drink (recorded from Dâureb Damara at Gudipos, Ugab River).

The seeds are burned and ground into a powder which is applied to burns (recorded in Sesfontein) or cuts (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein. Similarly, powder from the dried or roasted root-bark is used to treat boils and burns (recorded from Tsoaxau Damara at ‖Gaisoas and Dâureb Damara at Gudipos on the Ugab River, and from |Khomani Damara, Malansrust Farm). A decoction from the roots is drunk to treat symptoms of gonorrhea (recorded from Purros (originally !Oe-≠gaa), ‖Khaoa-a and Dâureb Damara in Sesfontein).

Browsed by goats (recorded from |Khomani Damara, Malansrust Farm).
The burned seeds are ground into a powder which can be used as a black cosmetic (recorded in Sesfontein) and rubbed on goat skins as a tanning agent (recorded from ‖khaoa-a Damara in Sesfontein). A powder of the soft root is used by women as a 'douche' to make them attractive to men (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River).

The Herero names omunjinga (tree), ozonjinga (fruit) were recorded in Sesfontein and from

Purros Damara; see also Malan and Owen-Smith, 1974: 160).
The fruits are eaten (recorded in Sesfontein, Malan and Owen-Smith, 1974: 160). Oil from the seed is sometimes used by poorer Himba and Tjimba of Kaokoveld as a substitute for animal fat which is commonly rubbed into the body, often pigmented red with ochre (Malan and Owen-Smith, 1974: 160).

The Nharo eat the fruits (Story, 1950 in Steyn, 1981: 26) as do the !kung, |Gwi and ‖Gana San (Tanaka, 1976: 117; Lee, 1979: 160). The fruits of *X. caffra* Sond. are a major food source for the Dobe !Kung (Lee, 1979: 160) and Marshall (1976: 120) reports that they are eaten and the charred seeds, pound into a powder and mixed with fat, are rubbed onto the body as a medicine for pains.

The fruits of *Ximenia* spp. are eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249) and *X. caffra* Sond. fruit are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 54).The two South African species of *Ximenia* (*X. americana* and *X. caffra* Sonder) were the subject of exploration into the commercial value of oil extracted from the fruit kernel but trials indicated that it was of inferior value to vegetable oils already in commercial production (Schweickerdt, n.d.: 179-182).

The fruits are eaten by Maasai and Kipsigis and the roots are used by the Maasai to make tea (Glover *et al*, 1966: 193), and the fruits are eaten in Ethiopia (Getahun, 1974: 53). Luo herbalists of east Kenya administer a decoction of the roots in combination with other species to treat constipation and other gastrointestinal disorders (Johns *et al*, 1990: 381). The bark of *X. caffra* Sond. is boiled and added to milk which is drunk in the treatment of stomach upsets by Samburu pastoralists (Fratkin, 1996: 75).

OXALIDACEAE

Oxalis purpurascens Salter
FSWA: 630 BRI: 3936
Called by the Nama **|gabe.s/n** (du Pisani, 1983: 11); Eiseb *et al* (1991: 21, 24, 28) record the names **|khawe.b** and **|khawpe.b** for *O. semiloba*(?) of which the bulbs are called **≠hao.s.** Among the Nama the leaves and small elongated bulbs are eaten raw and the bulbs are also cooked in milk or roasted (Schultze, 1907: 194, 202; Giess, 1966: 64; du Pisani, 1983: 11).

PEDALIACEAE

Harpagophytum procumbens (Burch.) DC. ex Meisn. *procumbens*
FSWA: 1310 BRI: 7771
‖Huribe‖kham, **‖uribe‖kham**, **‖kurube‖kame.b**, **gamako.s** (recorded in Sesfontein, e.g. by ‖Khaoa-a Damara); **‖khuripe‖khams** (recorded from Tsoaxau and Dâureb Damara at ‖Gaisoas, Ugab River, ≠Ao-Dama, Rietkuil Farm, |Khomani Damara, Malansrust Farm, and in du Pisani, 1978: 15; Eiseb *et al*, 1991: 22, 27; Van den Eynden *et al*, 1992: 78); **‖khuri‖khams** (recorded as the Nama term in Eiseb *et al*, 1991: 22, 27); **kâ.s** (refers to the bitterness of the plant) (recorded from Tsoaxau and Dâureb Damara at ‖Gaisoas, Ugab River); **amahu** (recorded along Aba-Huab); **(g)amaku.s** (Eiseb *et al*, 1991: 18, 22, 27); **goma khu.b** (du Pisani, 1983: 9).
The tuber of this plant is a valued medicine throughout Namibia and is the basis for both informal and commercial trade. The tuber is roasted and eaten or made into a decoction to treat stomach and menstrual pains (including cancer according to ≠Ao-Dama, Rietkuil Farm), (see also Van den Eynden *et al*, 1992: 78), to assist with expelling the afterbirth and for heartburn, high blood pressure, liver complaints, very bad coughing, and diarrhoea, and to cure worms. When prepared as a decoction, a small piece is boiled in a cup and half a cup is drunk 2-3 time a day for 2 days. A powder from the dried tuber is put onto boils (recorded from ≠Ao-Dama, Rietkuil Farm). Du Pisani (1978: 15) states that it is used by Damara along the Ugab 'for medicinal purposes' and in 1983 (p. 9) records that a decoction of the tuber is taken by the Nama for coughs, stomach upsets and indigestion, and TB. Watt and Breyer Branduijk (1962: 830) records the use of the fresh tuber as an ointment for the treatment of (skin?) cancer as well as the use of this species to treat TB (see also Von Koenen, 1977: 82-83).

The Herero name is otjihangtere (Kajujaha-Matundu, 1994).

Rogeria adenophylla Gay ex Delile
FSWA: 1310 BRI: 7776 Author's coll. no. SS0231
In Sesfontein this plant is referred to as **poposi** (e.g. by ǁKhaoa-a Damara); **ǀhâ ǀhâ** (which refers to the sound made when the seeds are shaken out of the pod, e.g. by Namib/!Naren and Purros (originally !Oe-≠gaa) Damara), **≠erebe** (by Purros Damara) and **kai** or 'large' **ǀgame/b** (e.g. by Namib/!Naren and Purros (originally !Oe-≠gaa) Damara); Van den Eynden *et al* (1992: 49) state that *R. longiflora* (Royen) D. Gay is called **dau ǀana.b** or **ǁgam ǀawi.b** by the Kuiseb Topnaar.
The black seeds can be eaten (recorded from Namib/!Naren and Purros (incl originally !Oe-≠gaa) Damara).
This species is used to treat a sickness of the nails called **ǀhor ǀhaan** in which the nails break, by pounding the seeds, mixing with fat or, today, vaseline and rubbing on the nails (recorded from Dâure.b Damara in Sesfontein).The Kuiseb Topnaar apply the roasted and pound seeds, sometimes added to fat, to wounds to stop the bleeding and to relieve the pain of burns, and applied warmed leaves to women's breasts to relieve mastitis (Van den Eynden *et al*, 1992: 50).
Bees collect nectar from this plant and birds eat the seeds (recorded from Purros Damara in Sesfontein).

The Herero name omuzeba was recorded from Purros Damara in Sesfontein.

Sesamothamnus guerichii (Engl.) E.A.Bruce
FSWA: 1310 BRI: 7774 Author's coll. no. SS0129
!Gawa.s (recorded throughout former Damaraland); this name is also commonly used for *Catophractes alexandri*, Bignoniaceae, and the two species can be said to have a superficial similarity in appearance; **ǀkhîni** (recorded from ǁkhaoa-a, Purros (incl. originally !Oe-≠gaa) Damara in Sesfontein); **ǀhoe.b** (recorded from Dâure.b Damara in Sesfontein).

The root and small stems are used to treat stomach pain (recorded in Sesfontein, and from ǀKhomani Damara, Malansrust Farm), gonnorrhea (recorded from Purros Damara in Sesfontein), and is given to women to stem bleeding/expel afterbirth (?) (recorded from Purros Damara in Sesfontein). A paste from the roasted seeds is spread onto circumcism wounds (recorded from Purros Damara in Sesfontein). The bark is chewed or drunk as a decoction for indigestion after eating meat (recorded from Tsoaxau Damara at ǁGaisoas, Ugab River).

Browsed by goats. Bees sometimes make hives in the trunk of this tree (e.g. recorded from ǁkhaoa-a Damara in Sesfontein). The dead wood is good for firelighting because of a flammable resin or oil in the trunk (ǀKhomani Damara at Rietkuil farm, Dâure.b Damara from ǁGaisoas on the Ugab River).

As with *Catophractes alexandri*, Bignoniaceae, it was reported that if you steal meat that someone else has cooked, putting **!gawas** leaves on the meat will stop you from getting boils; similarly, adding the leaves to meat before it is cooked will help cure boils thatyou already have. Boils thought to be related to 'talking too much' (recorded from Dâureb Damara at Gudipos, Ugab River).

The Herero names okombadi, ogumbati were recorded from Purros Damara in Sesfontein and ongumbati in Malan and Owen-Smith (1974: 161).
Venereal disease is treated by the Himba by using an extract of the roots of this species (Malan and Owen-Smith, 1974: 161).

Sesamum rigidum Peyr. cf. *merenskyanum* Ihlenf. & Seidenst.
FSWA: 1310 BRI: 7777 Author's coll. no. SS0405
≠Erebe (recorded from Purros Damara in Sesfontein); **ǀgaibaka** (**ǀgai** = weak) (recorded from Dâureb Damara in Sesfontein).
The black seeds can be eaten like **poposi**, i.e. *Rogeria adenophylla* (recorded from Purros Damara in Sesfontein).
A powder from the roasted plant is used to treat boils (recorded from Dâureb Damara in

Sesfontein)

The leaves and fruit of *Sesamum* spp. are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 52).

PERIPLOCACEAE

Curroria decidua Planch. ex Hook.f. & Benth.

FSWA: 1130 BRI: 6739 Author's coll. no. SS0156

|Girihai.b ('**|giri**' means 'jackal', i.e. jackal plant) (recorded throughout former Damaraland); **|gaire** (= jackal) **hai.b** (recorded from ≠Ao-Dama, Rietkuil Farm); **≠hobo≠hobo.b**, the name referring to the taking or sucking of nectar by bees from its flowers, is also used by Purros Damara from Sesfontein; **girihai-i** (du Pisani, 1983: 7) and **|hini.s** (Eiseb *et al*, 1991: 20, 26); recorded as **arihai.b** and **|hini.s** in Van den Eynden *et al* (1992: 78) who also refer to an unidentified plant called **|girehai.b** (p. 54) by the Kuiseb Topnaar whose medicinal uses indicate that it could be *C. decidua*; **pirihai.s** (**piri** = goats) recorded from Purros Damara from Sesfontein.

A decoction of the root (which has a milk or **dai** inside), made from a piece about 10cm long and 1.5cm in diameter, is drunk as a laxative to 'clean the stomach' and treat constipation and relieve stomach pain; one cup will cause diarrhoea and/or vomiting that day (recorded throughout former Damaraland). Dâure.b Damara at ‖Gaisoas on Ugab River report that 'the old people' used to introduce a powder from the roots into incisions made in the lower abdomen and back to treat gonorrhea, and a decoction of the roots is drunk for the same reason. ‖Khaoa-a Damara state that when you take the root for medicine you should leave some money at the plant in return. Du Pisani (1983: 7) also records that the Nama take a decoction from the pounded root as a laxative, but pregnant women should not use this for fear of losing their babies and Hildesheim (1986: 339) records that the Nama use a decoction from the roots as a purgative. A decoction is similarly drunk to relieve menstrual pain (recorded in Sesfontein). Van den Eynden *et al* (1992: 54, 78) record that in Sesfontein a decoction of the roots is given to apparently rabid dogs while the Kuiseb Topnaar chew the root or take a root-decoction of the unidentified **|girehai.b** to relieve stomach pains and constipation, and use this decoction to treat similar conditions in livestock, particularly donkeys. A decoction of the plant parts is drunk (3 times a day) for colds and TB symptoms (recorded from ≠Ao-Dama, Rietkuil Farm).

Purros Damara from Sesfontein report that the bark is used for '**sâi**', i.e. perfume.

Browsed by livestock (recorded in Sesfontein).

The bees make honey from its flowers (recorded in Sesfontein).

Hildesheim (1986: 339) reports that the Nama use this plant 'against bad luck', probably by burning in the fire.

This species is recognised as a '**daihai.s**' or '**dairu**', i.e. as having a milky latex ('**dai**' = 'milk') (recorded in Sesfontein). It is called a jackal (**|giri**) plant because jackals are observed to dig a hole and urinate at this plant and then go straight to that plant when it is next in that place, even if it is several months later (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River).

The Herero name okarondero was recorded in Sesfontein; omuhambambwa or ehambambwa (Malan and Owen-Smith, 1974: 161).'A potent laxative is extracted from the roots' and used by the Himba to treat venereal disease, assist with expelling the afterbirth and to prevent constipation, and is used similarly for livestock (Malan and Owen-Smith, 1974: 161).

POACEAE

Anthephora schinzii Hack.

FSWA: 1600 BRI: 9901 Author's coll. no. SS0205

|Uru (= ripe) **|gâ.b** (= a generic term for grass and grass-like plants) (recorded from Purros Damara in Sesfontein); **≠aeda** and **!nabise** recorded from Dâure.b Damara in Sesfontein;

!nabira, i.e. **!na** = throw, and the name describes the way that the plant is seen as throwing the seeds onto the ground (recorded from Dâure.b Damara at ǁGaisoas on the Ugab River); **|howe.s**, **|hobe.s** and **!uru |gâa.b** recorded for *A. pubescens* in Eiseb *et al* (1991: 20, 22, 25).

Aristida cf. *effusa* Henrard
FSWA: 1600 BRI: 9902 Author's coll. no. SS0270

!Gaebiburu≠gahe (used for bothe the **|gâ.b** or plant and the **sâu.n** or seeds), described as a **'tînki'** type of **|gâ.b** or grass (recorded in Sesfontein, e.g. by ǁKhaoa-a and Purros Damara); |Khomani Damara at Rietkuil farm refer to this as **|huru |gâ.b** with seeds termed **|huni.b** which stick to you; Eiseb *et al* (1991: 21, 25) record the name **|khuru.b** (i.e. brackish) for *Aristida* spp. and **|guru.b** was recorded from Dâure.b Damara in Sesfontein; **|hoe sâu** recorded from ≠Ao-Dama, Rietkuil Farm, because the seeds are thin and narrow.

'!Gaebiburu≠gahe' refers to the difficulty of preparing these seeds because they are so thin (**'buru'** means winnow, **'≠gahe'** means 'put in' in the sense of putting in the **≠goub** or winnowing bowl).
'Tînki' is a generic name for types of grass or **'|gâ.b'** that have awns which are not hairy/feathery (feathery awns are called **'!haburo'**), i.e. *Aristida* spp. have 3 hairless awns whereas *Stipagrostis* spp., with their hairy awns are **'!haburo |gâ.n'**).

The seeds are eaten after collecting from harvester ant nests (**'≠goburu.n ≠oms'**) (recorded from ǁKhaoa-a and Purros Damara in Sesfontein). They are often mixed in the nests with other types of **sâu.n**, predominantly *Stipagrostis* spp. grasses. Schultze (1907 in du Pisani, 1983: 14) also records that the Nama collect the seeds from *Aristida* grasses from harvester ant nests and consume them with milk.

Tînki grows near the |Giribes plains to the north-west of Sesfontein, cf. Julia Tauros describes going with her father from Sesfontein to collect it.

The seeds of *Aristida* sp. are eaten by Dobe-area !Kung (Lee, 1979: 167).

Cenchrus ciliaris L.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0008, SS0177,SS0236

|Uiobageda (recorded in Sesfontein); **|hoobe |gâ.n** (recorded from |Khomani Damara at Malansrust farm); is a **|huru** (or 'ripe') **|gâ.n** (recorded in Sesfontein)

'|Uiobageda' describes this species as 'the brother-in-law' to wheat, due to its appearance and the fact that it commonly grows in irrigated gardens where wheat is grown (recorded in Sesfontein).

Cows, horses and tortoises are described as eating this grass (recorded from |Khomani Damara at Malansrust farm).

The Herero name orurenda is recorded in Malan and Owen-Smith (1974: 161) who describe this grass as 'valuable grazing for livestock' in Kaokoveld.

Chloris virgata Sw.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0263

Nanube (recorded in Sesfontein); **≠hara≠gai** (= 'foot-at-the-end') (recorded in Sesfontein); **!nobo≠gai (!nobo** =a bird, possibly redcrested korhaan) (recorded from ǁKhaoa-a Damara in Sesfontein); **haa≠aare**, i.e. horsetail is used by Purros Damara in Sesfontein and refers to the shape of the inflorescence.
This species is described as having a **≠hara ≠gai** (or 'foot-at-the-end') type of raceme, i.e. terminal, cf. *Cynodon dactylon*.

Stated in Sesfontein (e.g. by ǁKhaoa-a Damara) that the seeds are collected by harvester ants and eaten with **sâu.n** (eeds of *Stipagrostis* spp.).

Cladoraphis spinosa (L.) S.M.Phillips
FSWA:1600 BRI: 9902

Du Pisani (1983: 7) records the Nama name as **|game.s.**Dry stems of this grass are used along

the lower Kuiseb to kindle fires (du Pisani, 1983: 7).

Cynodon dactylon (L.) Pers.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0238
≠Hara ≠gai (see also *Chloris virgata* above) , described as a **|hom** or lawn-forming type of **|gâ.b** or grass (recorded in Sesfontein). Purros and ‖Khaoa-a Damara also describe it as **!nobo≠gai**, **!nobo** = a bird, possibly a redcrested korhaan. Eiseb *et al* (1991: 20, 26) refer to this species as '**|gari.b**'.

'**≠Hara**' means 'the end', '**≠gai**' means foot, together meaning 'the foot at the end' which describes the appearance of the terminal digitate raceme. *Chloris virgata* and *Dactyloctenium aegyptium* also fall into this category. This species is also a **|hom |gâ.b**, i.e. a grass in which the leaves and stems form a thick lawn due to its underground runners. **!Hare.s**, i.e. *Cyperus* sp. also falls into this category.

Cattle graze (recorded at Rietkuil farm).

The Herero name is otjiwena and it is consider by the Himba as good grazing for livestock (Malan and Owen-Smith, 1974: 161).

Dactyloctenium aegyptium (L.) Willd.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0213
This species is a **≠hara ≠gai |gâ.b** (recorded in Sesfontein), see notes for *Cynodon dactylon*; also referred to as **ari≠ga.i** or dog-foot (‖Khaoa-a and Namib/!Naren Damara) and **!nobo≠ga.i** (**!nobo** =a bird, possibly redcrested korhaan) (recorded from ‖Khaoa-a and Purros Damara in Sesfontein); recorded as **|uru** (= ripe) **|gâ.b** by Purros (incl. originally !Oe-≠ga) Damara in Sesfontein. Referred to as **!naba≠hara** by Dâureb Damara in Sesfontein (see notes for *Entoplacamia aristulata*); described as family with **≠are.s** (*Setaria verticillata*) by Dâureb Damara at Gudipos, Ugab River.
Dâureb Damara at Gudipos, Ugab River, state that the seeds are edible, are white when clean, and are found near ‖Gaisoas.

The seeds of *Dactyloctenium* sp. (*D. radulans*) are eaten by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25).

Danthoniopsis dinteri (Pilg.) C.E.Hubb.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0234
≠Nami.b/n (plant and seeds) (recorded throughout former Damaraland and for an unidentified species in Van den Eynden *et al*, 1992: 87); Dâure.b Damara at ‖Gaisoas on the Ugab River also describe it as similar to **≠uu**, i.e. *D. ramosa*, see below); ?called a **≠nara≠gai** (foot-at-the-end) **|gâ.b** (cf. *Cynodon dactylon*) by Purros (originally !Oe-≠ga) Damara in Sesfontein.
The seeds are eaten; when 'cleaned' or husked they appear white like **≠u sâu.n** (recorded in Sesfontein e.g. by ‖Khaoa-a Damara, and at Palm farm).

D. ramosa (Stapf) Clayton
FSWA: 1600 BRI: 9901
≠U, **≠hu** (recorded in Sesfontein and in State Museum, n.d.); **≠ami.b**? (**≠nami.b**) recorded from Purros Damara in Sesfontein.
The seeds are eaten. Is considered a white type of '**sâu.n**' (recorded in Sesfontein and along the Ugab).
Occurs to the west of Dâure.b, i.e the Brandberg. The seeds are collected by **gai≠goburun** (large harvester ants) called **saru.i** into small nests (not **!kare ≠goburun**, i.e. *Pheidole* cf. *kaokoensis*, nests) (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River).

Enneapogon cenchroides (Roem. & Schult.) C.E.Hubb.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0207
!Nabise, i.e seen as related to *E. desvauxii* (recorded in Sesfontein); **|huru** (= ripe) **|gâ.b** recorded from ‖Khaoa-a, Purros (!Oe-≠gaa), and Namib/!Naren in Sesfontein.

The Herero name ejomba was recorded from Dâureb Damara from Gudipos, Ugab River; okahundanduzu is recorded for *E. scoparius*, described as good grazing in Kaokoveld (Malan and Owen-Smith, 1974: 161)

E. desvauxii Beauv.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0240
(≠**Khari**) **!nabise** |**gâ.b**, ≠**khari** |**huru** |**gâ.b**; (recorded in Sesfontein, e.g. by ‖Khaoa-a and Purros Damara); |**ami**, i.e. ostrich, |**gâ.n** (= grass) recorded from |Khomani Damara at Malansrust farm because ostrich eat this grass; ‖**gari.i** (Eiseb *et al*, 1991: 21, 27).

'≠**Khari**' means small (from ≠**khariro**) and distinguishes this type of '**!nabise**' from *Monelytrum luederitzianum* (see below) which has the same name and, on the basis of appearance, is considered to be the same type of grass. '|**Huru**' refers to the similarity of the seed heads in appearance to ripe wheat, which make **sâu.n**, i.e. *Stipagrostis* spp. grass seeds, 'dirty' in harvester ant nests.

The seeds are collected with other types of **sâu.n** from harvester ant nests and eaten.

Entoplacamia aristulata (Hackel and Rendle) Stapf
FSWA: 1600 BRI: 9902 Author's coll. no. SS0200
!Nawa ≠**hara** |**gâ.b**, translated literally as 'rhino's testicles grass', referring to the sharpness of the inflorescences which stick in your groin when walking through this grass, making you angry like a rhino (recorded from Purros Damara from Sesfontein); **kai** (= big) |**game** (i.e. prickly plant) (recorded from ‖Khaoa-a and Namib/!Naren Damara in Sesfontein); ≠**hauta**≠**aebe** recorded from Dâure.b Damara in Sesfontein (≠**ae** = sticky/prickly); **!nara.b** (Eiseb *et al*, 1991: 27).

Eragrostis cf. *annulata* Rendle ex Scott-Elliot
FSWA: 1600 BRI: 9902 Author's coll. no. SS0111, SS0145, SS0174
|**Homara** |**gâ.b** (recorded in Sesfontein); |**gâ.b** is a generic term for grass; There are reportedly three types of |**homara** |**gâ.b**.
The seeds are collected directly from the plant, pounded into flour and cooked as a porridge with milk and salt if available (recorded in Sesfontein, e.g. from ‖Khaoa-a Damara). Today they are collected when collecting **sâu.n** (*Stipagrostis* spp. grass seeds) or **bosu.i** (*Monsonia* spp. seeds) from harvester ant nests.

Seeds of *Eragrostis* spp. are consumed by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25) and Alyawara Aborigines in north Australia (O'Connell, 1983: 84).

E. cf. *biflora* Hack. ex Schinz
FSWA: 1600 BRI: 9902 Author's coll. no. SS0264
|**Homara** (recorded from ‖Khaoa-a and Namib/!Naren Damara in Sesfontein); ?called ≠**nami.b** (usually *Danthoniopsis dinteri*) by Purros (originally !Oe-≠ga) Damara in Sesfontein.

E. cf. *cylindriflora* Hochst.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0276?, SS0209?
|**Homara** |**gâ.b** (recorded in Sesfontein, e.g. by ‖Khaoa-a and Purros Damara), |**gâ.b** is a generic term for grass; **!gari-ao-oâ** recorded from ‖Khaoa-a and Dâure.b Damara in Sesfontein.
The seeds are collected directly from the plant, pounded into flour and cooked as a porridge with milk and salt if available (recorded in Sesfontein, e.g. by ‖Khaoa-a and Purros Damara). Today they are collected when collecting **sâu.n** (*Stipagrostis* spp. grass seeds) or **bosu.i** (*Monsonia* spp. seeds) from harvester ant nests.

E. cf. *omahekensis* de Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0212?
|**Homara** (recorded from ‖Khaoa-a, Namib/!Naren and Purros (incl. originally !Oe-≠ga) Damara in Sesfontein).

The Herero name omurontji was recorded from Purros Damara in Sesfontein.

E. nindensis Ficalho & Hiern
FSWA: 1600 BRI: 9902 Author's coll. no. SS0142
|Homara |gâ.b (recorded in Sesfontein); **!nobonxara≠uhe**, i.e. is eaten (= **≠uhe**) by **!nobo.s**, i.e. a bird, possibly redcrested korhaan or francolins (recorded from Purros Damara in Sesfontein); **|nâu** seeds and **|nâu |gâ.b** (recorded from Dâureb Damara at Gudipos, Ugab River).
The seeds are collected directly from the plant, pounded into flour and cooked as a porridge with milk and salt if available (recorded in Sesfontein, e.g. by ‖Khaoa-a Damara). Today they are collected when collecting **sâu.n** (*Stipagrostis* spp. grass seeds) or **bosu.i** (*Monsonia* spp. seeds) from harvester ant nests. Cornelia at Gudipos, Ugab River, describes how she used to collect **|nâu** straight from the grass when she lived at ‖Gaisoas where she had her first three children.
Goats eat (recorded from Dâureb Damara at Gudipos, Ugab River).

The Herero name is ongangahozu and this species is grazed by livestock in Kaokoveld (Malan and Owen-Smith, 1974: 161).

Eragrostis sp. Wolf
FSWA: 1600 BRI: 9902 Author's coll. no. SS0180
|Homara |gâ.b (recorded in Sesfontein, e.g. by Purros Damara). See notes for *Eragrostis* spp. above.

Fingerhuthia sesleriiformis Nees
FSWA: 1600 BRI: 9903 Author's coll. no. SS0135, SS0183b
!Nabise |gâ.b (recorded from Purros Damara in Sesfontein).
Cattle eat (recorded from |Khomani Damara at Rietkuil farm)

Kaokochloa nigrirostris de Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0182a, SS0247, SS0192
(?**!Habise**), **|huru |gâ.b**, **|hurube** (plant), **≠haa** (seeds) (recorded in Sesfontein); **|huru** (= ripe) **|gâ.b** by Namib/!Naren Damara in Sesfontein; **≠narabe |gâ.b** (plant), **≠narabe !khom** (= seeds) (recorded from Daureb Damara at Palm farm and Purros (!Oe-≠gaa) Damara in Sesfontein); recorded as **≠uu** by Dâureb Damara from Gudipos, Ugab River, who say it used to be collected from Manikams and is hard to pound.
'**|Huru**' (said with the inflection down) means 'ripe' as in ripe ears of wheat (**!horo** (= wheat) **ge go |huru** (or **|nuru**) means 'the wheat is ripe'). This name refers to the similarity of this grass when it is ripe to ears of wheat. The open, empty seed heads or '**|huru.n**' are collected by harvester ants into their nests and can make **sâu.n** and **bosu** 'dirty' thus requiring extra work to 'clean' or winnow these seeds.
The seeds are eaten (e.g. by Purros Damara from Sesfontein). Collected from harvester ant nests where they may be found on their own or mixed with other types of **sâu.n** such as *Stipagrostis* spp. (**|hoe sâu.n**, **!garibe sâu.n**) and *Indigofera* sp. (**!ganikie sâu.n**). (Observed @ |Giribes plains, north-east of Sesfontein). Also recorded as food by Dâureb Damara from Gudipos, Ugab River. Reported in Sesfontein that ‖Khaoa-a Damara clean **sâu.n** of these seeds and do not eat it.

The Herero name omurontji was recorded from Purros Damara in Sesfontein.

Monelytrum luederitzianum Hack.
FSWA: 1600 BRI: 9902 Author's coll. no. SS0179
(Kai) !nabise |gâ.b (recorded in Sesfontein); called **≠am≠are** by Dâure.b Damara in Sesfontein.
'**Kai**' means 'large' and distinguishes this type of **!nabise |gâ.b** (grass) from *Enneapogon desvauxii*; i.e. the two species classed as the same apart from their size differences due to similarities in their appearance.

Cattle eat (recorded from |Khomani Damara at Rietkuil farm).

Panicum sp. L.

FSWA: 1600 BRI: 9901 Author's coll. no. SS0175

!Gari-ao-oâ (recorded in Sesfontein); **|homara** (recorded in Sesfontein e.g. by ‖Khaoa-a Damara).

The seeds are eaten, often in mixes with other grain flours. Collected straight from the plant (recorded in Sesfontein, e.g. by ‖Khaoa-a and Purros Damara).

The seeds are eaten by Dobe-area !Kung (Lee, 1979: 167).

The seeds of *Panicum* spp. are eaten by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25) and Alyawara Aborigines in north Australia (O'Connell, 1983: 86).

Pogonarthria fleckii (Hack.) Hack.

FSWA: 1600 BRI: 9903

Purros Damara from Sesfontein call it **|gomanxa≠uhetama**, i.e. meaning that cattle (= **|gomanxa**) can't (= **tama**) eat (= **≠uhe**) it, because the seeds reportedly stick in their throats (see also *Stipagrostis hirtigluma*, Poaceae).

The Herero name turamangombe, meaning that cattle can't eat it because the seeds reportedly stick in their throats (see also *Stipagrostis damarensis*, Poaceae) was recorded from Purros Damara in Sesfontein.

Schmidtia cf. *kalihariensis* Stent

FSWA: 1600 BRI: 9902 Author's coll. no. SS0245

|Khuru |gâ.b (recorded throughout former Damaraland); Eiseb *et al* (1991: 21, 25, 29) state that **|khuru.b** is used for *Schmidtia pappophoroides*, *S. kalahariensis* and *Aristida* spp. Referred to as **!nabise** by Dâure.b Damara in Sesfontein.

'**|Huru**' (said with the inflection up) means 'salty' or 'brackish' ('**|gâ.b**' means 'grass'). This name is also given to *Schmidtia* cf. *pappophoroides*, the two species being seen as essentially the same.

S. cf. *pappophoroides* Steud.

FSWA: 1600 BRI: 9902 Author's coll. no. SS0246

|Huru |gâ.b (see notes for *S. kalihariensis*).

Setaria finita Launert

FSWA: 1600 BRI: 9902 Author's coll. no. SS0271

!Gari-ao-oâ-e, **!gari-ao-oâ** (recorded in Sesfontein); Van den Eynden *et al* (1992: 86) record the use of unidentified seeds called **!gariaôai**.

'**!gari-ao-oâ**' describes how a woman who can pound these very hard seeds must be very strong (and will bear strong, brave sons) ('**!gari**' means 'strong/hard/brave', '**ao**' means 'male/men' and '**oâ**' means 'baby').

The seeds are eaten, often in mixes with other grain flours. Collected straight from the plant (recorded in Sesfontein, and see Van den Eynden *et al*, 1992: 86).

S. verticillata (L.) Beauv.

FSWA: 1600 BRI: 9902 Author's coll. no. SS0229

≠Are.s/b/n (recorded throughout former Damaraland; and see also Eiseb *et al*, 1991:24, 29; Van den Eynden *et al*, 1992: 79).

'**≠Are.s**' describes how the seeds stick to you, i.e. '**≠ae**' means 'sticky'.

The seeds are collected directly from the plant by spreaded a skin or material underneath the plant and beating the plant so that the seeds fall onto the skin. After this they are cleaned using a **≠gôub**, and eaten as a porridge with water and salt. Often mixed with other grain flours (recorded throughout former Damaraland and in Van den Eynden *et al*, 1992: 79). Cornelia at Gudipos, Ugab River, stated that she used to collect when she lived at ‖Gaisoas where she had her first three children.

Is eaten by **!nobos**, i.e. francolins (recorded from Dâureb Damara from Gudipos, Ugab River).

The Herero name karamada was recorded from Purros Damara in Sesfontein.

Stipagrostis spp. Nees

FSWA: 1600 BRI: 9902

The plant is known as **!gaburogu |gâ.n**, i.e. feathery grass, which is a reference to the feathery awns of these species which are observed to carry the seeds down to the ground when they've been blown off the plant by the wind. The seeds are known throughout former Damaraland as **sâu.n**; **saw.i** (Steyn and du Pisani, 1984/1985: 45), and the empty seedhead (i.e. the lemma with no seed inside) as **‖na.i**.

Throughout former Damaraland *Stipagrostis* seeds are collected from harvester ant nests (**≠goburun oms**) and eaten, usually as a porridge, today often mixed with other grain flours, with water and/or milk, and salt, sugar, and/or fat if available (du Pisani, 1978: 14 and Van den Eynden *et al*, 1992: 86 also refer to this use of unidentified seeds). Beer is also commonly brewed from the seeds with sugar or honey (**dani.b**) (see also du Pisani, 1978: 14; Steyn and du Pisani, 1984/1985: 45; Van den Eynden *et al*, 1992: 86). The same batch of seeds can be used for upto 3 or 4 years and the old **sâu.n** can be re-used as food. The brewing of beer, usually by women, can be an important source of income and the unprocessed seeds are also sometimes sold (see du Pisani, 1978: 14). A liquor known as '**bâuga**' is also distilled from the seeds, to which sugar has been added. Usually this is practised purely as an income generating practice by women (recorded along the Ugab).

The Herero names are ombuma, ombuima (a general term for edible seeds?) or omuhui (described as the most common type of edible seeds) (recorded in Sesfontein). The seeds are collected by Herero from harvester ant nests and eaten as a porridge (recorded as Sesfontein).

Stipagrostis cf. *damarensis* (Mez) De Winter

FSWA: 1600 BRI: 9902 Author's coll. no. SS0214

This is a **sâu.n |gâ.b** (recorded in Sesfontein, and by ≠Ao-Dama, Rietkuil Farm); described as **|hoe** or tall **|gâ.b** in Sesfontein; **|ûbe sâu.n** (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River); **!nao** (plank) **|gâ.b** and **!gari** (= strong) **|gâ.b** recorded from ≠Ao-Dama, Rietkuil Farm, because it is very strong and livestock don't eat it; **≠u |gâ.b** and **!khom** (i.e. plant and seeds (recorded at Palm farm); Purros Damara from Sesfontein call it **|gomanxa≠uhetama**, i.e. meaning that cattle (= **|gomanxa**) can't (= **tama**) eat (= **≠uhe**) it, because the seeds reportedly stick in their throats (also the name for *Pogonarthria fleckii*, Poaceae).
The seeds can be collected from harvester ant nests and eaten as a porridge (recorded in Sesfontein and from Dâure.b Damara at ‖Gaisoas on the Ugab River).

The Herero name turamangombe, meaning that cattle can't eat it because the seeds reportedly stick in their throats (also the name for *Pogonarthria fleckii*, Poaceae), was recorded from Purros Damara in Sesfontein.

S. giessii Kers

FSWA: 1600 BRI: 9902 Author's coll. no. SS0249

Described as a **≠habo |gâ.b** which produces **sâu.n** (recorded from |Khomani Damara at Rietkuil farm) and as **|hoe gâ.b** by ‖Khaoa-a, Namib/!Narēn, Dâure.b and Purros (incl. originally !Oe-≠ga) Damara from Sesfontein and by Dâure.b Damara at ‖Gaisoas and Gudipos on the Ugab River, ≠Ao-Dama, Rietkuil Farm.).
The seeds are collected from harvester ant nests and eaten as a porridge.

S. hirtigluma (Trin. & Rupr.) De Winter *hirtigluma*

FSWA: 1600 BRI: 9902 Author's coll. no. SS0181

≠Habo |gâ.b which produces **sâu.n** (‖Khaoa-a, Namib/!Naren and Purros (originally !Oe-≠ga) Damara in Sesfontein) and **!garibe sâu.n** (Purros Damara from Sesfontein and Dâure.b Damara at ‖Gaisoas on the Ugab River); described as **|huru** (meaning ripe)(e.g. by ‖Khaoa-a

Damara in Sesfontein) which, according to |Khomani Damara at Malansrust Farm, is not a **sâu.n |gâ.b**; described as family with **|hoe sâu.n** (recorded from Dâureb Damara from Gudipos, Ugab River); is a **sâu.n |gâ.b** (recorded from ≠Ao-Dama, Rietkuil Farm).
The seeds are collected from harvester ant nests and eaten as a porridge.

The Herero name onkumba was recorded from Dâureb Damara from Gudipos, Ugab River.

S. cf. *hirtigluma* (Trin. & Rupr.) De Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0232
|Haebi≠are.b (i.e. oryx (= **|haebi**) tail (= **≠are.b**) Recorded from Purros Damara in Sesfontein), produces **sâu.n**; **!garibe sâu.n** (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River); recorded as **≠habo sâu.n** by Dâureb Damara from Gudipos, Ugab River; is a **sâu.n |gâ.b** (recorded from ≠Ao-Dama, Rietkuil Farm). See notes for *S.* cf. *hochstetterana* below.
The seeds can be collected from harvester ant nests and eaten as a porridge (recorded from Purros Damara in Sesfontein and Dâureb Damara from Gudipos, Ugab River).

S. patula (Hack.) De Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0248, SS0305
!Garibe |gâ.b, **!garibe sâu.n** (recorded throughout Damaraland);is a **sâu.n |gâ.b** (recorded from Dâureb Damara at Gudipos, Ugab River, and from ≠Ao-Dama, Rietkuil Farm); the seeds of this species are recorded as **saw.i** in Steyn and du Pisani (1984/1985: 45) '**!Garibe**' means 'hard' and the name refers to the hardness of the seeds which are also small in size.
The seeds are collected from harvester ant nests and eaten as a porridge (recorded in Sesfontein, from Dâureb Damara at Gudipos, Ugab River) and by Steyn and du Pisani, 1985/1985: 45).

S. cf. *hochstetterana* (L.C.Beck ex Hack.) De Winter *secalina* (Henr.) De Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0299, SS0262
|Hoe |gâ.b, **|hoe sâu.n**, described as so small you can hardly see the seeds (recorded throughout Damaraland), and also referred to as a **≠habo** or 'soft' **|gâ.b** , i.e. which sways and lies on the ground when the wind blows (recorded from by ‖Khaoa-a Damara, and recognised as a **sâu.n |gâ.b** at Rietkuil farm and by Dâureb Damara at Gudipos, Ugab River); produces **saw.i** (Steyn and du Pisani, 1984/1985: 45).
The seeds are collected from harvester ant nests and eaten as a porridge (see also Steyn and du Pisani, 1984/1985: 45). The seeds of this species are very small and they 'stick' you when collecting them.

S. cf. *uniplumis* (Licht.) De Winter
FSWA: 1600 BRI: 9902 Author's coll. no. SS0260
(?) **!Garibe |gâ.b**, **!garibe sâu.n** (recorded in Sesfontein) and as **≠habo |gâ.b** (i.e. a small, soft looking grass) and **sâu.n** (recorded throughout Damaraland); produces **saw.i** (Steyn and du Pisani, 1984/1985: 45); **≠hawo.b**, **≠habo(|gaa.b).b/s** (Eiseb *et al*, 1991: 24, 29).
'**!Garibe**' refers to the hardness of the seed, i.e. '**!gari**' means 'hard'.
The seeds are collected from harvester ant nests and eaten as a porridge (see also Steyn and du Pisani, 1985/1985: 45).

The Herero name ongumba was recorded from Dâureb Damara at Gudipos, Ugab River and in Malan and Owen-Smith (1974: 161).
It is a 'valuable grazing for cattle' in Kaokoveld (Malan and Owen-Smith, 1974: 162).

S. namaquensis (Nees) De Winter
FSWA: 1600 BRI: 9902
Du Pisani (1983: 11) and Eiseb *et al* (1991: 21, 29) record the Nama name of **khabi.b/n** or **khawi.b** for this species.
The stems are used in the manufacture of baskets and as thatch (Steyn and du Pisani (1984/1985: 45) and for brooms and in children's games by the Nama of Berseba (du Pisani, 1983: 11).

S. obtusa (Delile) Nees
FSWA: 1600 BRI: 9902
≠**Habo.b** (State Museum, n.d.); produces **sau.i** (du Pisani, 1978: 14).
≠**Habo** |**gâ.b** is described as a 'soft' grass (recorded in Sesfontein).
≠**Habo sâu.n** is described as a small seed in a very thin inflorescence (Tsoaxau Damara at ‖Gaisoas, Ugab River).

S. sabulicola (Pilg.) De Winter
FSWA: 1600 BRI: 9902
Referred to by the Nama as **karu.b** (du Pisani, 1983: 11; Eiseb *et al*, 1991: 19, 29) and as **arutara.b** (Eiseb *et al*, 1991: 18-19, 29).
Used in the Kuiseb for kindling f5res and as thatch (du Pisani, 1983: 11).

Urochloa brachyura (Hack.) Stapf
FSWA: 1600 BRI: 9901 Author's coll. no. SS0176
Recorded as ≠**narabe** by ‖Khaoa-a Damara, |**huru** (= ripe) |**gâ.b** (= grass) by Purros Damara, |**hoe** |**gâ.b** by Purros (!Oe≠gaa) Damara, and ≠**haa** by Namib/!Naren Damara in Sesfontein.
The seeds are collected from harvester ant nests and eaten (‖Khaoa-a Damara in Sesfontein).

PORTULACACEAE

Ceraria longipedunculata Merxm. & Podlech
FSWA: 290 BRI: 2419 Author's coll. no. SS0153, SS0304
Sora.b (recorded throughout former Damaraland); ‖**nora.b**, i.e. refers to its use (Dâureb Damara at ‖Gaisoas, Ugab River), see below and notes for *Sarcocaulon* cf. *marlothii*, Geraniaceae.
The powdered bark is added to milk and drunk to treat diarrhoea; is considered especially good for small children (recorded in Sesfontein, e.g. from Purros Damara, and Khowarib).
The waxy bark is used to decorate and mend smoking pipes and to help keep them cool (recorded from ‖Khaoa-a, Namib/!Naren, Purros (incl. originally !Oe-≠gaa), Dâureb Damara in Sesfontein) and to plug holes in containers; it is like a glue and is put on after melted on the fire (Dâureb Damara at ‖Gaisoas, Ugab River).

The Herero name of onova was recorded from Purros Damara in Sesfontein.

RHAMNACEAE

Berchemia discolor (Klotzsch) Hemsl.
FSWA: 790 BRI: 4868 Author's coll. no. SS0319
Commonly known as ≠**hûi.s** (see also Eiseb *et al*, 1991: 24-25; Van den Eynden *et al*, 1992: 79).
'≠**Hûi**' reportedly describes the sweetness of the fruit.
The fruits are eaten fresh or dried (see also Van den Eynden *et al*, 1992: 79). They are collected in large quanties, where trees occur north-east of Sesfontein. Collecting trips can last from several days to 3-4 weeks. Fruits are frequently sold in Sesfontein and Khowarib by those who collect large quantities. Beer can be brewed from the fruits by boiling with water and then leaving to cool and ferment (recorded in Khowarib).
Goats eat (recorded from ≠Ao-Dama, Rietkuil Farm) and knobkieries can be made from the wood (recorded in Khowarib).

The Herero names are omuve (tree), ozombe (fruit) (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 162); omuze (recorded from Purros Damara in Sesfontein).
The fruits are eaten (recorded in Sesfontein) and Malan and Owen-Smith (1974: 162) also report that a strong alcoholic drink is distilled from the fruits by Himba in Kaokoveld.

This is an important fruit tree in Owambo where its growth around kraals is encouraged (Giess, 1966: 107).

The fruits are also eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 47).

Ziziphus mucronata Willd.
FSWA: 790 BRI: 4861
Known throughout former Damaraland as **≠aro.s/n/i** (see also Haacke, 1982; du Pisani, 1983: 12; Eiseb *et al*, 1991: 24, 30; Van den Eynden *et al*, 1992: 80).

The thorniness of this tree is recognised in the saying '**≠aure tamab ge ≠aroreb ge**', which means the '**≠arore.b**' way is hard, i.e. thorny, unlike the '**≠aure**', alternate, way. Is a warning associate with important life decisions such as marriage.

The fruits are eaten, especially by children (see also du Pisani, 1983: 12; Van den Eynden *et al*, 1992: 80) and the fruits soaked in water make a tasty beverage called '**≠arote.s**'.

This is an all-purpose medicinal species: a decoction from the roots is drunk to treat diarrhoea, coughs and the symptoms of gonnorrhea, and is described as 'making a man strong', i.e. is used to treat impotence (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein); a decoction from the bark or root is drunk for back pain including period pain (recorded in Khowarib and Sesfontein).

The wood makes good knobkieries (recorded in Khowarib) and was favoured in Namaland for the construction of huts due to its elasticity and strength (Haacke, 1982; du Pisani, 1983: 12). A powder from the soft roots is used as a 'douche' by women to make them attractive to men (recorded from ǁKhaoa-a Damara in Sesfontein).

The Herero names are omukaru (tree), otjongaro/ozongaro (fruit) (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 162).
The berries are eaten in Kaokoveld and the dried leaves are ground into a powder and applied to open wounds such as skin ulcers and an extract of the bark may be used for the same purpose (Malan and Owen-Smith, 1974: 162).

The Nharo eat the fruits of this plant (≠xarroba) (Steyn, 1981: 20, see also Story, 1950 in Steyn, 1981: 27). The fruits are eaten raw by the !Koo, |Gwi, ǁGana and !Kung San (Heinz and Maguire, 1974: 41; Marshall, 1976: 113; Tanaka, 1976: 118; Lee, 1979: 160). The fruits of *Z. mucronata* subsp. *rhodesica* R.B. Drummond are eaten by Bemba and Lamda people of southern Shaba, Congo (Malaisse and Parent, 1985: 54). The fruits of *Ziziphus* spp. are eaten in Ethiopia (Getahun, 1974: 53) and the fruit of *Z. abyssinica* A. Rich. is a minor food for Gabra pastoralists of north Kenya (Stiles and Kassam, 1991: 27). *Z. mauritiana* Lam. is described as an important forage species by the Turkana (Barrow, 1990: 171) and the fruits are considered one of the most important sources of food for Senegalese Ferlo pastoralists (Becker, 1986: 63).

The indigenous arid-adapted *Z. jubjuba* Mill. and *Z. jujuba* var. *spinosa* Hu ex H.F. Chow. are grown commercially in China for their nutritious fruits and medicinal value; the fruits of the former are considered 'a special tonic' and fresh or dried and powdered fruits of the latter are taken to cure hypertension and stomach problems while the seeds are used as a sedative (Ming and Yun-wei, 1986: 5, 12-13).

RUBIACEAE

Amphiasma merenskyanum Bremek.
FSWA: 1150 BRI: 8136 Author's coll. no. SS0103
Eaten by goats (recorded at Palm farm) and used for sweeping the floor (recorded at farms along the Aba-Huab).

The Herero names omukorokokwa and omuryawosiso, meaning food of the donkey, are recorded for *A. benguellense* (Hiern) Bremek., a species which is browsed by small stock, donkeys, horses and occaionally cattle in Malan and Owen-Smith (1974: 162).

Gardenia volkensii K.Schum. *spathulifolia* (Stapf & Hutch.) Verdc.
FSWA: 150 BRI: 8285
The Herero names are omayeravi (recorded in Sesfontein); omuyarave (plant), ozondami (fruit) (Malan and Owen-Smith, 1974: 162). The flesh of the fruit is edible and is browsed by livestock (Malan and Owen-Smith, 1974: 162).
The fruit husks and kernels are collected by Himba and Herero women from the north of Kunene Region and traded throughout Kaokoveld and in Sesfontein for use as a body perfume. Herero women may travel from Sesfontein as far as the Kunene River to collect this and other perfume plants to trade within Sesfontein. The use of the bark and pips for body powder is also recorded in Malan and Owen-Smith (1974: 162).

A decoction of the boiled fruits of *G. jovis-tonantis* (Welw.) Hiern is drunk cold in the treatment of malaria by Samburu pastoralists (Fratkin, 1996: 78).

Kohautia cf. *caespitosa* W.Schnizl. *brachyloba*
FSWA: 115 BRI: 8136 Author's coll. no. SS0149
!Uru (recorded from Purros Damara from Sesfontein); **!aru.b** (recorded from Dâureb Damara at Gudipos on the Ugab River).
Goats eat (recorded from Dâureb Damara at Gudipos on the Ugab River).

RUTACEAE

Thamnosa africana Engl.
FSWA: 680 BRI: 4014 Author's coll. no. SS0048, SS0106
≠(K)hana.b (recorded throughout Damaraland and in Van den Eynden *et al*, 1992: 81); **≠gana**, used by the Nama (du Pisani, 1983: 12); Eiseb *et al* (1991: 24, 27) records the name **≠khana.b** (and **≠khona.b**) for *Gnidia polycephala* (Thymelaceae); |Khomani Damara from Rietkuil farm say that a different **≠khana.b** is found in the Usakos-Okombahe area.
Added to tea or coffee in former Damaraland (recorded from ≠Ao-Dama, Rietkuil Farm) and also in Namaland (du Pisani, 1983: 12).
A decoction from whole plant is an all-purpose medicine valued throughout former Damaraland and used to treat coughs, colds, chest pain and flu, to relieve stomach pains, to 'cleanse' the uterus after giving birth (by inducing vomiting), for menstrual problems, to increase the likelihood of conceiving and as a 'multivitamin' drink (see also medicinal uses among the Nama in du Pisani, 1983: 12, and the Kuiseb Topnaar in Van den Eynden *et al*, 1992: 50). The body is washed in water in which **≠khana.b** has soaked for genereral ill-health (recorded from Dâureb Damara at Gudipos, Ugab River). A decoction from the whole herb is also reported to induce vomiting and thereby relieve stomach pains and nausea and a body poultice made from the leaves helps to lower fever (Van den Eynden *et al*, 1992: 50, 81).

Is considered a **'sâi'** or perfume plant. |Khomani Damara at Riekuil farm describe how you can mix the powdered plant parts of **≠khana.b** with ground seeds from *Colophospermum mopane*, Fabaceae, for **sâi**, and describe how the aroma of the larger **≠khana.b** reported to occur in the Okambahe-Usakos area is used to prevent snakes from entering the house. In Kaokoveld the roots and flowers are reported as ground into a neck perfume called otjizumba (Malan and Owen-Smith, 1974: 162).

If an older person collects it for you and/or waves it over you it will bring you good fortune and if the rain is too heavy in a storm, putting a little bit of this plant into the fire will stop the thunder (recorded from Tsoaxau Damara at ‖Gaisoas, Ugab River). Similarly, Van den Eynden *et al* (1992: 50) report that the leaves are thrown onto the fire by the Kuiseb Topnaar to 'induce happiness'.

Omukorikoko (recorded from Purros Damara in Sesfontein and in Malan and Owen-Smith, 1974: 162).

Zanthoxylum ovatifoliolatum (Engl.) Finkelstein
FSWA: 680 BRI: 3991
Nokoma, *noboheda*, *pepahai.s* (recorded in Sesfontein and by Van den Eynden *et al*, 1992: 81); the latter name was recorded at farms along the Aba-Huab River for the alien species *Schinus molle* (Anacardiaceae); **nokome/nokoma/noboheda** recorded from ≠Ao-Damara at Rietkuil farm.
'**|Noboheda**' refers to 'rubbing hands together', i.e. to make powder for '**sâi**' or perfume. Van den Eynden *et al* (1992: 81) report that a decoction of the fruits is drunk to relieve throat pain.
The dried fruits and seeds are ground into a body perfume (recorded in Sesfontein, e.g. from Purros Damara), usually gained through trade with Himba from Kaokoveld (Malan and Owen-Smith, 1974: 162).

The Herero name Omutungo omubara was recorded from Purros Damara in Sesfontein; omuhandwa (Malan and Owen-Smith, 1974: 162).
An extract from the roots is used by the Himba to treat a variety of animal and human complaints, mainly stomach disorders. This is a valued commodity and the roots are traded with Herero and Owambo from elsewhere in Namibia (Malan and Owen-Smith, 1974: 162).

The aromatic twigs of *Z. chalbeum* Engl. are used as toothbrushes and breath fresheners and decoctions of the roots or seeds are administered by Luo herbalists from east Kenya for chest pains and stomach problems (Johns *et al*, 1990: 381). This species is used medicinally and as a minor food sources by Gabra pastoralists of north Kenya (Stiles and Kassam, 1991: 27).

SALVADORACEAE

Salvadora persica L.
FSWA: 780 BRI: 6446 Author's coll. no. SS0195
Known throughout former Damaraland as **xori.s** or **khori.s** while the small fruits are known as **|naube** (recoreded from Namib/!Naren in Sesfontein), **kaibe.b** refers to the large fruits ('**kai**' means 'large') and the dried fruits are called **|hara** (recorded from Namib/!Naren in Sesfontein); **khoori.s** (Eiseb *et al*, 1991: 19, 29); **khori.s** (Van den Eynden *et al*. 1992: 81).

The fruits are eaten in large quantities when available throughout Damaraland, and are described as very filling requiring that you only drink water for the rest of the day; they can be boiled into a sweet porridge (see also Steyn and du Pisani, 1984/1985: 45; Van den Eynden *et al*, 1992: 81). Is described as 'Damara sugar' and is sometimes used to sweeten hot drinks (recorded in Sesfontein). The dried fruit can be crushed into a ball and eaten like a sweet and the fruit can be used to make beer (recorded in Khowarib).

A decoction from the roots is taken to treat coughs, colds and stomach disorders (recorded in Sesfontein e.g. from ‖khaoa-a, Purros (incl. originally !Oe-≠gaa) Damara, and in Van den Eynden *et al*, 1992: 51, 81), and eating the menthol-tasting large fruits (**kaibe.b**) also helps colds (recorded from Namib/!Naren in Sesfontein).

The leaves and fruit are eaten by livestock.

A powder from the root is used as snuff (recorded from ‖khaoa-a Damara in Sesfontein).

The large fruits (**kaibe.b**) have a hot menthol taste. It is thought that if men eat the fruits that are lying on the ground (**|hara**) the seeds will cause problems with urinating (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein).

The Herero names are omungambu (tree), otjingandiona (small fruit), ozongambu (large fruit) (recorded in Sesfontein); omugambue (recorded from Purros Damara in Sesfontein); Malan and Owen-Smith (1974: 162) record the names omungambu for the tree and ozongambu for the small red edible berries.
The small red berries are eaten by the Himba in Kaokoveld, a decoction from the roots is drunk to cure gonorrhoea (recorded in Sesfontein) and an extract from the roots is in important livestock medicine for treating intestinal complaints.(Malan and Owen-Smith, 1974: 162).

Large quantities of fruits are gathered by Turkana pastoralists (Morgan, 1981: 101; see also

Becker, 1986: 63), and this species is an important multi-purpose and forage resource in the Turkana Ekwar system of range management (Barrow, 1990: 170). It is used medicinally by Gabra pastoralists in north Kenya and for reasons of tradition (aada) is generally avoided as a source of firewood (Stiles and Kassam, 1991: 27, 30). A decoction of the roots is drunk in the treatment of stomach upsets by Samburu pastoralists and a concoction of the boiled roots mixed with sheep urine and dung is drunk and massaged into the abdomen to promote abortion and expellation of the placenta while the ground roots are similarly used for cows (Fratkin, 1996: 75, 79, 81).

SCROPHULARIACEAE

Aptosimum albomarginatum Marloth and Engl.
FSWA: 1260 BRI: 7467
!Kuxa.n (du Pisani, 1983: 6).
The Nama used to shred the roots and use as a spice or coffee substitute (du Pisani, 1983: 6).
A decoction from the crushed root is drunk by the Nama to treat chest complaints, stomach disorders and coughs (du Pisani, 1983: 6).

An extract of the roots is drunk by the Nharo to treat chest pains and coughing (Steyn, 1981: 8).

A. angustifolium/lineare
FSWA: 1260 BRI: 7467 Author's coll. no. SS0169
|Game (recorded from Purros (incl. originally !Oe-≠gaa) and Namib/!Naren in Sesfontein), **|gamero.s**, or specifically **tarare |game**, i.e. female-**|game** (recorded from Purros Damara in Sesfontein). The name '**|game**' refers to the roughness or stickiness of the leaf apices and inflorescences; **≠oa** (recorded from Dâureb Damara at Gudipos on the Ugab River).
The whole plant is drunk as a decoction to treat stomach disorders (by Purros Damara in Sesfontein).
Described as smelling like **sâi**, i.e. perfume (recorded from Dâureb Damara at Gudipos on the Ugab River).

A. cf. *spinescens* (Thunb.) Weber
FSWA: 1260 BRI: 7467 Author's coll. no. SS0349
The Herero name edinijomba was recorded from Purros Damara in Sesfontein.

Aptosimum sp. Burch. ex Benth.
FSWA: 1260 BRI: 7467 Author's coll. no. SS0448
|Gom |gom (recorded from Purros (incl. originally !Oe-≠gaa), ‖Khaoa-a and Dâureb Damara from Sesfontein); **|homexare** (recorded from ‖Khaoa-a Damara in Sesfontein).
The nectar can be eaten (recorded from Dâureb Damara in Sesfontein).
The bees take nectar from the flowers of this species (recorded from Purros (originally !Oe-≠gaa) and ‖Khaoa-a Damara from Sesfontein).

Aptosimum sp. Burch. ex Benth.
FSWA: 1260 BRI: 7467 Author's coll. no. SS0226
Pirihai.s (piri = goats) (recorded from Purros Damara in Sesfontein).
Goats eat (recorded from Purros Damara in Sesfontein).

Aptosimum sp. Burch. ex Benth.
FSWA: 1260 BRI: 7467 Author's coll. no. SS0447
‖Ona (recorded from ‖Khaoa-a Damara in Sesfontein); **|gom |gom** (recorded from Dâureb Damara in Sesfontein); **≠naada** (recorded from Purros Damara in Sesfontein).
Bees take nectar and produce a white honey from this plant (recorded from Purros Damara in Sesfontein).

Aptosimum sp. Burch. ex Benth.
FSWA: 1260 BRI: 7467 Author's coll. no. SS0344
≠Oa.s recorded from Dâuré.b Damara in Sesfontein and ǁGaisoas on the Ugab River); **|gom-|gom** (recorded from Dâureb Damara at Gudipos on the Ugab River); **ǁgau |gora.s** (**ǁgau** = 'home', **|gora.s** = 'divide/separate'), so-called because if you burn it on the fire it is believed to separate people through causing them to not understand each other (should be for *Geigeria acaulis*, Asteraceae?) (recorded from Dâureb Damara at Gudipos, Ugab River).
Used for circumcism medicine for boys (recorded from Purros Damara in Sesfontein); ash from the black seeds is rubbed onto burns (these uses should be for *Geigeria acaulis*?) (recorded from Dâureb Damara at Gudipos, Ugab River).
Is a **sâi** or perfume plant (recorded from Dâure.b Damara from ǁGaisoas on the Ugab River).
Goats eat (recorded from Dâure.b Damara in Sesfontein).

The Herero name okasukokarume, referring to circumcism for boys, was recorded from Purros Damara in Sesfontein.

Aptosimum sp. Burch. ex Benth.
FSWA: 1260 BRI: 7467 Author's coll. no. SS0067
Goats eat (recorded from Purros Damara in Sesfontein).

Sutera sp.Hilliard O.M.
FSWA: 1260 BRI: 7519 Author's coll. no. SS0273, SS0301
|Homexarebe (recorded in Sesfontein, e.g. from Purros Damara); **blomhai.n** is recorded as the name for *S. corymbosa* (Marloth and Engler) Hiern in Sesfontein (Van den Eynden *et al*, 1992: 81).
Van den Eynden *et al* (1992: 82) record that in Sesfontein a decoction from the roots is taken to relieve body pains and a powder from the roasted roots is applied to burns.

SOLANACEAE

FSWA: 1240 BRI: 7407 Author's coll. no. SS0318
Horobakie (recorded in Sesfontein but usually used for the red seeds of *Sesbania* sp., Fabaceae).
Birds eat the fruit.

*Datura innoxia** Mill.
FSWA: 1240 BRI: 7415 Author's coll. no. SS0386
|Oohai.s (recorded throughout former Damaraland in Van den Eynden *et al*, 1992: 82).
The warmed leaves and seeds are used to treat boils and draw out pus (recorded throughout former Damaraland) and Van den Eynden *et al* (1992: 82) report that in Sesfontein a warm leaf is placed on sores in the armpit to draw out pus.
If you eat the fruits of this plant it will 'make you mad' (recorded from Dâureb Damara in Sesfontein). Is a 'stinky' plant (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein. Described as a poisonous plant by |Khomani Damara, Malansrust Farm.

The Herero name otjitjize was recorded from Purros Damara in Sesfontein.

Lycium sp. L.
FSWA: 1240 BRI: 7379 Author's coll. no. SS0028, SS0119, SS0160,
SS0160 = **gubi |haans**, i.e. sheepskin (= **gubi**) mat/blanket (= **|hans**) recorded from Purros Damara in Sesfontein and for *Phaeoptilum spinosum*, Nyctaginaceae; **!ons** recorded for SS0160 and for *P. spinosum* by Dâure.b Damara at Gudipos on the Ugab River; SS0346 = **ǁkhuhai.s/b** (**ǁku.n** = thorns) (recorded from Purros Damara in Sesfontein); **≠oo** recorded for SS0346 from Dâure.b Damara at ǁGaisoas on the Ugab River; **ǁari.s** used by the Kuiseb

Topnaar for *L. cinereum* Thunb. (Van den Eynden *et al*, 1992: 51); **‖khai‖ari.b/s** used by the Nama for *L. oxycarpum* Dunal (du Pisani, 1983: 9; Eiseb *et al*, 1991: 22, 28); ?SS0346 recorded as **≠khea.s** by Dâureb Damara at Gudipos on the Ugab River

A decoction of the leaves of SS0346 (**‖khuhai.s**) is taken by Purros Damara in Sesfontein to treat coughs. In Namaland the pounded root of *L. oxycarpum* is bolied in water, the inner fibre strained and dried and pounded into powder used as snuff (du Pisani, 1983: 9).

The Kuiseb Topnaar use the dried crushed plant parts of *L. cinereum* to perfume the body and clothes (Van den Eynden *et al*, 1992: 51).

Browsed by goats (recorded from Dâure.b Damara at Gudipos and ‖Gaisoas on the Ugab River).

A leather tanning agent can be made from the leaves (recorded from Dâure.b Damara at ‖Gaisoas on the Ugab River).

The Herero names are: SS0160 = okahonokaaondu (mat = okahono, sheep = ondu) and SS0346 = omutete (recorded from Purros Damara in Sesfontein and for *Phaeoptilum spinosum*, Nyctaginaceae); otjingwahuhwa (Malan and Owen-Smith, 1974: 163).

An extract from the root is used by the Himba as a laxative and this plant is browsed by small stock in Kaokoveld (Malan and Owen-Smith, 1974: 163).

A decoction of the root of *L. europaeum* L. is drunk cold by Samburu pastoralists to relieve swelling; leaves and stems are added to this when the treatment is specifically for swelling in the breasts (Fratkin, 1996: 77, 79).

The fruit of *Lycium* sp. (*L. andersonii*) were consumed by the Hiach-ed O'odham of the Sonoran Desert (Crosswhite, 1981: 53).

*Nicotiana glauca** R.C. Graham
FSWA: 1240 BRI: 7434

The Kuiseb Topnaar use the warm leaves as a poultice to relieve pain and to draw out the pus from sores (Van den Eynden *et al*, 1992: 53).

The green branches are used as a minor construction material by the Kuiseb Topnaar and the dry wood for firewood (du Pisani, 1983: 10; Van den Eynden *et al*, 1992: 53). If tobacco is in short supply the dried leaves of this wild tobacco can be smoked as an alternative (du Pisani, 1993: 10). An extract of the leaves is used by the Kuiseb Topnaar as an insecticide against aphids Van den Eynden *et al*, 1992: 53).

Solanum incanum L.
FSWA: 1240 BRI: 7407
Soropees (Eiseb *et al*, 1991: 19, 27; Van den Eynden, 1992: 82).

Van den Eynden *et al* (1992: 82) reports that in Sesfontein a decoction of the root is drunk to treat venereal disease and urinary problems.

The Herero name is omundumbwiriri (Malan and Owen-Smith, 1974: 163); the juice of the yellow fruits is squeezed by Himba onto cuts on livestock.

The leaves of this and other *Solanum* spp. are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249) and the Bemba and Lamda peoples of southern Shaba, Congo (Malaisse and Parent, 1985: 52).

The peeled root is used for a variety of medicinal purposes by Samburu pastoralists; it is chewed or gargled in the treatment of sore throats, and an infusion is applied to skin rashes (Fratkin, 1996: 76, 77). The roots of *S. renshii* Vatke are also taken as a decoction or in sour milk for strength (ngolon) (Fratkin, 1996: 80). Juice of the fruit of *S. sessilistellatum* is administered orally to livestock to treat anthrax and other diseases by Luo herbalists of east Kenya (Johns *et al*, 1990: 380). The leaves of *S. nigrum* L. are eaten as a spinach by Maasai and Kipsigis (Glover et al, 1966: 194) and the fruits of *Solanum* spp. are eaten in Ethiopia (Getahun, 1974: 54).

Solanum spp. are major sources of fruit eaten fresh or after drying and storing by Martujarra Aborigines in Western Australia (Veth and Walsh, 1988: 25) and by Alyawara Aborigines in north Australia (O'Connell, 1983: 85, 93).

Solanum sp. L

FSWA: 1240 BRI: 7407 Author's coll. no. SS0071, SS0340

Ani‖nai.s (recorded from Tsoaxau Damara at ‖Gaisoas and Dâureb Damara at Gudipos on the Ugab River, ≠Ao-Dama, Rietkuil Farm).

An extraction from the root is drunk to treat stomach pain; its very bitter and a little, i.e. a spoonful, is drunk around 3 times a day (recorded from Tsoaxau Damara at ‖Gaisoas on the Ugab River).

The Herero name omutete, which refers to the thorns of this plant, was recorded from Purros Damara in Sesfontein.

The Nharo drink an extract of the root of *S. namaquense* Dammer for stomach pain, while an extract of the root of *Solanum* sp. is drunk by women to improve their fertility (Steyn, 1981: 19).

Solanum sp. L

FSWA: 1240 BRI: 7407 Author's coll. no. SS0318

Ani‖nai, i.e bird (= **ani**) **‖nai.s** (i.e. *Grewia* cf. *tenax*, Tiliaceae) (recorded from ‖Khaoa-a, Dâureb and Purros (originally !Oe-≠gaa) Damara in Sesfontein, Tsoaxau and Dâureb Damara on the Ugab River); **|awa ‖gube.s** (recorded from |Khomani Damara, Malansrust Farm).

The fresh fruits are ground into a paste and rubbed on the body to treat cold symptoms. The person should wrap themselves in blankets and sleep with this as a body poultice (recorded from Purros Damara in Sesfontein). The bitter fruits are also eaten as medicine for stomach pain; when they grow after the rains they are collected and stored in the house (recorded from Tsoaxau Damara at ‖Gaisoas on the Ugab River). The roots are chewed for stomach pain (recorded from Dâureb Damara in Sesfontein and |Khomani Damara, Malansrust Farm).

Birds eat the fruit (recorded from ‖Khaoa-a Damara in Sesfontein).

The Herero name omutioiroro was recorded from Purros Damara in Sesfontein.

Withania somnifera (L.) Dunal

FSWA: 1240 BRI: 7400

‖Auema (Van den Eynden *et al*, 1992: 83).

Van den Eynden *et al* (1992: 83) record that in Sesfontein the ground root is sniffed to treat nose cancer.

The berries are used in Sesfontein as beads (Van den Eynden *et al*, 1992: 83).

The Herero name is otjindumbu; an extract from the roots is used by the Himba as a remedy for diarrhoea in calves (Malan and Owen-Smith, 1974: 163).

STERCULIACEAE

Hermannia amabilis Marloth ex K.Schum.

FSWA: 840 BRI: 5056 Author's coll. no. SS0272

!Gauro.b (recorded from Purros Damara in Sesfontein).

H. modesta (Ehrenb.) Mast.

FSWA: 840 BRI: 5056 Author's coll. no. SS0227

!Hona.b (recorded in Sesfontein); **'draaibos'** (du Pisani, 1983: 9).

In Namaland the whole plant is boiled and the extract drunk or used as a body wash to treat colds (du Pisani, 1983: 9).

Sterculia africana (Lour.) Fiori
FSWA: 840 BRI: 5083 Author's coll. no. SS0306, SS0335

Hoe hanu and **!hoe.b** recorded in Sesfontein; **!khoe-hanu**, **kaihai.s** (= big tree), **‖khaio** for the seeds and **koaro.s** for the fruit (recorded from ‖Khaoa-a Damara); **!khoe hanu** (recorded from Namib/!Naren in Sesfontein); **khoe hanu** and **khoenu** (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein); **hoe hanu** (recorded from Dâureb Damara in Sesfontein); **gowa.b** (recorded from Purros Damara in Sesfontein, nb. this name is usually used for *Cyphostemma* spp., Vitaceae); **!uina.s** (recorded from Dâureb Damara at ‖Gaisoas, Ugab River, in Khowarib and in du Pisani, 1983: 14); the seeds are referred to as **po-e** which are larger than that from **tine.s**, i.e. *Commiphora saxicola*, Burseraceae (recorded from Dâureb Damara at ‖Gaisoas, Ugab River); **‖khaio.s** recorded for name of the tree by ≠Ao-Dama, Rietkuil Farm; **huina** (Van den Eynden *et al*, 1992: 83); **≠guuge-amme.s**, **≠gauga-amme.s** (Eiseb *et al*, 1991: 29)

The fruits are eaten (recorded from ‖khaoa-a Damara, in Sesfontein, Dâureb Damara at ‖Gaisoas, Ugab River, ≠Ao-Dama at Rietkuil Farm, and in Steyn and du Pisani, 1984/1985: 45). A decoction of the fruit is drunk to relieve pregnancy and post-natal pains (Van den Eynden *et al*, 1992: 84).

Is a **ǀî-sâi**, i.e. the bark is used and burnt for its aroma (recorded from ‖khaoa-a Damara, in Sesfontein). **≠Gae**, i.e. aromatic rotten wood, comes from this tree (recorded from ‖Khaoa-a Damara in Sesfontein).

The seeds, known as **‖khaio**, are used for beads (recorded in Sesfontein and at farms on the Aba-Huab, Dâureb Damara at ‖Gaisoas, Ugab River,≠Ao-Dama, Rietkuil Farm). This species is reported as providing a preferred wood for the carving of '**≠gou.b**' or winnowing bowls (recorded from Purros Damara in Sesfontein, and in du Pisani, 1978: 14). Bees make hives in the trunk of this species (recorded from Purros (originally !Oe-≠gaa) and Namib/!Naren Dâureb Damara in Sesfontein);

The Herero name is omuhako (recorded from Purros Damara in Sesfontein; Malan and Owen-Smith, 1974: 163).
The Himba drink a decoction from the bark to relieve post-natal stomach cramps and this species is browsed by livestock in Kaokoveld (Malan and Owen-Smith, 1974: 163).

This species is reported to be of important (but unspecified) ornamental value to Gabra pastoralists in north Kenya and is used to make cleaning cloths or sosso 'by shredding and then soaking the bark in fat' (Stiles and Kassam, 1991: 27, 31). A decoction from the roots is drunk to treat diaarrhoea ('children's stomach') by Samburu pastoralists (Fratkin, 1996: 75).

TAMARICACEAE

Tamarix usneoides E.Mey. ex Bunge
FSWA: 900 BRI: 5239 Author's coll. no. SS0218

Known throughout former Damaraland as **dabi.b**; **dawe.b/s** (Budack. 1977: 17; Haacke, 1982; du Pisani, 1983: 11; Eiseb *et al*, 1991: 18, 29).
'**Dabi.b**' means 'swaying' and it refers to the swaying of this tree in the wind.

In Namaland a decoction from the pounded root is taken for constipation and other stomach disorders (du Pisani, 1983: 11), and by the Kuiseb Topnaar for indigestion, diarrhoea and stomach pain (Van den Eynden *et al*, 1992: 53).

Browsed by livestock (recorded along the Ugab).
The wood is popular for spoons and stirring sticks (recorded in Khowarib); this is also reported for the Kuiseb Topnaar, especially in relation to harvesting and preparing **!nara** fruits (*Acanthosicyos horridus*, Cucurbitaceae), and the Topnaar also use wooden pegs from this species in animal skin-dressing (du Pisani, 1983: 11). The wood makes good, straight building poles (recorded in Sesfontein and by Steyn and du Pisani, 1984/1985: 41, 45) and is a good firewood (du Pisani, 1983: 11; Steyn and du Pisani, 1984/1985: 45). In Namaland the green wood is used for hut frames (Haacke, 1982; du Pisani, 1983: 11). The wood was fashioned by

Hurinin ≠Aonin into fishing spears known as '‖**hai-hais**' or 'throwing-stick/plant' (Budack,(1977: 17-19).

The Herero name is omungwati; it is used for house-building at Purros (Jacobsohn, 1988: 80).

TECOPHILAECEAE

Cyanella cf. *amboensis* Schinz
FSWA: 1490 BRI: 1233 Author's coll. no. SS0122
Ûia.s (recorded from ‖Khaoa-a and Dâureb Damara in Sesfontein).
Corms eaten (recorded from ‖Khaoa-a and Dâureb Damara in Sesfontein).

Walleria nutans Kirk
FSWA: 1490
‖**Nuu.s** (Eiseb *et al*, 1991: 30); ‖**nu.s** (Van den Eynden *et al*, 1992: 84).
Van den Eynden *et al* (1992: 84) record that in Sesfontein the potato-like tubers are roasted and eaten whole or mashed and are available for 10 months/year.

The Nharo eat the small bulbs (n‖usa) after roasting (Steyn, 1981: 20).
The bulbs of *Walleria* sp. are recorded as probably eaten by the |Gwi and ‖Gana San (Tanaka, 1976: 118), the bulbs of *W. nutans* are eaten by !Kung San (Marshall, 1976: 112) and the bulbs of *W. muricata* are eaten by Dobe-area !Kung (Lee, 1979: 164).

TILIACEAE

Grewia bicolor C.Juss.
FSWA: 810 BRI: 4966 Author's coll. no. SS0309
Recognised throughout Damaraland as ≠**âu.s/n** (e.g. by Purros Damara in Sesfontein) or more specifically by Purros (originally !Oe-≠gaa) and ‖Khaoa-a Damara as ≠**hoa.n** ≠**âu.n**, i.e. elephant ≠**âu.n** (see notes for *G. flava*); called **!naurise**≠**âu.s** by ‖khaoa-a Damara in Sesfontein and **kai** ≠**âu.n** (= large ≠**âu.n**) (recorded throughout former Damaraland), and !gari ≠âu.s (= strong ≠**âu.s**) by Tsoaxau Damara at ‖Gaisoas, Ugab River, ≠Ao-Dama at Rietkuil Farm, and |Khomani Damara at Malansrust Farm; **!gari**≠**âu.s** and **!garie**≠**âu.s** are recorded for *Grewia* sp. in Eiseb *et al* (1991: 22, 27).
The berries are eaten throughout former Damaraland.
Bark twine (|**hab**) is tied around the midrib to assist pregnancy by 'keeping the foetus in the womb', and to stop menstrual pains (recorded in Sesfontein, e.g. by Purros and Namib/!Naren Damara).
Browsed by goats (recorded from |Khomani Damara, Malansrust Farm).

The Herero name omuhamati was recorded by Purros Damara in Sesfontein; omuvapu (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 163).
The berries are eaten by Himba and Herero (recorded in Sesfontein and by Malan and Owen-Smith, 1974: 163).
The leaves are browsed (recorded in Sesfontein and by Malan and Owen-Smith, 1974: 163).
Stems of larger specimens are reportedly used by the Himba for making bows and arrow shafts, the stout base of plant is used for making short knobkieries and twine is made from bark (Malan and Owen-Smith, 1974: 163).

The berries are eaten by by !Kung San (Marshall, 1976: 113; Lee, 1979: 162).
The fruits are eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).The fruits are eaten in Ethiopia (Getahun, 1974: 54) and by Gabra pastoralists in north Kenya (Stiles and Kassam, 1991: 27). Samburu pastoralists consumed a stew of the berries (boiled for 5 hours) with milk to reduce soreness after childbirth and for general strength

(ngolon) and a decoction of the bark is drunk to relieve soreness after abortion (Fratkin, 1996: 79-80).

G. cf. *flava* DC.
FSWA: 810 BRI: 4966 Author's coll. no. SS0311
‖Narabe.s, **≠âu.n** (recorded in Sesfontein and along the Aba-Huab River); **‖narane ≠âu.b/s** (recorded from ≠Ao-Dama, Rietkuil Farm); resource sample 22 described as **!uri ≠âu.s/n** or 'white' **≠âun** by ‖Khaoa-a and Dâureb Damara in Sesfontein, **≠khari ≠âu.b** from ‖khaoa-a Damara and Namib/!Naren in Sesfontein, or **!gari ≠âu.n** (recorded throughout former Damaraland) and as **≠âu.n** by Purros (incl. originally !Oe-≠gaa), Dâureb and ‖Khaoa-a Damara in Sesfontein, and Dâureb Damara at ‖Gaisoas, Ugab River; also called **|ui** (thin) **≠âu.n** (recorded from Dâureb Damara at ‖Gaisoas, Ugab River); **≠âu.n** (du Pisani, 1978: 15) **≠ou.s** (du Pisani, 1983: 8); Eiseb *et al* (1991: 20, 24, 27) record the names **|awa** (i.e. 'red') **≠âu.n**, **|apa ≠âu.n** and **≠âu.n** for this species; **≠âu.n** is identified by Van den Eynden *et al* (1992: 85) as *G. tenax* (**‖nai.n**, recorded here for *G. tenax*, is decribed as similar to *G.* cf. *flava* but smaller).
The fruits are eaten and can be dried and stored for long periods (see also du Pisani, 1978: 15, 1983: 8; Steyn and du Pisani, 1984/1985: 44). Among the Nama the dried fruits are sometimes pounded and consumed with milk and in the past they were used in beer brewing (du Pisani, 1983: 8). Bark twine is tied around the midrib to assist pregnancy by 'keeping the foetus in the womb', and to stop menstrual pains (recorded in Sesfontein, e.g. by Purros, Dâureb and ‖Khaoa-a Damara).
Arrows are made from the branches (recorded along the Ugab) and the straight sticks were used in a Nama children's game called **‖ara.b** (du Pisani, 1983: 8).

There are various types of **≠âu.n**. e.g. **‖narabe.s** is described as orange and similar to '**≠âu.n**' but with a bitter taste, some are beige and you have to rub to get stalk off and the leaves are 'hairy' underneath ? = **≠hai ≠âun**, '**≠hai**' means trunk and this name refers to the hair in the skin of this fruit which means that it's like eating the trunk of a plant; **tsaurabe ≠âun** has soft flesh (**'tsaura**' means 'soft').

Called omuhamati by Purros Damara in Sesfontein; omundjembere (plant) omandjembere (fruit) (Malan and Owen-Smith, 1974: 163); the sweet fruits are eaten by Himba and Herero now refer to grapes by the name for the fruits of this species (Malan and Owen-Smith, 1974: 163).

The powdered bark and root are mixed with a little milk and given to a newly born baby for stomach problems (recorded in Sesfontein) and 'cows are dosed with an extract from the leaves to assist in expelling afterbirth' (Malan and Owen-Smith, 1974: 163).

The leaves are browsed and 'bows, arrow shafts and walking sticks are cut from the stems' by the Himba (Malan and Owen-Smith, 1974: 163).

Grewia spp. berries are eaten when available throughout Namibia and can be dried and stored for many months (Giess, 1966: 107). The Nharo eat the berries raw or after storing (see also Story, 1950 in Steyn, 1981: 27) and use pulp from the crushed roots to 'block the hind leg apertures of tortoise shells used as aromatic powder containers by women' (Steyn, 1981: 12).

The fruits are eaten raw, often after pounding and adding a little water, and the stems of *G. flava* are preferred for arrow shafts, hunting and musical bows, spears and knobkieries by the !Koo San of west Botswana (Heinz and Maguire, 1974: 37, 41). The fruits are a major food source for the Dobe area !Kung (Lee, 1979: 162, see also Marshall, 1976: 113) and are eaten by |Gwi and ‖Gana San (Tanaka, 1976: 117). The berries, leaves, resin and root are consumed by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249). The fruits of *Grewia* spp. are eaten by Maasai and Kipsigis children (Glover *et al*, 1966: 194).

G. flavescens Juss.
FSWA: 810 BRI: 4966
‖Nari.s and **|nore.s** recorded from Dâureb and Âtsas (Otjinbingwe) Damara respectively; **‖ari.s** and **‖khawis** recorded for *G. flavescens* var. *olukondae* (Schinz) Wild in Eiseb *et al*

(1991: 27); **|nobheda**, i.e. have to rub between palms of hands to remove skin (recorded from ‖Khaoa-a and Purros (originally !Oe-≠gaa) Damara in Sesfontein); Reportedly does not occur very near Sesfontein; **|khuru** (sour) **≠âu.n** (recorded from ‖Khaoa-a Damara in Sesfontein and Dâureb Damara at Gudipos, Ugab River); the fruits are also eaten by the ≠Aonin or Topnaar of the Kuiseb valley (Dentlinger, 1977: 34).

In Herero this plant is referred to as omuhamati (tree), ozuhamati (fruit) (recorded in Sesfontein); omuhe (plant), ozohe (fruit) (Malan and Owen-Smith, 1974: 163)
'The flexible branches are considered the best material for the otjihanda oven, which is used for smoking garments' and' consists of a wooden frame about one metre high, erected over a small bowl in which aromatic herbs are burnt' and over which skirts and blankets are spread to absorb the fragrance (Malan and Owen-Smith, 1974: 163).
The fruits are soaked by the Himba in water for 2-3 days to make a refreshing beverage (Malan and Owen-Smith, 1974: 163).This species is known for its religious significance (Malan and Owen-Smith, 1974: 163).

The Nharo eat the berries (Bleek, 1928 in Steyn, 1981: 22, and Steyn, 1981: 13). The berries are also eaten by !Kung, |Gwi and ‖Gana San (Marshall, 1976: 113; Tanaka, 1976: 118; Lee, 1979: 163, who reports the consumption of berries from a *Grewia* species which is possibly *G. flavescens*).The berries are eaten by Tswana-speaking Tlokwa of south-east Botswana (Grivetti, 1979: 249).

G. tenax (Forssk.) Fiori
FSWA: 810 BRI: 4966 Author's coll. no. SS0072, SS0241, SS0310
‖Nai.b/n (recorded throughout former Damaraland and by Eiseb *et al*, 1991: 22, 27); **‖narabe** (recorded from ‖khaoa-a, Namib/!Naren, and Purros (incl. originally !Oe-≠gaa) Damara, in Sesfontein, Dâureb Damara, Ugab River); **‖narabe ‖nai.n** recorded from |Khomani Damara at Rietkuil farm, Dâureb Damara at Gudipos, Ugab River; **‖narane ‖nai.s** (recorded from ≠Ao-Dama, Rietkuil Farm); different types of **‖nain** are recognised e.g. **‖narabe ‖nain** which is relatively hard, **tsaurabe** (i.e. soft) **‖nain**, **ani** (i.e. bird) **‖nain** which is not eaten by people.

The fruits are eaten throughout former Damaraland. **‖Narabe ‖nain** can be roasted and pound to make a coffee type drink (recorded at Rietkuil farm on Aba-Huab River)

Goats eat (recorded from ≠Ao-Dama, Rietkuil Farm).
The branches re used for digging sticks and rake handles (recorded in Khowarib), and arrow stems (recorded from Purros Damara in Sesfontein).

The Herero names are omutjendyere (tree), ozutjendyere, ozondjendjere (fruit) (recorded in Sesfontein and from Purros Damara); omundjendjere omunene (plant) ozondjendjere (fruit) (Malan and Owen-Smith, 1974: 163).
In Kaokoveld the berries are eaten, the leaves are relished by large stock and the stems are used for bows, arrows and walking sticks (Malan and Owen-Smith, 1974: 163).

The fruits are eaten in Ethiopia (Getahun, 1974: 54), by Gabra pastoralists in north Kenya (Stiles and Kassam, 1991: 27) and is considered one of the most important plant foods of Samburu pastoralists (Becker, 1986: 63).

G. villosa Willd.
FSWA: 810 BRI: 4966 Author's coll. no. SS0312
Known throughout former Damaraland as **sabibe.s/n**; referred to as **|gore.s** by |Khomani Damara at Malansrust farm.

The fruits are eaten throughout Damaraland; they reach the southern areas through informal trade and exchange networks. Van den Eynden *et al* (1992: 86) also describe the consumption of and unidentified fruit called **sapibe.s**.
The roots are cooked and given to children for stomach ache (recorded in Khowarib).

The Herero names are omuhamati (tree), ozuhamati (fruit) (recorded in Sesfontein and by

Malan and Owen-Smith, 1974: 163). Himba eat the fruits and livestock browse this species in Kaokoveld (Malan and Owen-Smith, 1974: 163).

The fruits are eaten in Ethiopia (Getahun, 1974: 54), by Gabra pastoralists in north Kenya (Stiles and Kassam, 1991: 27) and are considered one of the most important plant foods of Samburu pastoralists (Becker, 1986: 63).

Grewia sp. L.

FSWA: 810 BRI: 4966 Author's coll. no. SS0224

|Nore and **|horedi** (recorded at farms on the Aba-Huab River where |Khomani Damara also refer to them as **'Uis sabibe.s**, i.e. **sabibe.s** from Uis); Eiseb *et al* (1991: 20, 27) record the name **|gore.s** for *Grewia flavescens* var. *flavescens*.

The fruits are eaten.

For pregnant women, bark (i.e. **|ha.b**) twine is tied around the waist or below the belly to encourage the growth of the foetus, nornally at around 2-3 months into the pregnancy if the woman does not appear to be growing fast enough (recorded in Sesfontein, see also notes for *G. flava*).

Grewia sp. L.

FSWA: 810 BRI: 4966

!Naruse (recorded along the Ugab); **!naurise ≠âu.n** and **kai ≠âu.n** recorded by ǁKhaoa-a and Dâureb Damara in Sesfontein; **!naruse.b** = a *Grewia* sp. that grows in Kamanjab area (Eiseb *et al*, 1991: 23, 27); **≠âu.n** (recorded from Purros (originally !Oe-≠gaa) Damara in Sesfontein, Dâureb Damara, Ugab River and |Khomani Damara at Malansrust Farm); **|awa ≠âu.s** (recorded from ≠Ao-Dama, Rietkuil Farm).

The fruits are eaten. They can be soaked in water to make a refreshing drink (recorded from ǁKhaoa-a Damara in Sesfontein) and pound (**≠noa**) to make beer (Dâureb Damara at Gudipos, Ugab River).

TURNERACEAE

Turnera oculata Story *paucipilosa* Oberm.

FSWA: 880 BRI: 5360 Author's coll. no. SS0283

!Gauro.b (recorded from Purros Damara in Sesfontein); **!gawa.s** (recorded from |Khomani Damara, Malansrust Farm).

The stems are chewed for stomach pains (|Khomani Damara, Malansrust Farm).

Good browse for goats (|Khomani Damara, Malansrust Farm).

URTICACEAE

Forsskaolea hereroensis Schinz

FSWA: 170 BRI: 2012 Author's coll. no. SS0206, SS0250

≠Auda≠aebe (recorded from ǁkhaoa-a, Purros (incl. originally !Oe-≠gaa) and Dâureb Damara, in Sesfontein, and from Dâureb Damara at ǁGaisoas, Ugab River).

Goats eat (Dâureb Damara at ǁGaisoas, Ugab River).

This sticky plant is useful for plugging holes in buckets (recorded from ǁkhaoa-a, Purros (incl. originally !Oe-≠gaa) Damara, in Sesfontein).

The Herero name omujavatungu was recorded from Purros Damara in Sesfontein.

VISCACEAE

Viscum rotundifolium L.f.
FSWA: 225 BRI: 2093 Author's coll. no. SS0434?
Dai!hu.b, a generic name for hemi-parasites (recorded from Purros (incl. originally !Oe-≠gaa), Dâureb Damara from Sesfontein).
Goats eat (recorded from Purros Damara in Sesfontein).

Oviraura (recorded from Herero and Purros Damara in Sesfontein); appears to be a generic term for all similarly growing hemi-parasites cf. *Plicosepalus*, *Odontella* and *Tapinanthus* spp..
In Sesfontein the fruits are eaten, especially as a snack by children when in the field.

VITACEAE

Cyphostemma cf. *uter* (Exell & Mendonca) Desc.
FSWA: 800 BRI: 4918
Kowa.s (recorded in Sesfontein) (describes *Cyphostemma* spp. in Eiseb *et al*, 1991: 19, 26; Van den Eynden *et al*, 1992: 85).
The fruits can be eaten (recorded in Sesfontein) and Van den Eynden *et al* (1992: 85) also report that the juice from the fruits is drunk.

Omutjindi, omutindi (recorded in Sesfontein and for *Cyphostemma currori* in Malan and Owen-Smith, 1974: 164). Malan and Owen-Smith (1974: 164) state that the fruits are not eaten in Kaokoland because they contain crystals in the epidermis which cause a severe mouth irritation.

WELWITSCHIACEAE

Welwitschia mirabilis Hook. F.
FSWA: 130 BRI: 0
!Kharo.s (recorded in Sesfontein, e.g. from Purros (incl. originally !Oe-≠gaa), ǁKhaoa-a, Namib/!Naren and Dâureb Damara, and in Eiseb *et al*, 1991: 23, 30).
Inhabitants of Sesfontein describe how the fresh green cones, especially from female plants, can be eaten after the rains, usually after roasting in fire but occasionally eaten raw. Also recorded by Steyn and du Pisani (1984/1985: 45).

ZYGOPHYLLACEAE

Tribulis terrestris L.
FSWA: 650 BRI: 3978 Author's coll. no. SS0084
|Hini.s, **|kini.s** (recorded in Sesfontein and along the Ugab).
See *T. zeyheri*.

T. cistoides L. has minor medicinal value for Gabra pastoralists of north Kenya (Stiles and Kassam, 1991: 27).

T. zeyheri Sond. *zeyheri*
FSWA: 650 BRI: 3978 Author's coll. no. SS0073, SS0085, SS0086
|Hini.s, **|kini.s** (recorded in Sesfontein and along the Ugab); **|khiina.s**, **|khiini.s**, **|khinini.s** used to describe *Tribulus* spp. in Eiseb *et al* (1991: 29).
Tribulis spp. cf. *zeyheri* and *terrestris* are perceived as essentially the same, i.e. have the same name.

The Herero names are ohongo (recorded in Sesfontein); ozohongwe, ozohongo; eaten by small

stock, donkeys and horses in Kaokoland (Malan and Owen-Smith, 1974: 164).

Zygophyllum simplex L.
FSWA: 650 BRI: 3965 Author's coll. no. SS0257
|Âgeame (recorded in Sesfontein); **‖gamhairo.s** is the Hai‖om name in Eiseb *et al* (1991: 21, 30, n.b. **‖gam** means water and may refer to the succulent nature of this plant). '|Â' means wet, so perhaps the name makes reference to the succulent nature of this plant.
The succulent leaves are used as a soap substitute (recorded in Sesfontein).

The Herero name is onona; the plant is eaten by large and small stock, particularly goats, in Kaokoland (recorded in Sesfontein and in Malan and Owen-Smith, 1974: 164).

UNIDENTIFIED PLANTS

Author's coll. no. SS0113, SS0108, SS0093

Gânao (recorded from Dâureb Damara in Sesfontein).
!Noa.b (porcupines) eat (recorded from Dâureb Damara in Sesfontein).
Is a **!Garib sâ.i**, i.e. a perfume which comes from !Garib near the Kunene River. It is traded by the Himba with Damara in Sesfontein and, like *Spirostachys africana*, Euphorbiaceae, pieces of wood are burnt as a **|î-sâ.i**.
Otjikangua (recorded in Sesfontein).

‖Khu.n (recorded in Sesfontein and along the Ugab).
The tubers are eaten like potatoes (recorded along the Ugab).
Recorded in Sesfontein as a fodder plant.
'**‖Khu**' is described as like a grass with sticky prickles on the leaves and is common in the Kamanjab area.

‖Gabin, ‖gawin (recorded in Sesfontein and Khowarib).
Produces good fodder for livestock.

‖A-‖nai.s (recorded in Sesfontein).
Described as the source of medicine for small children (recorded in Sesfontein).

≠Oa (recorded in Sesfontein and also used to describe *Geigaria ornativa*, Asteraceae).
'≠Oa' means 'wind' and refers to the fact that you can smell the perfume ('**sâi**') of this plant when the wind blows.
Aromatic beads are made from this '**sâ-hai.s**' which is common in Kamanjab area.

≠hoea.b (recorded in Sesfontein).
The wood is used for making **≠gou.b** or winnowing bowls and **‖hoe.s** or buckets (‖Khaoa-a Damara in Sesfontein).

≠Gau-kho.i (recorded in Sesfontein).
The seeds are eaten (found in Hoanib in rainy season) (recorded in Sesfontein).

!Haie.s (recorded along the Ugab River); **|hai.b** (recorded in Khowarib); **!khai.b** (?), **|hai.b** and **|hawi.b** are recorded for *Vigna lobatifolia* Baker, Fabaceae, in Eiseb *et al* (1991: 20, 23, 29).
The tubers are eaten like potatoes (recorded along the Ugab River) and the fruits (?) are eaten (recorded in Khowarib).
!Haie.s is described as similar to **somae.s** but with horizontally spreading flowers (recorded along the Ugab).

≠Hau.n (recorded along the Ugab).
A tuber which is eaten like potatoes. Is said to be common near Omatjette (recorded along the

Ugab).

≠Gama-hairogu, i.e. brown-plant (recorded in Sesfontein).
The fragrant roots of this plant are collected by Himba |Herero women from the Kunene River and traded in Sesfontein for perfume or **sâ.i**.
The Herero name is okalui (recorded in Sesfontein)

|Nam-hai.b (recorded along the Ugab).
'**|Nam**' means 'love', i.e. 'love-plant'.
The roots are pounded, cooked and consumed for diarrhoea (recorded along the Ugab).
!Gae (recorded along the Ugab); **!gae.b** is recorded as the Hai‖om name for *Mundulea sericea* (Willd.) A. Chev. in Eiseb *et al* (1991: 22, 28).
The long root tuber is eaten (recorded along the Ugab).

Nau.b (recorded in Sesfontein); **iau.b** (**lau.b**) (Eiseb *et al*, 1991: 19, 29) for *Termitomyces* spp.; (du Pisani (1983: 12) and Eiseb *et al* (1991: 21, 29) record the Nama name **‖hawa.s** for the truffle *Terfezia pfeilii*).
This edible mushroom was recorded as eaten in Sesfontein.

Sei-si-seibe.b (recorded in Sesfontein and along the Ugab) possibly the same as **saitsi≠ane** recorded for *Osteospermum microcarpum* subsp. *septentrionale*, Asteraceae.
Is a small tree(plant) which is browsed by livestock (recorded in Sesfontein and along the Ugab).

Somae.s (recorded along the Ugab)..
The tubers are eaten (recorded along the Ugab).
Said to be similar to '**!haie.s**' i.e. ?*Vigna lobatifolia*, Fabaceae. The edible roots are like small potatoes in appearance.

Tobe (recorded along the Ugab); Eiseb *et al* (1991: 19, 28) record the name **toobe.b** for *Ophioglossum polyphyllum* A. Braun, Ophioglossaceae.
Leaves eaten (recorded along the Ugab).

Tsao.b (recorded in Sesfontein).
Used for medicine to treat goats (recorded in Sesfontein).

Ûia.b/s/n = possibly a generic term for edible corms (known and consumed throughout former Damaraland) of which there are different types, e.g. **≠khari** (meaning small) are small white corms common in the hills around Omatjette and widely eaten after the rains; **ko-e**, is a large **ûia.s**, approx. 5cm in diameter, consumption of which causes diarrhoea; **≠ao.n** (refers to an **ûia.b** with a long, thin shape which in Herero is called otunue, referring to the way it splits into thin pieces like fingers when roasted (recorded from Purros Damara in Sesfontein)) which is found with **≠khari ûia.s** at !Ao‖aexas near Windhoek (recorded along the Ugab). This is possibly **≠hao.s** which is recorded as the bulb of **|khawe.b**, i.e. *Oxalis semiloba*, Oxalidaceae, in Eiseb *et al* (1991: 24, 28) (n.b. *O. semiloba* is not recorded for Namibia in Kolberg *et al* (1992) but *O. purpurascens* Salter occurs in Kunene (Craven, pers. comm). 1995). SS0417 recorded as **ûia.s** by Purros (originally !Oe-≠gaa) Damara in Sesfontein, **soabe.s** (meaning valley or space where it grows) or ozuntungua (refers to its slightly hot taste) is common near Purros (recorded from Purros Damara in Sesfontein). ‖Khaoa-a Damara state that they have not eaten SS0417 and do not recognise it as **ûia.s**. Other ‖Khaoa-a Damara say that SS0417 looks like **|gari ûias** but it isn't this. SS417 is called **≠gari** (not **ûias**, the skin of **ûias** is white not brown) by Tsoaxau Damara at ‖Gaisoas who state that a big **ûias** called **ko-e** grows in Hurubes, i.e. a ‖Khaoa-a Damara area. Dâureb Damara at Gudipos, Ugab River, |Khomani Damara at Malansrust Farm, state that SS0417 is **≠gari**; **ûias** look like potatoes but **≠gari**, **ûias** and **!hanni** are described as the same 'family' and are all eaten after roasting or after drying, pounding and cooking like porridge. ≠Ao-Dama, Rietkuil Farm, describe SS0417 as **ûina.s** but

that some people call it **≠gari**; it's found in Outjo, Otjikondo and Omaruru areas and in |Khomas. Dâureb Damara at ‖Gaisoas, Ugab River, describe SS0417 as **≠hao** which is found at Hurubes, is related to ûias and is roasted and eaten.

Mutikaigo (recorded from Purros Damara in Sesfontein)
The root is burned and the smoke inhaled to clear headaches or **'tsuadana'** (recorded in Sesfontein).

|Horo.s (recorded in Sesfontein, e.g. by Purros and ‖Khaoa-a Damara); Tsoaxau Damara at ‖Gaisoas, Ugab River, suggest that it is the same type of plant as **‖hâube.s**, i.e. *Amaranthus* spp., but is found in the field rather than around people's homes and gardens; **|horo.b|i** recorded in Eiseb *et al* (1991: 20, 25) as *A. thunbergii*; **|kxoro.b** was recorded by Schultze (1907 in du Pisani, 1983: 14) as the Nama name for *Antherhicum* (*drenophyllum*?), Liliaceae, eaten as a vegetable (*Antherhicum* has not been recorded for Kunene, Craven, pers. comm., 1995).
The leaves are eaten like **‖gâube.s** and the plant grows in the field in the rain season and has red seeds (recorded in Sesfontein, e.g. by Purros and ‖Khaoa-a Damara, and from Tsoaxau Damara at ‖Gaisoas, Ugab River).

Simonhai.b (recorded along the Ugab).
A poultice from the root bark is used to treat burns and boils (recorded along the Ugab).
This is an important tree; to make the medicine work you have to put 1-5c at the base of the tree when you take the medicine (recorded along the Ugab).
Described as a small plant with yellow flowers which occurs in Omururu. Is a **!garo.b**, i.e. indigenous or field, species.

|Khomada.i (recorded in Sesfontein)
The seeds are eaten? This plant reportedly grows in mountains around Sesfontein (recorded in Sesfontein).

Sâhetama |aubed, **'sâ'** meaning perfume (recorded from Purros Damara in Sesfontein); **|gaube.b** is described as a **sâ.i** plant by Tsoaxau Damara at ‖Gaisoas, Ugab River; possibly the same as **|gâube.b** (i.e. **‖gamme.b**) recorded as the aromatic herb *Ocimum canum*, Lamiaceae by Eiseb et al (1991: 20, 21, 28).
The leaves are used for making tea (described by Tsoaxau Damara at ‖Gaisoas, Ugab River).The root is burned and the ash spread on burns (recorded from Purros Damara in Sesfontein).The plant parts of **|gaubeb** are used or making perfume or **sâ.i** (described by Tsoaxau Damara at ‖Gaisoas, Ugab River).

≠Habe.s (recorded at farms on the Aba-Huab).
Is a medicine plant (recorded at farms on the Aba-Huab).

So-|oâ (recorded from Purros Damara in Sesfontein).
Is a medicine plant (recorded from Purros Damara at Sesfontein).

!Uri!gonne (recorded from ‖Khaoa-a Damara in Sesfontein); **!uri|huu.s** (recorded from Purros Damara in Sesfontein).
The wood is used for making buckets or **‖hoe.s** and **≠goub**, i.e. winnowing bowls (recorded from Purros Damara from Sesfontein).

≠Â.i (recorded in Sesfontein).
'**≠Â** ' means 'think', implying 'think about it and tell me later'. Refers to losing your voice which will return once you've used this medicine plant.
Some of this tuber is eaten to cure a lost voice (recorded in Sesfontein).
This tuber is hung around the neck in the belief that its power will encourage a lost voice to return (recorded in Sesfontein).

!Khoebeb, adamihaib (recorded from ǁKhaoa-a Damara in Sesfontein); **ǁnoma** (recorded from Purros Damara from Sesfontein).
The bark is used as a leather tanning agent (recorded from ǁKhaoa-a, Purros Damara in Sesfontein).

Author's coll. no. SS0432

Omujaweka (recorded from Purros Damara in Sesfontein).

Ondengura (recorded in Sesfontein).
The roots are chewed or made into a decoction and drunk to treat coughs (recorded in Sesfontein). Described as a creeping plant, observed on *Terminalia prunoides*, Combretaceae.

Ozonduvi (recorded in Sesfontein); possibly onduvi recorded for *Lapeirousia* sp., Iridaceae (cf. Malan and Owen-Smith, 1974: 157).
The small tubers of onduvi, i.e. *Lapeirousia* sp., Iridaceae, are eaten (Malan and Owen-Smith, 1974: 157).

References

Barrow, E. 1990 Usufruct rights to trees: the role of Ekwar in dryland central Turkana, Kenya. *Hum. Ecol.* 18(2): 163-176.

Becker, B. 1986 Wild plants for human nutrition in the Sahelian zone. *J. Arid Environm.* 1: 161-64.

Berge, G. and Hveem, B. 1992 *L'utilisation des plantes sauvages: commentaires relatifs à la répartition de la population interrogée. Annexe 12.* Report détape, plantes sauvages, Projet de recherche SSE Environnement et Développement au Mali.

Bruce, W.G.G. 1975 Medicinal properties in the Aloe. *Excelsa.* 5: 57-70.

Campbell, A. 1986 The use of wild food plants, and drought in Botswana. *J. Arid Environm.* 1:181-91

Craven, P. (1995) Taxonomist with National Botanical Research Institute, Windhoek, Namibia.

Crosswhite, F.S. 1981 Desert plants, habitat and agriculture in relation to the major pattern of cultural differentiation in the O'odham people of the Sonoran Desert. *Desert Plants.* 3(2): 47-76.

Dentlinger, U. 1977 The !Nara plant in the Topnaar Hottentot culture of Namibia: ethnobotanical clues to an 8,000 year-old tradition. *Munger Africana Library Notes.* 3: 83-39. Institute of Technology, California.

du Pisani, E. 1978 Dama settlement and subsistence along the Ugab Valley, South West Africa (Namibia). *Norvorsinge van die Nasionale Museum.* 4(1): 3-20.

du Pisani, E. 1983 Past and present plant utilization in Namaland and the lower Kuiseb River valley, South West Africa (Namibia). A preliminary report. *Khoisis.*4: 1-19.

Felger, F. 1979 Ancient crops for the 21st century. in Ritchie, G.A. (ed.) *New agricultural crops. American Society for the Advancement of Science Symposium, 38.* Westview PressBoulder, Colorado.

Fratkin, E. 1996 Traditional medicine and concepts of healing among Samburu pastoralists of Kenya. *J. Ethnobiol.* 16(1): 63-97.

Geiss, W. 1966 The 'veldkost' of South West Africa. *SWA Yearbook.* 105-107.

Getahun, A. 1974 The role of wild plants in the native diet in Ethiopia. *Agro-Ecosystems.* 145-56

Glover, P.E., Stewart, J. and Gwynne, M.D. 1966 Masai and Kipsigis notes on East African plants: part II - domestic usesd of plants. *E. Afr. Agric. Forestry J.* October issue: 192-199.

Grivetti, L.E. 1979 Kalahari agro-pastoral-hunter-gatherers: the Tswana example. *Ecol. Food Nutr.* 7: 235-256

Heinz, H.J. and Maguire, B. (1974) Ethnobotany of the !Ko Bushman: their ethnobotanical knowledge and plant lore. *Occasional Papers of the Botswana Society.* 1: 1-53.

Johns, T., Kokwaro, J.O. and Kimanani, E.K. 1989 Herbal remedies of the Luo of Siaya District, Kenya: establishing quantitative criteria for consensus. *Econ. Bot.*44: 369-381.

Kokwaro, J.O. 1983 An African knowledge of ethnosystematics and its application to traditional medicine with particular reference to the medicinal use of the fungus *Englerǫmyces goetzei. Bothalia.* 14(2): 237-243.

Konstant, T.L., Sullivan, S. and Cunningham, A.B. 1995 The effects of utilization by people and livestock on *Hyphaene petersiana* basketry resources in the palm savanna of north-central Namibia. *Econ. Bot.* 49(4): 345-356.

Lee, R.B. 1979 *The !Kung San: men, women and work in a foraging society.* Cambridge University Press, Cambridge.

MacOwen, P. 1897 The Cape remedy for dysentery. *Agricultural J.* May 13: 591-598.

Malaisse, F. and Parent, G. 1985 Edible vegetable products in the Zambezian woodland area: a nutritional and ecological approach. *Ecol. Food Nutr.* 1: 843-82.

Malan, J.S. and Owen-Smith, G.L. 1974 The ethnobotany of Kaokoland. *Cimbebasia.* (B) 2(5): 131-178.

Marshall, L. 1976 *The !Kung of Nyae Nyae.* Harvard University Press, London.

Moll, E.J. 1972 The distribution, abundance and utilization of the Lala Palm, *Hyphaene natalensis*, in Tongaland, Natal. *Bothalia.* 10(4):627-635.

Morgan, W.T.W. 1981 Ethnobotany of the Turkana: use of plants by a pastoral people and their livestock in Kenya. *Econ. Bot.* 35: 96-130.

O'Connell, J.F., Latz, P.K. and Barnett, P. 1983 Traditional and modern plant use among the Alyawara of Central Australia. *Econ. Bot.* 37(1): 80-109.

Olpp, J. n.d. *A Nama/Damara Grammer.* Unpublished English translation by B. Fuller, Jr.

Rodin, R.J. 1985 The ethnobotany of the KwaNyama Owambos. *Monogr. Syst. Bot. Missouri Bot. Gard.* 9.

Schapera, I. 1930 *The Khoisan peoples of South Africa.* Routledge & Sons, London.

Schweikerdt, H.G. 1937 A note on the South African species of *Ximenia* L., and their possible economic uses. *Bothalia.* 3(2): 179-182.

Steyn, H.P. and du Pisani, E. 1984/1985 Grass-seeds, game and goats: an overview of Dama subsistence. *J. SWA Sci. Soc.* 39: 37-52.

Steyn, H.P. 1981 Nharo plant utilization: an overview. *Khoisis.* 1: 1-31.

Stiles, D. and Kassam, A. 1991 An ethno-botanical study of Gabra plant use in Marsabit District, Kenya. *J. East African Nat. Hist. Soc. and National Mus.* 81(198): 14-37.

Sullivan, S., Konstant, T.L. and Cunningham, A.B. 1995 The impact of the utilization of palm products on the population structure of the Vegetable Ivory Palm (*Hyphaene petersiana*, Arecaceae) in north-central Namibia. *Econ. Bot.* 49(4): 357-370.

Tanaka, J. 1976 Subsistence ecology of Central Kalahari San. pp. 98-119 in Lee, R.B. and DeVore, I. (eds.) *Kalahari hunter-gatherers: studies of the !Kung San and their neighbours.* Harvard University Press, London.

Van den Eynden, V. Vernemmen, P. and Van Damme, P. 1992 *The ethnobotany of the Topnaar.* Universiteit Gent, Gent.

Van Voorthuizen. E.G. 1976 The mopane tree. *Botswana Notes and Records.* 8: 223-230.

Veth, P.M. and Walsh, F.J. 1988 The concept of 'staple' plant foods in the Western Deset region of Western Australia. *Aust. Aboriginal Studs.* 2: 19-25.

Wang Min and Sun Yun-wei 1986 Fruit trees and vegetables for arid and semi-arid areas in north-west China. *J. Arid Environm.* 1: 13-17.