Namibia Damara CZAW Lib

Ecology of resource use and subsistence by

Damara 'agro-pastoral-gatherers' in arid north-west Namibia.

PhD Upgrading Report: Initial literature review, pilot study findings, and proposed fieldwork methods.

Sian Sullivan

Department of Anthropology, University College London
Department of Geography, School of Oriental and African Studies

December 1994

Table of contents

1.0 Introduction

This report presents an overview of the context of this on-going study, together with the results of preliminary data collection carried out during the pilot study (April-June 1994) and the proposed methods for further data collection and analysis in the next stage of the research. As such it consists of four main sections which deal in turn with the theoretical framework guiding this project, the historical and environmental background relevant to the study population and fieldwork area, a presentation of initial data concerned with the current socio-economic background and patterns of resource use, and a discussion of work planned for the main period of field data collection.

2.0 Conceptual framework

This study is an attempt at an interdisciplinary account and discussion of indigenous resource use issues in an arid, and therefore unpredictable, environment. As such it is situated within a theoretical framework influenced predominantly by the academic disciplines of anthropology and ecology, and its methods are derived from both these disciplines. This section thus presents the theoretical concepts of these disciplines considered relevant to the study of resource use and subsistence by the Damara of rural north-west Namibia.

2.1 A social ecology perspective

There is, today, a growing body of literature which discusses the importance of gathered plant resources to the livelihoods of many cultural and socioeconomic groups living in a variety of ecological and technological environments. This is associated with the rise in interest in 'indigenous technical knowledge' and traditional agricultural and resource management systems that occurred in the 1970s and 1980s (Richards, 1985). Studies of 'wild' resource use by cultivating groups or pastoralists build on the recognition that a wide range of interrelated quantitative and qualitative benefits accrue to such resource use, including:

- contributions to food security through the direct use of accessible wild foods, the sale or exchange of gathered products to obtain food, the provison of necessary nutrients through a diversified diet, and the use of trees as a kind of 'savings bank' to be converted into income in response to unexpected contingencies (Chambers and Leach, 1989);
- a source of independence and extra income for women who are often the primary gatherers of uncultivated resources;
- retention of autonomy through reduced dependence on manufactured goods, imported products and modern medicines.

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

Conversely, 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, has recently been widely criticised (see, for example, Schrire, 1984; Wilmsen, 1989;). These criticisms rest largely on the 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 such hunting and foraging subsistence strategies. As such they build on historical and archaeological evidence for the early and long-term involvement by populations currently classified as 'culturally hunter-gatherer' in regional trade networks and other components of subsistence such as cultivation and herding (Marks, 1972: 57; Elphick, 1977: 30-41; Schrire, 1980, 1984: xv, 1-25, 71-2; Alexander, 1984: 19-21; Denbow, 1984; Eibl-Eibesfeldt and Wiessner, 1984: viii-ix; Gordon, 1984; Hall, 1984; Hausman, 1982; Parkington, 1984).

In a wider context, the increased focus on the use of gathered resources by cultivating and herding groups is part of a shift in interest towards the perceived coherence of traditional subsistence and survival strategies in the setting of local environmental dynamics. From a political economy perspective, such production systems, together with the labour they exact, are typically undervalued at a national and international level due to the dominance of economic measures requiring that both productivity and 'real' work must have a monetary value to be included. Today, however, indigenous subsistence systems are often seen as holding the key to sustainable resource use, even though conventional wisdom has generally held that these same systems are environmentally degrading and irrational given the ecological context (Homewood, 1993). Often insights into the rationality of human resource use systems are accompanied by substantial challenges to the accepted validity of established thinking regarding the ecology of an area. Pure ecology studies can likewise inform human and social ecology studies of an area or cultural group.

2.1.1 Gender

The growing focus on subsistence and survival strategies necessarily involves a gender dimension because it comprises a shift towards domains of productivity associated with women. Today it is recognised that women are often the primary producers and distributors of food in subsistence societies and should be incorporated as primary actors within development initiatives (Talle, 1987: 51; Agarwal, 1989: 46). Unfortunately, many projects, by focussing 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 stimulated ecologically damaging effects (see, for example, Waters-Bayer, 1985: 9, 22; Carney, 1988: 34-7, 345-6; Lane and Swift, 1989: 4; Monimart, 1989: 12; Whitehead, 1990: 54, 62; Joekes and Pointing, 1991: 5-6).

The value of such a focus on women's role in household subsistence and its relationship to gathered products from the local resource base 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 production systems to overlook the productive role of women in these systems, the traditional mechanisms through which they are afforded some autonomy and the specific effects on women of externally driven change. In recent years there has been a (radical) reassessment of the underlying assumptions regarding sub-Saharan pastoralist production systems. Jowkar *et al* (1991: vii), for example, 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 impact on women of so-called 'desertification' and the role that women can play in understanding and preventing environmental degradation in drylands (Monimart, 1989; Evers, 1994a).

2.1.2 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 step 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 (see, for example, Falconer, 1990; Falconer and Arnold, 1991; Evers, 1994b; Schreckenberg, 1994).

A great deal of this 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 only enjoy long-term success if local people perceive that they will benefit from such projects, has stimulated efforts at community involvement in conservation. The harvesting of NTFPs in forest reserves by local people is one way in which the conservation of forested areas can be promoted alongside local development. An example of such an initiative is 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, thus raising the pressure for conversion of such areas into habitats of local use value (Davies and Richards, 1991; Evers, 1994b; Hartley, 1992; Schreckenberg, 1994).

Many of the concepts and assumptions found in this literature in terms of resources used, management systems surrounding their use and problems concerning their conservation, are not directly translatable to dry savanna and arid areas. At the same time, the growth of formal knowledge concerning the dynamics of dryland systems has, according to some (cf. Stott, 1994, pers. comm.), been hampered by the focus within the scientific international conservation communities on forest systems. This situation has contributed to the imposition over the last three decades of a plethora of multi and bilateral aid projects and State interventions into dryland resource use systems which are based on inappropriate ecological assumptions, and have caused enormous changes in the management of such environments with very few successful outcomes (Swift, 1977: 263; Raikes, 1981; Niamir, 1990: 1; Jowkar *et al*, 1991: vii; Homewood, 1992). Unfortunately, confusion may also arise in the description by some authors of dryland savanna woodlands and rangelands as forest systems, as in the title of Shepherd's

(1992) annotated bibliography of dryland resource use, 'Managing Africa's tropical dry forests'.

2.1.3 Existing studies of gathered plant resource use

To date, a very real problem confronted by any attempt to include the use of wild resources in development interventions affecting indigenous communities is the lack of information allowing widely understood and comparative values to be imposed on such resource use. Often the only information pertaining to the local use of gathered plant products is in the form of ethnobotanical lists of species used and descriptions of the purposes they are used for (see, for example, Williamson, 1956; Malan and Owen-Smith, 1974; Gilmore, 1977; Malaisse and Parent, 1985; Van den Eynden, 1992; Hines and Eckman, 1993). These species lists have value in that they provide some idea of the range of species used by a community, and it is recognised that such work is enormously time-consuming, requiring botanical knowledge in identifying the species concerned as well as discussions with local people regarding their (often multiple) uses. Their anecdotal nature, combined with the tendency of some studies to emphasize exotic uses and to treat such resources as remnants of a prehistoric form of subsistence, may, however, actually undermine the potential that these resources have of being taken seriously in the light of local development interventions.

In other words, gathered products, in which labour is only invested in their collection (normally by women) and not in their actual production, are rarely considered or understood as 'real' resources by development or conservation professionals who may potentially introduce radical changes into a community's system of subsistence. This situation remains the case even when ethnobotanical knowledge concerning the gathered resources used by a particular group exists.

Apart from lacking quantitative data on the requirements for 'wild' resources, there is often very little complementary information in resource use studies of the ecological availability of the products used and the biological characteristics of the species concerned. This makes it extremely difficult to include information on such resource use within the scope of modern land use planning and development, and particularly the role that such utilisation can play in the conservation of natural resources.

2.1.4 Arid land plant resource use by sub-Saharan pastoralists - an overview

As stated above, the role of gathered plant products in the subsistence strategies of pastoralist groups has been neglected in the focus on livestock and on range management systems. Evidence does suggest, however, that a wide range of indigenous plant species are used by pastoralist groups for a variety of subsistence purposes (see, for example, Malan and Owen-Smith, 1974, on the ovaHimba of Kaokoland, north-west Namibia; Pratt and Gwynne, 1977: 35-6; Morgan, 1981 and Barrow, 1988 for the Turkana and Pokot of north Kenya; Becker, 1986: 61, on Turkana, Samburu and Ferlo pastoralists of the Sahelian belt; Stiles and Kassam, 1986, on the Gabra of north Kenya; Niamir, 1990: 6). Unfortunately, however, the problems often found in wild plant use studies in general (as discussed in section 2.1.3) are even more pronounced regarding arid areas due to the overall paucity of research related specifically to the study of gathered plant use, and the difficulties of working with resources that tend to be widely dispersed and highly variable in annual availability. This situation has resulted in a number of anecdotal references to the importance of plant species but no quantified data and often without identification to the botanical name for the species referred to (Perlov, n.d. :145-

6).

Features of such arid land plant use for food include the following:
- while the consumption of edible plants often comprises a relatively low proportion of a population's total energy consumption it makes important nutritional contributions in the intake of essential vitamins and minerals (Becker, 86: 61);
- many edible plant products are gathered from perennial shrubby and woody species which are less vulnerable to the vagaries of variable rainfall than herbaceous species and, therefore, are more reliable as a food source (Becker, 86: 61);
- widely varying degrees of dependence on different resources exist including regular use, seasonal dependency related to both need and availability (Peters *et al*, 1984), and use in times of famine or scarcity of alternatives. The leaves of *Cyphostemma maranguensis* and *Cassia obtusifolia* are, for example, particularly important for the Peulh in north Senegal at the beginning of the wet season which corresponds with the period of lowest staple food supply (Becker, 1986: 61), while the nutritious fruits of *Boscia senegaliensis* **(mukheit)** comprise an important famine food in Darfur, Sudan (de Waal, 1989: 19).

In terms of management techniques the use of gathered plant resources by dryland communities has been described as inherently conservative (Barrow, 1988, 1990; Shepherd, 1992: 20-21), characterised, for example, by the use of dead wood for firewood, over-abundant and low-value scrubby species for kraal fences, the cutting of species in ways which allow, and may even stimulate, their further growth, and the conservation of important fodder and domestic use species. The simple and flexible traditional management of indigenous plant resources in a heterogenous environment is, therefore, directed towards interlocking benefits related to both domestic and herd requirements (Niamir, 1990: 2; Shepherd, 1992: 36). Some aspects of such use can be interpreted as having actively positive ecological effects, including:
- the facilitation of seed dispersal, particularly of species producing edible fruits;
- the protection of selected economically important species;
- the promotion of vegetative reproduction (coppicing) through branch lopping. Coppicing has been found to be an important means of regeneration in seasonal environments such as the dry tropics where seedling establishment is especially problematic (Janzen, 1975: 13; Ewel, 1980; Cole, 1986: 9; Behnke and Scoones, 1992: 18).

Following Malan and Owen-Smith (1974), however, some more negative ecological effects of indigenous plant use asociated with growing sedentary populations and cultural change in response to external influences may include:
- increasing timber removal related both to the growing need for substantial building poles to accommodate the replacement of traditional brushwood huts with more modern square structures as is common in many pastoralist groups (Ensminger , n.d. 134), and to supply the increasing tourist demand for carved items in many areas;
- increasing brushwood and dry branch removal for firewood in areas where sedentary populations are increasing, and the consequent effects on the positive role that accumulated material around the base of trees has on facilitating the recruitment of tree seedlings, protecting perennial herbaceous species and preventing local erosion of topsoil;
- the erosion of indigenous management techniques affecting dryland plant resources associated with the transfer of economic and political power from traditional leaders to the State, and the narrowing of management focus accompanying production for external markets (Shepherd, 1992: 37)

2.1.5 Discussion: plant gathering as the production of 'real' resources

In view of the points discussed above, there is an explicit need for the provision of relevant data which can facilitate the integration of indigenous systems of gathered plant resource use, together with traditional knowledge pertaining to their management, into development and conservation initiatives (Hartley, 1992: 19; Abbott, 1993; Homewood, 1994; Schreckenberg, 1994). This is perhaps particularly true for dryland areas. Apart from increasing overall recognition of the importance of the domestic use of wild resources to people's livelihoods, and the consequent interconnections between the users of gathered resources and the ecological resource base, research into these systems can illuminate differences regarding:

- resources used regularly for household consumption or sale, and those which are used either opportunistically when they are available, or as a last resort in times of scarcity;
- values placed on resources by different user groups;
- geographical location and the resulting effects of differing availabilities of resources;
- resources which reflect particular cultural preference or symbolic meaning and which are likely to continue to be sought after whatever the external influences or the availability of substitutes.

This information can allow issues of gathered resource use to be 'situated' within an appropriate continuum of possibilities which reflects the dynamic nature of resource use under the opportunities and constraints imposed by particular ecological and cultural circumstances. If combined with modelling techniques drawn from the disciplines of evolutionary biology and animal behavioural ecology, which highlight decision-making processes regarding resource use strategies, such studies can have predictive value in illuminating the ways that resource use practices may change in response to different circumstances.

Finally, such studies should take the ecological context into account so that the observed demand for gathered resources is defined with reference to the limits and opportunities of the productive base and the possible future impacts of such use can be adequately assessed.

2.2 An ecological perspective

> 'We only worry about the model's assumptions when the models make the wrong predictions' Pimm, 1991: 17.

A number of observations have made necessary an examination of the fundamental ecological assumptions underpinning the dynamics of African arid and semi-arid environments. From this it can be seen that many current issues regarding subsistence systems, conservation and development in drylands derive from similar ecological assumptions. These issues include: the acknowledged failure of many development interventions in African drylands; the general negative perception regarding the productivity of drylands despite the fact that they continue to be productive under heavy utilisation through grazing, browsing and branch removal (McKenzie, 1982; Shepherd, 1992 :7; Homewood, 1993); and the body of literature which asserts that widespread degradation and desertification processes abound in these areas and are related to overstocking practices by subsistence pastoralists.

Of particular importance to this discussion is the way that notions of equilibrium, as opposed to non-equilibrium, dynamics have translated themselves into assumptions concerning the way that ecosystems, and humans as integral components of those systems, behave. The theoretical concepts underlying this debate are presented and defined here in some detail in an attempt to both facilitate communication between the social and natural sciences, and to emphasise the importance of situating the environmental context of a particular project within an appropriate conceptual framework.

2.2.1 The equilibrium model

Conventional ecology tends to make the implicit assumption that communities of species are essentially in equilibrium; a stable balance of species densities is maintained through interactions which fine-tune the biotic component of the ecosystem within the opportunities and constraints presented by a relatively constant abiotic environment. The internal processes of the system, in other words, gradually 'equilibrate' to stable external conditions, the 'climax' of this process forming an equilibrium community which is stable through time unless disturbed. As discussed by Ellis *et al* (1993: 31), assumptions of equilibrium pervade evolutionary and ecological ideas from the 18th century onwards. They find expression, for example, in both Darwin's exposition on the gradual evolution of species through natural selection and competition, and Malthus' 1798 assertion that populations are regulated through density-dependent feed-back relationships within the constraints of available food resources.

This assumption of 'the balance of nature' has amounted to nothing less than an 'equilibrium paradigm' dominating ecological thought, and has guided the focus of ecological work, management policy and expectations of environmental productivity throughout this century. The notion of 'sustainable utilisation' which usually involves the aim to identify resource use levels which can be maintained through time is, for example, directly related to assumptions of equilibrium and stability in the behaviour of biotic communities.

The essential requirements of the equilibrium model are:

- biotic communities are typically, or potentially ecologically saturated, i.e. all niches are filled;
- ecologically saturated communities maintain themselves in a characteristic stable and steady state;
- this stability is conferred by biotic processes within a resource limited environment (Wiens, 1984: 439).

As is discussed below, the model has a number of variations which allow for varying degrees of resilience in the face of disturbance.

Static equilibrium state

In this model, there is only one possible biotic equilibrium and, in the absence of disturbance, the community will remain in this static or stable and unchanging state through time. Such a static equilibrium can be graphically depicted as a single point or node representing the movement (or, in this case, the lack of it) of a trajectory in multi-dimensional phase space (Holling, 1973: 3).

In ecological theory, examples of such stable equilibria in grazing ecosystems would be the maximum stable biomass of ungrazed vegetation in the absence of herbivores, or the equilibrium level at which natural vegetation growth rate exactly balances the loss rate due to herbivory (Noy-Meir, 1975; May, 1977: 172). This assumes that rates of herbivory increase monotonically until saturation of the available biomass resource is reached such that the level of herbivory is only limited by forage availability.

Following disturbance a community at stable equilibrium would be expected to oscillate or fluctuate around the equilibrium state, the fluctuations decreasing in amplitude and frequency until the original steady state is resumed. Differing degrees of disturbance would be reflected in the size and amplitude of the oscillations and in the length of time between the initial disturbance and the return of the original equilibrium (Holling, 1973: 2). The dynamic behaviour of a multidimensional ecological community is thus seen as being always channeled towards a 'single valley' in a landscape of theoretically possible states (May, 1977: 471). This 'global attractor' represents the unique stable state which will arise in this system from any initial conditions and to which this system will settle following any disturbance. The role of historical contingency is relatively unimportant in determining the nature of a community's equilibrium because such systems will always return to their steady state (May, 1977).

Stable limit cycles
In this theoretical extension of the above scenario, oscillations within limits by the community are perceived as the norm. The community trajectory thus follows a stable limit cycle between two or more equilibrium points and, if disturbed from this cycle of oscillations, will return to this cycle in a manner similar to that described above. The stable limit cycle of such a dynamic equilibrium can be referred to as the 'domain of attraction' of a system (Holling, 1973: 3).

Coppock (1993) has proposed that such a stable limit cycle is exemplified by the range use patterns of semi-sedentary Borana pastoralists in south Ethiopia. Here, opportunistic settlements were traditionally maintained around a given well until the forage in the immediate vicinity of the well was depleted through grazing to the extent that cattle production fell and encroachment of woody species occurred around the settlement in response to reduced competition from herbaceous species. Such changes in range condition typically resulted in the abandonment of the site and the recovery of herbs at a rate faster than the recruitment of the woody population. Fires supported by the renewed abundance of herbaceous material further reduced the regeneration of woody vegetation. Eventually such sites were re-inhabited and this 60-100 year cycle of grazing-induced vegetation dynamics was resumed, the recovery period of used sites (or 'abused' in Coppock's words), typically allowing for the long-term stability of the system (Coppock, 1993: 51, 55). As Coppock states, this cycle of herbacous followed by woody dominance, and return to herbacous dominance, is consistent with the theoretical concept of equilibrium within a stable limit cycle.

Multiple stable equilibrium states
This model is the extreme in complexity of the biotic equilibrium perspective. It proposes that an ecological community may possess the inherent potential for more than one equilibrium state or domain of attraction. These are defined by distinct boundaries or 'escape thresholds' where two or more stable equilibria become possible (May, 1977: 471). In this case inclusion of the reality of both stabilizing and destabilizing forces means that the system may fluctuate around the equilibrium defining the limits of a single domain of attraction, but fluctuations beyond this will cause instability to occur. This may result in the system collapsing discontinuously into a new stable state or domain of attraction (cf. Holling, 1973: 5; Noy-Meir, 1975; May, 1977: 472; Walker and Noy-Meir, 1982: 556; Westoby *et al*, 1989; Fuls, 1991: 13, 1992a: 63, 1992b: 192). In this case, even if the cause of disturbance returns to its original low levels the ecological community will not return to its earlier stable state. A new stable state will thus persist until its maintaining factors are removed or it is subject to sufficient perturbation to exceed the limits of the new stable state. The state to which a community settles is thus influenced by initial conditions and random changes in controlling parameters, and historical contingency can, therefore, be very significant (Holling, 1973: 12; May, 1977: 471). As Holling (1973: 13) summarises, the essential point of these systems is that they are not globally stable but can have distinct equilibrium states.

A proposed example of these dynamics is the Serengeti-Mara woodland-grassland ecosystem (Dublin *et al*, 1990; Dublin, 1991). Here, the rapid dramatic decline of woodlands in the 1960s is considered to be caused by the increased incidence of fire following unusually high rainfall. The current stable grassland state is maintained through pressure from herbivory, primarily by elephants, with seedling mortality rate and the inhibition of seedling regeneration being higher than the rate of recruitment of trees into adult age classes (Dublin *et al*, 1990: 1147, 1149). Previous explanations of the decline of the Serengeti-Mara woodlands, as the perceived climatic climax vegetation, are framed in conventional concepts of Clementsian succession, focusing on the role of fire in both causing a gradual decline or retrogression in woodlands and maintaining the existing grasslands through arresting or halting the expected succession to woodlands. A grassland state, paralleling the current vegetation status of the Serengeti-Mara is known, however, to also have dominated this region in the latter part of the 19th century, prior to the drastic herbivore die-off which occurred due to rinderpest in the 1890s (Dublin *et al*, 1990: 1148; Dublin, 1991). It is now hypothesized that such dynamics represent transitions between alternative stable states; stable savanna woodlands may regenerate from grasslands through time in pulses of even-aged stands, if conditions exceed the boundaries of maintenance of the grassland state. In other words, the multiple stable states concept suggests that more than one set of conditions can result in a stable ecological community, but these communities are likely to be qualitatively different because they depend on initial conditions.

Stability

In the above models, stability refers to the ability of the system to either absorb disturbance without deflection from equilibrium, or to return to equilibrium following disturbance (Holling, 1973: 14; 1986: 296; Connell and Sousa, 1983: 790). In the latter case, the more rapid the return, the more 'resilient' the system is considered to be. 'Return time' is thus a measure of how long it takes for homeostatic forces to bring perturbations in species density back to 'equilibrium'(Pimm, 1984: 399; DeAngelis and Waterhouse, 1987: 6). Rapid or high return rates represent close tracking of environmental fluctuations whereas longer return times can be viewed as resistance to these fluctuations.

Management implications of equilibrium dynamics

As Holling (1986: 310) states, the overall implications of an 'equilibrium-centred view of constant nature' is the attempt to reduce variability through management. This allows the calculation of economic measures such as the maximum sustained yield of a particular resource, such that excess production can be harvested without damaging the population. Conversely, by being able to define a community stable state which is considered to be the 'norm' of a particular environment, it also allows the label 'degradation' to be attached to any process thought to deflect the biotic system away from its perceived norm.

Mathematical ecology: the theoretical basis for the maintenance of equilibrium theory

Theoretical ecology uses the language of mathematics to describe and make predictions concerning the behaviour of species populations and communities. Many situations are, for example, modeled using first-order difference and differential equations; these predict the population that would be expected at a stated future time given the existing population and a value for the driving parameters controlling population change. As pointed out by May (1976: 459), however, an inherent bias exists in such mathematical exercises towards finding 'constant equilibrium solutions' to such dynamical models, and to analysing the stability of these solutions in response to small disturbances (May, 1972: 413; Holling, 1973: 5). Until recently, the consequence of this bias towards linear causality has been the constraining of mathematical analyses to analytically tractable ecological interactions which are only representative of presumed equilibrium situations. This is true, for example, of the assumption of density-dependent population growth (DeAngelis and Waterhouse, 1987: 1).

Studies from the 1970s onwards of the nonlinear properties of such models, especially evident at small scales, have revealed a rich variety of behaviours coincident with multiple stable cycles and apparently random fluctuations, as well as the single stable equilibria represented by stable points or stable limit cycles (May, 1976: 459). They also indicate that, as the driving parameters are increased, any particular stable state is likely to occupy an increasingly narrow window of parameter values, i.e. stability at small scales becomes more and more unlikely (May, 1976: 462; Wolf, 1983: 82). The dynamical properties that have recently been emphasized in such equations iterate the fact that apparently random fluctuations in real populations may not reflect 'noise' in the data (May, 1976: 66). Instead, they may constitute the reality of populations in a non-deterministic world, buffeted by a multiplicity of species interactions and stochastic environmental effects.

Such theoretical developments in ecology have fueled the controversy between the role of predictable natural laws on the one hand, and accidents of initial conditions and perturbations on the other, in determining perceptions of 'normal' ecosystem behaviour (May, 1977: 471; Westoby *et al*, 1989: 268).

2.2.2 Non-equilibrium ecosystems: an alternative paradigm?
As Wiens (1984: 455) states, however, '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. Challenges to this theory are now being presented by theoretical ecologists working with the properties of mathematical models, field ecologists seeking to explain observations inconsistent with the equilibrium model, and development practitioners trying to understand the failure of projects, particularly in drylands, to respond to attempts to increase productivity. Recently discussions have revolved around the possibility that non-equilibrium and instability may characterise the behaviour of many ecosystems, the assumption of equilibrium dynamics in response to constant environments being largely the result of northern temperate zone (particularly temperate forest) experience (Holling, 1986: 313). In this view instability in models of ecological behaviour is introduced by stochastic perturbations and strong biotic feedbacks, both of which will be discussed in turn below (DeAngelis and Waterhouse, 1987: 3; Bush and Whittaker, 1991, 355, 1993: 456).

Abiotic environment
The theoretical discourse surrounding the analytical norm of an ecological equilibrium conventionally simplifies the abiotic context by assuming a constant physical environment. This fundamentally precludes the possibility of environmentally driven ecological interactions and behaviours (DeAngelis and Waterhouse, 1987: 1), other than as a component of 'abnormal' disturbance of the biotic system away from the 'norm' of its ecologically saturated equilibrium state. In reality, however, aperiodic and idiosyncratic variations in the abiotic environment occur at amplitudes and frequencies which preclude the stabilising effects of feedback control by the biotic system. A variety of unstable biotic fluctuations may characterise such systems, ranging in level from noise to high frequency and magnitude events (Ellis and Swift, 1988: 452). Deterministic population parameters are thus replaced by random fluctuations with

environmental events exceeding the return time to equilibrium of the biotic component of the system.

Such non-equilibrial features are usually 'shoehorned' into the assumption of ecological equilibria through, for example, explaining away environments where such behaviour occurs as 'atypical' (Wiens, 1984: 449). As shown in Table 1, Wiens proposes that communities be placed on a gradient encompassing the continuum between characteristically nonequilibrium and equilibrium communities based on both environmental and biotic factors.

Table 1. Some proposed features of non-equilibrium and equilibrium ecological communities.

non-equilibrium .... equilibrium	
biotic decoupling species independence unsaturated abiotic limitation density independence opportunism large stochastic effects loose patterns **controlled more by environmental variability**	biotic coupling competition saturated resource limitation density dependence optimality few stochastic effects tight patterns **structured primarily by biotic forces such as self-regulatory population growth and compensatory interactions**

Source: Wiens (1984: 451), De Angelis and Waterhouse (1987: 3).

Biotic instability

Ecological instability may also be caused by nonlinear feedbacks and timelags in interactions of biological species which have a tendency to form potentially unstable interactive communities (DeAngelis and Waterhouse, 1987: 1, 3). Such biotic interactions include positive feedbacks such as continual population growth and competitive exclusion by dominant species. These 'strong interactions' may theoretically act as the driving parameter which keeps populations and communities at disequilibrium. Mathematical models of interaction matrices, for example, indicate that high food web connectance combined with a high degree of interaction strength creates instability beyond a threshold point (May, 1972: 414). Conversely, a high degree of connectance remains stable if the interaction strength is weak and vice versa.

Persistence in the face of instability

An acceptance of the roles of environmental fluctuations and strong biotic feedback as the driving forces defining the dynamics of many ecosystems, implies that a shift in the focus of ecological observation and analysis is required. Instead of concentrating on the ability of systems to return to an inevitable (but not easily defined) equilibrium following perturbation (i.e. resilience), such a shift could, for example, include a focus on the mechanisms facilitating the persistence of transient systems at defined scales in the face of continual change (Holling, 1973: 1-2; Connell and Sousa, 1983: 791, 806; Ellis and Swift, 1988: 453). Persistence in this context can be defined as the ability of a system to absorb change and disturbance and still maintain the same qualitative relationships between populations. Holling (1973: 14) and Behnke and Scoones (1992: 18) refer to this capacity of systems as 'resilience', although this term is usually applied to their ability to return to equilibrium following perturbation. The term 'persistence' will thus be used here. The important point about such systems is that they can be persistent in the long-term at the same time as having very low inherent stability at smaller temporal and spatial scales.

It is likely that factors increasing the compensatory flexibility of biotic systems driven by environmental variability, combined with the adaptive life history strategies of many species inhabiting variable and extreme environments, are fundamental to the persistence of such systems. Species in such environments are thus unlikely to become extinct, even though their absolute year to year productivity and population size may be highly variable.

In terms of possible instability caused by biotic feedback interactions in relatively constant external environments, persistence of the biotic community is thought to be conferred the way that food webs are hierarchically organised (Holling, 1986: 309). If food webs are assumed to be randomly constructed then, as noted before, stability is possible only if high species connectance is associated with low interaction strength and vice versa (May, 1972: 314; Auerbach, 1984: 418-9). Otherwise, increasing complexity leads to increasing instability (May, 1973: 77). This contradicts earlier assumptions that an increase in system complexity in terms of both greater diversity and more interactions between species produced a corresponding increase in stability (cf. MacArthur, 1955; Elton, 1958; McNaughton, 1977). If, alternatively, connectedness in food webs is assumed to be organised and structured into subgroups or blocks characterised by higher interaction strength, then a greater degree of stability emerges in models of ecological communities (May, 1971: 59, 1972: 314; Auerbach, 1984: 416).

Management implications for ecological systems not at equilibrium

The dominant problem associated with the inclusion of non-equilibrium dynamics in ecological (and economic) models is that it dramatically reduces the possibility of prediction, and thus control, when dealing with such systems. For example, the calculations of measures such as maximum sustained yield which rely on the linear dynamics of equilibrium models, would have to be replaced by approaches which, through tracking variability, aim to maintain persistence of the qualitative relationships characterising the system (Shepherd and Caughley, 1987: 191: 217). The recognition of spatial and temporal heterogeneity, as encountered in the patch use of resources, will also have implications for the calculation of average potential use rates (Kellner and Bosch, 1992: 99). Components of such an approach to resource use management are, therefore, likely to include flexibility, the maintenance of heterogeneity, a holistic view of the system and a recognition that the incidence of unpredictable and unexpected events are inevitable rather than abnormal (Holling, 1973: 21, 1986; di Castri, 1986: 318).

2.2.3 A brief note regarding scale

Often overlooked in analyses of the behaviour of ecosystems is the importance of spatial and temporal scale, and the recognition that the delimitation of communities and populations through time and space affects conclusions concerning how they behave (Auerbach, 1984: 414-5). In particular, defined external perturbations may affect smaller scales, both spatial and temporal, more than larger ones, while biotic dynamics may also become increasingly non-linear as the scale shrinks. Increasing spatial and temporal scales of observation, on the other hand, may reveal a larger degree of system persistence (Connell and Sousa, 1983; 792; DeAngelis and Waterhouse, 1987: 2-3). The shortlived or transient 'patch dynamics' often observed at smaller scales may, for example, be crucial elements in the persistence of systems at larger scales (DeAngelis and Waterhouse, 1987: 2). Large-scale persistence can thus be seen as an emergent property of small-scale instability and variability. As Wiens (1984: 454) has stated:

> '... processes do not operate independently of scale in space and time. If the local populations and communities that we study are non-equilibrial, vary independently of one another, and are governed by a wide array of underlying processes (many of which may have a substantial stochastic element), then the dynamics of various local communities may well seem chaotic. Nonetheless, the summation of such a heterogenous collection into larger regional or biogeographical sets may produce apparent patterns in community structuring. These may well be artifacts of the summation structure.'

The recognition of the role of local disequilibrium and instability in maintaining the persistence of systems at larger scales has important implications regarding discussion of disturbance due to animal and human patch use of the environment. In particular, it brings into focus issues surrounding the often implied degradation of environments through human use of local resources. Unclear areas include, for example, the extent to which such impacts are irreversible given the ability of environmentally driven systems to persist in the face of stochastic perturbations, and the implications for larger scales of the use of resources at small, local scales.

2.2.4 Arid environments as non-equilibrium systems

Drylands have conventionally been subsumed within a 'temperate zone paradigm' (Shepherd and Caughley, 1987: 192) which focuses on the constancy of driving parameters, and is expressed by the tendency to use averages to describe climatological behaviour (Hulme, 1992: 685). Within a conceptual framework allowing a continuum between equilibrium and non-equilibrium systems, both at different spatial and temporal scales and with different driving parameters, recent discussion has, however, placed arid environments at the non-equilibrium end of the gradient (see, for example, Wiens, 1984; Ellis and Swift, 1988). Features of such environments are:

- precipitation is so low, and evapotranspiration so high, that solar energy flows, which make biological productivity possible, are ultimately constrained by the availability of moisture. Nutrient availability, therefore, does not act as the primary limiting factor at such low levels of rainfall (Noy-Meir, 1973: 26);
- primary productivity is thus driven by precipitation events such that a large amount of variability in biological production can be accounted for by a linear regression relationship with precipitation above a threshold level of moisture availability (see, for example, Walter, 1955; Blaisdell, 1958; Noy-Meir, 1973: 45; Wellard, 1987: 35, 49; Robertson, 1987: 50-68). By extrapolation through the food web, herbivory and carnivory are also controlled by the availability of water;
- because water has, to a large extent, the property of cascading through a defined system rather than being recycled within it, it is a 'periodically exhaustible resource' under these conditions

of low precipitation (Noy-Meir, 1973: 28). This means that once it has been exhausted from defined scales within the system it can only be replenished from outside these scales;
- precipitation occurs in discrete or discontinuous events which have a high degree of variability with regard to both occurrence in time and space and magnitude of event[1];
- this variability is largely random or unpredictable.

Such environments are thus driven by an inherently unpredictable abiotic force (rainfall) and, following the logic of above theoretical discussion, would not be expected, under such conditions, to exhibit stable equilibrium population or community dynamics. Shepherd and Caughley (1987: 194) in describing an arid sheep and kangaroo grazing system, for example, assert that where the Coefficient of Variation (CV) of annual rainfall is greater than 30% then the long-term performance of the system is better described in terms of its variability than by average values (see also Noy-Meir, 1973: 31).

Arid and semi-arid grassland, steppe and desert environments account for some 34% of the total land area of the planet compared with 22% and 16% temperate forest and tropical forest respectively (Wiens, 1984: 450), while savannas are stated to comprise approximately half of Africa's land surface (Cole, 1986: 1; Scholes + Walker, 1993: ix). The dynamics of these relatively under studied systems, therefore, have huge implications for what is accepted as the 'norm' in ecology.

Persistence of arid environments

Such systems, however, are remarkably robust, displaying persistence in a qualitative sense through time in the face of stochastic but recurrent destabilising events. As Behnke (1993: 2) asserts, 'these are ecological systems with a considerable capacity to absorb perturbation'. This 'global' persistence belies descriptions of arid systems as 'fragile' and on the 'brink of collapse' (Walker and Noy-Meir, 1982: 563; 583).

The long-term persistence of populations within these variable systems is conferred by a diversity of ingenious adaptations at the levels of ecological life-forms and growth-forms and biological species (see, for example, Walter, 1971: 242-93; Louw and Seely, 1982; Wellard, 1987; Ghazanfar, 1991; Dean *et al*, 1992; van Rooyen *et al*, 1992). In plants these adaptations tend to allow both the rapid productive response to discrete rainfall events, while maintaining the ability to capitalise on future opportunities for production and reproduction through investing in stress-resistant biomass reserves. Members of higher trophic levels utilise a variety of stategies based on the productivity patterns of the plant community (Baker, 1987: 76). These include, for example, the opportunistic use of spatially and temporally dispersed resources through mobility and migration, and the flexible feeding of both pulse and reserve components of the plant biomass (Noy-Meir, 1973: 31).

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, also increases the likelihood of randomness throughout all temporal and spatial scales

1Robertson (1987: 16-17) and Caughley *et al* (1987: 159), in a study of rainfall patterns of Australian sheep rangelands, found that they were characterised by a Coefficient of Variation of 47% over 100 years of records with a very weak serial correlation between successive years of rainfall (r=0.13), and 100% variability through space as measured by 39 rainguages distributed over 3km.

of such environments (Noy-Meir, 1993: 33, 35). This creates opportunities for diversity at different scales in terms of life history strategies and physiognomic adaptations. Futhermore, by increasing the availability of compensatory patches which can be utilised by mobile species, and by providing alternative sources of species which may become extinct at local scales, the effect of this randomness is to confer persistence of the system at large-scales.

Noy-Meir (1979/80) in his 'aut-ecological hypothesis' of the persistence of arid systems, therefore, suggests that the biotic community of such systems is structured more by particular responses by individual species to drought-induced stress than by interactions among species. The system, in other words, is characterised by low interaction strength and high flexibility in response to unstable abiotic conditions.

2.2.5 Implications of non-equilibrium for African pastoralist ecology

The conventional assumption regarding the underlying ecology of pastoralist systems in sub-Saharan Africa is that African rangelands are potentially stable and at equilibrium and that, by using average rainfall and primary productivity values, economic measures such as maximum sustainable yield can be calculated (le Houerou and Hoste, 1977). Such models tend to ignore the effects of key variables such as between-year variability, the significance of environmental patchiness, and the ability of herbivores to employ diet-switching strategies (Caughley, 1987: 160) or to lower Basal Metabolic Rate in stress periods (Western and Finch, 1986). Any perceived destabilisation or degradation of such systems is consequently explained as due to excessively strong biotic interactions resulting from maladaptive strategies of overstocking with livestock by irrational subsistence pastoralists (Herskovitz, 1926; Stebbings, 1935; Russell, 1977: vii; Pratt and Gwynne, 1977; Lamprey, 1983; Barrett, 1989: 1, 3).

This view exists despite the facts that production indices have often not fallen in areas asserted to be irreversibly degraded (see, for example, Homewood, 1993) and pastoralists have inhabited and persisted in these environments for millenia. Such persistence is typically explained within the equilibrium paradigm by the prevalence of either a patch-dynamic equilibrium or stable limit cycle such as that described for Borana pastoralists in South Ethiopia by Coppock (1993), or the existence of alternative stable states into which a pastoralist system may collapse following degradation. An example of this latter point could perhaps be the replacement of cattle by goats. Both explanations assume that range degradation must have occurred but that pastoralism was able to persist by taking advantage of alternative opportunities in the form of either unexploited environments or new stock species (Ellis and Swift, 1988: 451).

The assumption of inevitable destabilisation of the environment following range use by subsistence pastoralists lends itself logically to development interventions focussed on restoring equilibrium. As Pratt and Gwynne (1977: 67) state, 'once a framework for the development has been established, the objective in range management is to achieve an equilibrium between animal numbers, forage and water'. A constant and calculable level of productivity is thus defined by assuming a density-dependent relationship between livestock production and forage availability such that the destructive effects of herbivory are balanced with the recuperative power of plant biomass production at the stable subclimax which ensures the highest level of livestock production (Abel and Blaikie, 1990: 2; Behnke, 1993: 2). It is presumed, therefore, that potential biotic productivity is time-invariant and can be controlled through managment techniques which are seen as fine-tuning the biotic components of the system to maintain productivity at a given level (Ellis and Swift, 1988: 451-3; Behnke, 1993: 2). Management recommendations concerning the nature of environmental degradation in semi-arid and arid lands, usually revolve around destocking and privatisation. Destocking is advocated because fluctuations in range condition are perceived to be the result of destabilisation through overstocking. Privatisation is instituted because overstocking is considered to be due to a 'Tragedy of the Commons' (Hardin, 1968) situation in which individual herders using communal pastures can only benefit from increasing their own herd size, while sharing the costs of range degradation and reduced productivity with other herders (Abel and Blaikie, 1990: 2).

The recognised failure of these development interventions, despite the technical expertise of the development professionals involved, indicates, however, that they are grounded on invalid assumptions concerning the fundamental behaviour of semi-arid and arid systems. As pointed out by Sandford (1983), Ellis and Swift (1988), Westoby *et al* (1989), Abel and Blaikie (1990) and Behnke (1993), there is a need for a shift in the conventional view of drylands, especially towards the more arid extreme, that acknowledges the influence of non-equilibrium dynamics and unpredictability. For these environments this amounts to a recognition that rainfall is the driving abiotic force which causes such major variations in primary productivity that an ecologically saturated environment in which biotic interactions maintain a dynamic equilibrium cannot possibly develop (Ellis and Swift, 1988: 453; Eldridge *et al*, 1990: 510; Chambers and Norton, 1993: 262). In other words, rainfall fluctuations have a greater impact on vegetation than animal numbers (Behnke, 1993: 3). The development of destabilizing forces resulting from over-strong biotic interactions such as grazing-induced vegetation degradation, is, therefore, impossible. Persistence of human production systems in these environments is consequently likely to be facilitated through reinforcing, as opposed to dismissing, a diversity of opportunistic and long-term range resource use strategies based on traditional techniques of 'tracking' environmental productivity (Sandford, 1983: 38; Coughenour *et al*, 1985: 619-22, 1990: 147-58; Ellis and Swift, 1988: 457; Leslie and Fry, 1989; Galvin, 1990: 212, 215; Westoby *et al*, 1989; Behnke and Scoones, 1992; Behnke, 1993: 3; Ellis *et al*, 1993: 40).

2.3 Ecology of resource use by Damara herders: some broad objectives and hypotheses

The objectives of the current project are to assess:

- the relative significance of arid land gathered plant resources to the livelihoods of rural Damara;
- the effects of such use on the local resource base.

These aims are structured by the following provisional hypotheses which have been influenced by, and formulated within, the conceptual framework described above.

1. The region in question is characterised by non-equilibrium dynamics. This is due to its great aridity and consequent variability of precipitation events through time and space.

2. Rural inhabitants subject to this fluctuating environment will employ various coping strategies to ameliorate unpredictable variations in potential productivity. One of these will be the use of gathered wild resources, especially products of perennial species, to offset shortages in dry periods.

3. Within the Damaraland area, fluctuating access to alternative forms of subsistence and

income will affect people's use of gathered plant resources at both the settlement and household level. More 'wealthy' households, for example, are likely to have a lower dependence on gathered resources.

4. The effects of the use of gathered plant resources on the local resource base will perhaps be noticeable in perennial woody species but will not be evident in annual/ephemeral herbaceous species. This is because the life history strategy of the latter involves a short 'pulse' of vegetative biomass production in response to rainfall, followed by long 'reserve' periods where species are only present in the form of seeds. Rainfall is thus the primary determinant of presence or absence of such species in their herbaceous form. Woody perennial species, on the other hand, may be affected by humans and livestock through removal or partial use. Such effects may be noticeable in the form of measures such as stem density, species composition and tree size. If measurable effects such as these are found then further criteria will need to be developed to decide whether or not they constitute long-term degradation.

5. A recognition of the importance of scale implies that the measured impact of local or patch use of perennial plant resources may not have any noticeable impact when the scale of observation and analysis is widened. Conclusions concerning the significance of observable resource use impacts on indigenous vegetation will, therefore, be scale-dependent.

3.0 Background

This will consist of two broad foci, namely an analysis of existing ethnography of the Damara and their portrayal in the historical and archaeological record, and an overview of the physical environment of the study area. The former is presented in some detail for, as will become clear, assumptions derived from early records of the Damara have far-reaching implications for the way that current subsistence patterns and practices are interpreted.

3.1.1 The Damara in historical times

The first recorded European observation of the people now known 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 as the Damaraland communal area.

At this time, the main locations of the Khoisan-speaking Damara are stated as the Auas, Erongo and Otavi mountain ranges and the Brandberg Massif. This resulted in their name the Berg- or !Hom- (i.e. Afrikaans or Nama for mountain) Damara (Vedder, 1928: 39). These prefixes also served to distinguish them from the OvaHerero who were known as cattle or gomaxa-Damara (Kamacha-Daman in Hahn, 1928: 220). 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. Similarly the Damara called themselves the ≠Nu-Khoen (Haukhoin in Hahn, 1928: 220) meaning 'black or real people', a term whose validity is still recognised by Damara today (cf. !Ganuses, 1994, pers. comm.) In terms of subsistence, they are described in the late 1800s as relying almost exclusively on gathering 'fruits of the veld', 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 earlier territory or subsistence practices of the Damara. Rather, habitation of remote and marginal areas was probably the result of recent historical circumstances in the form of violent and systematic persecution by the newly arrived OvaHerero who entered Kaokoland *c*1550 (Malan, 1973: 83), some moving further south in the 1700s (Malan, 1974: 114), and expanding Nama cattle herders, the latter with firearms gained through trade with settlers in the Cape (Hahn, 1928: 220; Vedder, 1928: 39; Knappert, 1981: 73, Lau, 1987: 18; Dierks, 1992: 37). It is stated in the historical literature 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 Fuller (1993: 11), however, interpretations of such 'missionary-ethnography' need to be made with care in the light of motives of colonial agents to amplify existing tensions among indigenous groups. Related to this and with greater locally disrupting effects, was the chronic warfare which developed between various alliances of well-armed Oorlam Afrikaner commandos (linked through trade to European Cape settlers), and Nama and Herero pastoralists throughout Namaland and Damaraland during the 18th and 19th centuries, as recorded by the early travellers Galton (1852) and Andersson (1856) (Hahn, 1928: 218; Schmidt, 1986: 330; Dierks, 1992: 40).

Prior to their apparent retreat to the region's mountainous areas, it is thought that the Damara occupied much of both Namaland and the old territory in central and northern Namibia known as Hereroland. 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, and it is likely that they practised herding for subsistence to varying extents, thus providing a rationale for observed raiding of later wealthier plains herders from their mountain hideouts (Hahn, 1928: 221). 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). Kinahan (1990: 25-6, 40) also describes 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 represented but again it is likely that Damara inhabiting the region were incorporated within and affected by such pastoralist and trading networks.

Apart from the impact of Nama and Herero incursions into areas previously inhabited by the Damara, they have in historical times been influenced, both indirectly and directly, by European factors over a long period of time, culminating in the profound transformation of life affecting all Namibians in the post-1915 colonial era (Lau, 1987: 1). European exploration of the Namib coastline occurred from the 15th century onwards and is documented as tapping into the existing regional livestock exchange network (Kinahan, 1986: 116) to gain livestock for provisions. These transactions had a profound impact on the regional livestock economy by essentially exchanging productive subsistence resources for unproductive but high-value goods such as beads, tobacco and iron products, and thus contributed 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) also affected much of Namibia and Botswana, the parameters of which were set by European markets. As documented elsewhere, this had a deep impact on indigenous populations through distorting existing power differences (Wilmsen, 1989).

In the late 1800s, the direct impact of European contact with the Damara began to be felt. Initially, this took the form of missionary activities, the Rhenish Mission acting as protectors of the Damara from their subjugation by the Nama and Herero and 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). Such missionary activities were a precursor to the establishment of German colonial rule in 1884 which relied on the forming 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 traditional rivalries and facilitated the seizure of productive resources (land and livestock) of groups that did not pledge allegiance to the new administration. The consequent erosion of people's ability to produce for subsistence was exacerbated by the establishment and enforcement of game laws at the turn of the century, together with district laws forbidding the collecting of veld foods (Vedder, 1928: 77). In other words, Damara dependence on the alternative subsistence opportunities offered by the settled reserves established by the Rhenish mission was enforced by the actions of the colonial government.

The resulting escalating resistance to these facets of German rule ultimately led to the so-called German-Herero war in 1904-7, in which the Herero population was reduced from an estimated 80,000 to approximately 20,000 (Dierks, 1992: 67) through systematic extermination and the emigration of remaining groups to Ngamiland in Botswana. These events, coupled with reduction of Nama power (who were reduced from 20,000 to less than 10,000), are portrayed as signifying an emphatic end to earlier subjugation by these groups of the Damara who, it is claimed, chose not to join the Herero against the German authorities who had acted as their protectors (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 and in many ways this conflict begs reinterpretation as a German-Namibian war (Union of South Africa, 1918: 35, in Fuller, 1993: 16).

As a consequence then of persecution and widespread political upheavals, coupled with introduced disease, rinderpest and the forbidding of ownership of cattle by the German government, 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 how they have been portrayed and treated throughout this century. They are, for example, considered as 'culturally hunter-gatherers' (Buttner, 1879: 288-9; Hoernle, 1923: 22; Köhler, 1959: 33, 56; Knappert, 1981: 71) in a way that implies that they have practised an unchanging mode of subsistence that has been little affected by historical events over the last 3-4 centuries. Several strands of historical evidence beg the reinterpretation of Damara subsistence norms: first, it is apparent that they occupied a much wider territory and have been marginalised in the recent past to less productive areas; second, there are early historical observations of large herds of livestock (including cattle belonging to the Bergdamara cf. Irle, 1906: 154-7 in Wilmsen, 1989: 94) 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; and third, 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), is anomalous with their portrayal as primitive hunters and foragers. Given that herding, foraging and hunting can all be adaptive strategies under similar 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 combination (see, for example, Yellen, 1984: 59; Bion Griffen, 1984; 115-7), or that transitions could not be made in both directions between herding and hunting.

3.1.2 Origin and racial affinities

Explanations in the historical literature regarding the origin of the Damara and their relationships to other groups remain largely conjectural. Early oral tradition asserted that they inhabited Namibia prior to the Herero immigration ca. 1500 and it is thought by some authors that they are the aboriginal inhabitants of Namibia (Vedder, 1928: 40). It is also believed that they were subjugated by Nama herders who entered Namibia at a later date and from whom they acquired their Khoekhoe language. Vedder (1928: 41), however, proposes an alternative explanation, suggesting that the Damara are descendants of negro servants accumulated by the original North African Hamites which moved southwards with their livestock and became the Khoekhoen herding populations of southern Africa. The linguistic evidence he cites in support of this hypothesis is the fact that no remnants of an original Damara language exist even in inaccessible areas, together with the existence of loan words in Damara which apparently derive from Sudanese languages (see also Malan, 1980). Apart from the rather spurious evidence (Barnard, 1992: 202), such an explanation seems unlikely given the lack of such a distinct servant people in association with any of the other Khoekhoen groups known historically throughout the subcontinent. Lau (1987: 4), on the other hand, has proposed that contemporary Damara and Nama are derived from descendants of an early Khoekhoen migration into Namibia from a core area around northern Botswana and for some reason evolved distinct characteristics and skills not shared by the larger body of Nama.

With regard to racial affinities, while Vedder (1928: 40) states that the apparently varied features of the Damara indicate that they 'can hardly be considered a pure race', recent biological evidence suggests that they are relatively racially distinct, despite their long history of contact with other ethnic groups. Genetic distance analyses of relationships within southern African groups have produced different classifications based on different distance linkages between populations: minimum distance linkages indicate that the Damara are more closely related to Bantu-speaking populations than Khoisan-speaking groups, while maximum linkages separate !Kung groups from Bantu-and Nama-speaking populations and classify Damara and Sesfontein Nama as the Nama-speaking groups most closely related to Bantu-speakers (Harpending and Jenkins, 1973: 185) Recent comparisons of levels of a single blood protein polymorphism in southern African groups (Morris, 1990), as well as multivariate and cluster analyses of anthropometric measures have indicated that the Damara have remained physically distinct from both Bantu-and Khoisan-speaking groups (Hitzeroth, 1976b: 219, 221). Linguistic evidence is suggestive of closer relationships with the non-Bantu speaking negroid Kwâdi of south-west Angola (also known as the Kuroka, Kwêpe or Kwakwa) (Hitzeroth, 1976a: 190; Barnard, 1992: 25), or to the pure Tjimba of the Baynes Mountain area of Kaokoland who spoke a Herero language in recent times (Malan, 1974: 116), but these hypotheses remain unconfirmed.

3.1.3 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; Kinahan, 1991). Its significance as a subsistence strategy 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 above, was encountered by European settlers in the region during the 18th century (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 are based on the assumption of an immigrant pastoralist society which displaces aboriginal hunter-gatherers, of which populations such as the San, and in this case the Damara, are seen as being remnants (Kinahan, 1991: 9). As Kinahan states (1991: 18), there is in such analyses an 'implicit denial of change other than in the form of ethnic or racial migrations', so that ethnicity, and associated subsistence practices and material culture, are 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) assemblages of artefacts are normally seen as having distinct 'ethnic' signatures such that the former is considered representative of a prepottery (c5000BP) lithic tradition associated with hunting and gathering and the latter, with its stone circle huts, pottery and metal tools, attributed to recent (c500BP) incoming herders (Rudner, 1957: 32-3; Viereck, 1967: 18-9; Kinahan, 1991: 17).

As Jacobson (1976) has stated, however, these assemblages may not be as distinct as was once thought. Kinahan (1991;1983: 96), has thus argued for a reinterpretation of the archaeological evidence that allows for more gradual innovation through diffusion of movable property (such as livestock) and changing social relations which permitted the accumulation of property in domestic livestock. Prehistoric societies 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 thus evolves through the transformation of the social relations of hunting and gathering, 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 with the use of pottery for the collection, storage and cooking of gathered grass and *Monsonia* seeds and of !nara (*Acanthosciyos horridus*) in coastal sites (Kinahan, 1991: 116). Sites in different locations and with different assemblages can thus be attributed to the same group of people, and often to habitation by a group at different times of the year in response to seasonally available resources (Kinahan, 1991). Wadley (1979), for example, describes the latter pattern of resource use in an analysis of edible food plant remains found in both upland and river valley sites in the Erongo mountain area inland of the Namib desert.

While it is recognised that enormous problems exist with associating modern groups with archaeological assemblages, several strands of evidence indicate some continuity between both historical accounts and contemporary observations of the Damara, and the archaeological record. For example, although the Damara do not practise pottery today, a fact which may be used to indicate stability of a 'pure hunter-gatherer' population, evidence exists that suggests a long-standing and widespread pottery-making tradition throughout the Damara. Du Pisani and Jacobson (1985: 109), for example, 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 special sites in the region.

The archaeological evidence concerning subsistence patterns in the region also reflect elements of contemporary resource use by rural Damara and is suggestive of continuity in local knowledge of the area's natural resource base (Wadley, 1979; Kinahan, 1990). The suite of gathered plant food resources documented in this study and historical records of such resource use are, for example, reflected in the suite of plant remains found in local archaeological sites.

3.1.4 Discussion: Damara subsistence in history and prehistory

I have presented a review of the literature relating to the Damara in some detail in the belief that it is advisable to understand how current assumptions regarding their subsistence practices are related to how they have been represented in these documents. It is clear from this review that some controversy exists over the nature of the Damara 'mode of subsistence'. Both the historical ethnography and contemporary literature describe the Damara as essentially hunter-gatherers, aspiring in recent times to keep livestock but not able to become as successful as other herders. Such assertions, on the other hand, do not fit the earlier observations of so-called Bergdamara with large herds of cattle and with a material culture normally associated with pastoralism, or the archaeological evidence for herding throughout the region associated with

Damara inhabitance for a long period of time. Obviously, the questions of whether it is assumed that the Damara are 'culturally hunter-gatherers' or 'culturally herders' , or whether these are valid categories at all, are extremely important in shaping the questions asked in this study about Damara resource use and subsistence. At this stage, the following interpretations will act as a guide for issues confronted by the project:

- it is perhaps more appropriate to think in terms of a continuum between herding and hunting and gathering rather than a strict dichotomy between two modes of subsistence. Thus, particularly in an arid environment where flexibility is essential for survival, it may be considered adaptive to employ varying combinations of all three depending on fluctuating environmental and economic circumstances;
- the existence of regional exchange networks for centuries could perhaps be seen as providing a means for the acquisition of livestock following periodic losses and dependence on hunting and foraging;
- the representation of Damara as an isolated hunter-gatherer group is a direct result of recent historical processes which served to marginalise them, and does not reflect their ability to maximise varying productive opportunities within a dynamic environment.

3.2 Environmental background

The study region corresponds broadly with the old communal area of Damaraland of north-west Namibia, which is today split into the new administrative regions of Kunene in the north and Omaruru in the south (Map 1).

3.2.1 Climate

The study area lies between the 150mm and 50mm isohyets. low annual rainfall, combined with high incoming solar radiation values (Damaraland = ±140-160x10^5 $Jm^{-2}day^{-1}$ in winter and ±240-260x10^5 $Jm^{-2}day^{-1}$ in summer (Schulze and McGee, 1978: 23)) and consequently high evapotranspiration rates (estimated as between 2800 - 3000mm^{a-1} per annum for the Sesfontein Basin (Infoscience, 1994: 8)), is, therefore, the most important constraint on overall productivity. The temperature regime is characterised by high diurnal and annual variation, reaching a summer day-time maximum of 22.5-27.5°C and a winter and night-time minimum of 7.5-10°C (Schulze and McGee, 1978: 28).

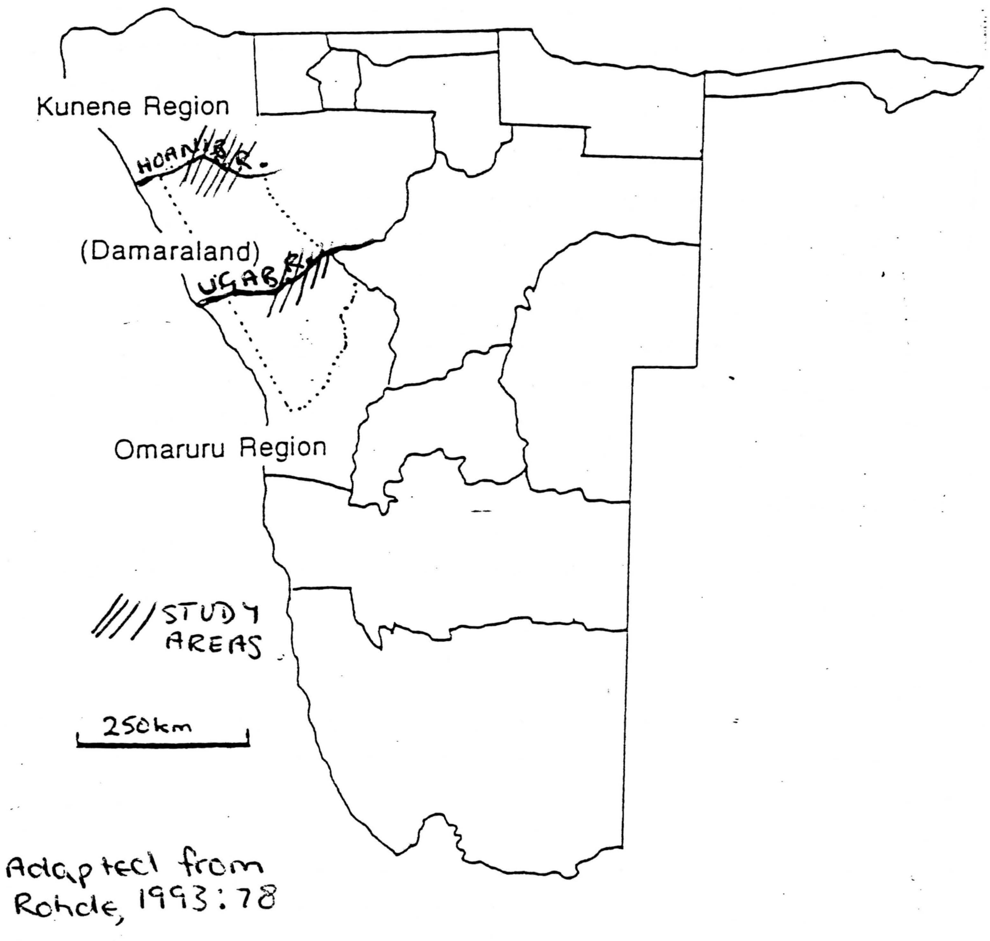
Normally associated with such low absolute amounts of rainfall is an extremely high degree of unpredictable temporal and spatial variability. Time series rainfall data from 1899-1980 for Fransfontein (20°13'S 15°1'E) and from 1970-1977 for Grootberg (19°47'S 14°22'E) have, for example, Coefficients of Variation[2] of 45.98% and 30.08% respectively and coefficients for settlements in the more arid west of the region are much higher (71.24% for Sesfontein, 19°8'S 13°39'E, data from 1902-1913 and 1957-1986, and 67.79% for Uis Mine, 21°15'S 14°45'E, data from 1935-1940 and 1967-1980; rainfall data for these locations are presented in more detail in section 4.1.3 on study sites)[3]. Following Noy-Meir (1973), Caughley (1987) and Ellis *et al*, 1993: 35), these coefficients suggest that the environment of the Damaraland area is better described by its variability than its average values.

---

[2]i.e. the standard deviation expressed as a percentage of the mean (Caughley, 1987: 1, 159).

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

Map 1. Namibia, showing the new Kunene and Omaruru regions and the old communal area of Damaraland.



3.2.2 Topography and morphology
The region can be divided into two morphological zones; the Central Hereroland Plateau or Interior Highlands in the east and the Transitional or Pro-Namib Plains, which merge into the Namib Coastal Plain, in the west (Mabbutt, 1952: 335-7; du Pisani, 1978: 3; Malan and Owen-Smith, 1974: 134). Broadly speaking, the study sites are situated on the western edge of the Transitional Plains. Soils are generally shallow and weakly developed calcareous soils characteristic of arid areas with soils derived from igneous rocks in the escarpment area, halomorphic soils in the west and alluvial sands and loams in low-lying river basin areas (von Harmse, 1978: 74-5).

Several large perennial rivers traverse these morphological regions. In the upland areas of the central plateau they form deeply incised valley systems while in the transitional plains area they cross flat plains of alluvial sands (Malan and Owen-Smith, 1974: 134, 136; Hall-Martin *et al*, 1988: 9). These river beds, where the water table is closer to the surface than elsewhere, form 'lifelines' for animal and human existence by extending the range of plant species normally typical of higher rainfall areas (Walter, 1971: 364; Hall-Martin *et al*, 1988: 17; Viljoen and Bothma, 1990: 86; Loutit, 1991). Both past and present settlements within the region are, therefore, often located on dry riverbeds which provide important sources of subterranean water and thus ameliorate to some extent the overall variability in primary productivity associated with arid environments. Within these river beds, springs forming linear oases may also provide permanent surface water thus forming foci for human settlement and livestock grazing.

3.2.3 Vegetation
Floristically the area is normally considered as part of the Karoo-Namib biogeographic Region (Werger, 1978: 145-70, 1986; White, 1983). It is, however, floristically highly individual having many taxa of the Sudano-Zambezian Region present, particularly along wider river valleys, alongside the largely succulent life-forms of the Karoo-Namib Regions (Werger, 1978: 234). Jürgens (1991: 21, 30-32) has thus redefined the area as the 'Damaraland-Kaokoland Domain' within his Nama-Karoo Region. Characteristic species include *Euphorbia virosa*, *Maerua schinzii*, *Boscia foetida*, and *Moringa ovalifolia*, while the numerous endemic elements include *Sesamothamnus guerichii*, *Acacia robynsiana*, *Commiphora giessii* and *C. krauseliana* (Jürgens, 1991: 32).

Giess (1971: 9-10) describes the area as containing many species characteristic of the northern extension of the 'semi-desert and savanna transition' zone within Namibia including two *Acacia* species only found in this vegetation type, *A. montis-usti* and *A. robynsiana*, and common *Acacias* being *A. senegal* var. *rostrata* and *A. tortilis* subsp. *heteracantha*. Other common species include various *Commiphora* species and *Colophospermum mopane* (Giess and Tinley, 1968: 251-2), the latter, with its relatively shallow root system, able to compete in areas where moisture accumulates at shallow depth (Cole, 1986: 116).

Overall, the vegetation area of the area can be described as extremely varied in structure physiognomy, and species distribution, thus reflecting diverse topographic factors.
Habitats include, for example, patches of evergreen and deciduous woodlands, particularly along watercourses, deciduous and evergreen thickets and open shrublands, open steppe-like and ephemeral plains grasslands, and pro-Namib *Commiphora* shrublands (Werger, 1978: 243). Life-form adaptations to aridity and strong desiccating winds also add to this diversity (Walter, 1971).

3.2.4 Conservation value
The area 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*). These and other animal wildlife species depend on the west-flowing ephemeral rivers throughout the region for food, water and cover (Loutit, 1991: 138), and conflict between wildlife and human populations in these river catchments is an important conservation issue. The recently proposed IUCN land-use zones for the old communal areas of Kaokoland and Damaraland attempt to incorporate the importance of these river catchment areas within an overall land-use plan which designates zones according to types of natural resource use considered commensurate with wildlife (Loutit, 1991: 136). The presence of many endemic plant taxa, as described above, also adds to the region's conservation value.

3.2.5 Discussion of environmental context

Broadly speaking, the study environment is driven by unpredictable temporal and spatial variability in rainfall which operates differentially through space in response to geographical heterogeneity. Under such conditions, and as observed for arid lands and pastoral production systems elsewhere, large fluctuations in primary productivity and herbivory, livestock dynamics, and human-herd dynamics are likely to be the norm rather than the exception (see for, example, Coughenour *et al*, 1985, 1990; Caughley, 1987; Ellis and Swift, 1988; Galvin, 1990; Ellis *et al*, 1993). This apparent instability is, however, coupled with remarkable long-term persistence in these production systems which, as discussed in section 2, would belie the description of arid lands as 'fragile' and 'on the brink of collapse'.

In the context of the current study, and despite the inherent environmental variability described above, the Damaraland area is typically perceived as suffering from widespread degradation, particularly due to overstocking and consequent overgrazing by livestock. Even as long ago as 1786, the explorer Thompson wrote that 'some people who have before visited a part of Caffraria[4] have said that it appeared to them to have been a country worn out by time, and had once been fruitful' (in Kinahan, 1990: 44). More recently, Van Warmelo, describing Sesfontein and environs in 1951 stated that,

> '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 ...' (1962: 39).

He therefore exhorted that 'overstocking ... must be avoided like the plague ... through careful supervision of stock and population' (Van Warmelo, 1962: 35). Thirty years later, the spectre of overgrazing has apparently not left us. A recent report concerning the development and conservation potential of the Sesfontein/Khowarib Basin states, for example, that 'eventually the whole ecosystem will suffer severely and collapse' if current stocking regimes continue and are supported through an increase in artificial water supply (Infoscience, 1994: 22).

At present, such assertions remain inconclusive, however, because they lack the following components of analysis:

a. a clear theoretical framework guiding assumptions concerning what are considered to be the normal ecological dynamics of this environment;

b. the absence of data measuring degradation processes;

c. the absence of detailed information concerning resource use and subsistence strategies by families within this environment.

This then, is the contemporary regional context of environmental issues within which the present study will be carried out.

---

[4]An early name describing the region known today as north-west Namibia and south-west Angola.

4.0 Pilot study (April-June 1994): initial data collection and results

4.1.1 Objectives

1. to select study sites for the main period of fieldwork;
2. to collect initial socio-economic and cultural data to ascertain the range of subsistence activities and sources of wealth available to households and individuals, broad features of household composition, and issues of resource use preferences;
3. to establish broad patterns of gathered plant resource use by households;
4. to begin to develop a botanical and ethnotaxonomical knowledge of the local resource base;
5. to situate local issues of resource use within wider contexts with regard to regional and national policy and planning initiatives.

4.1.2 Definitions

For the purposes of this study the following definitions are assumed:

Gathered products

The useful parts of plant species which are assumed to be essentially unimproved by human selection, and for which human labour is invested in collection and preparation and not in their actual production.

Household

It is recognised that there are numerous problems associated with the choice of satisfactory units of observation for any study. These problems have two components:

- the choice of the scale of observation appropriate for the objectives of the study;
- the accurate definition of the chosen unit.

For this study, household is defined as the group of people, generally related by kin, who normally eat together. Such a definition is complicated however, by the fact that households may be part of larger homestead groupings comprised of kin and their dependents, and, particularly within more wealthy families in this study, family members may be distributed between core settlements and satellite farms. It is thus very difficult to come to a satisfactory definition of the most appropriate 'household' unit for resource use observation and analysis. Particular problems include, for example, the movement of people and resources between both households (in terms of groups of individuals that normally eat together) in family groups, and between satellite farms and permanent settlements. These complications are likely to be reduced, however, in more impoverished households which are not part of family herding collectives and, with no or little livestock, are unable to support satellite farms. For the present objective of identifying significant factors in resource throughput, however, the former unit is considered appropriate for observational and analytical purposes. The dynamics of kin interactions and the movement of resources between family groups will be included as one of these factors of resource use for a core family group.

4.1.3 Selection of study sites

The importance of the westward flowing ephemeral rivers in this region for land and resource use by humans, livestock and wildlife, and the relevance of using river catchment areas as appropriate units of land use analysis (Loutit, 1991; Jacobson, 1994, pers. comm.), has provided the basis on which study sites have been selected. Settlements on two of these river systems, the Hoanib and the Ugab (see map 1), will thus provide the focus for household data collection, while the collection of data for the vegetation component of the project will take place within broader resource-use areas around these settlements. Broadly speaking, both study areas occur between the 150mm^{a-1} and 50mm^{a-1} isohyets, and are therefore subjected to similar levels of variability in terms of rainfall and, by extrapolation, primary productivity. Monthly and annual rainfall patterns for these sites are presented graphically in Fig 1a and b for Sesfontein and Fig 2a and b for Uis Mine near the Ugab river settlements.

Fig 1a Sesfontein annual rainfall
variability, 1901-1914 and 1957-1980

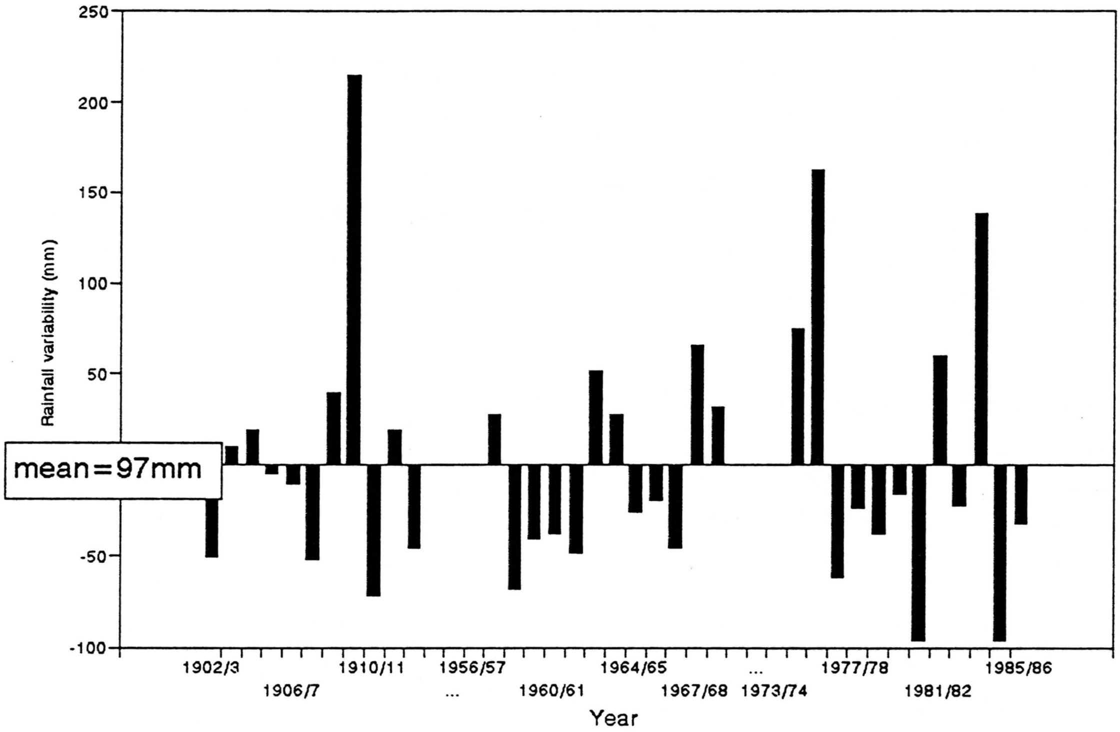


Fig 1b Sesfontein monthly rainfall,
Data from 1901-1914 and 1957-1980

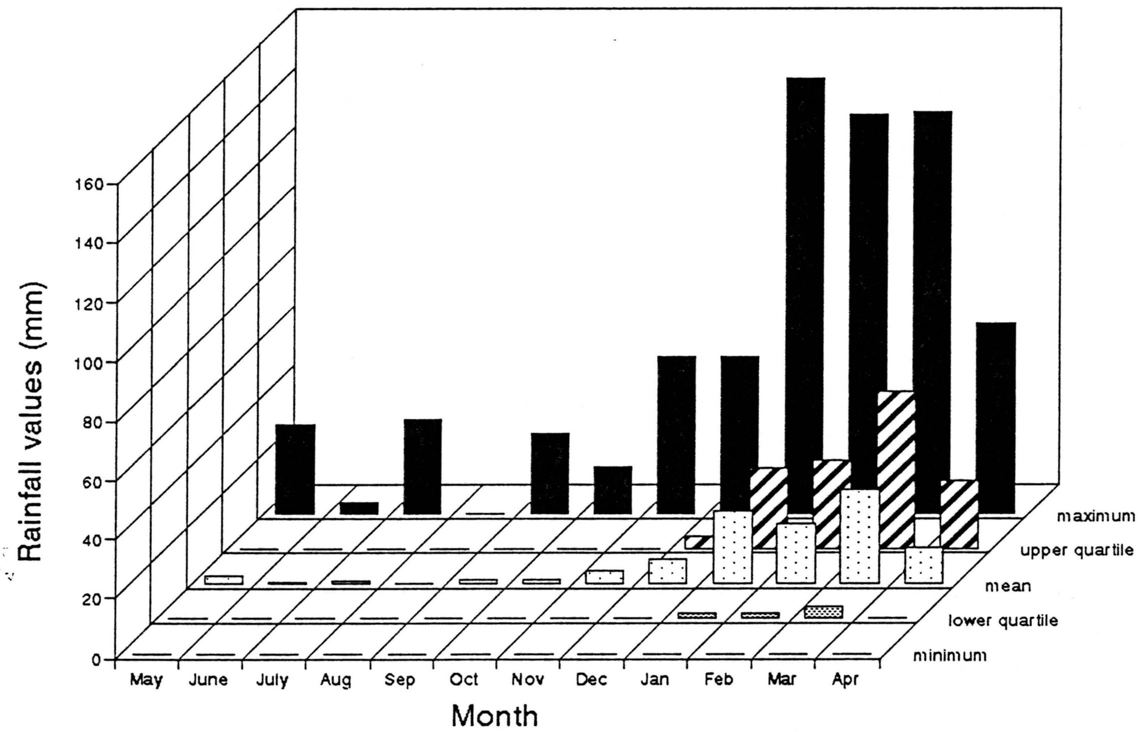


Fig 2a Uis annual rainfall variability

1935-1942 and 1966-1980

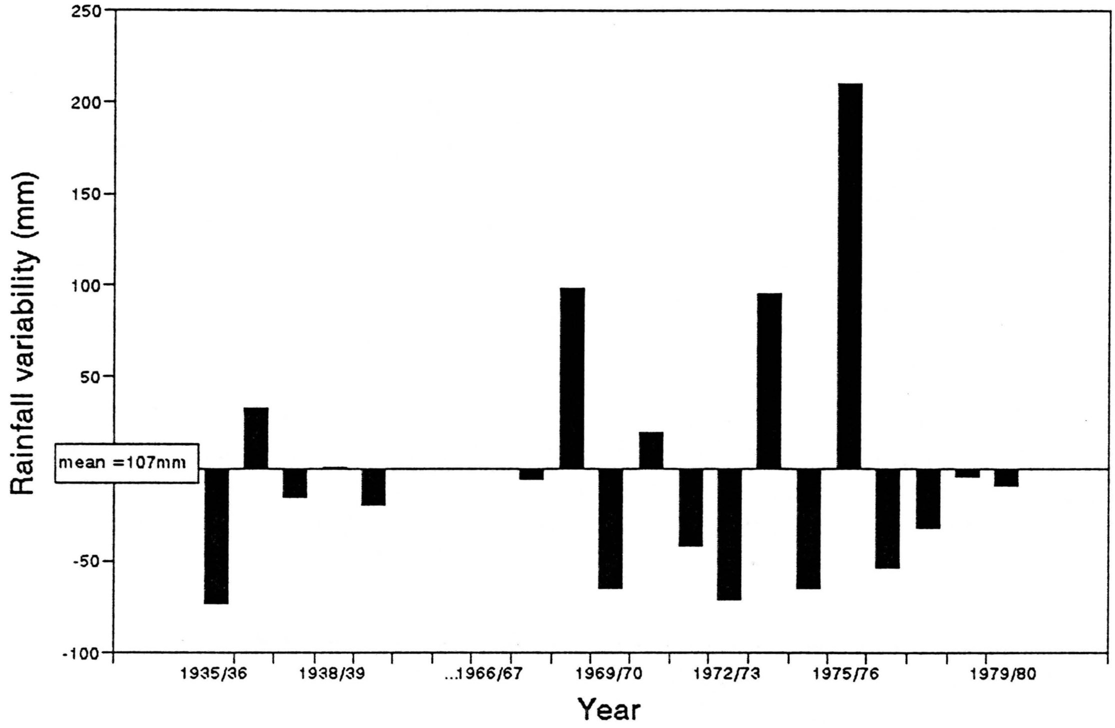
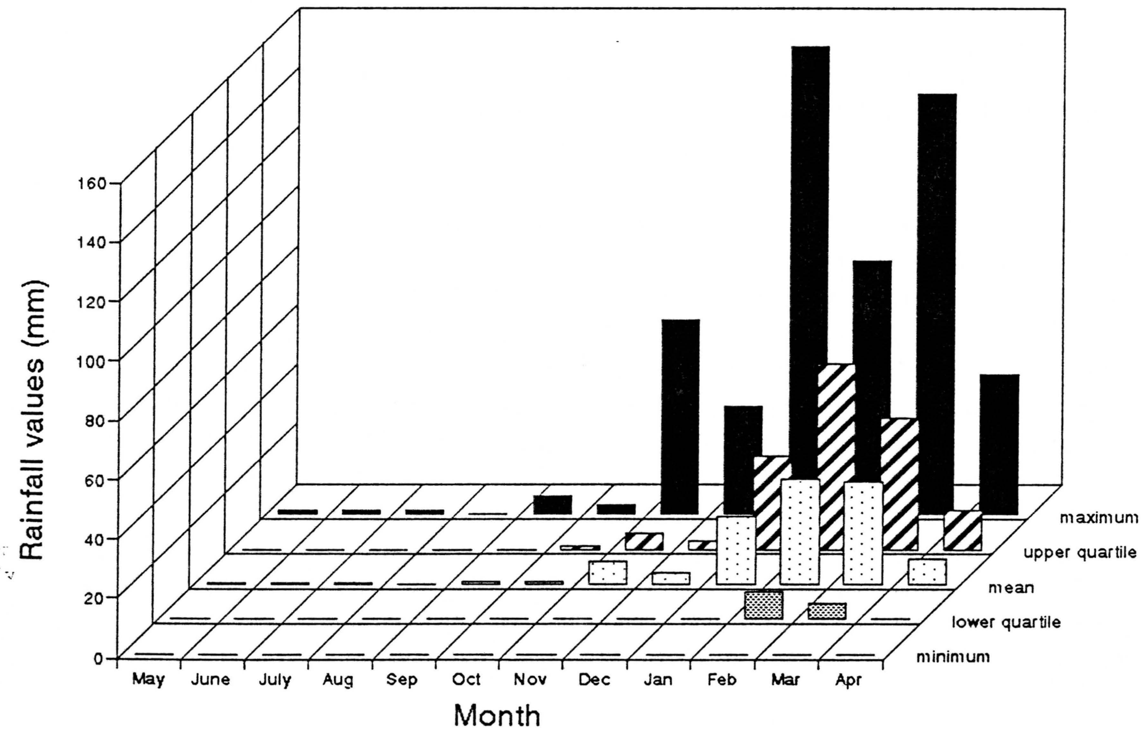


Fig 2b Uis monthly rainfall,

data from 1935-1942 and 1966-1980



The focal settlements will be Sesfontein and associated settlements on the Hoanib river, and the cluster of settlements on the Ugab east of the Brandberg Massif to Ani≠gab. Following Loutit (1991: 136), the former study site is located within the proposed IUCN land-use zone named 'resource reserve' which would 'provide protection for currently unprotected land in which only indigenous people may exploit the natural resources'. The latter site occurs within the zones named 'natural resource management area' and 'natural biotic area or anthropological reserve' designated for the north and south of the Ugab river respectively. The former refers to 'critical regions' in which management aimed at preserving endangered species may be considered crucial, while the latter refers to a conserved natural area in which humans are an important component. The history of these two areas is presented below.

Sesfontein

Sesfontein, with its 6 permanent springs and strategic location, has played a prominent part in the turbulent history of this region over the last 150 years, and is likely to have been a focus for human habitation and natural resource use for millennia. Some understanding of its (poorly) documented history is necessary for situating current resource use issues and potential sources of conflict.

In an extension of the general subordination of the Herero by the Oorlam leader Jonker Afrikaner throughout the 1800s, separate migrations of ‖Khau-/gôan or Swartbooi (‖ kou-/gõan in Van Warmelo, 1962: 41) and !Gomén or Topnaar (!oman in Van Warmelo, 1962: 41) Nama with firearms established bases here and at Gowareb (Khowarib) 30kms south of Sesfontein between 1850-70. From here they systematically raided livestock from the dispersed and nomadic ovaHimba of Kaokoland (Malan, 1973: 83; 1974: 114; Hitzeroth, 1976: 188). This caused the impoverishment of the latter group which, coupled with the effects of the rinderpest epidemic in 1896-7 and the German Herero war in 1904-7, led to their migration into Angola where they allied themselves with Ngambwe pastoralists. At the same time these activities appear to have displaced the Damara inhabiting the general area, many of whom were reputedly forced to work for the Nama groups in Sesfontein.

In 1902 a German military base was established in Sesfontein and around this time a circle of land covering a radius of 10kms from the Sesfontein springs was granted by the German colonial government to the Topnaar and Swartbooi Namas (Van Warmelo, 1962: 4). This was confirmed as a Native Reserve in 1923 by the South West African administration.

The gardens in Sesfontein were established at the end of the 19th century with irrigation and cultivation techniques reputedly brought 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 Namidaman from the region around Sesfontein and their inheritance of these gardens following the withdrawal of German colonists after World War 1, together with subsequent influxes of Damara groups, increased the ethnic and economic standing of Damara people within the Sesfontein (Fuller, 1993: 69).

During the early part of this century, the leadership and power of the Nama groups was also weakened through circumstances culminating in the lack of replacement of hereditary leaders coupled with problems recovering from huge livestock losses due to the 1897 rinderpest epidemic (Van Warmelo, 1962: 4). This century has also seen the movement of Herero populations from

Angola back into the old communal areas of Kaokoland and Damaraland who, under the militant leader Vita (Oorlog) and with Portuguese support, were able to restock with livestock through raiding neighbouring Owambo tribes. Following the defeat of the Germans in the first world war, they moved back into Kaokoland where they were joined in the south by Herero survivors of the German-Herero war (Malan, 1974: 83). A feature of regional land use this century is thus the continuing immigration and southerly expansion of Herero pastoralists and their livestock.

Today, several largely autonomous groups of Damara are still recognised according to the history of their families prior to the lumping together in the last 100 years of these different autonomous groups under the category of Damara 'tribe'. The so-called Namidaman and !Nara Damara (the latter after the food plant *Acanthosicyos horridus*), for example, come from further west in the Uniab, Hoanib and Hoarisib rivers where the **!nara** grow, while ‖ khao-a Damara (from ‖ **khaos** meaning *Euphorbia virosa*) come from south of Sesfontein, Daureb Damara come from the Brandberg area, and ‖ ubu Damara or Topnaar come from the coast (!Ganuses, 1994, pers. comm.).

The Ugab (!U- ≠ gab) settlements of the Okombahe Reserve

The Okombahe Reserve was originally established as a Rhenish Mission station and sanctuary for the Bergdamara in 1870 through an agreement between the Rev. Hugo Hahn and The Herero Chief Willem Zeraua of Omaruru (Köhler, 1959: 32). The reserve was largely inhabited by Damara who had been marginalised to the Erongo and Brandberg mountains. A major drought combined with escalating violence between the Nama, Damara and Herero disrupted their efforts to cultivate under the guidance of the Mission minister Daniel Cloete, and many of them returned to the mountain areas to support themselves through the gathering of wild foods (Köhler, 1959: 33). In 1894 following a request by Major Leutwein to the Herero Chief Manasse of Omaruru on behalf of the Mission and the Damara Chief Cornelius, the Okombahe Native Reserve was officially ceded to the Damara, with the proviso that it should be a source of labour to the government and the Herero living there would be allowed to remain (Hahn, 1928: 221; Vedder, 1928: 43; Köhler, 1959: 21, 34-5). The Damara were subsequently granted Okombahe by the German authorities as a specifically Damara Reserve in 1906 which was retained by the South West African administration and expanded to include the Sore-sores farm on the north of the Ugab in 1956 (Köhler, 1959: 39). Under the SWA administration a trust fund, comprised primarily of grazing fees, was established and administered by an elected board of Damara together with govenment representatives (Köhler, 1959: 49-51).

4.2 Baseline socio-economic and resource use data

4.2.1 Methods

Household survey

A broad-level household survey consisting of structured discussions was conducted with both male and female representatives of 54 Damara households. In order to facilitate flexibility in both responding to information offered without asking, and prompting where issues have not been covered, these interviews took the form of an open-ended checklist of topics to be addressed rather than a strict questionnaire format. The topics focussed on included:

a. socio-economic data to ascertain for each household:
- household composition;
- livestock holdings;
- other sources of subsistence and income, including whether:
    - the household had access to an irrigated 'garden' for cultivation;
    - any household members received a wage;
    - any individuals engaged in casual labour;
    - plant products sold for additional income.

b. plant resource use to establish:
- species used, purpose used for, part of plant used and how prepared;
- where particular species are found and rules governing access to these species;
- last time species was used for a particular purpose;
- preferred species used and problems associated with the use of particular species;
- temporal information regarding the availability and collection of plant products in relation to other subsistence activities.

Group discussions and interviews with key individuals
These were conducted to 'flesh-out' the information gained from the household survey by providing the opportunity for in-depth discussions of certain issues and practices.

4.2.2 Analysis
The results of this survey were organised using Paradox 4.5 and QuattroPro, and explored statistically using Minitab 7.1. Multivariate analyses of the range of gathered species used by households with differing socio-economic characteristics were carried out using Canoco 3.12. See appendix 1 for a discussion of the latter techniques.

4.2.3 Socio-economic features of the study population

Population structure and household composition
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 what was then known as Hereroland, but also occurring further south in Namaland (1928: 39). 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, which, assuming growth rates of 2.5% per annum from the population of 24,000 in 1981, has been considered to currently have a total population of approximately 31,000 people (Bayer *et al*, 1991: 60). A further 30% of the Damara population is accounted for by substantial urban migration to the Katatura township of Windhoek (van der Merwe, 1983: 48).

Tables 2 and 3 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. Appendix 3 contains further figures for the Okombahe Reserve and Omaruru District, in which the Ugab settlements are located, for the first half of this century. 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 from the figures for the Sesfontein and Ugab river settlements to be any reason to justify for these rural areas the assumption of a 2.5% population increase in the last decade for this region. It is possible, however, that rural-urban migration within Damaraland, accounts for the small increases, and even losses, indicated for these rural settlements. Second, there are noticeably higher numbers of females than males in almost all of the counts for which data on both sexes are available, this difference being statistically significant for Damara in the Okombahe Reserve for which the largest set figures were available (Mann-Whitney=119, p=0.004, 95% CI=350, 90.1). This probably reflects male labour migration away from rural areas (Köhler, 1959: 54).

Table 2 Population figures and structure for Sesfontein 1947/8 and 1991, and Khowarib 1991.

	Sesfontein		Khowarib
	1947/8 ♂ ♀ c	1991	1991
Damara	**374** 91 111 172	±480	♂82 ♀88
Herero	**262** 61 73 128	±200	
Other	**149** 44 50 55	±126	
Total	**785** 196 234 355	806	170

Source: Van Warmelo, 1962: 8,40; Population and housing census, 1991.

Table 3 Population figures for settlements on the Ugab River, 1956 and 1991.

settlement March 1956	population ♂ ♀ boys girls total	settlement census 1991*	population ♂ ♀ total
Ani-≠gab	42 72 33 30 177	Ani≠gab	18 18 36
‖Gai-oas	5 16 13 12 46	Gaes-oas	8 9 17
/Nai-≠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; Namibian population and housing census, 1991.
*nb. There are problems with knowing whether or not these 1991 settlements are equivalent to those with similar names in the 1956 census and this may account for some of the discrepancies.

Obviously, it is desirable that the household survey conducted during the pilot study should be representative of the main patterns discernible in the region's population structure. Of a total of 54 household interviews, 28 and 13 were carried out in the Hoanib river settlements of Sesfontein and Khowarib[5] respectively while 13 were carried out in the dispersed settlements on the Ugab River. In the 1991 government census these settlements were recorded as consisting of 134, 39 and 23 (comprised of Ani-≠gab, Gaes-oas, /Nai-≠gab and Sorri-sorris in the Ugab river site), households respectively, and this study thus covered 57%, 33% and 21% of households in these settlements. The proportion of specifically Damara households included in the Sesfontein site is likely to be much higher.

[5]The data presented for the Khowarib households was collected during a survey in August 1992 carried out by this author and T.L. Konstant.

The survey households comprised populations of 184, 80, and 66 individuals for Sesfontein, Khowarib and the Ugab settlements respectively, thus accounting for 38% of the Sesfontein Damara population, and 47% and 71% of the Khowarib and Ugab populations, as recorded in the 1991 census. These samples were comprised of 58, 25, and 20 adult females, 24, 12, and 15 adult males, and 102, 43, and 31 children in the Sesfontein, Khowarib and Ugab sites respectively (Fig 3). The survey thus reflects the pattern of more women than men described above for these areas from census figures at different times during this century. It is also reflected in the ratio of female to male participants in the survey, the sex of interviewee being female in 39 of the 54 interviews, and in 20, 7 and 12 of the interviews carried out in Sesfontein, Khowarib and the Ugab settlements respectively (Fig 3).

Apart from the absolutely higher numbers of women compared with men, there is also evidence in this data set for a large proportion of households which are female-headed. A total of 19 households or 35% of the sample population were formed around closely related adult females without resident adult males and apparently without regular connections with absent males. This is in stark contradiction to Vedder's (1928: 48-9) description of patrilocal residence and polygyny among the Damara and can perhaps be explained as an artefact of recent historical events resulting in male migration from rural areas. It makes more sense, however, in the light of Lau's (1987: 8-9, 11) assertion that all major subsistence activities among Nama groups were undertaken and managed by women such that, for example, livestock were herded by a woman's children and uninitiated males under the supervision of married women who were also the main producers of milk, collectors of veld foods, and builders of houses. As observed by Vedder (1928: 71), mechanisms which would facilitate female autonomy among the Damara include inheritance rules allowing female children to inherit from the mother and male children to inherit from the father and the fact that a woman may fully own livestock given as gifts by her husband or family.

The median household size for the total sample population was 7 individuals (range 1-14), with medians of 8, 6 and 6 individuals for the Sesfontein, Khowarib and Ugab samples respectively (ranges 1-14, 1-11, 2-8) (Fig 4). A oneway analysis of variance indicated that differences in household size among study settlements were significant (Kruskal-Wallis test=6.83, df=2, p=0.03). Larger household sizes in Sesfontein possibly reflect the general concentration of population in this site and greater success in the maintenance and establishment of kin ties.

The age structure of the interviewees is depicted in Fig. 5, from which it can be seen that a broad range of ages was covered although the dominant ages in the sample come from the over 50 age-groups. This can be explained by two reasons: first, it is common in the more remote areas of this region for grand-parents to act as child-carers for parents who are working elsewhere; second, as elderly people are generally seen as holding greater knowledge of gathered resources they were often the individuals who volunteered to participate in the survey.

Stock ownership and herding

Throughout the region the pattern of stock ownership has several interrelated features. First, is the widespread inequality between stock owners, occcuring between indigenous herders and European commercial farmers, within wealthy and poor herders within the same ethnic group, and between male and female herders. In 1913 there were an estimated 205,643 cattle in the country of which 89% were European owned (Dierks, 1992: 68). This pattern of unequal ownership continued throughout this century such that in 1987 of 1,835,400 cattle, 2,811, 300

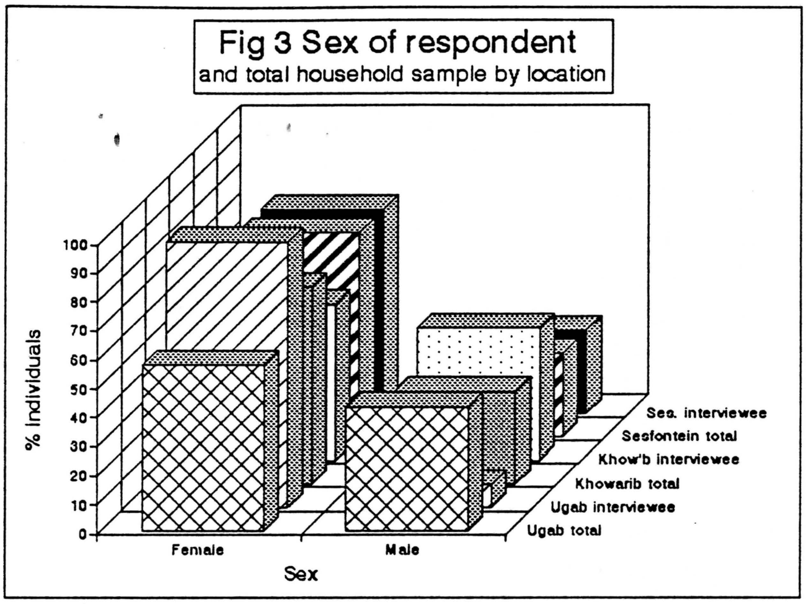


Fig 3 Sex of respondent
and total household sample by location

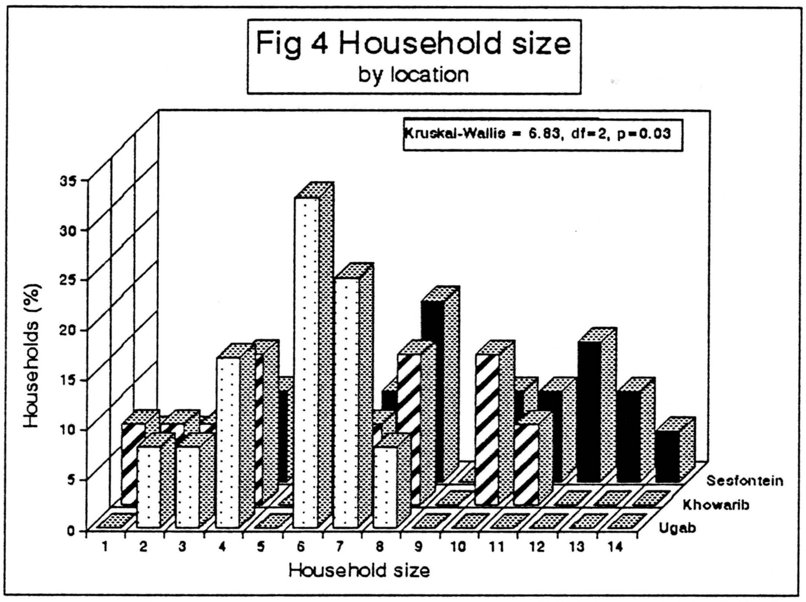


Fig 4 Household size
by location

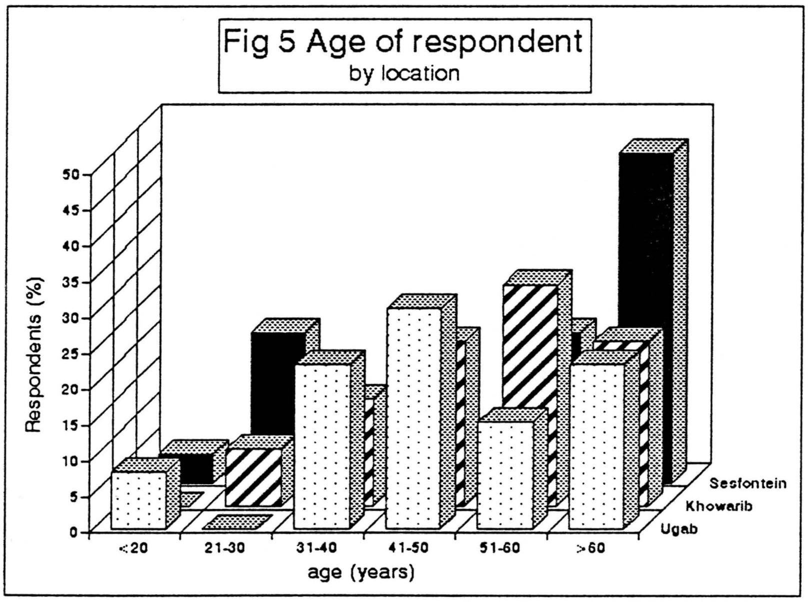


Fig 5 Age of respondent
by location

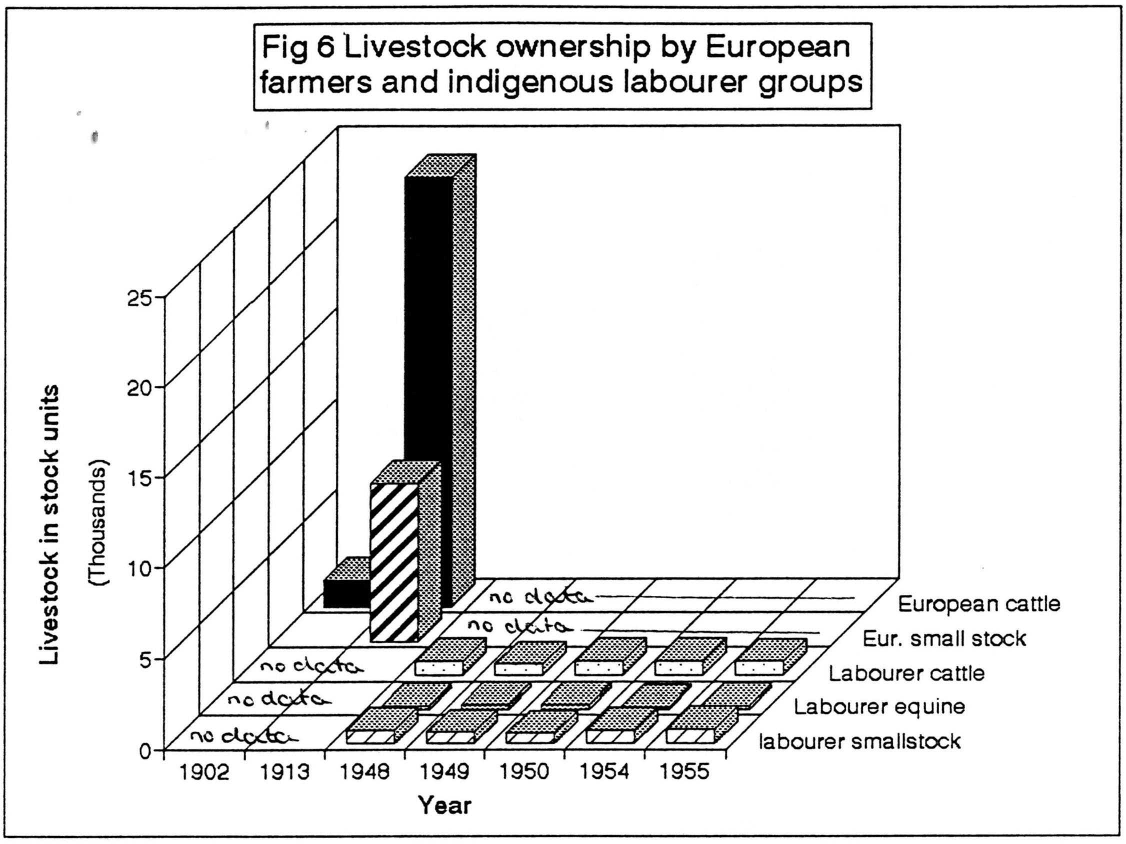


Fig 6 Livestock ownership by European farmers and indigenous labourer groups
Livestock in stock units
(Thousands)
25
20
15
10
5
0
no data
no data
no data
no data
no data
European cattle
Eur. small stock
Labourer cattle
Labourer equine
labourer smallstock
1902
1913
1948
1949
1950
1954
1955
Year

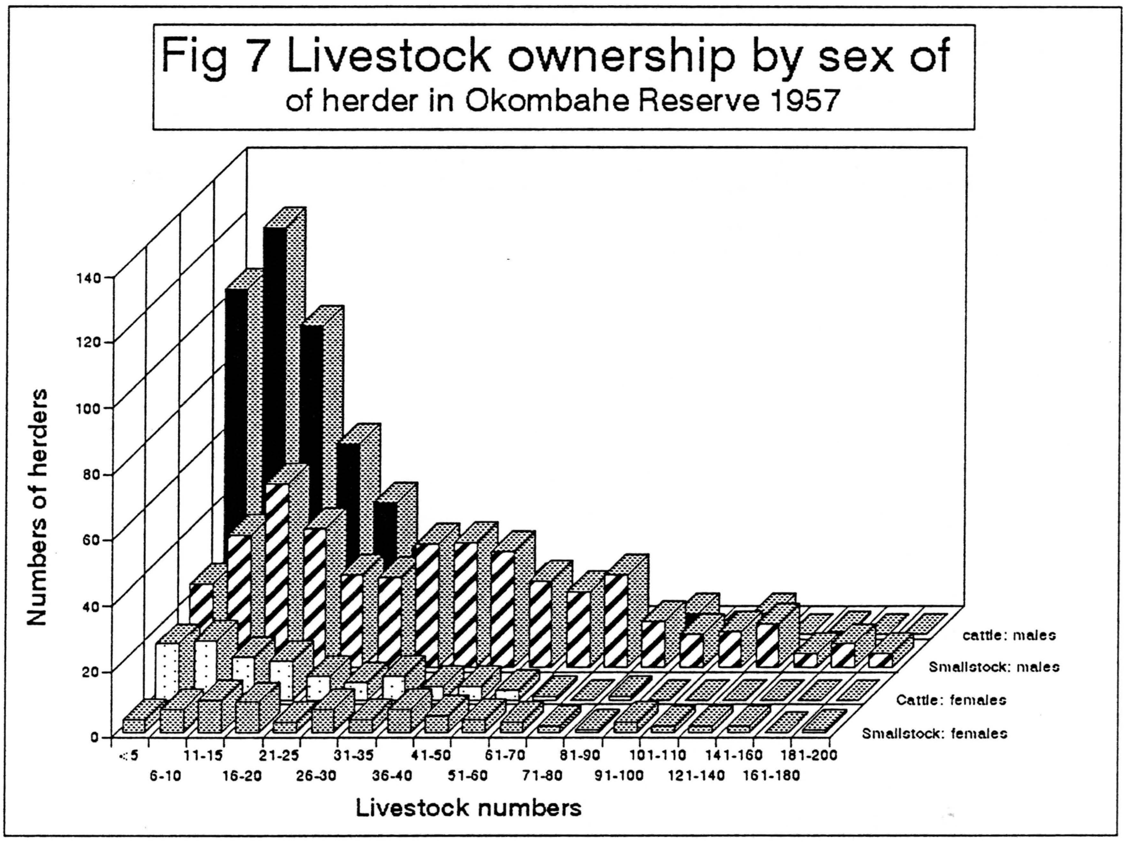


Fig 7 Livestock ownership by sex of
of herder in Okombahe Reserve 1957
Numbers of herders
140
120
100
80
60
40
20
0
cattle: males
Smallstock: males
Cattle: females
Smallstock: females
<5
6-10
11-15
16-20
21-25
26-30
31-35
36-40
41-50
51-60
61-70
71-80
81-90
91-100
101-110
121-140
141-160
161-180
181-200
Livestock numbers

sheep and 1,579.900 goats, only 41.5%, 10% and 52% respectively were owned by the vast majority of the population living in communal areas (Bayer *et al*, 1991: 22). The historical roots of this ownership pattern, and of inequality within indigenous groups and between herders of different sex, are shown in Figs 6 and 7 of livestock populations within the Omaruru District and Okombahe Reserve in the first half of this century. The latter pattern is clearly of interest given the higher proportion of women compared with men in the Okombahe Reserve at this time, and the high incidence of apparently female-headed households found in this study.

This broad pattern of livestock ownership was reflected in the households comprising the survey population for this study. The skewed distribution of livestock (as shown by Figs 8a-d), together with the high standard errors of their means, indicate that livestock ownership by these households is best described by their median numbers. These, however, are zero for all three species of livestock and for all locations, with slightly higher figures of 1.28, 2.96, 3.9 livestock units[6] recorded for Sesfontein, Khowarib and the Ugab settlements respectively. Ranges of livestock numbers are as follows:

	Sesfontein	Khowarib	Ugab	Total
cattle	0-25	0-25	0-80	0-80
goats	0-150	0-150	0-300	0-300
donkeys	0-4	0-12	0-7	0-12
TLU	0-43	0-49	0-131.5	0-131.5

Kruskal-Wallis and ANOVA analyses indicated no significant difference in livestock ownership between settlements at the 95% confidence level, except for the ownership of cattle (Kruskal-Wallis = 7.12, df=2, p=0.03). This is likely to be related to the single extremely large relative value recorded for one household in the Ugab settlements sample. It should be pointed out that this herder was one of a number of wealthy herders from the drought-affected Kamanjab District who, on the advice of the Ministry of Agriculture, have recently moved temporarily into the Ugab area to take advantage of this year's good grazing.

The figures above indicate discrepancies when compared with average herd figures for the Damaraland area of 12 cattle and 72 small stock (2 cattle and 43 small stock for Okombahe) derived from registered farmers (cf. Rohde, 1994: 4). This may be due either to the non-reporting in this survey of animals herded by other members of the family, or to a general lack of knowledge about the poorest households in the area who may be overlooked in Ministry of Agriculture statistics by not being registered farmers. Further work is needed to clarify this issue.

The observed pattern of herding among contemporary Damara stock herders, as recorded for Herero and Nama pastoralists (Malan, 1974: 119; Lau, 1987: 65), is one of stock movement between satellite stockposts or 'farms' which utilize grazing in a wider radius around a focal settlement and are attached to more sedentary relatives within this permanent settlement. As described above, wealthier herders may also move their herds to a completely different area in response to drought conditions, as in April-May 1994 when herders from Kamanjab area moved to the Ugab to take advantage of good pasture conditions. In families that can support a system of satellite farms, the bulk of the family remains in a permanent settlement where a portion of the herd is kept for day to day sustenance, while several family members, sometimes accompanied by employed labourers, take care of the main herd. This herd is the collective stock owned by different members of the family group.

[6] Following Bayer *et al* (1991: 26), conversion rates for livestock units (LSUs) are: 1 LSU = 1 head of cattle, 6 goats/sheep, and 2 donkeys.

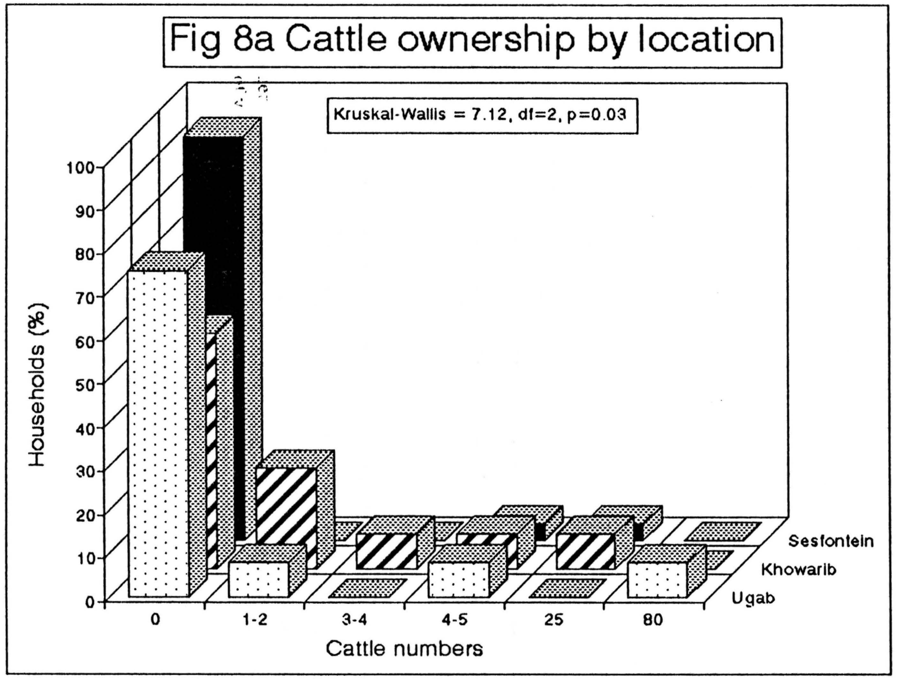


Fig 8a Cattle ownership by location

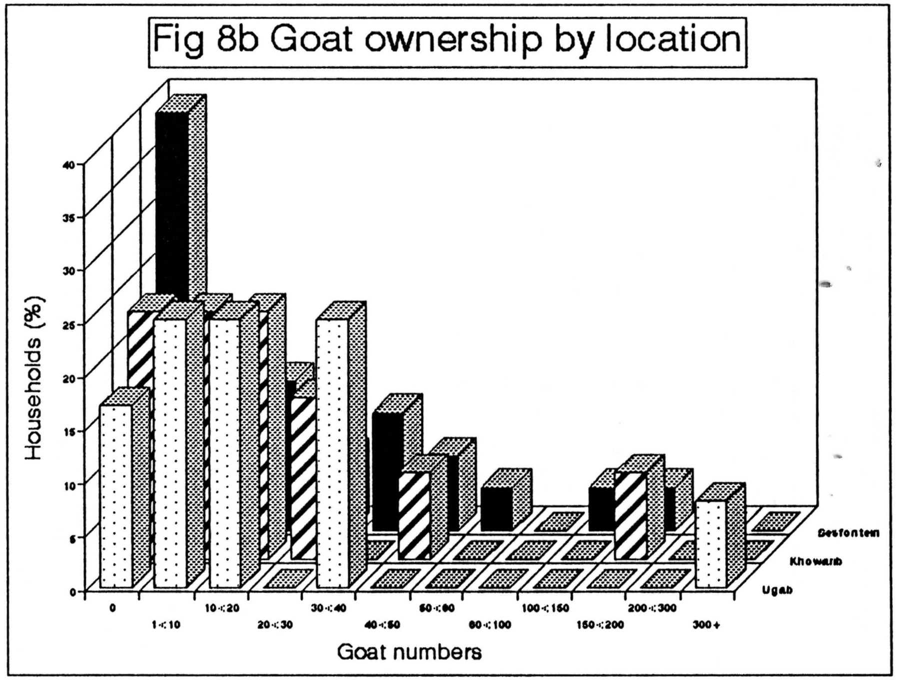


Fig 8b Goat ownership by location

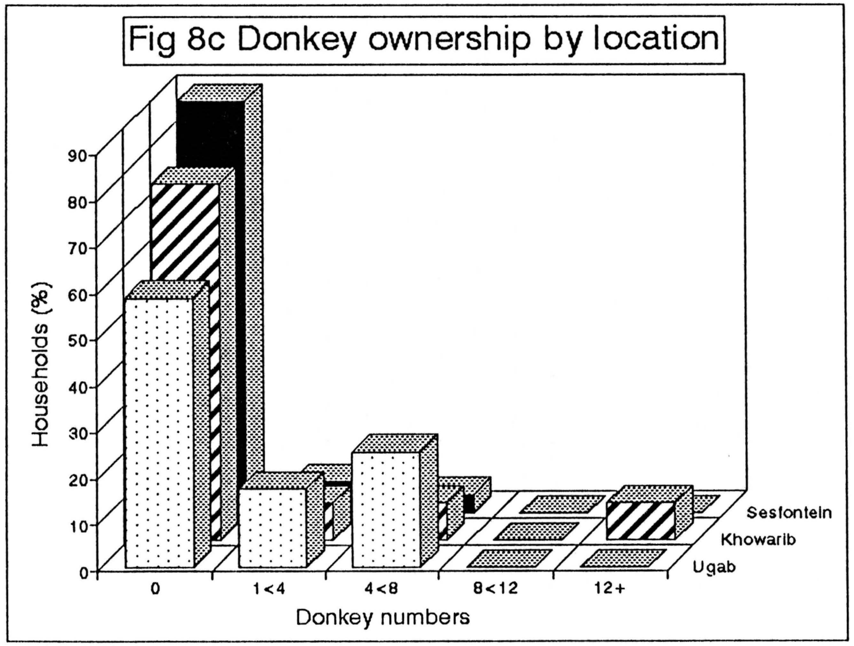


Fig 8c Donkey ownership by location

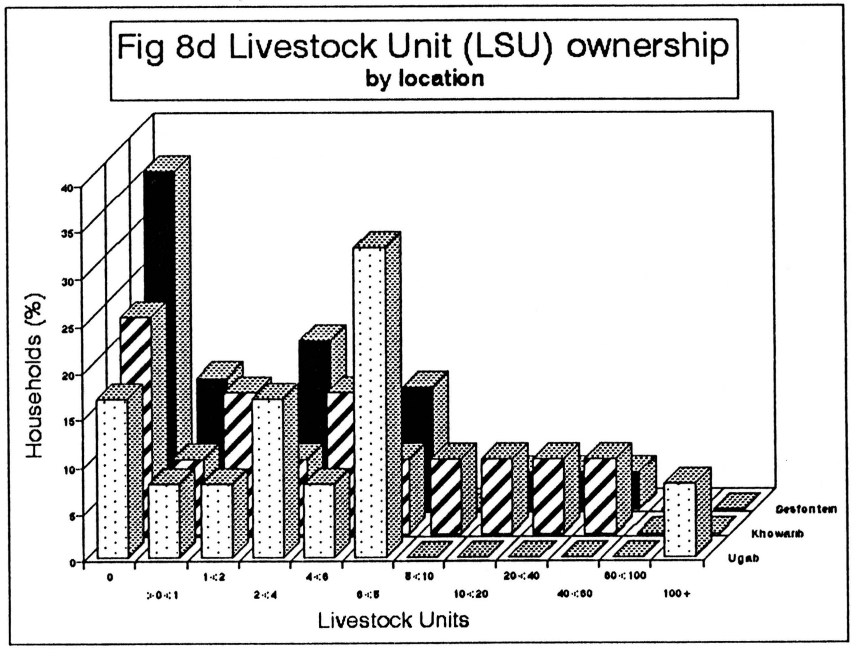


Fig 8d Livestock Unit (LSU) ownership **by location**

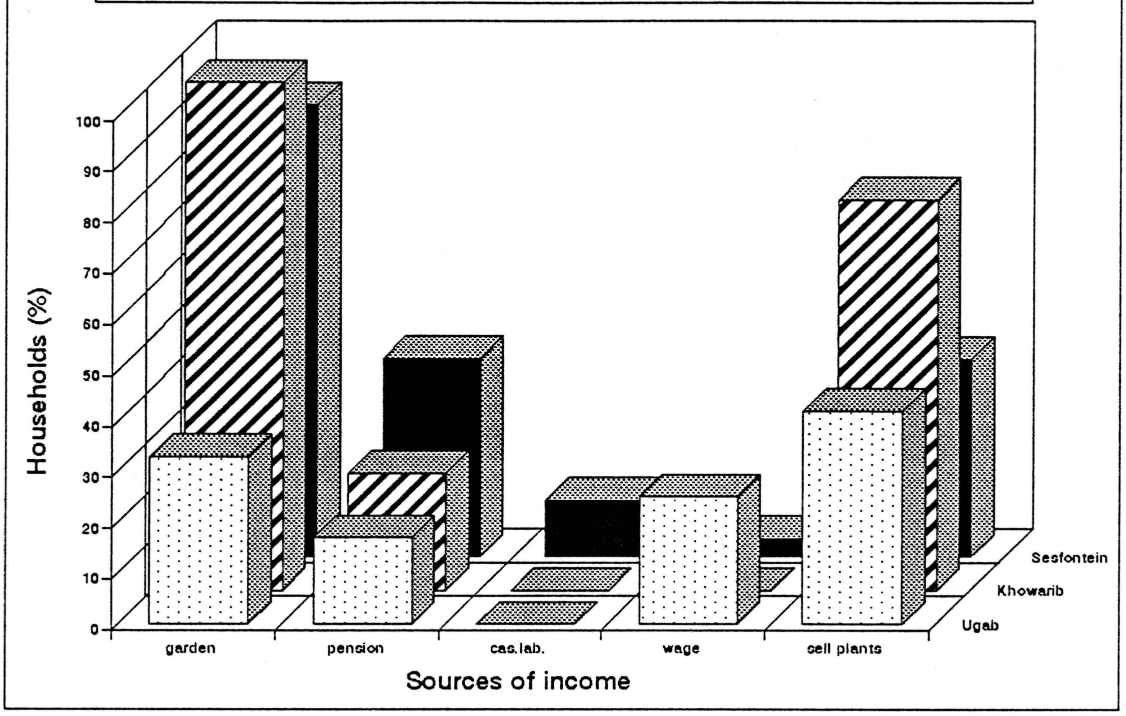


Fig 9 Other sources of household income
by location

Other sources of income

Fig 9 illustrates alternative sources of household income in each settlement. From this it is clear that most households cultivate gardens, some households receive a small cash income in the form of a government pension, very few households appear to have access to either a wage income or an income from casual labour, and substantial numbers of households gain additional income from the sale or exchange of gathered plants.

Crops planted at local gardens include wheat and maize as staples together with combinations of tobacco, watermelons, citrus fruits, vegetables such as carrots and potatoes, and dates. While the gardens along the Ugab are smaller and apparently less reliable, the garden complexes of Sesfontein are about 30ha in extent with wheat and maize yields estimated at around 1 ton/ha.

4.3.2 The gathering of plant resources

A full list of species encountered during this study and their Damara, Herero and botanical names, is presented separately in Appendix 1, together with the uses that were recorded for each species. Species identifications were arrived at through combining a variety of techniques:

- identifying species in the field with local informants and taking specimens of these species for formal botanical identification by the National Herbarium;
- cross-checking identifications by taking samples of plant products into households to increase the accuracy of recording local names and uses;
- field-trips and discussions with Namibian botanists;
- reference to existing ethnotaxonomical literature for the region (see, for example, Le Roux, 1971; Craven and Marais, 1986, 1992; Eiseb *et al*, 1991; Van den Eynden, *et al*, 1992).

A total of 118 'useful' species were recorded in this study, with 89, 50 and 64 species represented in the Sesfontein, Khowarib and Ugab household samples respectively. These figures are complicated by a number of factors, however, including:

- the presence of species with multiple uses. For example, the seeds of *Stipagrostis* species (eg. cf. *hirtigluma*) (**saun**) and *Monsonia umbellata* (**bosui**) are consumed widely as wild grain and are also used to brew beer and distil a spirit known as **bauga**, both of which can be sold and comprise significant income-earners for many women. The flowers of the latter species can also used as a tea substitute. The important fruit-bearing species *Salvadora persica* (**xoris**) and *Berchemia discolor* (**≠ hûis**), on the other hand, both have alternative uses, including beer-making and income-generation from the fruits, while the former also has a variety of medicinal uses and wood from the latter is used for making knobkieries;
- some species are used very commonly while others are rather more peripheral to overall subsistence. This is shown clearly for food species in fig 13 below;
- finally, a number of species have yet to be identified to their botanical name. This may reveal species that have been recorded more than once through the use of different local names for the same species.

The median number of species used by each household was 18 (range 3-51). Medians of 12, 23 and 21 (ranges 3-51, 10-36, 14-32) were recorded for Sesfontein, Khowarib and the Ugab households respectively, while medians of 16.5 and 20 (ranges 3-51 and 7-36) were recorded for female and male interviewees respectively (figs 10a and b). No significant differences in the reported household use of gathered plant resources with regard to the age or sex of the interviewee, or to household size were found (figs 10b-d). There was, however, a significant difference in species used between locations (fig 10a) (Kruskal-Wallis test = 9.17, df=2, p=0.01), which reflects the substantially lower median number of species used by the Sesfontein households. This result is, however, complicated by the fact that the household which reported the greatest number of species used was also from Sesfontein.

Of particular interest in the context of this study is the relationship between gathered plant resource use and household 'wealth' in terms of alternative resources such as livestock, cultivated foods and cash income from sources such as regular wages, irregular casual labour, and government pensions. Pearson product moment and Spearman rank correlations were therefore carried out between the number of species used by each household and various combinations of the above indices of wealth. None of these correlations between 'wealth' and either total reported gathered plant use, or plant use split into the categories of food, medicinal, forage, income-generation or 'other' uses, yielded significant results. From these tests of association we must therefore accept the null hypothesis that there is no significant relationship between numbers of 'useful' gathered plant species reported by households and access to alternative household resources.

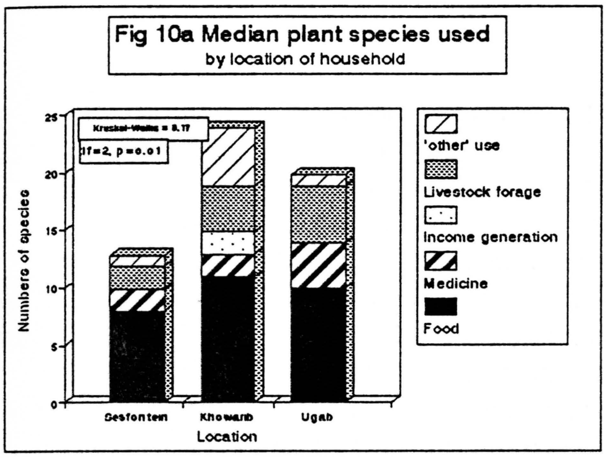


Fig 10a Median plant species used by location of household

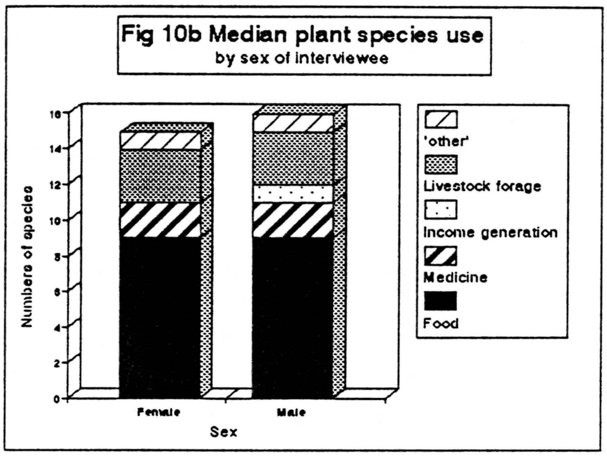


Fig 10b Median plant species use by sex of interviewee

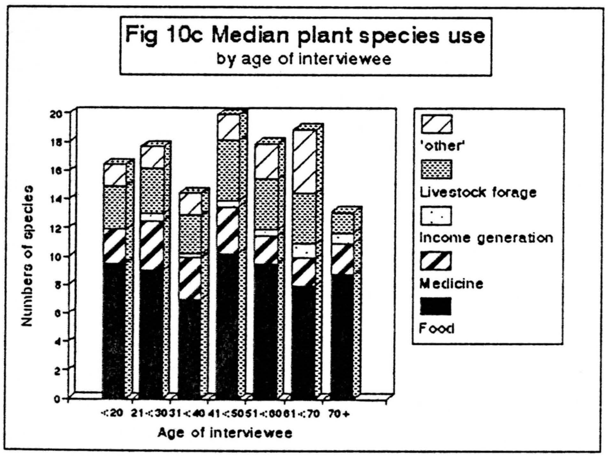


Fig 10c Median plant species use by age of interviewee

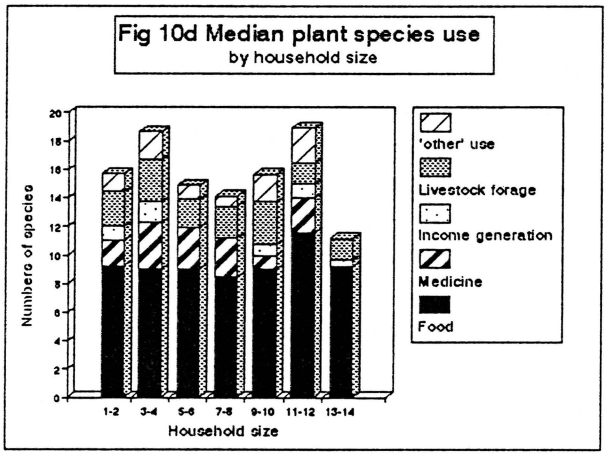


Fig 10d Median plant species use by household size

These tests comprise, however, an extremely crude way of exploring this data set for the following reasons. First, the tests take account of only the numbers of species used by each household and are not sensitive to the actual species used. Second, each household is characterised by different combinations of the socio-economic variables and this individuality is lost in the above tests. Finally, by converting figures to rank orders, the range of variability recorded for a particular category in the data set is lost. For example, consecutive ranks representing household cattle numbers of 25 and 80 animals, as is found in these data, completely obscure the great difference observed between the actual numbers.

The data set is, in other words, multivariate in nature and much of the relevant information it contains is lost by not taking this multivariate structure into account. For this reason, the data were further explored using standard multivariate ordination techniques (detrended and canonical correspondence analyses or DCA and CCA) developed for elucidating community structure in the distribution and abundance of species among samples and along environmental gradients (see appendix 2). For this data set, each household was treated as an individual sample while the socio-economic data collected for each household were treated as environmental variables. For the purposes of the study two species-by-samples (i.e. households) matrices were analysed, the first consisting of the total number of species reported as used by each household, and the second consisting of the food species used by each household. DCA and CCA of the latter matrix are presented in the section on the food use of gathered resources below.

Figs 11a and b are the ordination diagrams produced by DCA of all the species reported as used by households. The first two axes explain only 12.3% of the total variance in the data set and, as can be seen from the ordination diagram, not a great deal of structure has emerged from the data set even when the actual species used by households are taken into account. Th indicates that all households share broad similarities in the gathered resources used. This species which contribute most to the ordination, i.e. those which are the most commonly used, thus occur towards the centre of the species plot where they are shared by the majority of households. These species are *Acacia tortilis* (**/narab**), *Berchemia discolor* (**≠ hûis**), *Ficus sycomorus* (**/nomas**), *Grewia* sp. (**≠ âun**), *Monsonia umbellata* (**bosu**), *Salvadora persica* (**xoris**), *Stipagrostis* sp. cf. *hirtigluma* (**sâun**), *Ziziphus mucronata* (**≠ aros**) and *Colophospermum mopane* (**tsauraheis**). With the exception of *C. mopane*, these are all important food species although many have other uses as well. Conversely, the least recorded species generally occur on the outside of the species plot and explain the distribution of the more peripheral households in the samples plot.

The cluster of households outlined on the samples plot (Fig 11a) are those found in the Ugab river settlements and their location on the diagram indicates that they share broad differences with the Sesfontein and Khowarib settlements on the Hoanib river which appear much more similar. This pattern can largely be explained by the common use for medicinal purposes in the Ugab households of *Dicoma tormentosa* (**soreb**), a species not recorded in the Sesfontein and Khowarib households, and conversely the lack of *B. discolor*, an important fruit-bearing species, in the Ugab samples. In other words, while it appears that both the Hoanib and Ugab river households had access to a largely similar suite of species, there are probably some broad differences in species distribution which are reflected in the resource-use patterns characterising these sites.

Fig 11a DCA ordination diagram of households for total species use.

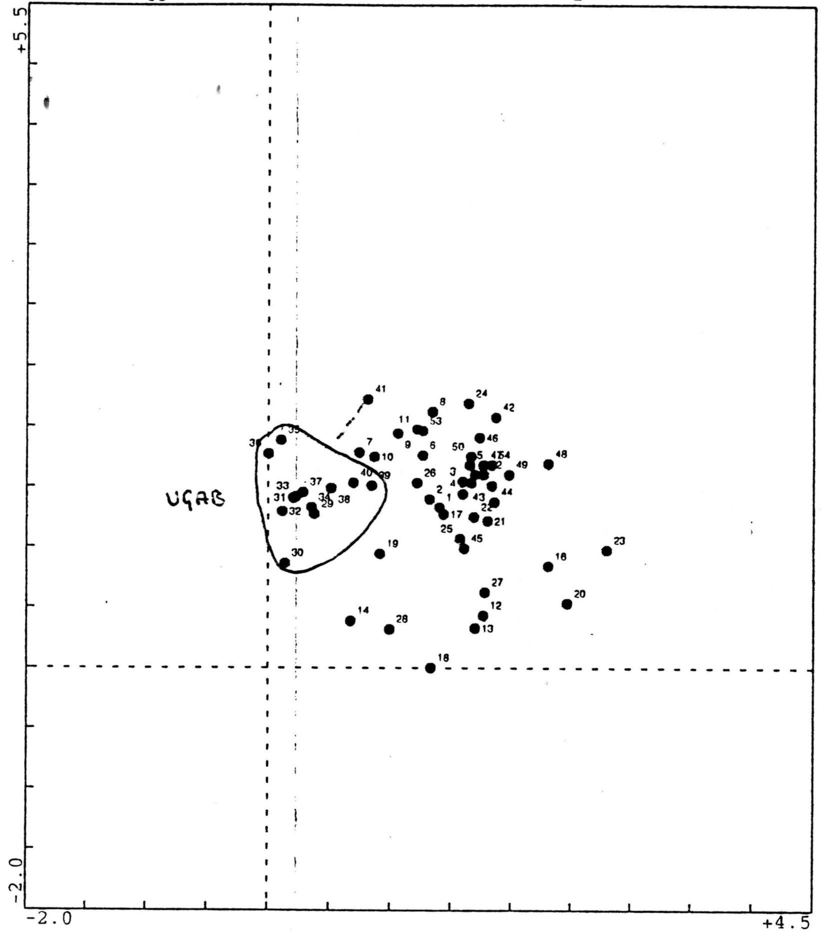


Fig 11b DCA ordination diagram of species for total species use.

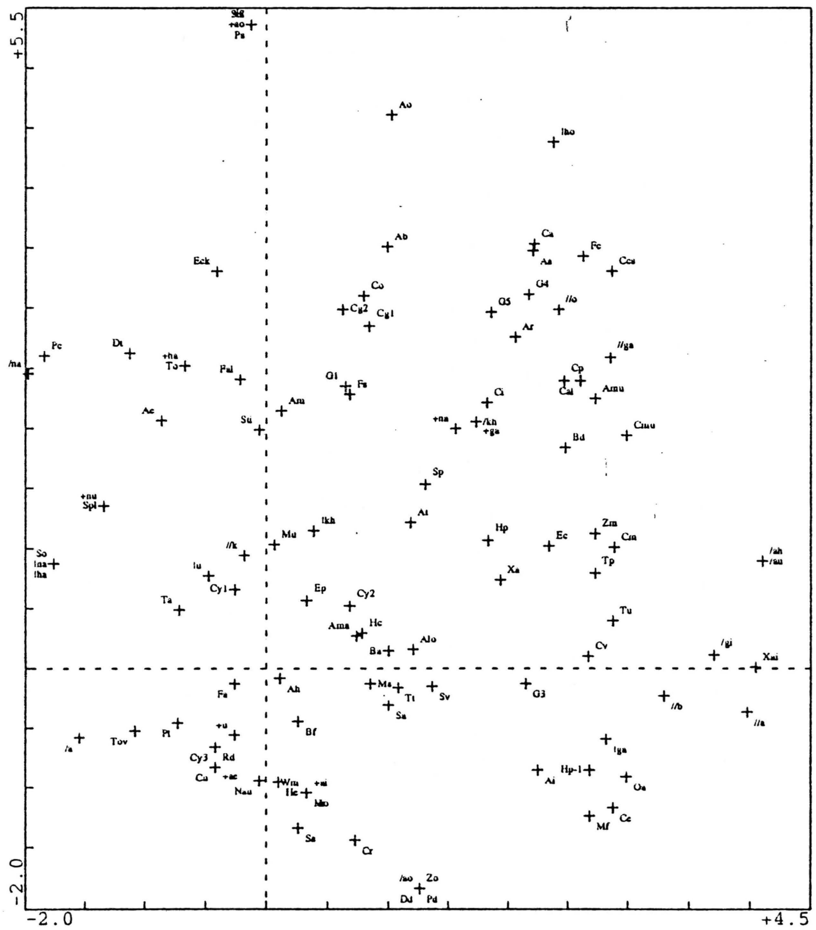


Fig 12a CCA ordination diagram of households for total species use combined with the socioeconomic features of each household.

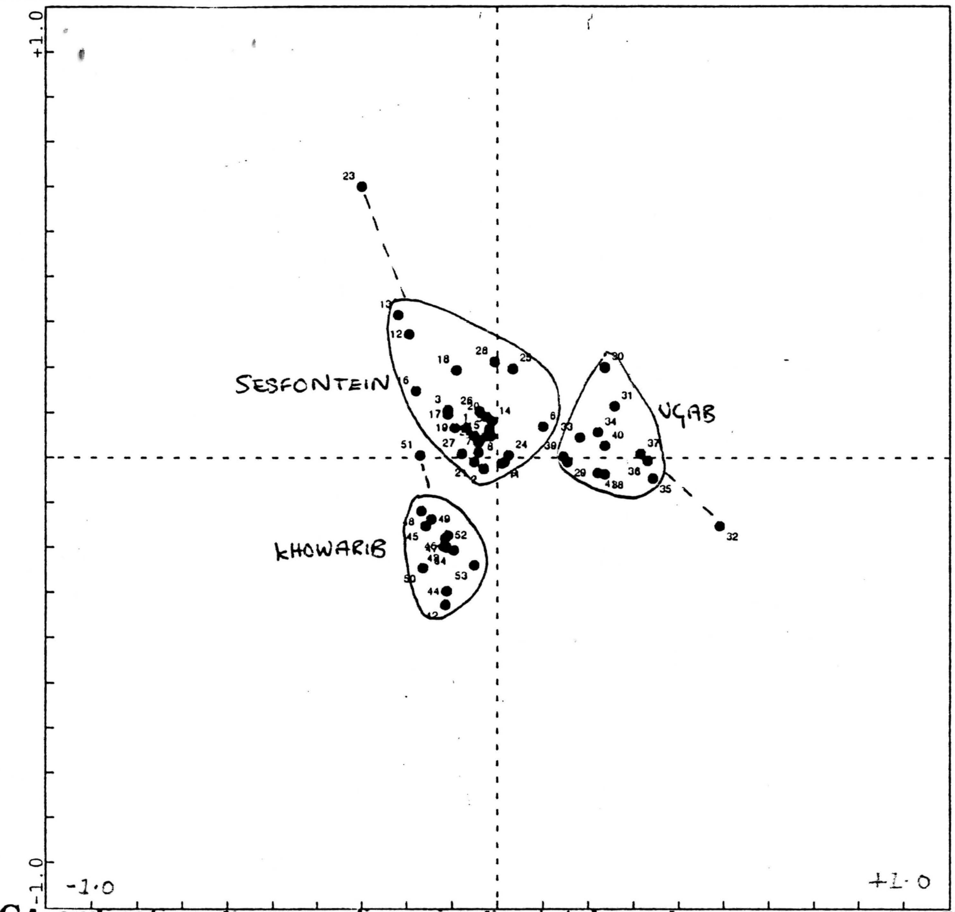
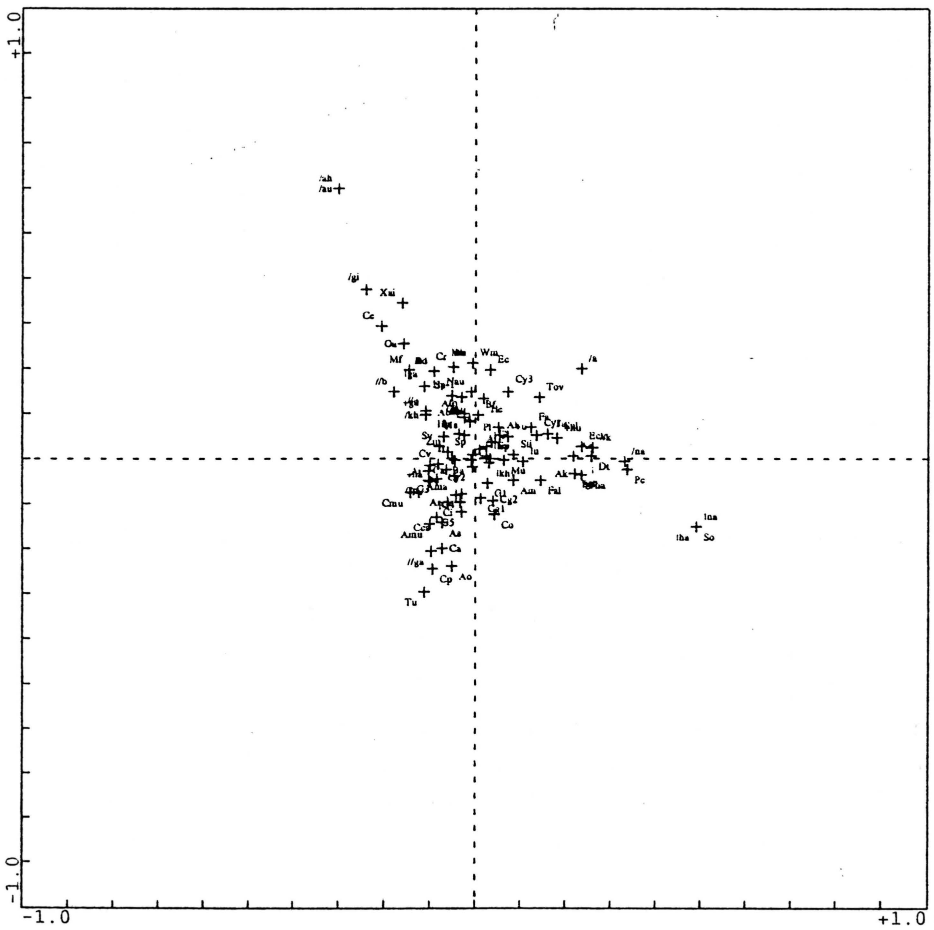


Fig 12b CCA ordination diagram of species for total species use combined with the socioeconomic features of each household.



Figs 12a and b are the ordination diagrams produced by the CCA of total species use combined with the socioeconomic information recorded for each household. In this case, while the overall variance in the data set is still high (gradient length or sum of all unconstrained eigenvalues = 4.92) the environmental variables can explain some 44.1% of the variance in the species-by-households data (sum of all canonical eigenvalues = 2.17). Again, the pattern indicates that, while households share much in the way of the range of species they use, there are some observable differences. These are largely related to where households are located as indicated by the correlation coefficients of 0.86 for river catchment location and the first species axis, and -0.69 for location in Khowarib and the second species axis. The socio-economic variables and species axes, on the other hand, have extremely low correlation coefficients suggesting, as above, that there is a very low degree of association between these variables and the range of species utilised by households.

4.3.2 Gathered plant use by 'use category'

Figs 10a, b, c and d above illustrate the median number of species recorded for each use by location, sex of interviewee, age of interviewee and household size. As can be seen from these figures, the reported use of gathered resources was broadly similar for each variable. Each use category, i.e. food, medicine, income generation, forage, and 'other', and its relationship with different socioeconomic variables will be discussed separately below.

4.3.3 Food

Fig 13 indicates the range of food species reported as used by location in this study. Some of the more commonly used species, together with the plant parts that comprise the foods, are presented in table 4. A total of 64 food species were recorded by this study, 47, 29 and 37 used at Sesfontein, Khowarib and the Ugab settlements respectively. A median of 9 species was recorded for each household (range 2-28), and Kruskal-Wallis and ANOVA tests indicated that there was no significant difference in numbers of food species recorded in different locations, by male and female interviewees, by different ages of interviewees or by household size.

A DCA ordination of a species-by-households matrix for food species to illuminate the broad patterns associated with the range of species used by households characterised by similar socio-economic variables and located in different areas, displayed a very similar pattern to that described above for all the species recorded in this study. The first two axes explained 17.5% of the variance in the species by households data set and there were no discernible groupings in the samples (households) plot and the species plot again placed the most commonly used species towards the centre of the scatter and the least used species towards the periphery. The DCA ordination diagrams will therefore not be presented here.

Figs 14a and b show the CCA ordination diagrams for food species use by households combined with the socio-economic data. Similar to the CCA for total species use, the environmental variables explain 47.3% of the total variation in the species by households data. Unlike the total species use diagrams, however, there appears to be no readily distinguishable pattern by location, and rather the scatters of both households and species is indicative of a largely overlapping sample with a few outliers. These outliers can be readily explained with reference to their socioeconomic characteristics. Household 32, for example, had by far the highest numbers of livestock and, although currently residing in the Ugab river valley, was from the Kamanjab area and therefore reported the use of species not generally available in the Ugab area (as is indicated in Fig 14b of the species by the cluster of species around the outlier of this household). Households 12 and 13, on the other hand, were the only ones that had members engaged in casual labour.

Fig 13 Range of food species use
by location

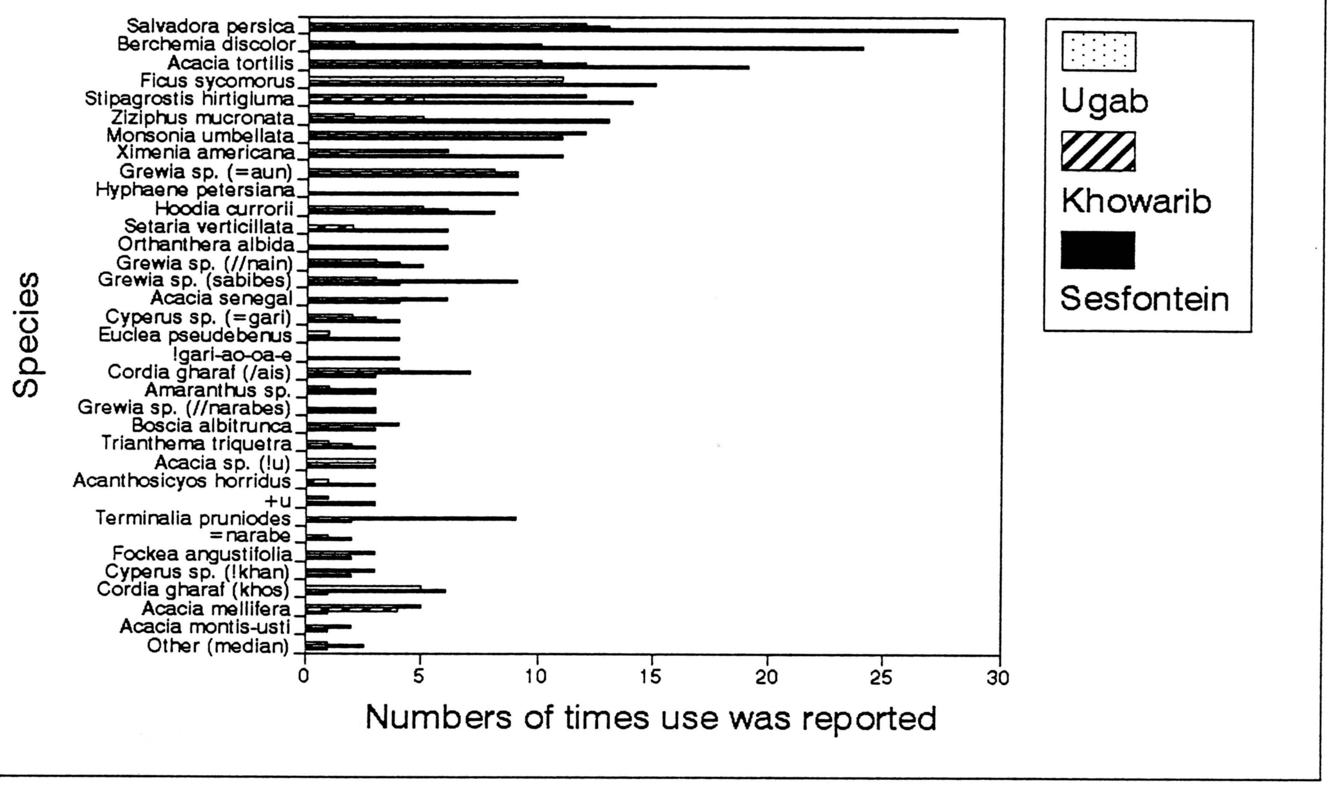


Table 4 Recorded household food species use (all species with at least 10 records).

Species	Damara name	Times use recorded			plant part
		Hoanib n=41	Ugab n=13	Total n=54	
Berchemia discolor	≠ hûis	35	2	37	fruit
Cordia gharaf	‖ khōs; / ais	16	9	25	"
Ficus sycomorus	/ nomas	19	11	30	"
Grewia sp.	≠ âun	18	8	26	"
Grewia sp.	sabibes	13	3	16	"
Grewia sp. cf. *flavescens*	‖ aib	9	3	11	"
Salvadora persica	xoris	41	12	53	"
Ximenia americana	≠ eros	11	6	17	"
Ziziphus mucronata	≠ aros	18	2	20	"
Acacia senegal	nûb; tûn	10	1	11	exudate
A. tortilis	/ narab	30	10	40	exudate/pods
Terminalia prunoides	≠ kheeras	11	2	13	exudate
Monsonia umbellata	bosu	17	11	28	seeds
Stipagrostis hirtigluma	sâu	19	10	29	"
Hoodia currorii	!khobas	16	5	21	stems

Fig 14a CCA ordination diagram of households for food species use combined with the socioeconomic features of each household.

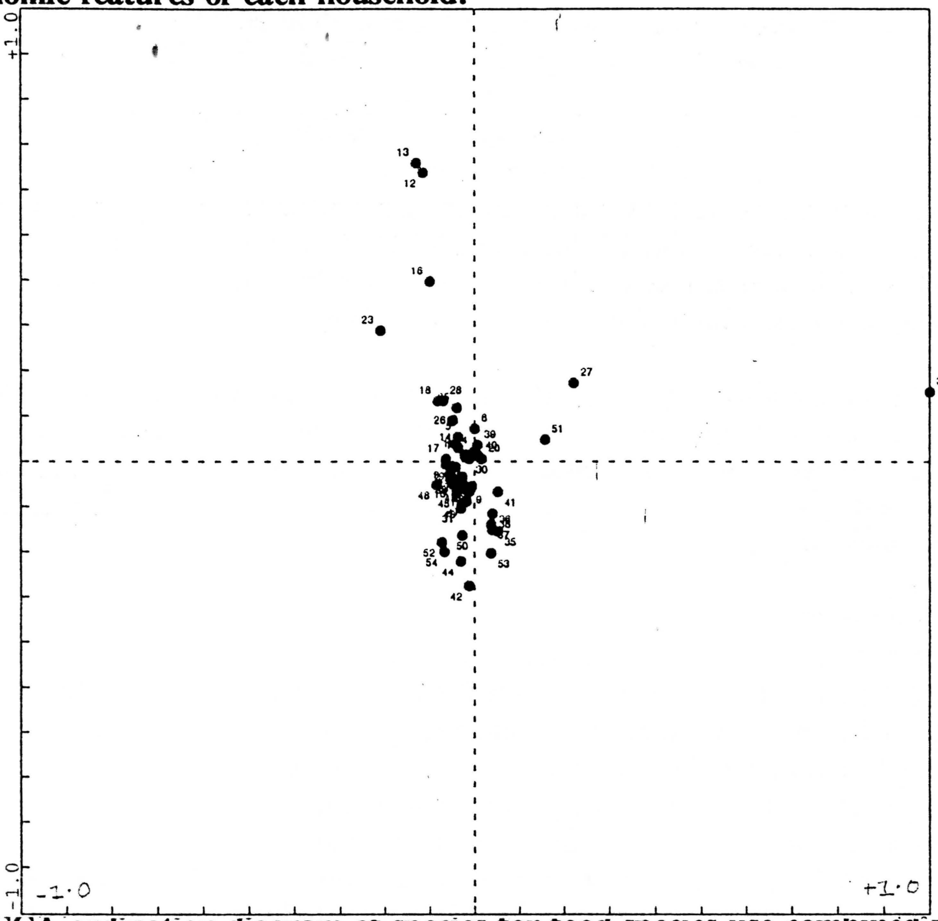
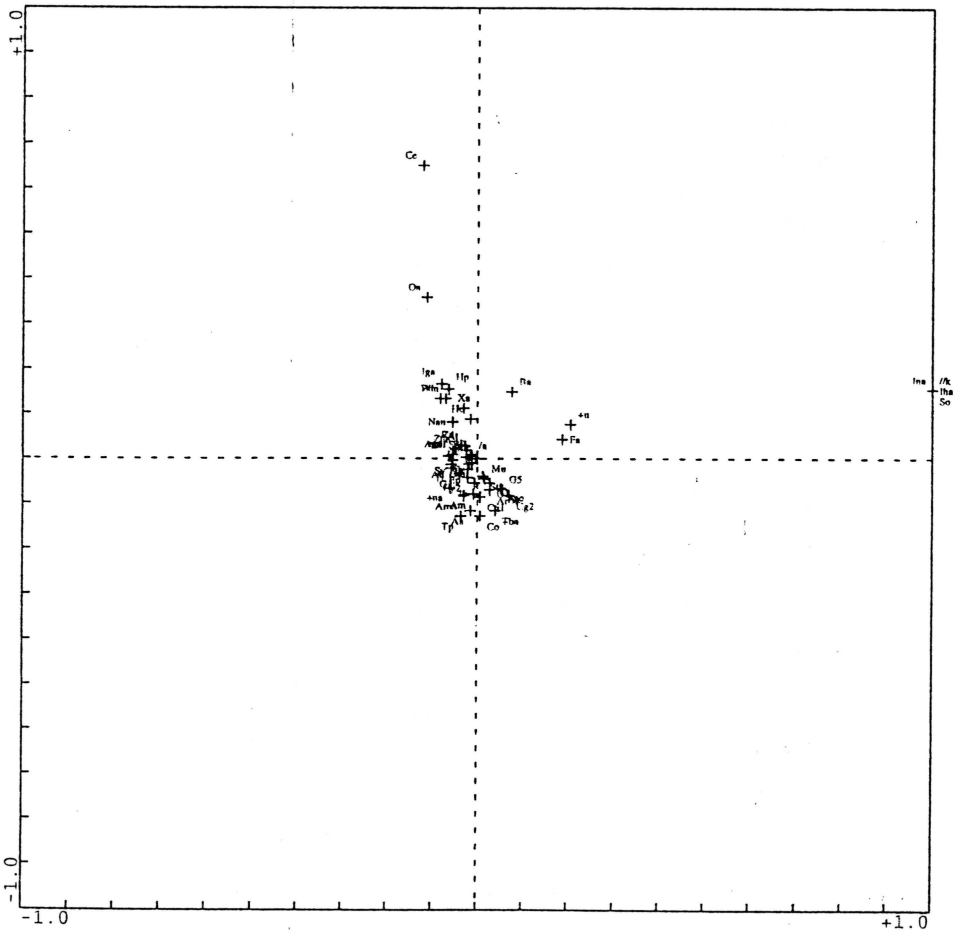


Fig 14b CCA ordination diagram of species for food species use combined with the socioeconomic features of each household.



It appears from Fig 13 and the ordinations of food species use by households that, while a wide range of species are used to provide food, these species can be divided into two broad categories:
1. those which are very commonly used, their use being reported across different locations and by households characterised by different socioeconomic factors;
2. those whose use was recorded far less frequently and which appear to be rather more peripheral for subsistence purposes. In Fig 13, for example, the category of 'other' species represents approximately 15 species whose use was only recorded by one or two households (nb. this may also reflect identification problems as described above).

Within the category of commonly used species such as those presented in table 4, two further patterns of use can be discerned. First, are those which appear to be used in large quantities when they are available and can perhaps be considered to be a staple part of the diet, at least during these times. Second, are those which are described as snack foods or 'sweets'. Both of these will be discussed separately below.

Regularly used gathered foods
These fall into two main types: wild grains and fruits. The most commonly used wild grains are seeds of the *Stipagrostis* genus **(sâun)** and those of the *Monsonia* genus (cf. *umbellata*) **(bosu)**. Both of these are gathered from the underground storage chambers of harvester ant *Messor barbarus capensis* (≠ **goburun) nests** (≠ goburun oms). This practice has the advantage of procuring several kilogrammes of a normally dispersed food resource from a single location, and once collected the seeds can be stored for long periods of time. They are prepared by winnowing using a winnowing bowl called a ≠ **goub** to 'clean' the seeds and sort the edible ones from species such as *Kaokochloa nigrirostris* (**!habise**) collected into the nest but that cannot be eaten. They are then normally roasted and ground to form a 'meal' which can be cooked into a porridge. Such food species use has been observed and recorded bothin the historical literature (eg. Vedder, 1928: 60) and more recently (eg. du Pisani, 1978: 14; Steyn and du Pisani, 1985: 3) but it remains unclear as to exactly how important a dietary contribution these food items make.

The fruits of several species are also widely used, particularly of *Salvadora persica* (**xoris**), *Berchemia discolor* (≠ **hûis**), *Ficus sycomorus* (**/nomas**), and various *Grewia* species. These are normally collected following the rainy season and some, including *S. persica*, *B. discolor* and *F. sycomorus*, can be sun-dried and stored for later consumption. Patterns of collection are broadly determined by the distribution of these species. *S. persica*, which is presented in relatively high densities along all the westward flowing river systems in this area, can be easily collected whenever the fruits are available. *B. discolor* and *F. sycomorus* are much more dispersed occurring around areas of permanent surface water such as springs and requiring special collecting trips when the fruits are in season.

Snack foods
Broadly speaking, the exudates produced by species such as *Terminalia prunoides* and *Acacia tortilis* are eaten incidentally as snack foods if found when in the field for some other purpose. They are particularly enjoyed by children who consider them as 'sweets'. Some fruit species such as those from the *Grewia* genus may also fall into this category. The stems of *Hoodia* spp. are also eaten intermittently and have the dual purpose of being considered as both

a food item and having medicinal properties related to lowering high blood pressure, and for relieving stomach, chest and eye complaints.

Earlier ethnobotanical studies

Earlier ethnobotanical studies in similar regions of Damaraland and Kaokoland have also recorded the use of many of these species. Du Pisani (1978: 15), for example, records the use of *Ficus sycamorus* (**/nomas**), *Hoodia* sp. (**!khobas**) and *Grewia flava* or **≠ âun** fruits and Malan and Owen-Smith (1974: 154-63) list the importance of *Salvadora persica* (**xoris**), *Berchemia discolor* (**≠ hûis**), *Grewia* spp., *Ziziphus mucronata* (**≠ aros**), *F. sycomorus*, *Ximenia americana* (**≠ eros**) and *Boscia albitrunca* (**/hunib**). Many of the species from which edible exudates are obtained, such as *Acacia erubescens*, *A. mellifera* subsp. detinens (**!noe.s**) and *A. reficiens* (**!gûb**) reported in Steyn and du Pisani (1985: 44) are also similar and records from the late 19th century and the early 20th century indicate that resins have long been a food resource that was sought after (Von François, 1896: 249-50; Vedder, 1923: 71). While there is some overlap in the range of species recorded in these studies when compared with those recorded by this project, there are also a substantial number of species listed here whose use has not been recorded elsewhere. Similarly, there are species whose utilization is described in other studies of the same region but which were not recorded as utilized for the same purposes in this study.

Seasonality and variability

Two sources of variability in the productivity of species used are likely to affect gathered food use. First is the highly seasonal nature of the environment, and second is the interannual variability in rainfall.

4.3.4 Medicine

Vedder (1928: 46) stated that Damara knowledge of medicine is very small having been acquired only among those people who spent time with Nama, Herero or Bushman groups. The observations of this study, however, indicate that the Damara have a broad secular understanding of common ailments which are treated within the household using remedies for which the necessary knowledge and resources necessary are available to everyone. The cosmopolitan medicinal use of many of these resources reinforces the evidence for the effectiveness of these household medicines.

A total of 38 medicinal species were recorded by this study, 27, 10, and 16 recorded at Sesfontein, Khowarib and the Ugab settlements respectively. A median of only 2 species was recorded for each household (0-12), and Kruskal-Wallis and ANOVA tests indicated that there was no significant difference in numbers of medicinal species recorded in different locations, by male and female interviewees, and by different ages of interviewees. The most commonly used species are indicated in table 5.

Table 5 Recorded use of medicinal species (all species with at least 4 records).

Species	Damara name	part used	purpose	Times use recorded		
				Hoanib n=41	Ugab n=13	Total n=54
Colophospermum mopane	tsauraheis	leaves	head/stomach	15		15
Thamnosa africana	≠hanab	whole plant	multi-purpose	8	15	23
Combretum imberbe	!hab	leaves/bark	stomach/coughs	13		13
Commiphora virgata	/ãnas	leaves/bark	multi-purpose	14		14
Salvadora persica	xoris/gaibeb	roots	multi-purpose	5		5
Terminalia prunoides	≠kheeras	bark/root	stomach	4		4
Ziziphus mucronata	≠aros	roots/bark	multipurpose	5		5
Hoodia spp. cf *currorii*	!khobas	stem/juice	multipurpose	4	9	13
Harpagophytum procumbens(?)	‖ huribe ‖ kham	tuber	stomach/worms	6	1	7
Dicome tormentosa	soreb	whole plant	coughs		10	10
Aloe spp.	koreb	leaves	general/goat med.	16	1	17

4.3.5 'Other' uses and income generation

Thirty-three species were recorded as having uses other than those of the main use categories with 21, 20 and 6 species recorded for Sesfontein, Khowarib and the Ugab settlements respectively. There was a significant difference in the numbers of species with 'other' uses by location of household (Kruskal-Wallis test = 16.65, df=2, p=0.001; ANOVA F=12.55, p=0.0001) reflecting higher numbers recorded for Khowarib households. Higher numbers were also recorded for the older age groups (Kruskal-Wallis = 26.01, df=12, p=0.01) which possibly reflects the retention of knowledge concerning more obscure uses for indigenous plant resources which is now being lost in younger generations.

Table 6 'Other' uses of gathered plant species (all species with at least 3 records).

Species	Damara name	part used	purpose	Times use recorded		
				Hoanib n=41	Ugab n=13	Total n=54
Acacia montis-usti	/hūb	wood	buckets/ ≠goub	7		7
		roots	leather dye	11		11
Colophospermum mopane	tsauraheis	wood	knobkieries etc	7		9
		bark/root	leather dye	7		7
Combretum imberbe	!hab	leaves	leather dye	9		9
Commiphora multijuga	!gãuab	wood	buckets/ ≠goub etc	8		8
		bark	leather dye	2	1	2
Cyperus sp.	!hares	bulb	perfume	2	1	3
			beads	2	1	3
Ficus sycomorus	/nomas	bark	leather dye	8	1	7
Monsonia umbellata	bosu	seeds	beer	4		5

Such uses, as presented in table 6, include, for example, the carving of wood for household utensils, the brewing of beer for domestic consumption and the cosmetic use of species, particularly those which are aromatic. A variety of the latter species are ground into a powder and used as perfume commonly known as **sâi** and often referred to as **buchu** in the historical literature. This body powder is documented as having an important symbolic role including the

following components:
- a girl was instructed in how to make it during a period of seclusion when she experienced her first menstruation. During this time she received her first sâi container which was made out of a tortoise shell and symbolised her femininity;
- sâi symbolised female potency and fertility, made women more attractive and was considered to have both strengthening and calming medicinal properties (Schmidt, 1986: 335).
- as the symbol of feminine life-giving power, it was forbidden for women to use it if their husbands were absent for fear that would increase female strength and thereby reduce male killing potency on their expeditions (e.g. for hunting) (Schmidt, 1986: 336).

Many of these alternative uses of gathered plant resources form the basis for entrepreneurial household activities. A total of 17 species were recorded as used for the purposes of income generation with 7, 11 and 1 recorded at Sesfontein, Khowarib and the Ugab settlements respectively. Kruskal-Wallis and ANOVA analyses revealed no significant difference in the numbers of species used by sex or age of interviewee or by household size. ANOVA of species used for income generation by study site, however, did indicate a significant difference between these sites ($F=3.22$, $p=0.048$). This possibly reflects the establishment in 1992 of a community-run tourist camp at Khowarib, its small craft shop acting as an outlet for the production of crafts from local resources. Table 7 indicates those species most commonly used for income generation.

Table 7 Species used for income generation (all species with at least 3 records).

Species	Damara name	part used	Times recorded		
			Hoanib n=41	Ugab n=13	Total n=54
Berchemia discolor	≠hûis	fruit/wood	5		5
Salvadora persica	xoris	fruit	5		5
Stipagrostis spp.	sâun	seeds: food	3		3
		beer		3	3
		liquor		4	4

Some of these activities can act as significant and regular sources of income, particularly if value is added to the raw resource through processing. For example, the brewing of *Stipagrostis* spp. seeds into beer and, in particular, the distillation of these seeds into a spirit known as **bauga** can earn a household or individual a substantial amount of money. One informant in this study reported that she had earned approximately N$2,500 in the first few months of 1994 through distilling **bauga**. Such activities are almost without exception carried out by women who sell largely to male buyers. In view of the high incidence of female-headed households in this area this rural industry can be seen as being very important in maintaining the economic security of several households.

4.3.6 The importance of woody species for livestock forage

The importance of perennial woody species in the provision of browse for the livestock of pastoralists is usually not given as much attention as the availability of pasture. In many areas of sub-Saharan Africa, however, the productivity of nutritious pasture in response to the low and variable rainfall characteristic of these regions is extremely seasonal in nature. Under these circumstances, there are typically long periods of the year when livestock have to rely on browse as their main form of sustenance. Rees (1974) in Homewood and Rodgers (1991: 159) found, for example, that ±34% of metabolisable energy from forage in the Zambian **chitemene** resource use system during the dry season came from browse and Homewood and Hurst (1986) in Homewood and Rodgers (1991: 159) similarly found that browse comprised up to 40% of wet season feeding time, even though this was the time of peak annual availability of graze. This importance of browse is certainly the case in Namibia, where in years of particularly low rainfall the leaves of perennial woody species may be the primary source of food throughout the year for livestock.

In this study, the significance of woody species in the provision of livestock forage was recognised throughout the households interviewed (Table 8), many people specifying the parts of a species that are particularly nutritious. The nourishing pods of the *Acacias* and the browse and fruits of *Boscia* spp., *Terminalia prunoides* and *Maerua schinzii* are, for example, known to be sought after by domestic livestock and many species of wild herbivores throughout Damaraland and Kaokoland (Hahn, 1928: 229; Malan and Owen-Smith, 1974: 141-59; Steyn and du Pisani, 1985: 49). Wealthy herders with vehicles have even been known to drive to riverine areas where *Acacia* pods are abundant and fill their cars with these pods as feed for the livestock on their farms where such forage resources may be less available (B. Loutit, 1994, pers. comm.).

Table 8 Important livestock forage species (all species with at least 5 records).

Species	Damara name	Times recorded		
		Hoanib n=41	Ugab n=13	Total n=54
Acacia erioloba	‖ ganas	2	12	14
A. tortilis	/narab	24	9	33
Boscia albitrunca	/hunis	6	2	8
Catophractes alexandrii	!gawas	10	10	10
Colophospermum mopane	tsaurahais	9	3	12
Faidherbia albida	anahais	7	13	20
Maerua schinzii	goradab	3	2	5
Salvadora persica	xoris	9	15	24
Terminalia prunoides	≠ kheeras	17		17

This study recorded a total of 35 species important as forage for livestock, with 20, 19 and 17 reported for Sesfontein, Khowarib and the Ugab settlements respectively. Despite these figures for the range of species used at each study site, the Sesfontein households reported significantly lower numbers of forage species than the Khowarib or Ugab households (Kruskal-Wallis test = 14.27, df=2, p=0.001; ANOVA, F=6.86, p=0.002). This perhaps reflects a larger proportion of households interviewed which had no or very low numbers of livestock and were therefore not as forthcoming with stating which species are important as forage. No significant differences were observed in the numbers of forage species reported by age or sex of interviewee or household size.

4.4 Discussion

At this stage, the following features of gathered plant resources, are important in guiding future research:

1. It is apparent that gathered plant species are widely used for a variety of different purposes.

2. There do not appear to be any discernible trends either in numbers of species used or the range of species used by households that would indicate a higher degree of dependence on gathered resources among poorer households. This is suggestive of a cultural preference for these resources rather than their use purely out of economic need. The emphasis placed on gathered food resources as 'our Damara foods' would, for example, indicate that the use of these foods is a source of cultural identification. It is impossible to clarify this issue without observing the relative quantities of these resources used by households characterised by different levels of 'wealth' or access to alternative resources.

3. The high observed incidence of female-headed households has far-reaching implications within this study for issues of resource use and the management of household resources. Even within households where resident men were present it was apparent that women were the primary gatherers of plant resources. This, therefore, requires a focus on women in future research to elucidate their coping strategies under such circumstances.

5.0 Proposed aims and methods for the main period of fieldwork (January 1994 - April 1996)

5.1 Objectives

1. Demand factors

- to quantify the relative significance of gathered resources in their contribution to household food and income security;
- to assess how this contribution changes both in response to environmental factors causing fluctuating productivity, and subsistence factors relating to differing access to alternatives;

2. Supply factors

- to assess:

i. the availability of species categorised as 'useful';

ii. the impact of resource use by different settlements and vegetation formations, and at varying distances from settlement sites;

3. In addition, and in view of current debate concerning the degradation effects of wild resource use in arid lands:

- to assess the implications of vegetation data collected in this study for assertions regarding environmental degradation in Namibia;
- to ascertain the effects of using different scales of analysis on conclusions drawn concerning the ecological impacts of resource use.

5.2 Household components of resource use and subsistence

5.2.1 Sampling strategy and schedule

For the purposes of monitoring and quantifying the throughput of households resources and the relative importance of gathered resources throughout the year, the 16 month fieldwork period will be divided into ±7 x 2-3 month blocks. The two selected study areas will thus be visited every 2-3 months throughout the fieldwork period (±7 visits). The samples from which household resource use data will be derived will have the following multi-level structure.

1. Broad household sample

A relatively broad sample of around 10-15 households in each study area will be carried out in each fieldwork block, focussing on dietary intake, resource use and other dynamic features of subsistence such as the acquisition and/or loss of livestock.

2. Focal households

Within each of the study sites, 4-6 households will be selected as focal households for repeated measurement of gathered and other resource use. Apart from their willingness to participate in the study, these households will be chosen according to levels of household wealth in the form of livestock. Thus the samples from each area will include households with no livestock and those with substantial numbers of livestock.

3. Focal individuals

The individuals comprising each of the focal households will provide the focus for observations concerning individual dietary intake, and for anthropometric measures.

5.2.2 Methods

1. 24-hour dietary recall
This will be the primary technique used in the broad household sample for establishing general dietary patterns, and will also be used in the study of focal households.

2. Monitoring of throughput of resources
In each of the fieldwork 'blocks' 2 days will be spent with each focal household and quantification of the significance of indigenous plant products and other resources to these households will be based on:
Food use
- direct observation of foods consumed and weighing of foods where this does not cause inconvenience;
- 'kitchen surveys' of foods stored in the household;
- 24 hour/3 meal dietary recall, calibrated by occasional weighing or container measurement;
- observation of the sources of consumed foods and collected products and the assigning of foods to different classes depending on their origin, i.e. cultivated, livestock products, bought (using income from which source), and gathered (from where, etc).

Medicine use
Repeat above where appropriate.
Wood use
- measurement of all building materials plus replacements during the fieldwork period;
- frequency of collection of firewood, where collected from, species used and size classes (cf. Poschen and Eiche, 1986: 11, 13);

Further information concerning resource use issues will be derived through:
- informal but semi-structured discussion regarding livestock losses and gains, cash income patterns and the importance of different resources now and in previous years;
- discussion regarding the relative importance of different sources of income and subsistence;
- participation in resource collection and preparation activities.

3. Anthropometry
Standard anthropometric measures will be applied to individuals within the focal households and related to food intake to give some idea of variations in body fat in relation to household resource availability throughout the study period. The measures to be used have been chosen on the basis of their expedience and non-intrusiveness and are as follows:
- biceps and triceps skin-fold thickness using Holtain calipers;
- arm circumference.

5.2.3 Analysis
Within the social and biological sciences it is becoming increasingly recognised that data collected usually have an inherently hierarchical structure. This means that, for example, individuals should be analysed as members of groups and not as samples drawn randomly from a population (Paterson and Goldstein, 1991: 387). Much, if not all, of the data collected by the methods described above may be most appropriately analysed using multilevel modelling techniques, i.e. extensions of ordinary regression analyses which take into account the

hierarchical nature of the data set[7]. These models recognise the importance of understanding the relationships between measurements made at different levels of a hierarchy (Goldstein, 1987: vii). They are also useful for repeated measurement data on individuals in which the lowest level units are measurement occasions and the second level units are individual subjects (Paterson and Goldstein, 1987: 389).

In the final data set envisaged for this project, for example, explanations of the variance in anthropometric measurements of focal individuals is likely to be compounded by the effects of clusters of those individuals coming from the same households and/or having the same parents. Such effects can be taken into account by using the complete data set for longitudinal and cross-sectional analysis so as to not assume that individuals from the same household represent a random sample of the total population (as occurs in single-level regression analyses). Furthermore, by treating higher levels themselves as random samples, inferences can be made concerning variations between the total population at these levels and not only those that comprise the sample, as is the case with standard analyses of covariance (Paterson and Golstein, 1991: 388).

Another advantage of the method for this type of study is that it is insensitive to missing data and, therefore, longitudinal data for individuals and households can be included even if they do not all have the same number of repeat measures.

Analysis will focus on trying to elucidate:
- the effects of differing socio-economic variables on the degree and type of gathered plant resource use and how this varies throughout the study period;
- the consequent effects of these factors on individual dietary intake and nutritional status;
- the possibility of making predictions concerning patterns of resource use that can be expected under varying socioeconomic factors.

5.3 Vegetation work:
The vegetation component of the study will consist of three main elements:
1. survey of perennial woody species;
2. phenology study of a few perennial woody species;
3. field experiments and monitoring of herbaceous growth.

5.3.1 Perennial woody species
Perennial woody species above a threshold basal diameter will be sampled using a 'zig-zag' transect (i.e. plotless) technique. In this sampling method each consecutive tree is sampled according to its proximity to the preceding individual, providing it is within 45° on either side of a stated compass bearing from the preceding individual (Leithead, 1979; Amuyunza, 1988). Each transect will consist of ca. 40 individuals. The strength of this technique lies in the fact that the vegetation itself dictates the length of the transect and, therefore, removes any preconceived ideas concerning density. This feature of the technique is extremely important for an arid area such as Damaraland where vegetation is inherently patchy and dispersed.

[7]The possibility of using software developed by the Institute of Education is currently being explored.

For sampling purposes, the area can clearly be divided into different topographic categories characterised by broadly different vegetation formations. Of these, the categories comprising 'plains' and 'riverine' vegetation will provide the focus for stratified random vegetation sampling because the woody species with the greatest use values tend to come from these broadly defined habitat types. The species occurring on mountain slopes will not be included in this survey due to the following reasons:
- the species with the highest use values do not occur in these formations, although the incidence of endemic species such as *Acacia robynsiana* and *A. montis-usti* on areas of high relief could be considered to raise the conservation value of these habitats;
- the confounding factors of micro-habitat changes in areas of high relief in response to differing altitudes, slope aspect and gradient, substate variability and drainage patterns make it extremely difficult to separate these influences from utilization effects in any analysis of species composition and distribution.

Data recorded for each individual will include:
- species;
- distance between individuals;
- height;
- basal diameter and diameter at breast height (measured in cms). These measurements will be taken in preference to canopy cover which is much harder to measure accurately and which is inherently more variable between years and seasons in response to rainfall;
- apparent use/damage. Following previous fieldwork experience in the area the height of **livestock browse line** will be measured when easily discernible, while **branch removal through cutting by humans** will be indexed subjectively according to a scale such as:
  0 no branch removal;
  1 slight branch removal, i.e. 1-2 large branches or only small branches removed;
  2 moderate branch removal, i.e. 25-50% of branches removed;
  3 severe branch removal, i.e. >50% branches removed;
  4 cut through the main trunk/s so that the height of the tree is substantially reduced.
- apparent coppicing and/or root suckering potential of individuals from which branches have obviously been removed will be recorded as follows:
  - coppicing from main stem;
  - coppicing from lopped branches;
  - regrown as a sucker from the root;
  - unknown, i.e. only recently cut;
  - dead.

5.3.2 Analysis
These data will be appropriate for analysis using vegetation classification and multivariate ordination techniques (see appendix 2) in which measured levels of utilization can be related to floristics, the distribution of woody species providing a long-term indicator of settlement impact. Further components of analysis in relation to different study sites and vegetation formations, at different distances from individual settlements, and under different intensities of apparent utilization include the following:
- plant species diversity using Simpson's index of diversity which calculates the proportion that

each species represents in a sample population and the probability that an individual drawn at random from this population will be of a particular species (Simpson, 1949);
- plant species dominance using Hill's N2 diversity index (Hill, 1973) derived by CANOCO from Simpson's index of diversity and representing the number of effective of dominant species in a sample population (Ludwig and Reynolds, 1988: 85: 90-1);
- mean distance between individuals and overall transect length will provide comparative density indications for different study areas[8];
- differences between areas with regard to the degradation of standing stock and the recruitment of species will be assessed from the sizes of individuals derived from height, basal diameter and diameter at breast height measurements. Further indications of condition of standing stock and regeneration success will be provided by the construction of ratios indicating the proportion of individuals of a particular species which are cut, coppicing or dead compared to the total contribution of that species to the sample. Similarly, complementary measures of recruitment levels will be derived by comparing the contribution of seedlings (i.e. following Viljoen and Bothma (1990: 89) who also worked in the northern Namib-savanna transition zone, established seedlings will be considered as those ≤ 1.50 and > 0.5m tall) compared to that for mature individuals for a given species in each study area.

The household and vegetation data in combination will be used for the following components of analysis aimed at linking household resource use with resource availability and apparent impact caused by utilization.
- the diversity of 'useful' species (i.e. those recorded as having a particular use) will be expressed as a proportion of the total number of species in the different samples for each area and compared to existing information for different vegetation formations[9];
- relative abundance of 'useful' species as a proportion of the vegetation sample;
- the construction of selection ratios to indicate whether species are selected because they are the most abundant or because they are considered superior i.e.

$$SR = \frac{\text{\% contribution of a species to a particular use category}}{\text{\% abundance of that species at the site}}$$

(> 1.5 indicates strong selection) (cf. Sourd and Gautier-Hion, 1986);
- comparison of selection ratios with apparently preferred species to assess differences in supplies of these species in different areas. Discrepancies may indicate serious constraints on the availability of important resources and/or resource degradation.

5.3.3 Phenology

Phenology data is important to ascertain exactly when certain plant products become available for collection given the particular abiotic conditions presented for each study site during the main period of fieldwork. Basic phenology data are lacking for these areas. *Salvadora persica*,

---

[8]Following Leithead (1979: 30) the average number of trees per hectare for a zig-zag transect can be derived by dividing the number of square metres in a hectare (10,000m^2) by the square of the average distance between the trees in the transect (in metres).

[9]Prance *et al* (1987), for example, described only 49%-79% of all species present per hectare plot in Amazonian *terra firme* rainforest (for which biological diversity is stressed as a conservation value) as having a recorded 'use value', whereas Birchenough (1993) found that 83%-92% of all species present per 0.2ha plots in less diverse miombo woodland had local use values.

Berchemia discolor and *Ficus sycomorus* will comprise the sample of woody species selected for phenology observations, these being recorded in the pilot study as the most important fruit-producing species. Individuals of these species will be identified in the vicinity of each of the study areas and phenological information will be recorded in every two month block of fieldwork period. The phenology data collected will include the timing of:
- leaf flushing;
- leaf development;
- leaf senescence;
- leaf fall;
- flower budding;
- flowering and flower fall;
- fruiting and fruit fall;
- *in situ* fruit regeneration;
- incidence of fire, pests, etc.

Following Childes (1989: 154) The relative abundance of leaf buds, mature and dead leaves, flower buds and open flowers, and unripe and ripe fruits, will be assessed subjectively and assigned to one of three categories i.e. none, few, many.

Herbaceous vegetation (with support from the Desert Ecological Research Unit, Namibia)
As stated in the section on the theoretical framework, it is likely that the aridity of the study area will make fluctuating moisture availability the primary determinant of herbaceous productivity. There is, however, a need for the establishment and monitoring of field experiments in which the condition of ground cover in response to factors such as grazing pressure and drought can be assessed.

Field experiments of this sort normally imply the attempt to make comparisons between land subjected to varying intensities of grazing stress, thus requiring the construction of exclosure plots so that grazing can be controlled. As the establishment of such exclosures on communal grazing land could be a potential source of conflict and ill-feeling, it is proposed that this component of the field study should take place on private land as close as possible to the general study region, through agreement with the commercial farmers who own the land. Bioassays comparing soils from the main study areas with those from the site for the herbaceous species monitoring will be carried out to provide some indication of soil fertility differences between these sites.

The objectives of this study will be to assess differences between baseline herbaceous cover (reflecting history of grazing and rainfall patterns in previous years) and subsequent cover during the rainy season of 1996, following a range of grazing intensities and water regimes (i.e. stress factors) imposed during the rainy season of 1995. This will require the establishment of a number of 5 x 5m exclosure plots which will be subjected to the following treatments:

	YEAR 1	
YEAR 2	Natural rainfall	controlled rainfall (simulating drought, i.e. through covering plots)
Natural rainfall	heavy grazing x 3 plots of 5x5m light grazing x 3 plots of 5x5m no grazing x 3 plots of 5x5m	heavy grazing x 3 plots light grazing ... no grazing
Supplemented rainfall (i.e. through watering plots)	heavy grazing light grazing no grazing	heavy grazing light grazing no grazing

6.0 Acknowledgements

This research project is funded by the Economic and Social Research Council. Additional funding for the pilot study was received from the Boise Fund of the Department of Biological Anthropology at Oxford University, and the Parkes Foundation of the Department of Biological Anthropology at the University of Cambridge. Additional financial support for the main period of fieldwork has also been received from the Emslie Horniman and Ruggles-Gates Funds of the Royal Anthropological Institute. The project would not be possible without a grant from UCL's Equipment Fund for the purchase of a field vehicle. Thanks also go to the Graduate School at UCL for the funding of language training in Damara/Nama.

Within Namibia, I should like to acknowledge the assistance of the National Herbarium, the Desert Ecological Research Unit and the Ministry of Environment. Special thanks also go to Linda Baker, Suro !Ganuses, Blythe and Rudi Loutit, Sharon Montgomery, Dr Gillian Maggs and Pat Craven.

Finally, thanks go to my supervisors, Dr Kathy Homewood at UCL and Prof. Phil Stott at SOAS, to Dr Tim Allott at UCL's Geography Dept. for assistance with the multivariate analysis, and to my 'support network' ... my parents, Ruth, Guy, Bruce and especially Phil.

7.0 Bibliography

Abbot, J. (1993) *Sustainability analysis of the use of minor forest produce within Lake Malawi National Park.* Unpub. PhD upgrading report, Dept. of Anthropology, University College London.

Abel, N.O.J. and Blaikie, P.M. (1990) Land degradation, stocking rates and conservation policies in the communal rangelands of Botswana and Zimbabwe. *ODI Pastoral Development Network Paper* 29a.

Agarwal, B. (1989) Rural women, poverty and natural resources: sustenance, sustainability and struggle for change. *Econ and pol. weekly*. Oct. 28: 46-63.

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.

Amuyunza, C.L. (1988) Woodland resources survey in Central Turkana, Kenya. *in* Amuyunza, C.L. and Oba, G. (eds.) *Vegetation resources of Central Turkana district, Kenya.* TREMU Technical Report D-21. UNESCO: Nairobi.

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.

Auerbach, M.J. (1984) Stability, probability and the topology of food webs. pp. 413-36 *in* Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence.* Princeton University Press.

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: Cambridge University Press.

Barrett, S. (1989) On the overgrazing problem. *LEEC paper.* 1989-07.

Barrow, E. (1988) Trees and pastoralists: the case of the Pokot and Turkana. *Social Forestry Network Paper* 6b, ODI.

————, E. (1990) Usufruct rights to trees: the role of Ekwar in dryland central Turkana, Kenya. *Human Ecol.* 18(2): 163-76.

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(1): 61-4.

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. Nairobi, December, 1993.

Bion Griffin, 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*, London: Academic Press, Inc.

Birchenough, (1993)

Blaisdell, J.P. (1958) Seasonal development and yield of native plants on the Upper Snake River and their relation to certain climate factors. *United States Dept. of Agric. Tech. Bull.* 1190.

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.

Büttner, C.G. (1879) The Berg-Damara. *Cape Monthly Magazine*: 285-294.

Bush, M.B. and Whittaker, R.J. (1991) Krakatau: colonization patterns and hierarchies. *J. Biogeogr.* 18: 341-56.

Carney, J.A. (1988) Struggles over crop rights and labour within contract farming households on a Gambian irrigated rice project. *J. of Peasant Studies*. 15(3): 334-349.

Caughley, G., Shepherd, N. and Short, J. (eds.) (1987) *Kangaroos: their ecology and management in the sheep rangelands of Australia*. Cambridge University Press: Cambridge.

————, G. (1987) Ecological relationships. pp. 159-87 *in* Caughley, G., Shepherd, N. and Short, J. (eds.) *Kangaroos: their ecology and management in the sheep rangelands of Australia*. Cambridge University Press.

Chambers, R. and Leach, M. (1989) Trees as savings and security for the rural poor. *World Development* 17(3): 329-42.

Chambers, J.C. and Norton, B.E. (1993) Effects of grazing and drought on population dynamics of salt desert shrub species on the Desert Experimental Range, Utah. *J. Arid Environm.* 24: 261-75.

Childes, S.L. (1989) Phenology of 9 common woody species in semi-arid deciduous Kalahari sand vegetation. *Vegetatio*. 79: 151-63.

Climate Research Unit (1993) *Namibian rainfall data*. University of East Anglia.

Cole, M.M. (1986) *The savannas: biogeography and geobotany*. Academic Press: London.

Connell, J.H. and Sousa, W.P. (1983) On the evidence needed to judge ecological stability or persistence. *American Naturalist*. 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 and IIED: London.

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: 619-24.

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 Environ.* 19: 147-59.

Craven, P. and Marais, C. (1986) *Namib flora*. Gamsberg publishers: Windhoek.

————, P. and Marais, C. (1992) *Damaraland flora*. Gamsberg Macmillan Publishers (Pty) Ltd: Windhoek.

Dahl, G. (1981) Production in pastoral societies. pp. 201- 209 *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.

Davies, A.G. and Richards, P. (1991) Rain forest in Mende life: resources and subsitence strategies in rural communities around the Gola North forest reserv (Sierra Leone). A report to ESCOR, ODA: London.

DAWN (1985) Development crisis and alternative visions: third world women's perspectives. Christian Michelsen Inst.: Bergen.

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.

DeAngelis, D.L. and Waterhouse, J.C. (1987) Equilibrium and nonequilibrium concepts in ecological models. *Ecol. Monogr.* 57: 1-21.

Denbow, J.R. (1984) Prehistoric herders and foragers of the Kalahari: the evidence for 1500 years of interaction. pp. 175-93 *in* Schrire, C. (ed.) *Past and present in hunter gatherer society*, London: Academic Press, Inc.

de Waal, A. (1989) Famine mortality: a case study of Darfur, Sudan 1984-5. *Popn Studs.* 43: 5-24.

di Castri, F. (1986) Commentary. pp. 317-20 *in* Clark, W.C.T. and Munn, R.E. (eds.) *Sustainable development of the biosphere*. Cambridge University Press.

Dierks, K. (1992) *‖khauxa!nas: growing to nationhood*. Longman: Namibia.

Dublin, H.T., Sinclair, A.R.E. and McGlade, J. (1990) Elephants and fire as causes of multiple stable states in the Serengeti-Mara woodlands. *J. Animal Ecol.* 59: 1147-64.

Dublin, H.T. (1991) Dynamics of the Serengeti-Mara woodlands: an historic perspective. *Forest and conservation hist.* 35: 169-78.

Dudziński, 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.

du Pisani, E. (1978) Dama settlement and subsistence along the Ugab Valley, SWA (Namibia). *Navorsinge Van Die Nasionale Museum, Bloemfontein.* 4(1): 1-20.

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: 109-11.

Eden, M.J. (1990) *Ecology and land management in Amazonia*. Belhaven Press: London.

Eibl-Eibesfeldt, H. and Wiessner, P. (1984) Foreword, pp. xiii-xiv *in* Schrire, C. (ed.) *Past and present in hunter gatherer society*, London: Academic Press, Inc.

Eiseb, E., Giess, W. and Haacke, W.H.G. (1991) A preliminary list of Khoekhoe (Nama/Damara) plant names. *Dinteria.* N1 21: 17-30.

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: 502-12.

Ellis, J.E. and Swift, D.M. (1988) Stability of African pastoral ecosystems: alternative paradigms and implications for development. *J. Range Mgmnt.* 41: 450-59.

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 and IIED: London.

Elphick, R. (1977) *Kraal and castle: Khoikhoi and the founding of white South Africa,* Yale University Press: New Haven.

Elton, C.S. (1958) *The ecology of invasions by animals and plants.* Chapman and Hall: London.

Ensminger, J. (n.d.) Monetization of the Galole Orma economy: changes in the use of fuel and woodstock. pp. 124-40 *in* Barnes, C., Ensminger, J. and O'Keefe, P.O. (eds.) *Wood, energy and households: perspectives on rural Kenya.*

Evers, Y. (1994a) Dealing with risk and uncertainty in Africa's drylands: the social dimensions of desertification. *IIED Drylands Network Programme Issue Paper 48.*

Evers, Y. (1994) *Subsistence strategies and wild resource utilization: Pugu Forest Reserve, Tanzania.* MSc thesis, Anthropology Dept. University College London.

Falconer, J. (1990) *The major signficance 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. (1991)

Fuller, B. B. (1993) *Institutional appropriation and social change among agropastoralists in central Namibia, 1916-1988.* Unpublished PhD thesis, Southeastern Massachusetts University.

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.

——————, E.R. (1992a) Semi-arid rangelands: a resource under siege due to patch-selective grazing. *J. Arid Environm.* 22: 191-3.

——————, E.R. (1992b) Ecosystem modification created by patch over-grazing in semi-arid grassland. *J. Arid Environm.* 23: 59-69.

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. (1852) *Interior of South Africa.* London.

Galvin, K.A. (1990) Nutritional ecology of pastoralists in dry tropical Africa. *Amer. J. Hum. Biol.* 4: 209-21.

!Ganuses, S. (1994), Women's Institute of Sesfontein.

Gauch, H.G. (1982) *Multivariate Analysis in Community Ecology.* CUP: Cambridge.

Ghazanfar, S.A. (1991) Vegetation structure and phytogeography of Jabal Shams, an arid mountain in Oman. *J. Biogeogr.* 18: 299-309.

Giess, W. (1971) A preliminary vegetation map of SWA. *Dinteria.* 4: 5-114.

Giess, W. and Tinley, K.L. (1968) South West Africa. pp. 250-4 *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.

Goldsmith, F.B., Harrison, C.M. and Morton, A.J. (1986) Description and Analysis of Vegetation. *in* Moore, P.D. and Chapman, S.B. (eds.) *Methods in Plant Ecology.* Blackwell Scientific Publications: Oxford.

Goldstein, H. (1987) *Multilevel models in educational and social research*. Oxford University Press: London.

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.

Grandin, B. (1988) Wealth and pastoral dairy production: a case study from Maasailand. *Human Ecol.* 16: 1-21.

Hahn, C.H. (1928) Damaraland and the Berg Damaras. *Cape Monthly Magazine.* :218-230, 289-297.

Hall, M. (1984) Frontiers in southern African archaeology. pp. 1-10 *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.

Hall-Martin, A., Walker, C. and Bothma, J du P. (1988) *Kaokoland: the last wilderness.* Southern Book Publishers (Pty) Ltd: Johannesburg, South Africa.

Hardin, G. (1968) The tragedy of the commons. *Science*. 162: 1234-48.

Harpending, H. and Jenkins, T. (1973) Genetic distance among southern African populations. pp. 177-99 *in* Crawford, M.H. and Workman, P.L. (eds.) *Methods and theories of anthropological genetics*. Albuquerque: University of New Mexico Press.

Hartley, D. (1992) *Forest resource use and subsistence i Sierra Leone*. Unpub. PhD thesis, Dept. of Anthropology, University College London.

Hausman, A.J. (1982) The biocultural evolution of Khoisan populations of southern Africa. *Amer. J. Phys. Anthrop.* 58: 315-30.

Hecht, S. and Cockburn, A. (1989) *The fate of the forest: developers, destroyers and defenders of the Amazon*. Penguin: London.

Herskovitz, M.J. (1926) The cattle complex in Africa. *Amer. Anth.* 28.

Hildesheim, S.S. (1986) The relations of Nama and Dama women to hunting. *Sprache und Geschichte in Africa.* 7(1): 329-349.

Hill, M.O. (1973) Diversity and evenness: a unifying notation and its consequences. *Ecology.* 54: 427-432.

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, 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(9): 209-26.

———, H.W. (1976b) On the identity of the stone-working Tjimba, SWA: a comparative study based on fingerprint pattern frequencies. *Cimebasia*. B 2(7): 187-202.

Hoernle, A. (1923) SWA as a primitive culture area. *SA. Geog. Journal.* :14-28.

Holling, C.S. (1973) Resilience and stability of ecological systems. *Annual Reve. of Ecol. and Systematics.* 4: 1-23.

———————, C.S. (1986) The resilience of terrestiral ecosystems: local surprise or global change. pp. 292-317 *in* Clark, W.C.T. and Munn, R.E. (eds.) *Sustainable development of the biosphere*. Cambridge University Press.

Homewood, K. and Hurst, A. (1986) Comparative ecology of pastoralist livestock in Baringo, Kenya. *Pastoral Development Network* 21b. ODI: London.

———————, K. and Rodgers, A. (1991) *Pastoralist development and wildlife conservation in Ngorongoro, Tanzania*. CUP: Cambridge.

———————, K. (1992) Development and the ecology of Maasai pastoralist food and nutrition. *Ecol. of Food and Nutrition*. 29: 61-80.

———————, K. (1993) Pastoralists, environment and development in East Africa. *in* Zaba, B. and Clarke, J. (eds.) *Environment and population change*. IUSSP/BSPS 1992 Symposium. Ordina Editions.

———————, K. (1994) Methods in the study of African land use. *African Studies Center* Working paper 182: Boston University.

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 from the conference held in Nairobi, August 4-8, 1980. IDRC, Canada.

Hulme, M. (1992) Rainfall changes in Africa: 1931-1960 to 1961-1990. *Intern. J. Climatology*. 12: 685-99.

Infoscience (1994) *Report on sustainable development in the Sesfontein/Khowarib Basin*. Windhoek, Namibia.

Irle, J. 1906 *Die Herero: Ein Beitragc zur Landes-, Volks-, und Missionskunde*. Gütesloh: Bertelsmann.

Jacobson, L. (1976) A critical review of the Damaraland Culture. *Cimbebasia*. (B) 2(8): 203-8.

Jacobson, P. (1994) Desert Research Foundation of Namibia.

Janzen, D.H. (1975) *Ecology of plants in the tropics*. Edward Arnold: London.

Joekes, S. and Pointing, J. (1991) *Women in pastoral societies in East and West Africa*. Drylands Network Programme Issues Paper 28. IIED.

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.

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, J. (1983) Walking to the rain: prehistoric nomads of the Brandberg. *SWA Annual* : 93-6.

———————, J. (1986) Settlement patterns and regional exchange: evidence from recent Iron Age sites on the Kavango River, north-eastern Namibia. *Cimbebasia*. (B) 3(4): 109-16.

———————, J. (1990) Four thousand years at the Spitzkoppe: changes in settlement and landuse on the edge of the Namib desert. *Cimbebasia*. 12: 1-14.

———————, J. (1991) *Pastoral nomads of the Central Namib Desert: the people that history forgot*. Namibian Archaeological Trust and New Namibian Books: Windhoek.

———————, Jill. (1990) The impenetrable shield: HMA Nautilis and the Namib Coast in the late 18th century. *Cimbebasia* 12: 23-61.

Knappert, J. (1981) *Namibia: land and people, myths and fables*. E.J. Brill.

Köhler, O. (1959) *A study of Omaruru District South West Africa*. Ethnological Publications 43, Government Printer: Pretoria.

Kolberg, H., Giess, W., Muller, M.A.N. and Strohbach, B. (1992) List of Namibian plant species. *Dinteria*. 22: 1-121.

Lamprey, H.F. (1983) Pastoralism yesterday and today: the overgrazing problem. pp. 643-66 in Bourliere, F. (ed.) *Tropical savannas: ecosystem 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.

Lau, B. (1987) *Southern and central Namibia in Jonker Afrrikaner's Time*. Windhoek Archives Publication Series no. 8 National Archives: Namibia.

Lebzelter, V. (1934) *Eingeborenenkulturen in Südwest- und Südafrika*. Verlag Kal W. Hiersmann: Leipzig.

Le Houerou, 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): 181-9.

Leithead, H.L. (1979) Measuring the growth of trees. *Rangelands.* 1(1): 29-30.

Le Roux, P.J. (1971) *The common names and a few uses of the better known indigenous plants of SWA.* Government Printer: Pretoria.

Leslie, P.W. and Fry. P.H. (1989) Extreme seasonality of births among nomadic Turkana pastoralists. *Amer. J. Phys. Anth.* 79: 103-115.

Loutit, R. (1991) Western flowing ephemeral rivers and their importance to wetlands in Namibia. *Madoqua*. 17(2): 135-40.

Loutit, B. (1994) Save the Rhino Trust, Namibia.

Louw, G.N. and Seely, M.K. (1982) *Ecology of desert organisms*. Longman: London.

Ludwig, J.A. and Reynolds, J.F. (1988) *Statistical Ecology: A Primer on Methods and Computing.* John Wiley and Sons: New York.

Mabbutt, J.A. (1952) The evolution of the middle Ugab Valley, Damaraland, SWA. *Trans. Roy. S. Afr.* 33(3): 333-65.

MacArthur, R.H. (1955) Fluctuations of animal populations and a measure of community stability. *Ecology*. 36: 533-6.

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.

————, J.S. (1974) The Herero-speaking peoples of Kaokoland. *Cimbebasia* (B) 2: 113-29.

————, J.S. (1980) *Peoples of SWA Namibia.* Haum.

————, J.S. and Owen-Smith, G.L. (1974) The ethnobotany of the Kaokoland. *Cimbebasia.* 2(5): 131-78.

Marks, S. (1972) Khoisan resistance to the Dutch in the seventeenth and eighteenth centuries. *J. Afr. Hist.* 13(1): 55-80.

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.

———, R.M. (1972) Will a large complex system be stable? *Nature*. 238: 413-4.

———, R.M. (1973)

———, R.M. (1976) Simple mathematical models with very complicated dynamics. *Nature*. 261: 459-67.

———, R.M. (1977) Thresholds and breakpoints in ecosystems with a multiplicity of stable states. *Nature*. 269: 471-77.

McKenzie, B. (1982) Resilience and stability of the grasslands of Transkei. *Proc. Grassld. Soc. Sth. Afri.* 17: 21-4.

McNaughton, S.J. (1977) Diversity and stability of ecological communities: a comment on the role of empiricism in ecology. *Amer. Nat.* 111: 515-25.

Mendes, C. (1989) *Fight for the forest*. Latin American Bureau: London.

Monimart, M. (1989) Women in the fight against desertification. *Drylands Programme Issues Paper*. 12, IIED.

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.

National Meteorological Library (1993) *Namibian rainfall data 1970-1977*. London.

Niamir, M. (1990) Herder's decision-making in natural resources management in arid and semi-arid Africa. FAO Community Forestry Note 4.

Noy-Meir, I. (1975) Stability of grazing systems: an application of predator-prey graphs. *J. Ecol.* 63: 459-81.

Noy-Meir, I. (1979/80) Structure and function of desrt ecosystems. *Israel J. Bot.* 28: 1-19.

Parkington, J.E. (1984) Soaqua and Bushmen: hunters and robbers, pp. 151-74 *in* Schrire, C. (ed.) *Past and present in hunter gatherer society*, London: Academic Press, Inc.

Paterson, L. and Goldstein, H. (1991) New statistical methods for analysing social structures: an introduction to multilevel models. *British Educational Res. J.* 17(4): 287-93.

Perlov, D.C. (n.d.) Exploiting the forest: patterns and perceptions in Highland Samburu. pp. 141-63 *in* Barnes, C., Ensminger, J. and O'Keefe, P.O. (eds.) *Wood, energy and households: perspectives on rural Kenya*.

Peters, C.M. Gentry, A.H. and Mendelsohn, K.O. (1989) Valuation of an Amazonian rainforest. *Nature*. 339: 655-6.

Pimm, S.L. (1984) Food chains and return times. pp. 397-412 *in* Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence*. Princeton University Press.

———, S. (1991) *The balance of nature?* University of Chicago Press.

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.

Prance, G.T., Balée, W., Boom, B.M. and Carneiro, R.L. (1987) Quantitative ethnobotany and the case for conservation in Amazonia. *Conservation Biol.* 9(4): 296-310.

Pratt, D.J. and Gwynne, M.D. (1977) *Rangeland management and ecology in east Africa*. Robert, E. Krieger Publishing Co.: New York.

Raikes, P. (1981) *Livestock development and policy in East Africa*. Centre for Development Research: Copenhagen, Scandinavian Institute of African Studies: Uppsala.

Rees, W.A. (1974) Preliminary studies into bush utilization by cattle in Zambia. *J. Applied Ecol.* 11: 207-214.

Richards, P. (1985) *Indigenous agricultural revolution: ecology and food production in West Africa*. Unwin Hyman: London.

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.

Rohde, R. (1993) *Afternoons in Damaraland: common land and common sense in one of Namibia's former 'homelands'*. Occasional paper 41, Centre for African Studies: Edinburgh University.

———, (1994) Tinkering with chaos: towards a communal land tenure policy in former Damaraland. *SSD Discussion Paper*, 8 . University of Namibia.

Rudner, J. (1957) The Brandberg and its archaeological remains. *J. of the SWA Scientific Soc.* 12: 7-44.

Russell, E.W. (1977) Foreword. pp. vii-viii *in* Pratt, D.J. and Gwynne, M.D. *Rangeland management and ecology in east Africa*. Robert, E. Krieger Publishing Co.: New York.

Sandelowsky, B.H. (1977) Mirabib: and archaeological study in the Namib. *Madoqua*. 10(4): 221-84.

———, B.H., Van Rooyen, J. and Vogel, J. (1979) Early evidence for herders in the Namib. *S. African Arch. Bull.* 34: 15-32.

Sandford, S. (1983) *Management of pastoral development in the third world*. John Wiley and Sons: Chichester.

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.

Schmidt, S. (1986) The relations of Nama and Dama women to hunting. *Sprache und Gesichichte in Afrika* 7.1: 329-49.

Scholes, R.J. and Walker, B. H. (1993) *An African savanna: synthesis of the Nylsvley study*. Cambridge University Press: Cambridge.

Schreckenberg, K. (1994) *The role of indigenous tree products in the west African savanna with particular reference to the Bassila Region of Benin*. Unpub. manuscript.

Schrire, C. (1980) An enquiry into the evolutionary status and apparent identity of San hunter-gathers, *Human Ecology*, 8: 9-32.

———, C. (ed.) (1984a) *Past and present in hunter gatherer society*, London: Academic Press, Inc.

———, (1984b) Wild surmises on savage thoughts. pp. 1-25 *in* Schrire, C. (ed.) *Past and present in hunter gatherer society*, London: Academic Press, Inc.

———, (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*, London: Academic Press, Inc.

Schulze, R.E. and McGee, O.S. (1978) Climate indices and classifications in relation to the biogeography of southern Africa. pp. 19-52 *in* Werger, M.J.A. (ed.) Biogeography and ecology of southern Africa. *Monogr. Biol.* 31. Junk: the Hague.

Simpson, E.H. (1949) Measurement of diversity. *Nature*, 163: 688.

Sourd, C. and Gautier-Hion, . (1986) Fruit selection by a forest guenon. *J. Animal Ecol.* 55: 235-44.

Stebbings, E.P. (1935) The encroaching Sahara. *Geog. J.* 86: 510.

Steyn, H.P. and du Pisani, E. (1985) Grass-seeds, game and goats: an overview of Dama subsistence. *SWA Wissenschaftliche Gessellschaft.* 39: 37-52.

Stiles, D. and Kassam, A. (1991) An ethno-botanical study of Gabra plant use in Marsabit District, Kenya. *J. East Afr. Nat. Hist. Soc and National Museum.* 81(8): 14-24.

Stott, P. (1994) Head of Dept., Dept. of Geography, School of Oriental and African Studies: London.

Swift, J. (1977) Sahelian pastoralists: underdevelopment, desertification and famine. *Ann. Rev. Anthrop.* 6: 457-78.

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.

ter Braak, C.J.F. (1986) Canonical Correspondence Analysis: a new eigenvector technique for multivariate direct gradient analysis. *Ecology.* 67(5): 1167-79.

-————-, C.J.F. (1987a) The analysis of vegetation-environment relationships by CCA *Vegetatio.*: 69-77.

-————-, C.J.F. (1987b) Partial correspondence analysis *in* Beck, H.H. (ed.) *Classification and related methods of data analysis.* Proceedings of IFCS Conference, June 1987, Amsterdam, Holland: 557-564.

-————-, C.J.F. (1988) CANOCO - and extension of DECORANA to analyse species-environment relationships. *Vegetatio,* 75: 159-160.

Thompson, T.B. (1786) Manuscript entitled: *Narrative of a voyage performed in His Majesty's Sloop Nautilis, under my command, for the purpose of investigating the western coast of South Africa, from latitude 33° 00'00"S to 16° 00'00"S.* Ref. no. Adm 55/92, Public Record Office, Kew Botanic Gardens.

Union of South Africa, (1918) *Report on the natives of South West Africa and their treatment by Germany.* London: His Majesty's Stationary Office.

Van den Eynden, V., Vernemmen, P. and Van Damme, P. (1992) *The ethnobotany of the Topnaar.* Universiteit Gent and EEC.

Van der Merwe, J.H. (ed.) (1983) *National atlas of South West Africa (Namibia).* Windhoek: Directorate of Development Co-ordination.

Van Rooyen, M.W., Grobbelaar, N., Theron, G.K. and Van Rooyen, N. (1992) The ephemerals of Namaqualand: effect of germination date on the development of three species. *J. Arid Envionm.* 22: 51-66.

Van Warmelo, N.J. (1962) *Notes on the Kaokoveld (South West Africa).* Ethological Publications 26, Government Printer: Pretoria.

Vedder, H. (1928) The Berg Damara. *in. The Native Tribes of South West Africa.* Cape Town: Cape Times Ltd.

Viereck, A. (1967) The Damaraland Culture: a 'Later Stone Age' horizon in SWA. *J. of the SWA Scientific 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.* Baensch: Magdeburg.

Von Harmse, M.J. (1978) Schematic soil map of southern Africa south of latitude 16°30'S. pp. 71-5 *in* Werger, M.J.A. (ed.) Biogeography and ecology of southern Africa. *Monogr. Biol.* 31. Junk: the Hague.

Wadley, L. (1979) Big elephant shelter and its role in the Holocene prehistory of central South West Africa. *Cimbebasia* B 3(1): 1-76.

Walker, B.H. and Noy-Meir, I. (1982) Aspects of stability and resilience of savanna ecosystems. pp. 556-90 *in* Huntley, B.J. and Walker, B.H. (eds.) *Ecology of tropical savannas. Ecological Studies* 42. Springer-Verlag, New York.

Walter, H. (1955) Le Facteur eau dans les régions arides et sa signification pour l'organisation de la végétation dans les contrées sub-tropicales. *Collogue sur les régions écologiques du globe.* 59: 27-39.

———, H. (1971) *Ecology of tropical and subtropical vegetation.* Oliver and Boyd: Edinburgh.

Waters-Bayer, A. (1985) *Dairying by settled Fulani women in Central Nigeria and some implications for dairy development.* Pastoral Development Network Paper 20c, ODI.

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.

Werger, M.J.A. (ed.) (1978) Biogeography and ecology of southern Africa. *Monogr. Biol.* 31. Junk: the Hague.

———, M.J.A. (1978) Biogeographical division of southern Africa. pp. 145-70 *in* Werger, M.J.A. (ed.) Biogeography and ecology of southern Africa. *Monogr. Biol.* 31. Junk: the Hague.

———, M.J.A. (1978) The Karoo-Namib domain. pp. 231-99 *in* Werger, M.J.A. (ed.) Biogeography and ecology of southern Africa. *Monogr. Biol.* 31. Junk: the Hague.

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 Magmt.* 42: 266-74.

White, . (1983) *The vegetation of Africa.* UNESCO: Paris.

Whitehead, A. (1990) Food crisis and gender conflict in the African countryside. pp. 54-67 *in* Bernstein, H., Crow, B., Mackintosh, M. and Martin, C. (eds.) *The Food Question.* Earthscan Publications Ltd: London.

Wiens, J. (1984) On understanding a non-equilibrium world: myth and reality in community patterns and processes. pp. 439-57 *in* Strong, D.R., Simberloff, D., Abele, L.G. and Thistle, A.B. (eds.) *Ecological communities: conceptual issues and the evidence.* Princeton University Press.

Williamson, J. (1956) *Useful plants of Malawi.* Government Printer: Zomba.

Wilmsen, E.N. (1989) *Land filled with flies: a political economy of the Kalahari.* University of Chicago Press: London.

Wolf, A. (1983) Simplicity and universality in the transition to chaos. *Nature.* 305: 182-3.

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.

Appendix 1 Recorded uses of indigenous plants in the Damaraland area of north-west Namibia.

KEY

Order of families follows Kolberg *et al* (1992).

Specimens collected by the author are deposited at the National Herbarium of Namibia, Windhoek.

? - species that need to be positively identified with specimens from the field.
* - introduced species.

MED: - medicinal uses
(Ses) - Sesfontein
(Kho) - Khowarib
D - Damara
D/N - Damara/Nama (Sesfontein only)
H - ovaHerero
HHs. - households

Household sample sizes:
Hoanib river:
Sesfontein (1994 survey) = 32 households
(28 Damara/Nama; 4 ovaHerero)
Khowarib (1992 survey) = 13 households (Damara)
Ugab river settlements: = 13 households (Damara)

PLANT FAMILY: ?0. ALARIACEAE
Ecklonia sp.
Damara name: hurib!guib; //gam-!guib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	burn/sore	plant	powder						
Ugab	D			1	burn/sore	plant	powder						

PLANT FAMILY: 0130. WELWITSCHIACEAE
Welwitschia mirabilis Hook. F.
Damara name: !kharos
Herero name: onyanga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 17.)	D/N	1	cones										

PLANT FAMILY: 0160. MORACEAE
Ficus cordata Thunb. subsp. cordata
Damara name: //ui; /nomtabes
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D/N			1	kidney	bark	decoction						
Hoanib (Ses) (SS 17.)	D/N										leather dye	bark	1

Ficus sycomorus L.
Damara name: /nomas
Herero name: omukuyu (tree); omakuju (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	3	fruit								leather dye	bark	3
Hoanib (Ses)	D/N	15	fruit								leather dye	bark	5
Hoanib (Ses)	H	1	fruit										
Ugab	D	2	seeds										
Ugab	D	9	fruit								leather dye	bark	1

PLANT FAMILY: 0190. OLACACEAE
Ximenia americana L. subsp. microphylla
Damara name: ǂeron\s
Herero name: omunjinga; ozonjinga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	fruit										
Hoanib (Ses)	H	2	fruit										
Hoanib (Ses) (SS 12.)	D/N	11	fruit						1	food			

PLANT FAMILY: 0190. OLACACEAE
Ximenia americana L. subsp. *microphylla*
Damara name: ‡eron\s
Herero name: omunjinga; ozonjinga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	6	fruit										

PLANT FAMILY: 0220. LORANTHACEAE
Tapinanthus oleifolius (Wendl.) Danser
Damara name: hai-!huis\b
Herero name: oviraura

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 01.)	D/N	1	nectar					1					
Hoanib (Ses) (SS 01.)	H	1	nectar	1	gonorrhoea	leaves/stem	decoction	1					
Ugab	D	1	nectar					2					

PLANT FAMILY: 0225. VISCACEAE
Viscum rotundifolium L.f.
Damara name:
Herero name: oviraura

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 02.)	D/N	1	fruit										

PLANT FAMILY: 0250. NYCTAGINACEAE
Phaeoptilum spinosum Radlk.
Damara name: //arib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D			1	diarrhoea	roots	decoction						

PLANT FAMILY: 0270. AIZOACEAE
Trianthema triquetra Willd. subsp. *parvifolia* (Sonder) Jeffrey
Damara name: ‡urusoab; ‡nurusoab
Herero name: onona (plant); oruandjero (food from plant)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	seeds										
Hoanib (Ses) (SS 14.)	D/N	3	seeds										
Hoanib (Ses) (SS 14.)	H	1	seeds					1					
Ugab	D	1	seeds										

PLANT FAMILY: 0270. AIZOACEAE
Trianthema triquetra Willd. subsp. parvifolia (Sonder) Jeffrey
Damara name: ǂurusoab; ǂnurusoab
Herero name: onona (plant); oruandjero (food from plant)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

PLANT FAMILY: 0320. CHENOPODIACEAE
Suaeda plumosa Aellen
Damara name: ǂaub
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab (SS 23.)	D							1					

PLANT FAMILY: 0330. AMARANTHACEAE
Amaranthus sp. (?)
Damara name: /horob; !horob
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	4	leaves										
Hoanib (Ses)	D/N	1	roots										
Hoanib (Ses)	D/N	3	leaves						1	food			

Calicorema capitata (Moq.) Hook. F.
Damara name: ǂnugus
Herero name: ongarad\ti

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H							1			beer/wine	root	1

PLANT FAMILY: 0470. CAPPARACEAE
Boscia albitrunca (Burchell) Gilg & Benedict
Damara name: /hunib\s
Herero name: omutendereti; epembati

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	fruit					4					
Hoanib (Ses)	D/N	3	fruit					2					
Hoanib (Ses)	H										milk pails	roots	1
Hoanib (Ses)	H	1	fruit					1			beer	fruit	1
Ugab	D	4	fruit					2					

PLANT FAMILY: 0470. CAPPARACEAE

Boscia albitrunca (Burchell) Gilg & Benedict
Damara name: /hunib\s
Herero name: omutendereti; epembati

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Boscia foetida Schinz
Damara name: xaubes
Herero name: otjinautoni

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							1					
Hoanib (Ses)	D/N							1					
Hoanib (Ses)	H	1	fruit	1	coughs	twigs	decoction	1					
Ugab	D	2	fruit					2					

Cadaba schroeppeli Suesseng.
Damara name:
Herero name: okahuno kondo

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H							1					

Maerua schinzii Pax
Damara name: goradab; //gae-dab
Herero name: etengu; omuhaseviwa

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			1	earache	root	ointment	1					
Hoanib (Ses)	D/N			2	eyes	leaves	ointment	2					
Hoanib (Ses)	H							1					
Ugab	D							2					

PLANT FAMILY: 0500. MORINGACEAE

Moringa ovalifolia Dinter & Berger
Damara name: !khoe‡hanus
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N										perfume (sâi)	bark	1

PLANT FAMILY: 0510. MYROTHAMNACEAE
Myrothamnus flabellifolius Welw.
Damara name: //khootorotorosen (green); !hotorotorosen (dry)
Herero name: ohandukaze

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N										tea	leaves	3
Hoanib (Ses)	H										tea	leaves	1

PLANT FAMILY: 0600. FABACEAE
Acacia erioloba E. Meyer
Damara name: //ganab; //ānas
Herero name: otumbuende

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							1					
Hoanib (Ses)	D/N							1					
Hoanib (Ses)	H			1	general health	smoke, pod	burnt						
Ugab	D							12					

Acacia karroo Hayne (?)
Damara name: //hus
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	exudate										

Acacia mellifera (Vahl) Benth. subp. detinens (Burchell) Brenan
Damara name: !noes
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	4	exudate										
Hoanib (Ses)	H	1	exudate										
Ugab	D	5	exudate					1					

Acacia montis-usti Merxm.& A. Schreiber
Damara name: /hūb; /hū-haib
Herero name: omutungi (tree); ozondowa (fruits)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										buckets	wood	1
Hoanib (Kho)	D										spoons	wood	2
Hoanib (Kho)	D	1	exudate					1	1	goub	leather dye	roots/bark	7
Hoanib (Kho)	D	1	root								ǂgoub	wood	4
Hoanib (Ses)	D/N	1	seeds								leather dye	roots/bark	4

PLANT FAMILY: 0600. FABACEAE

<u>Acacia montis-usti</u> Merxm.& A. Schreiber
Damara name: /hūb; /hū-ḫajb
Herero name: omutungi (tree); ozondowa (fruits)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H			1	chest pain	bark	decoction						

<u>Acacia reficiens</u> Wawra subsp. <u>reficiens</u>
Damara name: !gûb
Herero name: omungondo

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	3	exudate										
Ugab	D			1	diarrhoea	root	decoction						

<u>Acacia robynsiana</u> Merxm. & A. Schreiber
Damara name: !nueb
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

<u>Acacia senegal</u> (L.) Willd. var. <u>rostrata</u> Brenan
Damara name: nûb; tûn
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	6	exudate										
Hoanib (Ses)	D/N	4	exudate										
Hoanib (Ses)	H	1	exudate										

<u>Acacia</u> sp.
Damara name: !uri!huni; !goros\b
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	1	exudate										
Hoanib (Ses)	D/N	2	exudate										
Ugab	D	3	exudate										

PLANT FAMILY: 0600. FABACEAE

Acacia sp.
Damara name: herare
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N										perfume (sâi)	exudate	2
Ugab	D										perfume (sâi)	exudate	1

Acacia sp. cf. *reficiens*
Damara name:
Herero name: orupunguja

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H							1					

Acacia tortilis (Forsskal) Hayne subsp. *heteracantha* (Burchell) Brenan
Damara name: /narab
Herero name: omunjarava

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	12	exudate	1	back pain	root		4					
Hoanib (Ses)	D/N	9	exudate					20					
Hoanib (Ses)	D/N	9	pods										
Hoanib (Ses)	H	1	pods										
Hoanib (Ses)	H	2	exudate					1					
Ugab	D	10	pods					9					

Caeselpinia rubra (Engl.) Brenan (?)
Damara name: au-a-uri
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	burns	leaves	powder						
Hoanib (Ses)	D/N			1	throat	seeds					perfume (sâi)	leaves	2

Colophospermum mopane (Kirk ex Benth.) Kirk ex Leonard
Damara name: tsaurahais\b
Herero name: omutati

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										bow	branch	1
Hoanib (Kho)	D										digging stick	twig	1
Hoanib (Kho)	D										pipes	wood	1
Hoanib (Kho)	D										spoons	wood	3
Hoanib (Kho)	D			2	headache	leaves	poultice		1	knobkieries	knobkieries	wood	1

PLANT FAMILY: 0600. FABACEAE

<u>Colophospermum mopane</u> (Kirk ex Benth.) Kirk ex Leonard
Damara name: tsaurahais\b
Herero name: omutati

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Kho)	D			5	stomach	leaves	decoction	3	1	firewood	leather dye	bark/roots	6
Hoanib (Ses)	D/N			1	headache	leaves	poultice						
Hoanib (Ses)	D/N			7	stomach	leaves	decoction	6			leather dye	bark	1
Ugab	D							3					

<u>Faidherbia albida</u> (Del.) A. Chev
Damara name: ana
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Kho)	D							4					
Hoanib (Ses)	D/N							3					
Ugab	D							13					

<u>Parkinsonia africana</u> Sonder (?)
Damara name: !khaas\b; !khâb;
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Kho)	D										leather dye	roots	1
Hoanib (Ses)	D/N			1	coughs	leaves	decoction						
Ugab	D	1	pod										

<u>Prosopis grandulosa</u> Torrey* (?)
Damara name: /aras
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Ugab	D	1	pod										

Damara name: /hubes
Herero name: ehuu

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	H	1	pod										

PLANT FAMILY: 0600. FABACEAE
Sesbania sphaerosperma Welw.
Damara name: nana-tu
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N										coffee	seeds	2

PLANT FAMILY: 0640. GERANIACEAE
Monsonia sp. cf. umbellata Harvey
Damara name: bosu
Herero name: ondami; omurondji

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	5	seeds								beer	seeds	2
Hoanib (Ses)	D/N										tea	flowers	1
Hoanib (Ses)	D/N	11	seeds								beer	seeds	2
Hoanib (Ses)	H	2	seeds								beer	seeds	1
Ugab (SS 20.)	D										tea	flowers	1
Ugab (SS 20.)	D	11	seeds								beer	seeds	1

PLANT FAMILY: 0650. ZYGOPHYLLACEAE
Tribulis zeyheri Sonder
Damara name: /hinis; /kinis
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Zygophyllum simplex L.
Damara name: /âgeame
Herero name: onona

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 09.)													

PLANT FAMILY: 0670. EUPHORBIACEAE
Euphorbia damarana Leach
Damara name: //haos; kuib
Herero name: otjiharava; otjintine

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

PLANT FAMILY: 0670. EUPHORBIACEAE

Euphorbia damarana Leach
Damara name: //haos; kuib
Herero name: otjiharava; otjintine

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Euphorbia kaokoensis (White, Dyer & Sloane) Leach (?)
Damara name:
Herero name: ohahi

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H			1	pain relief	stems	powder in tattoos						

Euphorbia virosa Willd.
Damara name: //khaos/b
Herero name: eyao

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Ricinis communis L.*
Damara name: /hera
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Spirostachys africana Sonder
Damara name: auib; au-haib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D								1	beads			
Hoanib (Ses)	D/N			1	chest	wood	decoction				beads	wood	2
Hoanib (Ses)	D/N			2	stomach	wood	decoction				perfume (sâi)	wood	1
Ugab	D			1	chest	wood	decoction						

PLANT FAMILY: 0680. RUTACEAE

Thamnosa africana Engl.
Damara name: ǂhanab
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	prevents pregnancy	plant	decoction						
Hoanib (Ses)	D/N			2	cough	plant	decoction						
Hoanib (Ses)	D/N			2	multivitamin	leaves	decoction						
Hoanib (Ses)	D/N			3	cleanse uterus	plant	decoction						
Ugab	D			4	cleanse uterus	plant	decoction						
Ugab	D			4	multivitamin	leaves	decoction						
Ugab	D			7	cough		decoction						

Zanthoxylum ovatifoliolatum (Engl.) Finkelstein
Damara name: nokoma; /noboheda; pepahais
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N										perfume (sâi)	dry fruit	1

PLANT FAMILY: 0700. BURSERACEAE

Commiphora anacardifolia Dinter & Engl.
Damara name: !khoebeb; !khōe-anub
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										ǂgoub	wood	2
Hoanib (Ses)	D/N										ǂgoub	wood	1

Commiphora crenato-serrata Engl.
Damara name: antob; anto-hais
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										ǂgoub	wood	1
Hoanib (Kho)	D										leather dye	bark	2
Hoanib (Kho)	D										pipes	wood	1
Ugab	D			1	cough	bark	decoction						

PLANT FAMILY: 0700. BURSERACEAE

Commiphora krauseliana Heine (?)
Damara name: !hâs; /ana
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Ugab	D							1					

Commiphora multijuga (Hiern) Schumann
Damara name: !gâuab
Herero name: omuzumba

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Kho)	D										‡goub	wood	2
Hoanib (Kho)	D										buckets	wood	1
Hoanib (Kho)	D										leather dye	bark	2
Hoanib (Kho)	D										pipes	wood	2
Hoanib (Kho)	D								1	spoons	spoons	wood	2
Hoanib (Ses)	D/N							1			‡goub	wood	1
Hoanib (Ses)	H							1			perfume (sâi)	bark	1

Commiphora pyracanthoides Engl.
Damara name: /in‡b
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Kho)	D							2					

Commiphora sp. cf. tenuipetiolata Engl.
Damara name:
Herero name: omungorua

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	H							1			leather dye	bark	1

Commiphora sp. cf. virgata Engl.
Damara name:
Herero name: omumbara

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	H			1	indigestion	twigs	chew				perfume (sâi)	bark	1

PLANT FAMILY: 0700. BURSERACEAE
Commiphora sp. cf. virgata Engl.
Damara name:
Herero name: omuwonga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H	1	fruit								chewstick	twigs	1

Damara name: /ânas\n
Herero name: omuwonga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			1	coughs	leaves	decoction	2					
Hoanib (Ses)	D/N			2	post natal	leaves/bark	decoction						
Hoanib (Ses)	D/N			2	stomach	leaves/bark	decoction						
Hoanib (Ses)	D/N			3	cough	leaves	decoction	1					
Hoanib (Ses)	D/N			3	general health	leaves/bark	body wash						
Hoanib (Ses)	D/N			3	general health	leaves/bark	decoction						

PLANT FAMILY: 0780. SALVADORACEAE
Salvadora persica L.
Damara name: xoris; kaibeb (large fruits)
Herero name: omungambu (tree); otjingandiona (small fruit); ozongambu (late, large fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			1	gonorrhoea	roots	decoction						
Hoanib (Kho)	D	13	fruit	1	stomach	roots	decoction	2	2	food	beer	fruit	1
Hoanib (Ses)	D/N			1	stomach	roots	decoction						
Hoanib (Ses)	D/N	28	fruit	2	colds; coughs	roots	decoction	7	3	food	sugar	fruit	2
Hoanib (Ses)	H			1	gonorrhoea	roots	decoction						
Hoanib (Ses)	H	2	fruit	2	colds; coughs	roots	decoction	1					
Ugab	D	12	fruit					6					

PLANT FAMILY: 0790. RHAMNACEAE
Berchemia discolor (Klotzsch) Hemsley
Damara name: ǂhûis
Herero name: omuve (tree); ozonbe (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D								1	knobkieries	knobkieries	wood	1
Hoanib (Kho)	D	10	fruit						4	food	beer	fruit	1
Hoanib (Ses)	D/N	25	fruit										
Hoanib (Ses)	H	3	fruit										
Ugab	D	2	fruit										

PLANT FAMILY: 0790. RHAMNACEAE
Ziziphus mucronata Willd.
Damara name: ǂaros\n\ǂ
Herero name: omukaru (tree); otjongaro\ozongaro (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			1	back pain	bark	decoction						
Hoanib (Kho)	D	5	fruit	1	cough/chest	roots	decoction				knobkieries	wood	1
Hoanib (Ses)	D/N			1	cough/chest	roots	decoction						
Hoanib (Ses)	D/N	13	fruit	2	diarrhoea	roots	decoction						
Hoanib (Ses)	H	2	fruit										
Ugab	D	2	fruit										

PLANT FAMILY: 0800. VITACEAE
Cyphostemma uter (Exell & Mendonca) Desc.
Damara name: kowas
Herero name: omutjindi; omutindi

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	1	fruit										
Hoanib (Ses)	H	2	fruit										

PLANT FAMILY: 0810. TILIACEAE
Grewia sp.
Damara name:
Herero name: omuvapu

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H										knobkieries	wood	1

Damara name: ǂâun\s
Herero name: omutjendyere (tree); ozutjendyere (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	9	fruit						1	food			
Hoanib (Ses)	D/N	9	fruit										
Hoanib (Ses)	H	3	fruit	1	stomach (babies)	bark/root	drink	1					
Ugab	D	8	fruit								arrows	branch	1

Damara name: !naruse
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	fruit										

PLANT FAMILY: 0810. TILIACEAE

Grewia sp.
Damara name: !naruse
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Damara name: //narabes
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	3	fruit										
Hoanib (Ses)	D/N	3	fruit										

Grewia sp. (cf. flavescens Juss.)
Damara name: //aib; //naib\n
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	5	fruit										

Herero name: omusepa (tree); ozosepa (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										digging stick	wood	1
Hoanib (Kho)	D	4	fruit								rake handles	wood	1
Ugab	D	3	fruit										

Damara name: sabibes\n
Herero name: omuhamati (tree); ozuhamati (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	9	fruit	1	stomach	roots	cook, eat				spoons	wood	1
Hoanib (Ses)	D/N	4	fruit										
Hoanib (Ses)	H	3	fruit										
Ugab	D	3	fruit										

PLANT FAMILY: 0840. STERCULIACEAE
Hermannia modesta (Ehrenb.) Masters
Damara name: oara
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 05.)													

PLANT FAMILY: 0900. TAMARICACEAE
Tamarix usneoides E.Meyer ex Bunge
Damara name: dabib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										spoons	wood	1
Ugab	D							2					

PLANT FAMILY: 0940. CUCURBITACEAE
Acanthosicyos horridus Welw. ex Hook. F.
Damara name: !narab
Herero name: omungaraha

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	3	fruit	1	stomach	root	decoction						
Ugab	D			3	stomach	root	decoction						

Citrillus ecirrhosus Cogn.
Damara name: tsamas
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	2	fruit										

Coccinia sp. (?)
Damara name: /hâs; /kiros (fruits); /âan
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	fruit					1					
Ugab	D	2	fruit										

PLANT FAMILY: 0990. COMBRETACEAE

Combretum apiculatum Sonder
Damara name: ‡ōn
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							1					

Combretum imberbe Wawra
Damara name: !hāb
Herero name: omuborombonga

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			6	coughs	leaves					leather dye	leaves/bark	7
Hoanib (Ses)	D/N			1	stomach	leaves/bark	decoction						
Hoanib (Ses)	D/N			4	coughs	leaves/bark	decoction	1			leather dye	leaves	2
Hoanib (Ses)	H			2	coughs	leaves	decoction						
Ugab (SS 18.)	D							2					

Combretum wattii Exell
Damara name:
Herero name: omutapati

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Terminalia prunoides Lawson
Damara name: ‡kheeras
Herero name: omuhama

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D			1	swelling	bark	poultice				hoe handles	wood	1
Hoanib (Kho)	D	9	exudate	1	stomach	bark/root	decoction	9	1	knobkieries	knobkieries	wood	1
Hoanib (Ses)	D/N	2	exudate	1	stomach	bark/root	decoction	8					
Hoanib (Ses)	H	1	exudate	1	stomach	bark/root	chew	1					
Ugab	D	2	exudate										

PLANT FAMILY: 1070. EBENACEAE

Euclea pseudebenus E. Meyer ex A. DC.
Damara name: tsabis\b
Herero name: omuzema

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D										spoons	wood	1
Hoanib (Ses)	D/N	4	fruit								spoons	wood	2
Ugab	D	1	fruit										

PLANT FAMILY: 1070. EBENACEAE
Euclea pseudebenus E. Meyer ex A. DC.
Damara name: tsabis\b
Herero name: omuzema

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

PLANT FAMILY: 1140. ASCLEPIADACEAE
Fockea angustifolia K. Schum
Damara name: ǂhawas; //hawas
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	2	tuber										
Ugab	D	3	tuber										

Damara name: !na-ǂhawab
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	stomach, diarrhoea	?							

Hoodia currorii (Hook.) Decne. var. currorii
Damara name: !khobas\b
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab (SS 24.)	D			5	high blood pressure	stems	eaten						
Ugab (SS 24.)	D	5	stems	4	stomach, coughs	stems	eaten						

Hoodia sp. cf currorii (Hook.) Decne. var. currorii
Damara name: !khobas\b
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	6	stems	1	eyes	juice	ointment						
Hoanib (Ses)	D/N			1	high blood pressure	stems	eaten						
Hoanib (Ses)	D/N			1	stomach, coughs	stems	eaten						
Hoanib (Ses)	D/N	7	stems	1	eyes	juice	ointment		1	food			

PLANT FAMILY: 1140. ASCLEPIADACEAE
Orthanthera albida Schinz
Damara name: /hāurutabes
Herero name: orunavi

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	6	pods					3					
Hoanib (Ses)	H	1	pods					1					

Pergularia daemia (Forsskal) Chiov. (?)
Damara name: dai-!guib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N							1					

PLANT FAMILY: 1200. BORAGINACEAE
Cordia gharaf (Forsskal) Ehrenb. ex Asch.
Damara name: //khōs
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	5	fruit						1	ǂgoub			
Hoanib (Ses)	D/N	1	fruit										
Ugab	D	5	fruit										

Damara name: /ais
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	7	fruit										
Hoanib (Ses) (SS 13.)	D/N	3	fruit										
Ugab	D	4	fruit								bows	branch	1

Ehretia rigida (Thunb.) Druce (?)
Damara name:
Herero name: omusepa (tree); ozosepa (fruit)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H	1	fruit										

PLANT FAMILY: 1280. BIGNONIACEAE
Catophractes alexandri D.Don
Damara name: !gawas\b
Herero name: omukaravize

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							6					
Hoanib (Ses)	D/N							4					
Hoanib (Ses)	H							1					

PLANT FAMILY: 1300. ACANTHACEAE
Blepharis gigantea Oberm.
Damara name:
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D							3					

Ecbolium clarkei Hiern
Damara name:
Herero name: omutikaiko

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 03.)	H							1					

Petalidium coccineum S. Moore
Damara name: //khonas
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab (SS 22.)	D							2					

Ruellia diversifolia S. Moore
Damara name: //huib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 16.)	D/N	1	nectar										

PLANT FAMILY: 1310. PEDALIACEAE
<u>Harpagophytum procumbens</u> (Burchell) DC. ex Meissner subsp. <u>procumbens</u> (?)
Damara name: //huribe//kham; //uribe//kham; gamakos
Herero name: otjihangtere (O)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	worms	tuber	decoction; eat						
Hoanib (Ses)	D/N			5	stomach, menstruation	tuber	decoction						
Ugab	D			1	stomach, menstruation	tuber	decoction						

PLANT FAMILY: 1390. ASTERACEAE
<u>Dicoma tomentosa</u> Cass.
Damara name: soreb
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab (SS 19.)	D			10	coughs	plant	decoction						

<u>Geigaria acaulis</u> Benth. & Hook. F. ex Oliver & Hiern
Damara name:
Herero name: okaputi

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H			1	circumcision	plant	ointment						

<u>Helichrysum roseo-niveum</u> Marloth & O. Hoffm.
Damara name: !abis
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 06.)	D/N										cotton wool	fluff	1

<u>Pechuel-loeschea leubnitziae</u> (Kuntze) O. Hoffm.
Damara name: autsi!khanneb
Herero name: omundumba

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	insect bites	leaves	poultice				perfume (sâi)	flowers	1
Ugab	D			1	rash	leaves	body wash						

PLANT FAMILY: 1470. LILIACEAE

Aloe spp. (A. hereroensis & A. asperifolia)
Damara name: g\koreb; aukoreb;//gores
Herero name: otjindombo

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	general health	leaves	wash						
Hoanib (Ses)	D/N			2	cough	leaves	decoction						
Hoanib (Ses)	D/N			3	general medicine	leaves							
Hoanib (Ses)	D/N			4	stomach	leaves	decoction						
Hoanib (Ses)	D/N			6	goat medicine	leaves	drunk						
Ugab	D			1	high blood pressure	leaves	decoction						

Sansevieria aethiopica Thunb.
Damara name:
Herero name: ongwehe

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

PLANT FAMILY: 1600. POACEAE

Cenchrus ciliaris L.
Damara name: /uiobageda
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 08.)	D/N												

Danthoniopsis dinteri (Pilger) C.E. Hubb.
Damara name: ‡hamib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	1	seeds										

Kaokochloa nigrirostris de Winter
Damara name: !habise
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses) (SS 07.)	D/N												

PLANT FAMILY: 1600. POACEAE

Setaria verticillata (L.) Beauv.
Damara name: ǂares
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	seeds					1					
Hoanib (Ses) (SS 15.)	D/N	6	seeds										

Stipagrostis spp. (esp. S. hirtigluma (Trin.& Rupr.) De Winter subsp. hirtigluma)
Damara name: sâu
Herero name: ombuma (?)

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	5	seeds								beer	seeds	1
Hoanib (Ses) (SS 04.)	D/N	14	seeds						3	food	beer	seeds	1
Hoanib (Ses) (SS 04.)	H	2	seeds								beer	seeds	1
Ugab (SS 21.)	D								4	liquor			
Ugab (SS 21.)	D	10	seeds						3	beer	beer	seeds	4

PLANT FAMILY: 1620. ARECACEAE

Hyphaene petersiana Klotzsch
Damara name: !unis
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D								1	baskets	baskets	leaves	1
Hoanib (Ses)	D/N	9	fruit						1	carved trinkets			

PLANT FAMILY: 1650. CYPERACEAE

Cyperus marginatus Thunb.
Damara name: /haru
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Cyperus sp.
Damara name: !hares
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D								1	beads	beads	bulb	1
Hoanib (Ses) (SS 12A.)	D/N										beads	bulb	1
Hoanib (Ses) (SS 12A.)	D/N										perfume (sâi)	bulb	2
Ugab	D			1	headaches	bulb	inhale smoke				perfume (sâi)	bulb	1

PLANT FAMILY: 1650. CYPERACEAE

Cyperus sp.
Damara name: !hares
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D			1	stomach	bulb	eat				beads	bulb	1

Cyperus sp. (?)
Damara name: !han; !khan
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	2	tuber										
Ugab	D	3	tuber										

Damara name: ûiab; ǂgari; ǂaon
Herero name: ozonduvi

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	2	bulbs										
Hoanib (Ses)	D/N	4	bulbs										
Hoanib (Ses)	H	1	bulbs										
Ugab	D	3	bulbs										

PLANT FAMILY:

Damara name:
Herero name: omuwore, omaore

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H	1	fruit										

Herero name: ondawo

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	H			1	stomach	roots	decoction						

PLANT FAMILY:

Damara name:
Herero name: ondengura

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	H			1	coughs	roots	decoction						

Damara name: a; ha
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N	1	seeds										

Damara name: aei
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N										perfume (sâi)	bark	1

Damara name: ai
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N			1	throat	tuber	eat						

Damara name: gau-khoi
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N	1	?seeds										

Damara name: haun
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Ugab	D	1	tuber										

PLANT FAMILY:

Damara name: narabe
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	1	seeds?										
Hoanib (Ses)	D/N	2	seeds?										

Damara name: nugub
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D			1	digestion	roots	decoction						

Damara name: u; hu (white sau)
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	3	seeds										
Ugab	D	1	seeds										

Damara name: !gae
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	tuber										

Damara name: !gari-ao-oa-e
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	4	seeds						1	food			

Damara name: !haies
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	tuber										

PLANT FAMILY:

Damara name: !haies
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs

Damara name: !hona
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N							1					

Damara name: !naruse
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D												

Damara name: //a-//nais
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	children's health								

Damara name: //gabin; //gawin
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							1					
Hoanib (Ses)	D/N							1					

Damara name: //gaubes
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	1	leaves										

PLANT FAMILY:

Damara name: //khu; //khun
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N							1					
Ugab	D	1	bulbs										

Damara name: //onan
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N							1					

Damara name: /ami/ubus
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N			1	cough								

Damara name: /amixaus
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N			1	children's health								

Damara name: /girihaib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N			1	menstruation		decoction						

Damara name: /gixaub
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	FOOD: Part	MED.: HHs.	MED.: Disease	MED.: Part	MED.: Preparation	FORAGE: HHs.	INCOME: HHs.	INCOME: Sold as:	OTHER: Use:	OTHER: Part	OTHER: HHs
Hoanib (Ses)	D/N			1	stomach		decoction						

PLANT FAMILY:

Damara name: /haib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D	1	fruit										

Damara name: /khomadai
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	1	seeds?										

Damara name: /nam-haib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D			1	diarrhoea	roots	decoction						

Damara name: /nanas
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D			1	coughs	leaves	cough						

Damara name: abu-//noro
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	stomach								

Damara name: ai-haib
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							2					
Hoanib (Ses)	D/N			1	liver						perfume (sâi)	bark	1

PLANT FAMILY:

Damara name: ao-anab
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Kho)	D							1					

Damara name: nanube
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	1	seeds?										

Damara name: naub
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N	2	tuber										

Damara name: sei-si-seibeb
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D							1					

Damara name: somaes
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	tubers										

Damara name: tobe
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Ugab	D	1	leaves										

PLANT FAMILY:

Damara name: tsaob
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			1	goat medicine								

Damara name: xai(b)-khob
Herero name:

LOCATION & COLLECTOR NO.	ETHNIC GR.	FOOD: HHs.	Part	MED.: HHs.	Disease	Part	Preparation	FORAGE: HHs.	INCOME: HHs.	Sold as:	OTHER: Use:	Part	HHs
Hoanib (Ses)	D/N			2	children's medicine	?	?						

Appendix 2 Techniques for multivariate analysis

Classification

The vegetation data set will be described using the TWINSPAN (Two-Way Indicator SPecies ANalysis) program (Hill, 1979b). This is a polythetic divisive classification technique which uses information on all the species data to divide the samples into a hierarchy of successively smaller and smaller groups based on indicator species and floristics (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). The values presented in the resulting table are new values or 'pseudospecies' based on levels of abundance for each species in each sample.

Ordination: Detrended Correspondence Analysis (DCA)

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; Goldsmith *et al*, 1986: 501-2; ter Braak, 1986: 1167; Gaillard *et al*, 1992: 7). The reduction of multi-dimensional data to a low-dimensional space (i.e. 2-3 dimensions) using CANOCO 3.12 is possible because other dimensions or axes are normally correlated with the most influential axes and, therefore, the location of species and samples along these axes is likely to reflect the underlying structure of the data (Gauch, 1982: 116). The strength of these axes or gradients, i.e. the total variability they account for, is represented by their eigenvalues (Dudziński and Arnold, 1973: 905; ter Braak, 1988: 159).

Relationships between community patterns and known environmental variables can be inferred from the ordination to produce an ecological interpretation of the community data which can be tested using other methods. As such, ordination is an indirect gradient analysis method from which species-environment relationships can be explored and described in a qualitative manner (ter Braak, 1986: 1167).

Canonical Correspondence Analysis (CCA)

CCA, applied using CANOCO 3.12, is a multivariate analysis technique developed by ter Braak to relate community composition directly to environmental variables, by finding the ordination axes which reveal to the greatest possible extent the common structure of samples-by-species and samples-by-environmental variables matrices (Gauch, 1982: 163; ter Braak, 1986: 1167, 1987a, 1988: 159). Canonical ordination techniques such as CCA can combine 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, 1988: 159).

A CCA of a data set can be presented as an ordination diagram in which the species and sites are represented as points and the environmental variables as vectors portrayed in two ways: as arrows if the variable is ordinal or continuous, or points if the variable is nominal or dichotomous (ter Braak, 1986: 1167). In the case of ordinal variables, environmental information is expressed by the directions and relative lengths of the representative arrows. The length of the arrow is a measure of how much of species change is accounted for by that variable. More important variables (i.e. those with higher eigenvalues) are, therefore, represented by longer arrows. The position of a species point in relation to the arrows of the ordinal environmental variables reflects the distribution of that species along that environmental gradient. 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.

Testing of specific hypotheses: Monte Carlo permutation testing and partial CCA

Using the program CANOCO, specific hypotheses can be tested concerning the influence of particular environmental variables on the vegetation community using the forward selection of these variables by Monte Carlo permutation tests (Ter Braak, 1988: 159; Gaillard *et al*, 1992: 7). Environmental variables are viewed as 'treatments' imposed on the species distribution and the resulting pattern of species as the 'response' to this treatment (Gaillard *et al* 1992: 9). 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 random permutations (Gaillard *et al*, 1992: 7). To overcome the problem of close association between variables a partial CCA can be applied so that the effect of 'background' variables are statistically partialled out as covariables and the significance of a particular variable in its effect on the vegetation assemblage can be tested (ter Braak, 1987b: 557, 1988: 159; Gaillard *et al*, 1992: 9).

Diversity

CANOCO can also be used to produce Hill's N2 diversity index for each sample and these figures were then related to distance from the settlement (Hill, 1973). This is based on Simpson's index (λ) which calculates the proportion that each species represents in a population and gives the probability that an individual drawn at random from this population will be of a particular species (Simpson, 1949). Hill's N2 index summarises this information in a single figure which represents the number of effective or dominant species in a sample. A sample with a single very abundant species is, therefore, described by a low N2 (Ludwig and Reynolds, 1988: 85, 90-1).

Simpson's diversity index (λ) (From Ludwig and Reynolds, 1988: 90-1)

$$\lambda = \sum_{i=1}^{s} Pi^2$$

where Pi = the proportional abundance of the ith species given by $Pi = \frac{n_i}{N}$ i = 1,2,3,...S

where n_i = the number of individuals of the ith species and N isthe 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 2 individuals drawn at random from a population will belong to the same species. If P = 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). Usually, however, ecologists work with infinite populations because it is impossible to count all the individuals. An unbiased estimator (λ) developed by Simpson is, therefore, used.

$$\lambda = \sum_{i=1}^{s} \frac{n_i(n_i-1)}{n(n-1)}$$

The reciprocal of λ yield's Hill's second diversity number N2.

Appendix 3 Total non-European and Damara population in Omaruru District, 1911-1956.

Year	Omaruru District						Okombahe Reserve	
	Damara	Total*	Farm labourers		Uis mineworkers		Damara	Total
			Damara	Total	Damara	Total		
1911	2759	6449						
1913	2370	6764						
1938								1268
1939	♂ 741 ♀ 861 c 745 2347	2579 2396 1685 6660					379 480 448 1307	400 505 467 1372
1944	2916	7729						
1945	3355	8147						
1946	2643	8034						
1947	2881	8225						
1948	♂ 808 ♀ 1012 c 943 2763	3288 2616 1950 7854	139 117 146 402	1463 492 406 2361			469 636 594 1699	507 654 617 1778
1949	♂ 911 ♀ 1071 c 959 2941	3539 2750 2040 8329					629 780 694 2103	673 794 709 2176
1950	♂ 806 ♀ 1038 c 1077 2921	3193 2673 2211 8077	106 93 110 309	1087 431 378 1896			445 698 687 1830	493 723 720 1936
1951	♂ 1032 ♀ 1159 c 1343 3534	3486 2812 2391 8689					608 843 940 2391	671 876 973 2520
1952	♂ 1103 ♀ 1241 c 1409 3753	3938 2725 2180 8843					623 847 1031 2501	683 877 1070 2630
1953	♂ 1123 ♀ 1245 c 1421 3789	3990 2729 2205 8924					566 815 1033 2414	630 848 1067 2545
1954	♂ 1299 ♀ 1212 c 1448 3959	3880 2839 2525 9244	300 260 310 870	1054 539 610 2203			570 768 883 2221	625 810 934 2369
1955	♂ 1180 ♀ 1225 c 1476 3881	3751 2890 2601 9242						
1956	♂ 1158 ♀ 1113 c 1465 3736	3942 2614 2586 9142	58 46 36 140	788 217 255 1260*	29	243	673 979 1175 2827	708 997 1199 2904

Source: Köhler, 1959: 24-8, 42-3.

*Fall in numbers is an artefact of the redefinition of the District in 1956.