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**PERCEPTIONS AND REALITIES OF LAND DEGRADATION IN ARID**

**OTJIMBINGWE, NAMIBIA**

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## ABSTRACT

We examined the perceptions and realities of land degradation in a communal farming area, Otjimbingwe, in arid Namibia. It is commonly perceived that large-scale degradation of Otjimbingwe has occurred through a mixture of improper pastoral practices and pressures induced by high human population growth rates. We sought to determine whether the inhabitants perceived land degradation to have taken place and whether their perceptions were consistent with empirical data. Furthermore, we wished to determine whether these pastoralists had management strategies to help them withstand the harsh environmental conditions in which they live. We found that all respondents in our surveys perceived that the environment had become degraded. The claimed source of this degradation, a decline in annual rainfall, is inconsistent with long-term rainfall records (there was no change, or cyclicity, in rainfall over time). No overall pastoral strategy exists in Otjimbingwe, and options for management are extremely limited due to a variety of external and internal pressures such as high human population growth rates, high immigration into Otjimbingwe, restricted water availability due to dams constructed upstream, and limited movement opportunities for livestock in drought periods.

## INTRODUCTION

“In disputes over range degradation and stocking rate, all evidence, whether scientific or other, should be empirically validated, evaluated in relation to the ideology of its constructors, compared with other sources of information - local knowledge in particular - and judged according to its own merits” (Behnke and Abel 1996).

Pastoral peoples are suffering considerable erosion of their lifestyles in many arid parts of Africa through long-term land degradation, increased population densities, and increased competition with people needing areas for cultivation (Behnke *et al.* 1993, Scoones 1993, Mokwunye 1996). The communal farming area of Otjimbingwe in arid central Namibia is such an area. There has been a huge increase (about 500-800 %) in human population densities in Otjimbingwe since the 1950's. Heavy grazing is apparent, particularly in frequent dry years, and human population densities are rapidly increasing. Furthermore, there has been an apparent change in the type of livestock farmed, from cattle (predominantly) to goats and some sheep. This change is associated with a change in the human population. Otjimbingwe was once almost entirely populated by Herero people, who are largely cattle farmers (see e.g. Andersson 1859, Vedder 1934). However, at least since the national population census of 1981, the population is approximately 50% Herero and 50% Damara. This latter group of people farm mostly with goats (Paskin *et al.* 1996). This change indicated to us that, perhaps, land degradation had occurred to such an extent that it was no longer possible to raise large grazing animals such as cattle, and that only the small browsing/grazing animals such as goats could be

sustained. If so, this would constitute evidence of land degradation or desertification of the area.

In this study we examined how the pastoral inhabitants perceived changes in the quality of their environment, how these perceptions matched the realities of their situation, and how they responded to these changes. Land degradation is frequently a slow, long-term process, which makes it difficult for people to perceive that changes have occurred because sufficient time is available for them to become accustomed to the shifts in environmental quality (Behnke & Abel 1996). Such problems of perception are particularly acute where land degradation occurs in an environment with inherently high variability. However, recognition of land degradation is necessary in order for people to develop strategies to counteract the problems created by it.

We also wished to determine how these pastoralists perceived the grazing resource as a whole, and how this perception affected the reality of environmental quality. A conventional view of communal pastoralism is that there is little or no management or protection of the resource being used. This lack of resource management may lead to what is known as the 'tragedy of the commons' (*sensu* Hardin 1968). That is, because the grazing resource belongs to nobody, nobody cares for it. Should the grazing resource in Otjimbingwe be perceived in such a light, the potential for land degradation may be high. We note here that the 'tragedy of the commons' concept has been heavily criticized in recent years, by Ellis and Swift (1988), Scoones (1993) and Werner (1994), among others. The criticism of the 'tragedy of the commons paradigm' is twofold:

(1) in spite of communal ownership and lack of fencing to separate grazing areas, many communal farms have a high degree of management by the local communities. In

many communal areas, tribal leaders and/or community groups decide on who may graze where and how long they may use the resource for.

(2) the high inherent variability of many arid African pastoral ecosystems is driven by the availability of rainfall. Consequently, the effect of high stocking rates is frequently rather small in comparison with the effects of abiotic variables such as local rainfall (e.g. Ellis *et al.* 1993, Scoones 1993, Tapson 1993, Sullivan 1996). Overgrazing, in this view, is therefore a short-term problem that is rectified by large rainfalls in subsequent years.

As an arid area (mean annual rainfall = 168 mm), Otjimbingwe is an extremely variable environment, with large inter-annual fluctuations in rainfall (c.v. = 0.694). Hence, it may be particularly difficult for the inhabitants to perceive land degradation, particularly if it is a slow, long-term process. In the light of the above, our objectives in this study were to determine:

1) whether the change in the proportion of people of the two tribes in the Otjimbingwe population resulted in a change from cattle to goat farming, and that such a change was necessitated by the decline in environmental quality. Such a result would be consistent with the notion that desertification was occurring.

2) whether and how the people of Otjimbingwe considered the area to have become degraded over time, and whether they had management policies to avoid problems such as the 'tragedy of the commons' and reduced environmental quality.

## General overview of the Otjimbingwe environment

The Otjimbingwe reserve sits astride the Swakop river, one of the Namibia's major seasonal rivers (Jacobson *et al.* 1995) (**Fig. 1**). Until the mid 1970's, annual floods from the Swakop river provided the residents of Otjimbingwe with necessary water for irrigation. Large tracts of the river bed were plowed and sown with wheat as the principal crop at the end of major rainy seasons after the water in the river subsided. Annual harvests of 20 tons of wheat were common which, when added to income from pastoral activities, provided the African community with economic independence (Fuller 1993).

In recent years, only a small fraction of the wheat field has been planted. This reduction in cultivation is due primarily to the construction of Swakoppoort Dam about 50km upstream from Otjimbingwe, and perhaps secondarily to the building of the Von Bach Dam upstream on the Swakop river at Okahandja in the 1960's about 100km upstream from Otjimbingwe. These dams were built with the purpose of providing urban areas, especially Windhoek (Namibia's capital city) with water. It was hoped at the time of their construction that these dams would also facilitate controlled releases of flood water downstream. However, these controlled releases of water have seldom been forthcoming, resulting in water becoming less available to the residents of Otjimbingwe (**Fig. 2**). Indeed, the river downstream of these dams has flooded only twice since the building of the dam (**Fig. 2**).

Many of the inhabitants of Otjimbingwe, including the young and supposedly economically-active, depend in one form or another on old-age pensions or government hand-outs. Many young people have left the area to seek jobs in the towns, leaving an

older population<sup>data?</sup> behind. Alcoholism, drug use and crime (mainly theft) are common in the area (Fuller 1993). Ethnic tensions are still prevalent between the Damaras and the Hereros and are a constant feature of contemporary life (Fuller 1993).

### Brief history of Otjimbingwe

Our goal in this article is to describe perceptions and realities of land degradation in Otjimbingwe today, with special emphasis on the effects of the human population on the local environment. In order to describe the changes that have occurred in the environment and human perceptions of changes, we need first to establish the historical effects of humans on Otjimbingwe. Thus, the following accounts deal with the history of Otjimbingwe, with emphasis on those events that may have affected the quality of the environment for the people living there today.

### Hereros

The early history of Otjimbingwe is largely a Herero history. The premier oral historian of the Herero people of Namibia, Kaputu, records (pers. comm.) the establishment of Otjimbingwe as follows: During the drought period of 1690 in Opuwo (Kunene region of northwestern Namibia), the Herero people were forced to move to find pasture in other areas. This migration lasted until about 1700. They moved south along the river beds, splitting up in separate clans. Members of the Ongavana Hempapu and Mberijandja clans moved over 550 km south, until they discovered Ondondu jomarunga

in the vicinity of the present-day Otjimbingwe. About 80 people with some 500-600 head of cattle were found there when Mberriua arrived in 1695. Around 1810-1817, a Herero clan called Ovazandu Vomarunga occupied the site of the present-day Otjimbingwe town, at the junction of the Swakop and Omusema rivers. A Herero travelling to Walvis Bay from central Namibia, Tjiponda uaKamarenga, found the Ovazandu Vomarunga living at the junction of the aforementioned rivers at about this time. He was very impressed with the beauty of the area and named it "Otjiua mozingua momutina" (translated as: "a beautiful place that the heart loves"). This was later abbreviated as Otjizingwe, and then still later corrupted to Otjimbingwe.

In 1850, an early white trader, Charles John Andersson, noted the presence of some 50-60 huts of the Hereros, who numbered some 200 people at the time, in Otjimbingwe. He also made frequent mention of the Hereros' cattle at Otjimbingwe. In 1864, in a letter to Andersson, Green cites the missionary Johannes Rath as estimating that there were 400-500 Hereros in Otjimbingwe (Lau 1989). Although the Hereros were largely cattle farmers, they did possess some sheep and goats. A map of the Rhenish mission station at Otjimbingwe in 1864 shows a sheep corral next to the cattle corral, although the latter is almost twice as large as the former (Guedes and Reiner 1993). This contrasts with the situation today, where 70% of the Hereros' animals are small stock (see below).

The Herero presence at Otjimbingwe was not entirely settled. Kaputu records that, as a result of reductions in grass availability in drought years, some of the Hereros were also forced to move to Omatjete and to the Otjozondjupa regions in more mesic north-central regions of Namibia (see also *Maharero's movements* below).



The Herero chief Maharero arrived in Otjimbingwe from Okahandja in 1863 (Pool 1991), by which time Otjimbingwe was already a thriving missionary and trading centre run by Europeans (see below). Pool (1991) claims that the main reason Maharero moved was to seek protection from the raids of another major Namibian tribe, the Nama, who were led by descendants of Jonker Afrikaner (first Christiaan Afrikaner and then later, his brother Jan Jonker). The European traders were willing to supply the Hereros with arms and ammunition. Maharero built his homestead near the missionaries, perhaps because of the protection it afforded. An additional 100 or so houses of his followers were built nearby. While the presence of the traders attracted Maharero because of the protection they could afford from the Nama warriors, they also served as an attraction for the Namas for their trading. Thus, the Namas arrived in Otjimbingwe shortly after Maharero and proceeded to attack the Hereros. After beating off the Afrikaner group of Nama people in 1863, Maharero was declared chief of the Hereros in Otjimbingwe. A large number of battles with the Namas continued for many years, eventually drawing the trader Andersson into the battles as the military leader of the Hereros. In 1868, Maharero moved back to Okahandja because of the drought in Otjimbingwe. He left 40 men (plus families) of his band of Hereros in Otjimbingwe when he left. Thereafter, Zeraua, a native of the area, took over the leadership of the Otjimbingwe Hereros, although he too was forced to leave Otjimbingwe for Omaruru in 1868 because of the drought (Geudes and Reiner 1993). In addition to being a recognized local chief, he was also the self-appointed leader of the Herero copper miners (see under *Europeans* below) who moved into Otjimbingwe as a result of the economic misfortunes of the copper industry and the attractions provided by the traders. Protection by the missionaries and traders at

Otjimbingwe (see below) from Nama raids may also have been an additional attraction for the miners. From the point-of-view of this article's objectives, it is clear that the presence of the European traders and missionaries created an impetus for the native peoples to move into the area. This resulted in large numbers of people, and their herds, being concentrated there for periods that varied considerably in time, and that their numbers were limited by drought. For example, in April 1864, Maharero sent 3000 soldiers to fight the Namas in the surrounding areas and stationed another 1000 warriors (and their cattle) in Otjimbingwe. The missionary Hahn (reported by Vedder 1934) estimated that for every warrior in Otjimbingwe there were at least five other people.

#### European presence at Otjimbingwe

On 20 August 1850, the explorers Francis Galton and Charles John Andersson landed at Walvis Bay, from where they traveled to Otjimbingwe. Andersson (1856) recorded the Rhenish mission, run by the missionary Rath, as having started in 1849 in Otjimbingwe (Guedes and Reiner 1993).

The first European trading in Otjimbingwe was started in 1855, when the headquarters of the Matchless copper mine (owned by the Walfisch Bay Mining Company) were established in the town. C.J. Andersson settled in Otjimbingwe in 1859, when he bought out the bankrupt Matchless copper mine and its property. He then set up his trading empire, which reached as far as Botswana and Angola, from this site. He and other European traders had large numbers of cattle in Otjimbingwe at different times, which contributed significantly to the human environmental impact on the area. For

example, Andersson is recorded as sending 1400 cattle from Otjimbingwe to the Cape (South Africa) in 1861 (Láu 1989). Lau (1989) also cites missionary sources as saying that Andersson's (1862) cattle 'train' (which may have included sheep and goats) comprised 4000 animals. These animals, and those of other traders and Herero peoples, must have been sustained on the vegetation of the area, at least prior to being traded. Livestock also formed part of the spoils of war: in March 1864, Green captured 3000 cattle and a larger number of small stock from the Namas, and kept these at Otjimbingwe (Vedder 1934). Hence, large stock numbers are not a recent phenomenon at Otjimbingwe, and may have contributed to land degradation.

In 1884, South West Africa was annexed by Germany. On 8 July 1889, German troops arrived at Otjimbingwe. The German governor set up his capital in Otjimbingwe, although he later moved his headquarters to Tsaobis, some 20 km southwest of the European trading village in Otjimbingwe, because it was easier to defend from Nama attacks. In 1902, the German colonial governor Leutwein submitted all recommendations he had received regarding all Herero reserves to Berlin. On 14 November 1902, a German commission that included the governor, decided to establish only the Otjimbingwe reserve, which covered 130 000 km<sup>2</sup>, under the leadership of the Herero chief Zacharias (son of Zeraua - see above). Leutwein had the following to say during the session on Otjimbingwe: "Owing to its situation, the area selected for the proposed reserve is less suited for settlement by Whites" (Mossolow 1993). Thus, the German colonial government created the reserve not out of concern for the Herero occupants but rather due to its apparent lack of suitability for white farmers. Contrastingly, other proposals for reserves owned by Hereros in more mesic areas of the country were

squashed because they held promise for white farmers. Thus, from an agricultural point-of-view, the poor environmental conditions in Otjimbingwe were already recognized by Europeans in 1902. The Otjimbingwe reserve was proclaimed on 8 December 1903, little more than one month before the outbreak of the German-Herero war (1904-1907) (Mossolow 1993). From this time on, until independence from South Africa in 1990, the local inhabitants lost all control over land ownership and where they could live.

### Damaras

The Damara people, who were subjugated by the Nama people in the early 18th century, came to the Otjimbingwe region with the Nama chieftain Jonker Afrikaner some time after 1830. The Damara people had no stock, and occupied the mountains in the vicinity (in Afrikaans, they are known as Berg Damaras, or literally Mountain Damara)(Fig. 3). As an enslaved people of the Namas, the Damaras had few possessions. While frequent mention is made in the historical literature of the Damaras' subjugation by the Namas, it is also important to note that the Hereros also frequently enslaved them (see e.g. Vedder 1934, Mossolow 1993).

The first known meeting of Europeans and Damaras was in the Auas mountains near Windhoek in 1792 when Willem van Reenen led an expedition into Namibia. A member of this expedition, Pieter Brand, wrote that the Damaras were subjugated by the Namas at that time, and owned no sheep or cattle and lived on roots and "uintjies" (a sedge, *Cyperus* spp.), and the gum of thorn trees (Steyn and du Pisani 1984/85). In May 1837, Alexander found Damaras living in the Khomas Hochland near the Kuiseb River

(about 100 km south of Otjimbingwe) (Alexander 1838). They possessed no cattle or small stock and lived by hunting and gathering. Their diet was described by their headman as consisting of mice, lizards, roots and sometimes leaves (Alexander 1838).

In 1850, Andersson recorded no Damaras at Otjimbingwe. His first mention of Damaras in the region is at Onanis, in the hills some 60 km southwest of Otjimbingwe. He recorded them as possessing no livestock and living off wild fruit and roots. Like the Hereros and Namas, the Damaras were attracted to Otjimbingwe by the presence of the European trading and mission stations. Their presence in Otjimbingwe in the early years was almost entirely in association with the Europeans in the town, either as domestic workers or workers in various aspects of European trading. The Damaras were later encouraged by the missionaries to farm with crops in the Swakop river at Otjimbingwe. Some Damaras later acquired goats, as indicated by Andersson in 1864 (Lau 1989). He did not mention them possessing any cattle. Palgrave (1877) recorded the Damara as owning stock, especially small stock, in the 1870's, especially after they moved to Okombahe (see below). According to Vedder (1923), the Damaras obtained cattle "recently". Büttner (1879) recorded that the Damaras were given (or stole) goats to ranch with by the Hereros (this was also mentioned by the Herero oral historian, Kaputu (pers. comm.)). Similarly, Range (1914) records Damara ownership of stock as being the result of a patron-client relationship with either the Herero or Nama peoples, while Hahn (1877) and Irlé (1906) record Damara as obtaining livestock by barter. Gürich (1891), Schinz (1891) and Von Francois (1896) claim that the Damara obtained their livestock by theft. Thus, in the light of our objectives in this article, it is clear that the Hereros were the first people in Otjimbingwe, and that they were stock farmers, while the Damaras arrived far

later, were usually not stock farmers, and were mostly associated with trade activities with the Europeans.

Around 1870, the Herero chief Zeraua gave the Damaras the area of Okombahe, some 110 km north of Otjimbingwe. This agreement was formalized in 1894, in an agreement between the German colonial governor Leutwein and Zeraua and the Herero chief of the Omaruru district, Manasse. In Otjimbingwe, those few Damaras who remained, continued with the cultivation of their fields in the Swakop river bed. The above-mentioned agreement regarding Okombahe kept many Damaras out of the German-Herero war of 1904-1907. The consequence of this, according to the Herero historian, Kaputu, was that the Damara populations and their stock herds were not as heavily decimated as those of the Hereros, allowing them to recover and increase more easily after the conflict. This may have had carry-over effects on the subsequent growth of the Damara and Herero populations in Otjimbingwe.

#### Otjimbingwe after the First World War

After the German-Herero war (1904-1907), there was a long period of erosion by European farmers' pressure groups of the original 130 000 km<sup>2</sup> Otjimbingwe reserve granted to the Hereros by the German colonial government in 1903. In 1915, South African troops, on behalf of the British government, overthrew the Germans in what was then called South West Africa. From then on, and especially during the apartheid era in Namibia (1948-1990), the number of European settlers increased enormously. Between 1913 and 1962, the area of white-owned commercial farms increased from 11 490 000 ha

to 39 812 000 ha, an increase of 346 % (Fuller 1993). This pressure on the land resulted in very high stocking rates in the small areas that the Hereros were restricted to. In 1921, for example, the farm Otjimbingwe Nord (13 000 ha - a subset of the current Otjimbingwe) was a largely Herero-controlled communal farm (declared a native reserve by the German colonial government in 1907) with 10 000 small stock and 800 large stock (Fuller 1993). This is equivalent to a stocking rate of 6.8 ha / LSU (the recommended rate for Otjimbingwe is 27.6 ha / LSU - Fuller (1993)); that is the stocking rate was four times higher than the recommended rate. These high stocking rates became particularly problematic because the increased land area of commercial farms prevented people in Otjimbingwe from moving out in drought years in order to find better grazing further north, as they traditionally had done. As black people, the residents of Otjimbingwe did not have the option to purchase land elsewhere, such as in commercial areas, particularly from the time of the South African occupation in 1915.

As the result of government reviews and deputations from the residents, Otjimbingwe was established in its present form in 1923. The Otjimbingwe reserve consisted of six farms (Ojimbingwe Sued, Otjimbingwe Nord, Otjimbingwe, Audawib Ost, Anawood Nord, and Ubukhoes), comprising 83 053 ha (Fuller 1993). In 1929, the southern portion of the farm Audawib West was added to this area, to bring the reserve size up to 92 000 ha. Although most members of the population were involved in stock farming (it is too dry to grow crops outside of the river beds), much crop farming was conducted in the seasonal Swakop river. Crop farming was a relatively succesful enterprise in the first half of the 20th century. For example, in 1949, 70 ha were planted throughout the reserve. A mean wheat harvest of 24 tons/year was recorded (Fuller

1993). Additionally, many inhabitants worked on the the neighbouring European-owned commercial farms and in the cities. For example, in 1928, the Native Reserves Commission Report of South Africa found that 46.6% of adult men in Otjimbingwe worked in the white-controlled commercial sector of the economy (Fuller 1993).

The Otjimbingwe human population increased exponentially from about 1954, with a growth rate very similar to the national average (**Fig. 4**). By the time of the 1981 national population census, 2500 people were recorded as living in Otjimbingwe, of whom 60% were Damaras and 40% Hereros (Fuller 1993). Today, some 5000-6000 people live in the Otjimbingwe communal area, although there are reports of as many as 8000 people. Between 800-2000 of these people live in the town, and the rest live in the surrounding farming area. All respondents in 1996-1997 recorded Herero- and Damara-speaking people as being approximately equally abundant, with small numbers of Namas and Owambos also present. The large increase in the number of people in Otjimbingwe between 1981 and 1997 is largely due to immigration from local commercial farms and even further afield.

The number of farming families per unit of farming area is much greater today than it was in the past. For example, in 1952, 224 families had 406 ha/family to graze their stock (Fuller 1993), while in 1996, 472 families had 248 ha/family for their stock. In 1927, 952 people on Otjimbingwe had 3 665 large stock and 16 593 small stock (=5549 LSU), with 16.58 ha/LSU (Fuller 1993). In 1952, 1164 people had 7 001 large stock and 12 977 small stock (=8443 LSU), with 10.90 ha/LSU (Fuller 1993). Today, there are 6200 LSU on Otjimbingwe (=17.8 ha/LSU). It is therefore clear that



Otjimbingwe has long had, and still has, a large human population and high livestock population densities.

## METHODS

### Livestock surveys

We used a variety of sources to obtain data on the numbers of livestock in Otjimbingwe at various times, including Fuller (1993), semi-annual surveys by the Namibian Directorate of Veterinary Services, and direct surveys (see below) of farmers in the Otjimbingwe reserve.

### Sociological study

We conducted two sociological surveys. In both surveys, we randomly selected mostly elderly, long-term residents for the survey. The reason for this choice of interviewees was to get reliable long-term information from them concerning changes in the ecology of the area. In order to ensure that the answers we received were reliable, we only selected people who had spent their whole lives in the area and were dependent on the land for their livelihood. All respondents were selected randomly and interviewed independently. Only native OtjiHerero-speaking and Damara-speaking interviewers were used in the surveys to remove possible biased responses to outsiders.

Survey 1:- We interviewed 28 residents of the town in December 1996. The goal of this first survey was to determine the perceptions of the residents of possible land degradation. All respondents were asked the same questions (Appendix 1).

Survey 2:- In February 1997, we interviewed 30 residents of Otjimbingwe. In this second interview series, we were interested in the reasons for migrations and movements of people into and away from Otjimbingwe. All respondents were asked the same questions (Appendix 2).

## RESULTS

### Livestock survey

In Otjimbingwe in 1995, of 472 stock owners, 48.5 % were 206 Damara farmers and 48 % were Hereros, with 2 % Owambo and 1.5 % Nama farmers. Women constituted 33 % of all livestock owners (n=136). There was no significant difference between men and women in the total number of livestock owned ( $F=0.793$ ,  $P = 0.374$ , error d.f. = 406), but there was a significant difference between Hereros (mean  $\pm$ S.E. =  $72.84 \pm 5.52$  animals) and Damaras ( $52.96 \pm 4.79$  animals). There was no significant interaction effect ( $F = 7.40$ ,  $P = 0.007$ , error d.f. = 406) between gender and tribal affiliation ( $F = 0.41$ ,  $P = 0.52$ , error d.f. = 406). There was no significant difference between men and women ( $F = 0.51$ ,  $P = 0.48$ , error d.f. = 406), tribal affiliation ( $F = 2.07$ ,  $P = 0.15$ , error d.f. = 406), nor interaction between these two factors ( $F = 0.46$ ,  $P = 0.50$ , error d.f. = 406) in the number of small stock units. However, there was a highly

significant difference between Damaras and Hereros ( $F = 39.61$ ,  $P < 0.0001$ , error d.f. = 406) in the number of large stock units. There was no significant difference between men and women ( $F = 0.27$ ,  $P = 0.61$ , error d.f. = 406), nor interaction between these two factors ( $F = 0.15$ ,  $P = 0.70$ , error d.f. = 406). Thus, the difference in total number of livestock between Hereros and Damaras is largely due to a difference in the number of cattle owned. Cattle comprise only  $6.6 \pm 2.0\%$  of the Damaras' stock, while they comprise  $26.0 \pm 2.2\%$  of the Hereros' stock.

We found a significant positive correlation between the number of cattle owned by Hereros and the number of small stock ( $r = 0.47$ ,  $F = 56.167$ ,  $P < 0.0001$ , error d.f. = 203). This result is also true of the Damaras, although far less of the variance is explained ( $r = 0.16$ ,  $F = 5.208$ ,  $P = 0.024$ , error d.f. = 205). These results indicate that wealthier people own both more small and large stock and that the type of stock that a farmer has is more likely due to wealth than a specific stocking strategy. This conclusion is supported by the observation that there is no evidence of a change in the ratio of small stock:large stock over time (**Fig. 5**), in spite of large fluctuations in rainfall and, hence, in grass availability. That is, an adaptive change in stock type from cattle (which require lots of forage) to goats (which require less forage to survive and can eat bushes as well as grass) has not occurred in Otjimbingwe.

## Sociological study

### Survey 1:

Respondents: - The percentage of literate people in our survey at Otjimbingwe (50%) was significantly lower than the national value determined in the 1991 Namibian population census (77%) ( $\chi^2=11.1$ ,  $P<0.001$ , d.f.=1) (Table 1). However, the percentage of all school attendees who had attended secondary school (28.6%) did not differ significantly from the national value (50%) ( $\chi^2=2.6$ ,  $P>0.1$ , d.f.=1), although this may be due to the small sample size in our census. All respondents owned a large number of livestock (Table 2) and hence were aware of grazing conditions in the area.

Changes over the years:- With regard to changes in conditions over the years, all respondents considered that distance to good grazing and time to collect firewood had increased over time. All respondents considered a decline in the mean annual rainfall to have been the main cause for the decline in grazing conditions in Otjimbingwe. This conclusion is inconsistent with the data (**Fig. 5**). All respondents considered the numbers of wild animals and plants to have declined over time. Table 3 lists those plant species perceived to have declined over time. All respondents particularly noted a decline in the abundance of 'uintjies' (*Cyperus* sp.), a species whose bulb is either eaten directly or first cooked on an open fire and eaten without further preparation.

Six respondents (21.4%) changed their livestock over the years from cattle to goats (which require less forage for survival, and eat bushes as well as grass), while 20

(71.4%) had made no changes. A further two respondents (7.2%) indicated that they started with cattle but they died because of the drought. Thus, these data support the results of the livestock surveys that show that adaptive changes in stocking strategies have not occurred.

A common consequence of over-use of water resources in arid areas is an increase in the salinity of the water. Water quality was considered by 3.6% of the respondents to have become more salty over time, 7.1% said it had become less salty, while 64.3% said that water quality had stayed the same. Of the respondents, a further 25% said that the water quality depends on the area of the town (presumably due to the use of different aquifers); people living further downstream were more likely to complain about the saltiness of the water. One respondent noted that he drew water from the waterpoint in Otjimbingwe town, rather than near his homestead on the Omusema river, because the former waterpoint always had sweeter water. Thus, overall, a highly significant proportion of respondents did not consider water quality to have changed with time ( $\chi^2=17.29$ ,  $P < 0.001$ , d.f.=1).

Most respondents (57.1%) rely on government hand-outs during drought conditions. Lesser proportions of respondents (10.7%) either move to better grazing areas, leave to work in urban areas (17.9%), or rent or receive (free-of-charge) grazing lands from commercial farmers (3.6%). The low percentage of people moving out of Otjimbingwe in response to drought is congruent with data from Fuller (1993) which show that even in the first half of the century, when there were more areas unoccupied by commercial farmland, the population did not respond to rainfall fluctuations by emigration (**Fig. 6**).

During drought periods, 60.7% of the respondents sold their animals, 35.7% said their animals simply died, while 3.6% moved to better areas with their animals. With regard to whether they keep extra animals for outsiders during good rainy seasons, 78.6% said yes, while 21.4% said no, indicating that the animals maintain a high grazing pressure even in good years.

All of the respondents indicated that the Headman and/or community does not make any stocking decisions and that stocking decisions are an individual matter. This response is consistent with data from Fuller (1993) and Namibian Veterinary Services semi-annual stock reports that show that there is no correlation between the number of large stock units in Otjimbingwe and rainfall (**Fig. 7**), i.e. animal numbers are not actively managed in response to environmental conditions. This result contrasts with the general observation that Hereros move their cattle depending on environmental conditions (see Results of second survey and *Brief History of Otjimbingwe* above), and is inconsistent with the claims of some researchers that communal farmers frequently show a high degree of coordinated management of pastoral resources (e.g. Ellis and Swift 1988, Werner 1994).

#### Second survey:

All of the respondents indicated that the Hereros had more cattle than the Damaras. Regarding the perceived reduction in the numbers of Hereros in Otjimbingwe, 73% of the respondents said that this was not true, while 27% said that this was indeed the case ( $\chi^2 = 6.53$ ,  $P < 0.025$ ). There was a non-significant difference in the number of

respondents (19 out of 30 respondents) that claimed that the Hereros left because of drought and normally return after rain ( $\chi^2 = 2.13, P < 0.20$ ). These Herero people live a form of nomadic life, either renting neighboring pastures for grazing or keeping their cattle on the vegetated road verges between commercial farm fencelines during harsh drought periods. Some respondents (9%) said that some Hereros left Otjimbingwe during the war of liberation from South Africa, although the remainder said that this was not the case ( $\chi^2 = 19.20, P < 0.0005$ ). These people have settled in towns further north, such as Omaruru and Okahandja. The Damara headman claimed that many young Herero men had left to seek work in larger towns. Thus, in sum, the respondents considered Herero migrations to be largely temporary movements, although opinion was divided as to whether these movements were dependent on rainfall.

No date could be given by either the Herero or Damara respondents as to the time of arrival of the Damara people in Otjimbingwe. Herero respondents pointed to the absence of graves of earlier generations of Damaras as an indicator that they had not been present in Otjimbingwe for a long time. The Herero headman considered that the first Damaras arrived in Otjimbingwe during the German-Herero war from 1904-1907, and started working as poorly-paid laborers for the Hereros. An additional respondent mentioned remembering that the Damaras worked in the creamery in Otjimbingwe town in the 1920's.

All Damaras claimed that they arrived in Otjimbingwe because of the availability of water and grazing. There was also work for the Damaras to do, for the wealthier Hereros and for the white traders (who are no longer present). Indeed, today, the

Damaras are largely concentrated in and around the single town on the reserve, while the Hereros mostly farm in the surrounding areas.

No Damara respondents gave a clear answer as to why they did not come to Otjimbingwe earlier, although some mentioned that they thought that their ancestors did not come to the area because there was sufficient wild food to sustain themselves elsewhere. All Damara respondents agreed that Otjimbingwe was a better place to live in than the areas that they had previously occupied.

## DISCUSSION

### Changes in farming practices

Our initial observation that there had been a change in livestock practices in Otjimbingwe over time is not strictly correct. While it is true that the numbers of goat-raising Damaras has increased over time, it is not correct that the cattle-raising Hereros have left, and nor is it true that the Hereros are no longer able to sustain their cattle there. Rather, it appears that type of livestock is associated with wealth (cattle are more expensive than goats) and that both Damaras and Hereros own cattle and small stock. Wealthier people are likely to own more cattle and more small stock. Hereros are wealthier than Damaras and, hence, have more cattle. Similarly, there appears to be no adaptive strategy of changing either the type or number of stock in responses to changes in rainfall, although several farmers did sell their animals in droughts.



The practice of looking after animals for farmers from outside the reserve suggests that the land is not given time to recover after droughts as the herds build up. This practice is potentially damaging to the vegetation, but is also an important source of income to the inhabitants (communal farmers are paid about N\$10 per cow per month to look after other peoples' cattle).

Management of grazing areas and control thereof by the local headmen or community groups does not occur in Otjimbingwe, *contra* observations in other African communal areas (see e.g. Ellis and Swift 1988). Thus, Otjimbingwe does have the potential for the 'tragedy of the commons' to occur. In spite of this, and extremely high stocking densities, we have found no long-term degradation of soil resources (Ward *et al.* in prep.). Also, we have found that grass availability after a rainy season is similar to that on surrounding commercial farms, which have far lower stocking densities (Ward *et al.* in prep.). This result points to the extreme resilience of the Otjimbingwe environment and the over-riding importance of rainfall, and not stocking rates, on environmental quality.

Farmers do have strategies to deal with changes in environmental conditions, such as moving to other areas, renting or receiving grazing land free-of-charge on commercial land, or selling their stock. However, these options are limited by the large areas occupied by commercial farms. The large numbers of people who either depend on government hand-outs (57% of respondents) or leave to work in urban areas (17.9%) indicates that many actions are by force of circumstance, rather than by choice.

### Changes in water, wild plants and animals

All respondents considered there to have been a decline in the amount of rainfall over time, and that this was the main cause of land degradation in Otjimbingwe. However, there has been no change in rainfall over time. People may also remember extreme rainfall events and perceive them as the norm. The average level of education of our respondents was low, and thus are unlikely to be *au fait* with concepts such as global climate change (which may have influenced these statements). However, many possess a radio (69-79% of households - Paskin *et al.* 1996) and may have acquired knowledge of such concepts there, which may have influenced the answer received. Alternatively, the extreme variability in rainfall between years may limit the ability of people to perceive the magnitude of deviations from the long-term mean (Behnke and Abel 1996).

All respondents in our first survey considered the numbers of wild animals to have declined in Otjimbingwe over time. This perception is consistent with the data we have. For example, Andersson (1859) noted the presence of large game animals, including a black rhinoceros *Diceros bicornis* (and calf; i.e. evidence that they probably bred locally), as well as many interactions with lions *Panthera leo*, zebras *Equus zebra hartmannae*, gemsbok *Oryx gazella* and wildebeeste *Connochaetes gnu*. None of these species occurs in the vicinity today. Only one species of large mammal, the steenbok *Raphicerus campestris*, has been seen by us, or recorded by the respondents, in recent years in Otjimbingwe. Contrastingly, gemsbok, springbok *Antidorcas marsupialis*, and kudus *Tragelaphus strepsiceros* are all fairly abundant on the surrounding commercial farms (unpubl. data).

The widespread perception (all respondents) that the availability of 'uintjies' has decreased over time in Otjimbingwe is peculiar because Frederick T. Green in a letter to C.J. Andersson, dated 12 May 1864, states "The Berg Damaras no sooner trek in [to Otjimbingwe] than they are compelled to leave again for the same cause, as they subsist almost entirely on 'uintjies', which cannot be procured here" (Lau 1989). Von Francois (1896) records 'uintjies' as being plentiful on mountain slopes. Büttner (1879) recorded the seasonal abundance of 'uintjies' and the fact that the Damaras gathered bagsful of them and bartered them with the Hereros in Otjimbingwe in the 1870s; the price being an undressed sheepskin for a "bokzak" (Dutch for a "goat bag") filled with 'uintjies'. This observation further emphasizes the fact that the Damaras were not resident in Otjimbingwe at the time and that they owned no stock, and that the Hereros already owned small stock such as sheep with which they could barter. We tentatively suggest that the reason for the misconception that 'uintjies' have declined in Otjimbingwe (when they probably never occurred there in any great quantity) is that stories of great 'uintjie' abundance have been passed down by the Damara from the time when the 'uintjies' were indeed abundant when they lived in the mountains east and south of Otjimbingwe.

### Conclusions

The long-term residents of Otjimbingwe recognize that a number of environmental features of the area have changed and degraded over time. This identification of a problem, albeit with an occasionally misplaced concept of the source of the problem, suggests that there exists considerable potential for remedying the

environmental situation in Otjimbingwe. However, the limited alternatives available to these people due to lack of alternative farming practices suitable in the extreme environment, outside pressures causing limited flood water in the river, restricted freedom of movement for their animals during drought periods, and little or no management strategy at the community level make the likelihood of changes in the situation rather remote under current circumstances.

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**Table 1.** Details of respondents: years of residence in Otjimbingwe, age (years) and number of years of education. Of the 28 respondents, 60.7 % were women and 39.5 % men.

	RESIDENCE	AGE	EDUCATION
Average	36.54	57.43	3.14
S.E	3.77	2.74	0.64
Maximum	80	80	9
Minimum	5	30	0
Median	33	56	2
n	28	28	28

**Table 2.** Number of livestock of respondents.

	Cattle	Goats	Sheep	Donkeys	Chickens	Horses	Pigs
Average	22.86	53.4	21.2	3.86	8.3	2.75	4
S.E	5.55	17.03	8.35	0.44	1.65	0.48	
Max.	70	300	50	6	15	4	4
Min.	2	6	7	1	3	2	
Total	320	1068	76	84	50	11	4

**Table 3.** The respondents indicated that the edible plants listed below have declined in abundance, but may still be common during a good rainy season. A = Afrikaans, E = English.

Nama name: //ain

Common name: Rooi bessie

Scientific name: *Grewia tenas*

The small fruits are eaten raw when they become red, which indicates ripeness (Van den Eynden *et al.*, 1992).

Nama name: /hunin

Common name: Witgat, Witsstandboom (A), Caper bush (E).

Scientific name: *Boscia albitrunca*

The fruit is a round, pale yellow, smooth-skinned berry about 1 cm in diameter. Each berry consist of fleshy white pulp surrounding a single hard seed (Van den Eynden *et al.*, 1992).

Nama name: *Hairan*

Common name; Gum (E), Gom (A).

Edible gum from *Acacia erubescens*; *Acacia reficiens* ; *Acacia mellifera* (Steyn and du Pisani 1984/5).

Nama name: *!hanan*

Common name: Uintjies (A)

Scientific name: *Cyperus* spp.

Nutlike tubers grow at the end of slender, woody rhizomes (Steyn and du Pisani, 1984/5).

Nama name: *≠eron*

Common name: Sour plum (E), Kleinsuurpruim (A)

Yellow to red fruits 3 cm long are eaten raw (Van den Eynden *et al.*, 1992)

Nama name: Afrikaans name used.

Common name: Date palms (E), Dadel (A)

Scientific name: *Phoenix dactylifera*

The fruits are eaten fresh or dried (Van den Eynden *et al.*, 1992).

Nama name: Sapiben

Scientific name: Unknown.

The raw fruits, composed of 3 to 4 white-brown berries, are eaten (Van den Eynden *et al.*, 1992)

## Appendix 1

### QUESTIONNAIRE ON OTJIMBINGWE

(1) Years of residence in area

(2) Age

(3) Level of education

(4) Number and type of stock

(5) Have you changed your livestock over the years ?

(6) Has the distance your animals walk to graze changed over the years ? Has it got further ? : got shorter ? : no change ?

(7) Has the availability of water in the area changed over the years and how ? Has it got less ? : stayed the same ? : increased ?

(8) Has water quality changed ? Has it got more salty ? : less salty ? : stayed the same ?

#### FIREWOOD

(9) Has the quantity of firewood decreased ?

(10) Has the time needed for wood collecting changed over the years (as well as distance) ?

#### RAINFALL

(11) Have rainfall patterns changed over the years ? Have they worsened ? : got better ? : no change ?

(12) If conditions worsen, how do you cope ? (e.g. change stocking : alternative income : other)

(13) During droughts, do you sell your animals or do they just die ?

(14) During good rainy years, do you keep extra animals for outsiders ?

(15) Does the Headman/community make stocking decisions ?

(16) Is there a mechanism of regulations to adhere to decisions made ?

(17) Are there any changes in number of wildlife ? Name a few.

(18) Are there any changes in the amount of edible plants? Name a few.

(19) Has household size changed in recent years ?

## Appendix 2

### QUESTIONNAIRE ON MIGRATION

- (1) Have the Hereros left Otjimbingwe?
- (2) When did the Damaras mostly arrive?
- (3) Why did the Damaras arrive in Otjimbingwe?
- (4) If the Damaras lived near Karibib (only 50 km away), why didn't they come to Otjimbingwe before?
- (5) Did the Damaras think Otjimbingwe was a better place than they had been in before?
- (6) How many goats and sheep vs. cattle do they have?

## FIGURE CAPTIONS

- Fig. 1.** Map of the Swakop catchment (modified from Jacobson *et al.*, 1995), showing the position of Otjimbingwe. Inset: Position of the Swakop catchment in Namibia.
- Fig. 2.** Changes in water flow in the Swakop river at Westfalenhof weir. This farm is immediately upstream of Otjimbingwe. Note that the river has only flowed here (downstream of the Swakkoppoort dam) twice since the dam was built in 1977.
- Fig. 3.** Precolonial occupation of central Namibia (after Van der Merwe 1985).
- Fig. 4.** Growth of the Otjimbingwe human population. Data from 1926 to 1954 are from population censuses (Fuller 1993). From 1954 to 1997, a simple extrapolation using the national average growth rate of 3.0% was used. This extrapolation matched the actual population size in Otjimbingwe in 1981 remarkably well (extrapolation = 2478 people; actual population = 2500 people). However, the population has since grown to 5000-6000 people, which is 25-50% higher than that predicted by the extrapolation (=3976 people in 1997) at the national average growth rate. The difference in population is probably accounted for by immigration into Otjimbingwe.
- Fig. 5.** Ratio of small stock to large stock at Otjimbingwe and annual rainfall from 1924 to 1954, and from 1973 to 1995. Note that there was very little change in this ratio in spite of large changes in rainfall among years (Fig. 6). there is no correlation between population size and rainfall ( $r = 0.014$ ,  $F = 0.528$ ,  $P = 0.472$ , error d.f. = 37), nor any significant 1- or 2-year lag effect ( $P > 0.667$ ).



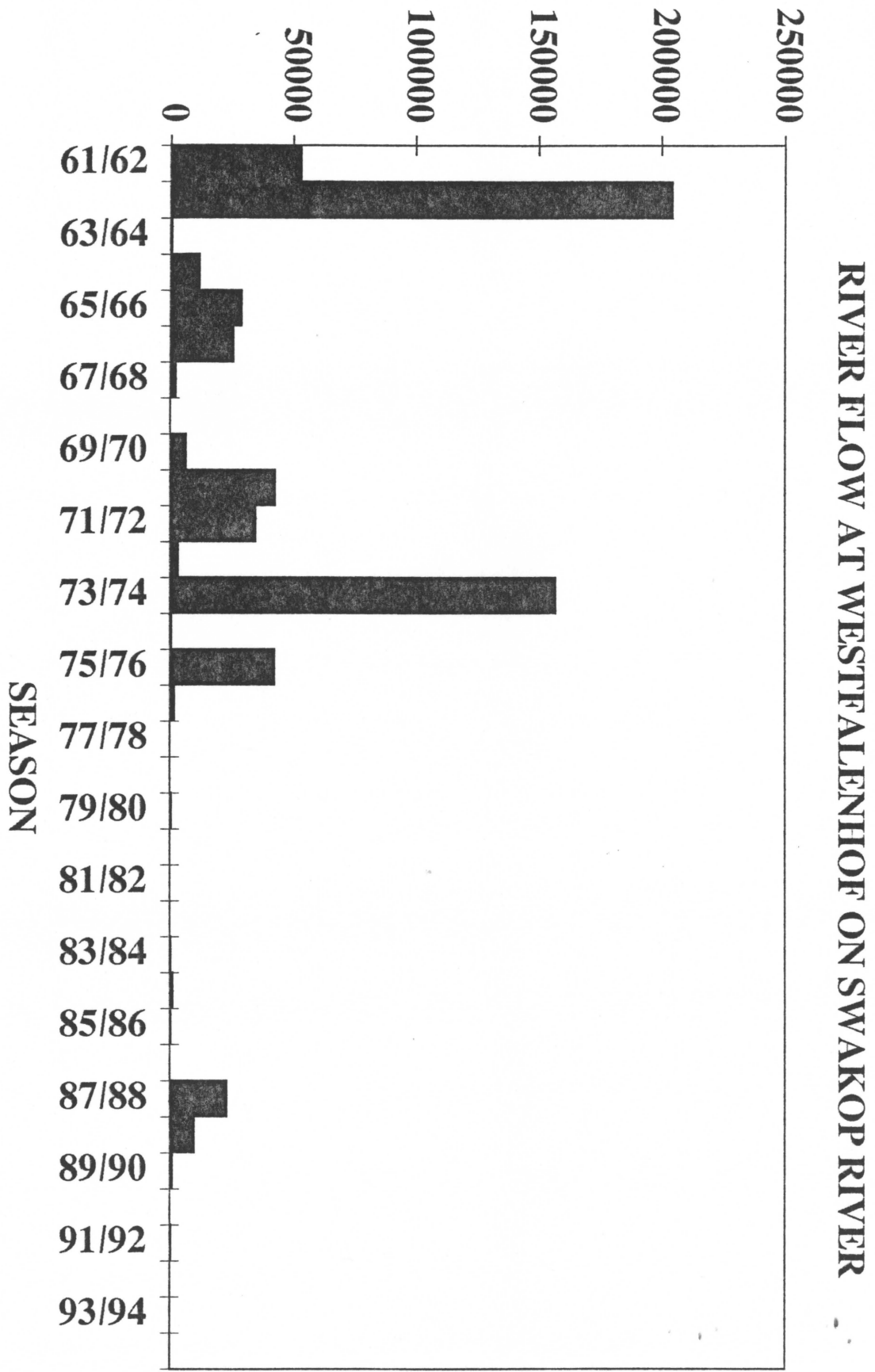
**Fig. 6.** Average annual rainfall at Otjimbingwe over the years. There is no significant change in rainfall over time ( $r = 0.14$ ,  $F = 1.547$ ,  $P = 0.217$ , error d.f. = 76).

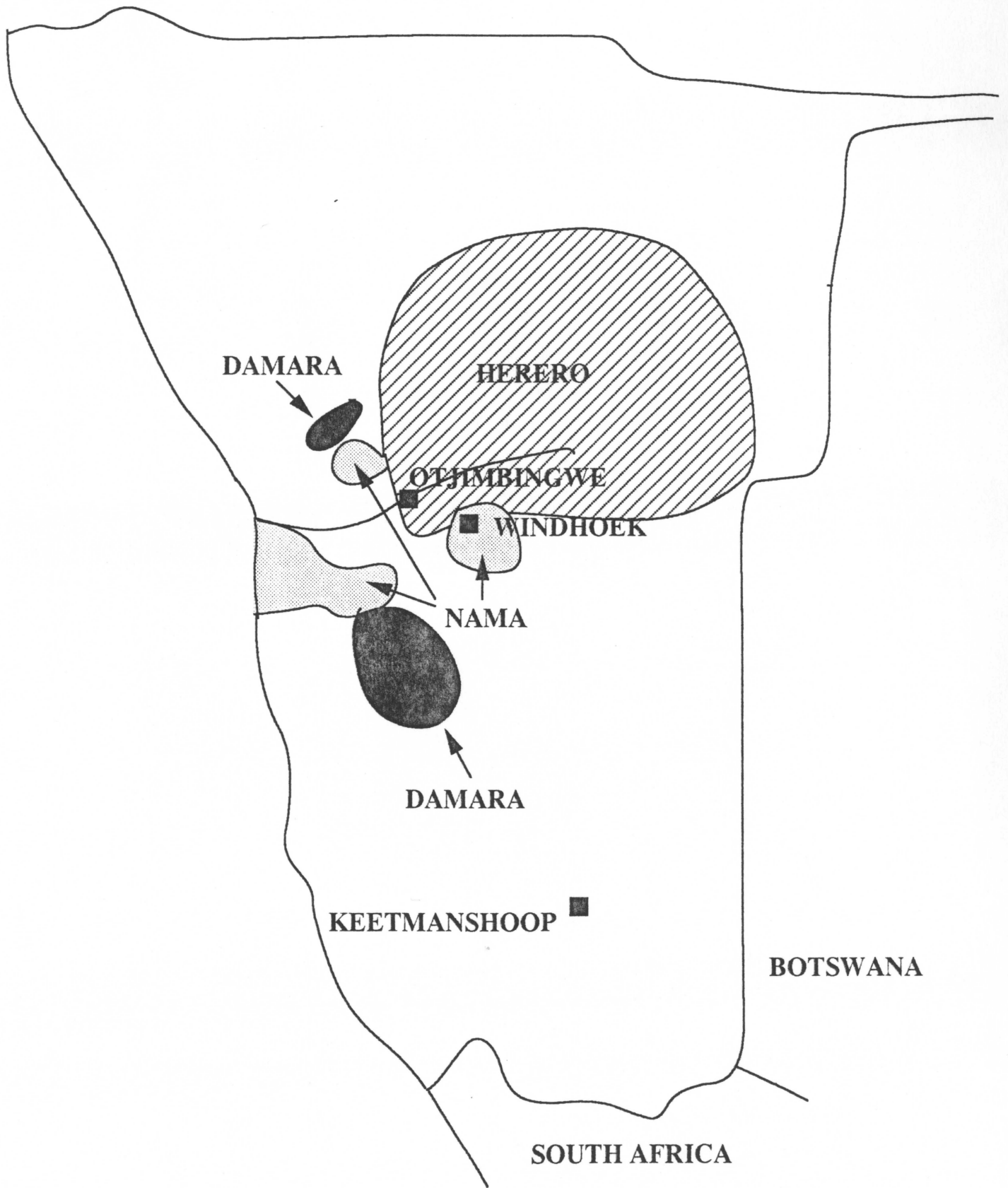
**Fig. 7.** Otjimbingwe human population size and annual rainfall from 1924 until 1954.

Note that there is no correlation between population size and rainfall ( $r = 0.012$ ,  $F = 0.303$ ,  $P = 0.587$ , error d.f. = 24), nor any significant 1- or 2-year lag effect ( $P > 0.311$ ).

**Fig. 8.** Otjimbingwe livestock population size (in LSU) and annual rainfall from 1924 to 1954, and from 1973 and 1995. Note that the correlation between number of LSU and annual rainfall is weak ( $r = 0.004$ ,  $F = 0.163$ ,  $P = 0.688$ , error d.f. = 37), nor any significant 1- or 2-year lag effect ( $P > 0.374$ ).

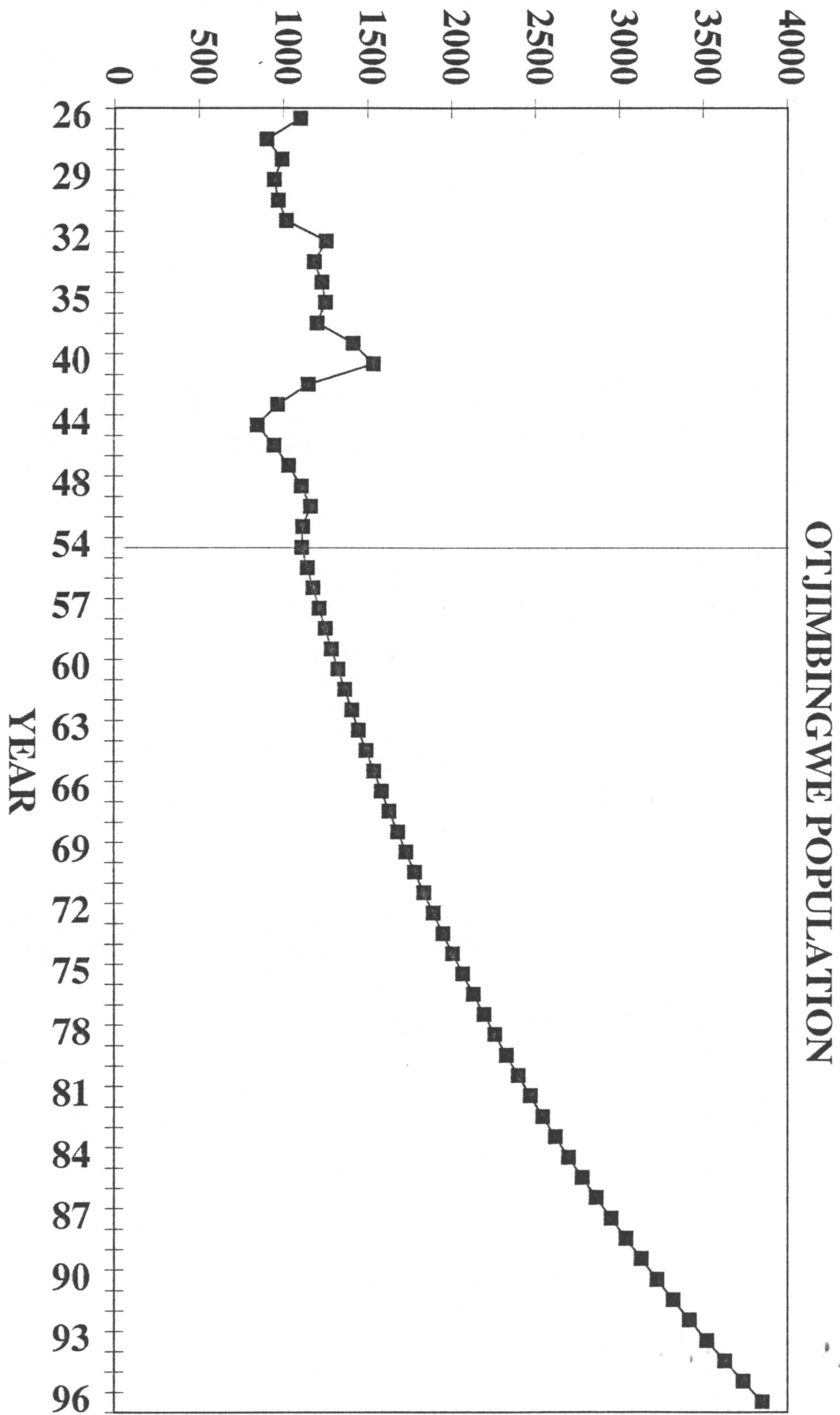
# RIVER FLOW (X 1000m<sup>3</sup>)





PRECOLONIAL OCCUPATION

# NUMBER OF PEOPLE



OTJIMBINGWE POPULATION

YEAR

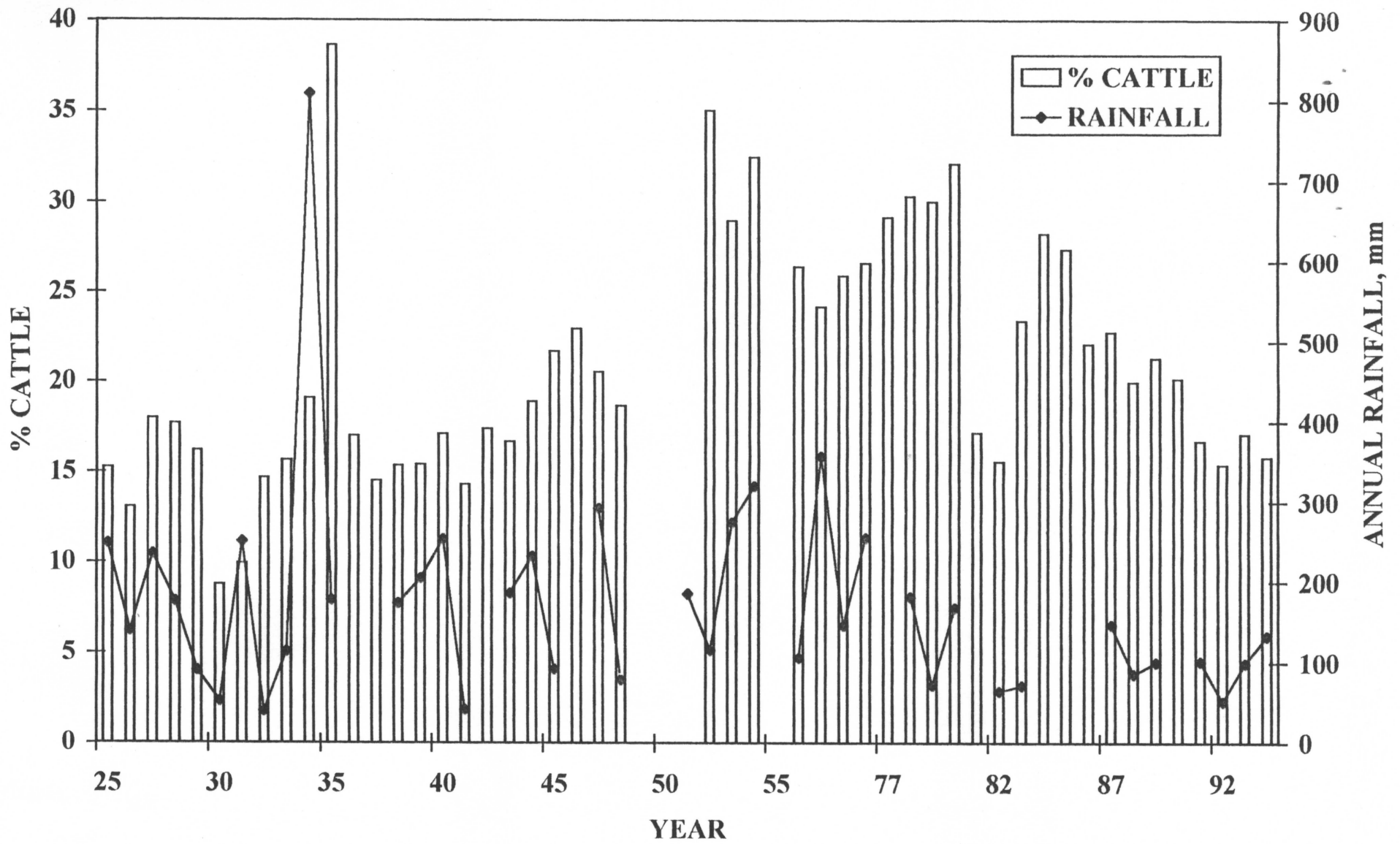


Fig. 5

# OTJIMBINGWE RAINFALL

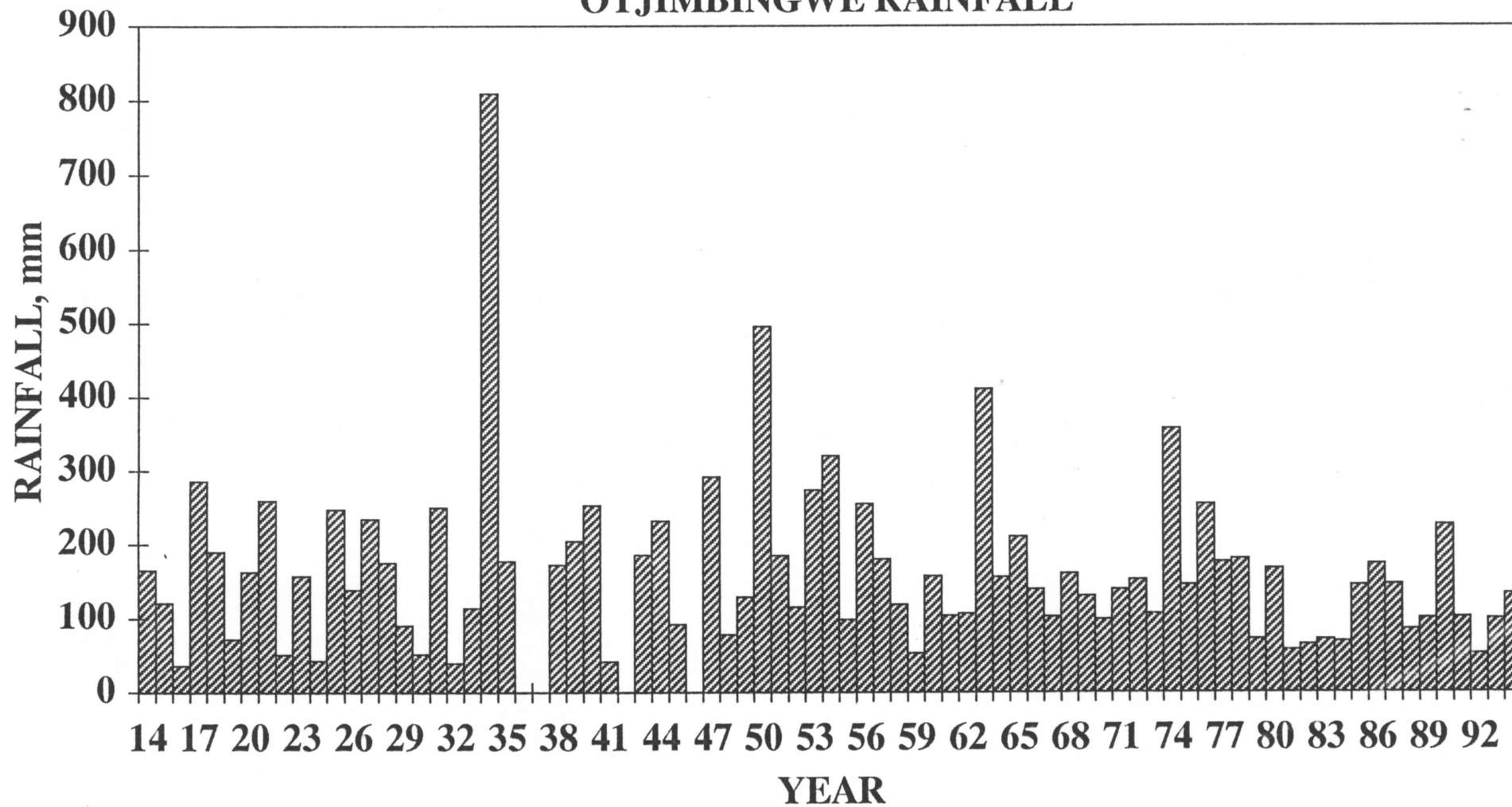


Fig. 6

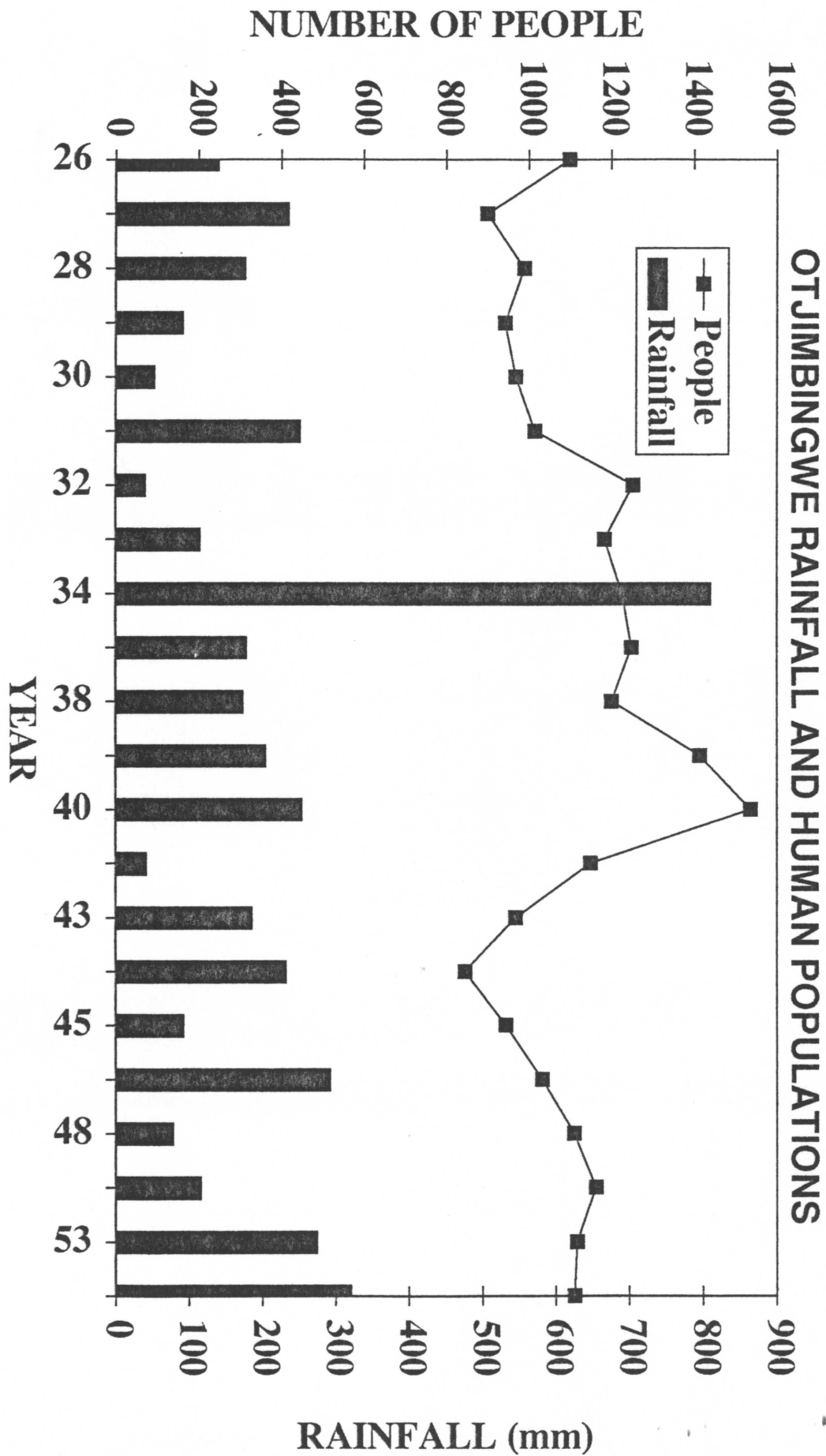


Fig. 7

### CHANGES IN OTJIMBINGWE CATTLE POPULATIONS

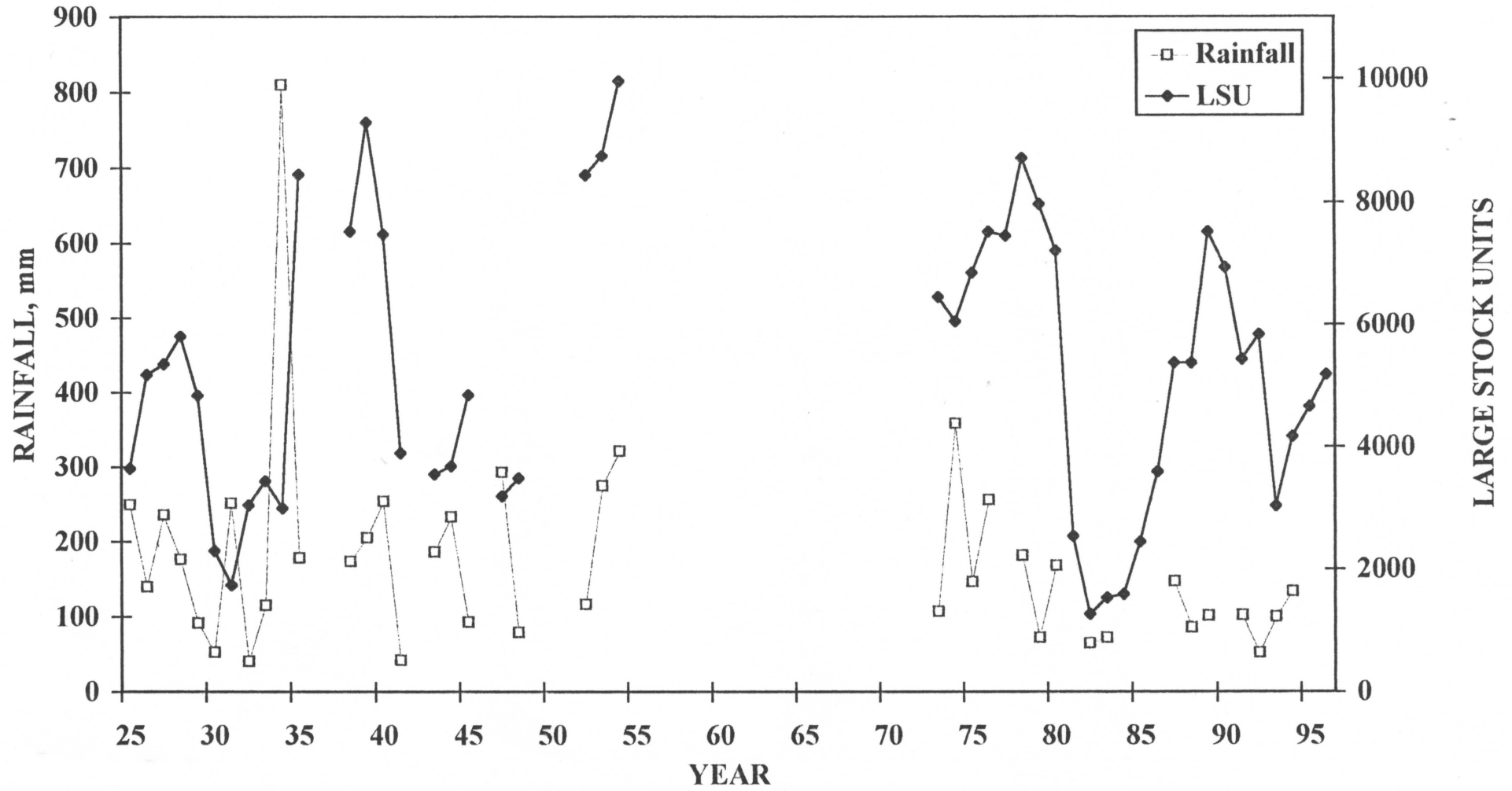


Fig. 8