Biology of *Xerus princeps* (Rodentia, Sciuridae)

B. HERZIG-STRASCHIL* AND A. HERZIG**

Mammal Research Institute, University of Pretoria, South Africa

Present address:
* Naturhistorisches Museum Wien, 1. Zool. Abteilung, A-1014 Wien, Postfach 417, Austria
** Biologische Station Neusiedlersee, A-7142 Illmitz, Austria

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ABSTRACT

The range of *X. princeps* is confined to a narrow band along the whole inland escarpment of SWA/Namibia, extending northwards into southern Angola. *X. princeps* are diurnal and reduce their exposure to high ambient temperatures through special behaviour (e.g. using the tail as a parasol). They live singly or in family groups of up to three (four?) animals. They dig simple burrows mainly among stones or rocks and feed on grass stems and roots. They also climb bushes to feed on plant lice. Some differences in habitat selection between *X. princeps* and *X. inauris* are described.

INTRODUCTION

Two species of ground squirrels of the genus *Xerus* occur in the southern African subregion: the Cape ground squirrel *X. inauris* and the mountain ground squirrel *X. princeps*. *X. inauris* is widely distributed in this region, whereas the range of *X. princeps* is confined to parts of the South West Arid biotic zone (see Davis 1962; Rautenbach 1978). While the biology and distribution of *X. inauris* has been studied in some details (eg. Smithers 1971; Herzig-Straschil 1978, 1979) no new information on life habits and distribution of *X. princeps* have been published since Shortridge (1934) and Roberts (1951) who characterized this species as an inhabitant of hilly and rocky and sometimes flat country in areas from Berseba north to southern Angola.

Recently, bioenergetics, thermoregulation and urin composition were studied on this species (Haim *et al.* 1987). In the present study we complete the distribution of *X. princeps* in the southern half of SWA/Namibia and discuss aspects of its biology.

MATERIAL AND METHODS

Observations on *X. princeps* were carried out in the summers of 1974, 1979 and 1985/86 in the Fish River valley, the Konkiep valley and Damaraland, all in SWA/Namibia. Binoculars (7×42) and a telescope (20×80) were used for the observations. A vehicle was used sometimes as a hide but in most cases rocks or the sparce vegetation had to suffice for this purpose.

Altogether 18 different individuals were observed for varying lenghts of time. Since *X. princeps* are very similar to *X. inauris* in their general appearance it needs some experience to distinguish between them in the field. The most striking differences are the more bushy and longer tail and yellow incisors in *X. princeps* compared to a less bushy and shorter tail and white incisors in *X. inauris*. In some cases the field identification was verified by live trapping or the collection of a specimen.

Data from the literature, from museum specimens and field observations of the authors were combined to produce the distribution map.

One burrow was excavated completely. Temperatures (air and surface temperature in the sun, the shade and in burrows) were recorded in December 1985 using maximum-mimimum thermometers in order to relate these to aspects of behavioural ecology.

RESULTS AND DISCUSSION

Distribution and habitat description

The distribution of *X. princeps* in SWA/Namibia is shown in Figure 1. It illustrates the additional localities documented by the present study which are situated south and southwest of Berseba (26° S), so far the southernmost localities published for *X. princeps* (de Graaf 1981; Smithers 1983). The localities further north are taken from the literature (Thomas 1929; Shortridge 1934; Roberts 1951; Hoesch & Lehmann 1956) supplemented by data from museum specimens (British Museum of Natural History, London; Kaffrarian Museum, King Williams Town; Transvaal Museum, Pretoria; Windhoek Museum, Windhoek). The range forms a narrow band along the whole inland escarpment of SWA/Namibia extending into southern Angola as far north as Mucungu (Hill & Carter 1941).

The main vegetation zones in which this species occurs are savannas and deserts (Giess 1971) and within these, mainly the Dwarf Shrub Savanna and Mopane Savanna as well as the Escarpment zone (the transition between semi-desert and savanna). Thus *X. princeps* inhabit areas with sparse ground cover where single trees or sparse bush may occur.

The average annual rainfall in these areas varies from below 125 mm to just above 250 mm (Schulze 1972). However, rain falls very irregular and long dry periods occur.

The ground substrate consists of gravel and rocks; only once was *X. princeps* found on more sandy soil.

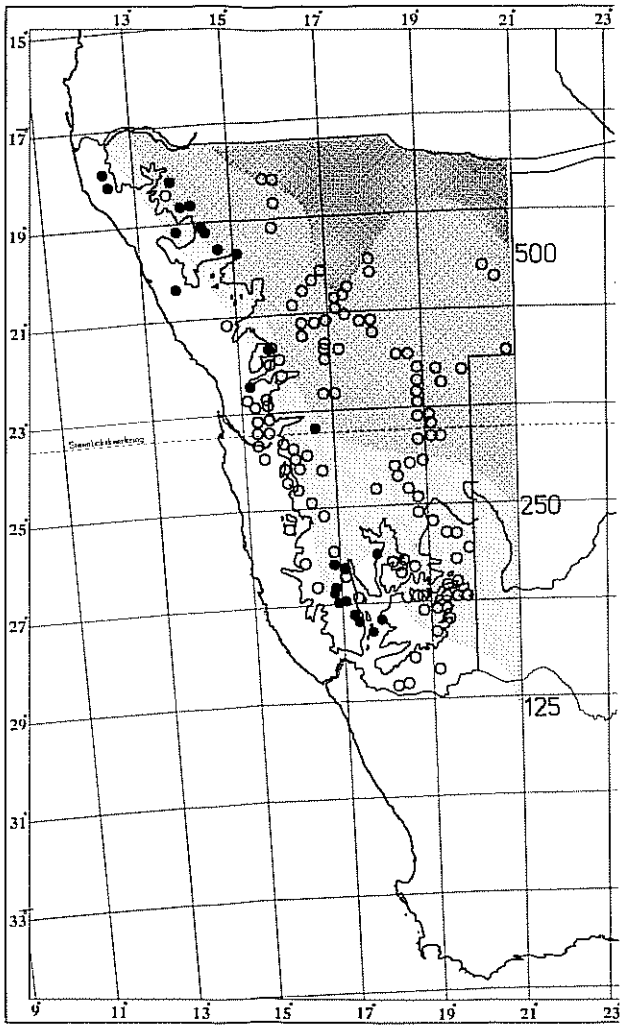

FIGURE 1: Distribution of *Xerus princeps* (●) and *Xerus inauris* (○) in SWA/Namibia. Inland solid line marks 1000 m altitude. Areas of different average annual rainfall (mm) are indicated by shading (see text for details).

The rocks are mainly granite but areas with limestone were also inhabited (Plate 1–4).

Daily activity, behavioural thermoregulation

X. princeps are strictly diurnal and spend the nights in burrows. During normal sunny days in summer they become active above ground between 06h55 and 07h50 and retired to the burrow between 18h05 and 19h15. Unfavourable weather (heavy rain, exceptional heat) usually alter these times causing them to leave the burrow later or alternatively, return to it earlier. This was observed on two windy days when temperature exceeded 55° C in the late morning (Fish River valley 1979) and virtually no shade occured in the vicinity; the ground squirrels returned to their burrows before midday and only a few of them reappeared in the afternoon.

On emerging in the morning squirrels sat in the sun for a short while and self-groomed. They started feeding and left the vicinity of the burrow within 10 to 15 minutes. No allogrooming or playing was observed among burrow mates. Most of the day was spent away from their burrows feeding. Animals were seen at distances of up to 1 km from their burrow.

In the evening, on returning to the burrow, they either entered it immediately of briefly paused in the vicinity of the tunnel opening to inspect the surroundings and sometimes groomed themselves.

In the morning when emerging from the burrow the squirrels sometimes showed signs of hypothermia (hair errection) and sat in the sun. During the heat of the day the animals used their long tails as portable parasols (Figure 2). This behaviour has been described for *X. inauris* (Smither 1971; Marsh *et al.* 1978; Herzig-Straschil 1978, 1979). Bennet *et al.* (1984) correlated this behaviour with environmental heat load and showed its use doubled the animals time for foraging. *X. princeps* has a longer tail than *X. inauris* (Analysis of the data from Figure 3: Mean tail length [mm] *X. princeps* – 245,4 ± 19,2 [S.D.]; *X. inauris* – 210.6 ± 15,3 [S.D.]; One Factor Anova reveal a significant difference at 95 %) which results in a more effec-

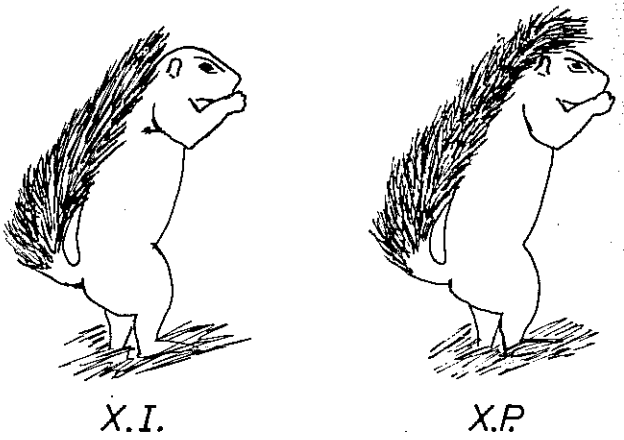

FIGURE 2: *Xerus inauris* (X.i.) and *Xerus princeps* (X.p.) using their tail as a parasol.

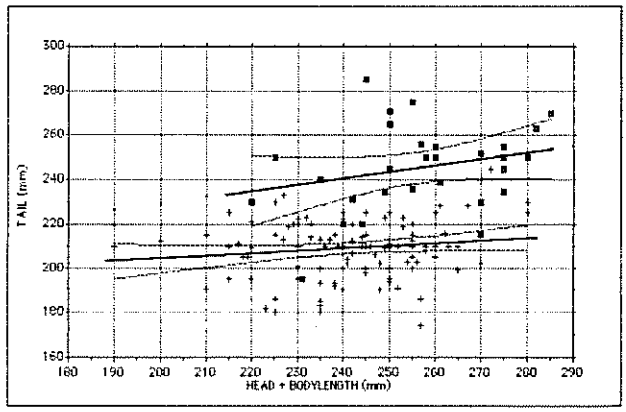

FIGURE 3: Relationship between head & bodylength and the length of the tail for *Xerus princeps* (■) and *Xerus inauris* (+). Regression lines and 95 % confidence intervals are indicated.
Regression equations: *X. princeps:* y = 0.294 + 170.31
X. inauris: y = 0.118 + 180.53
(Pooled data from museum specimens collected S. MS.P. 14 by M. Haupt [MRI] and the authors)

tive shading of the body and the head (Figures 2 & 3). When the sun was standing high *X. princeps* often kept in the shade of bushes, trees or rocks (Plate 4) and hurried across the exposed areas in between. Temperature measurements taken in such areas in December 1985 are given in Figure 4. It is apparent that air temperatures in the shade were 5°–12° C below those in the sun ($\bar{x}$ = 37.5° C) during the heat of the day. It

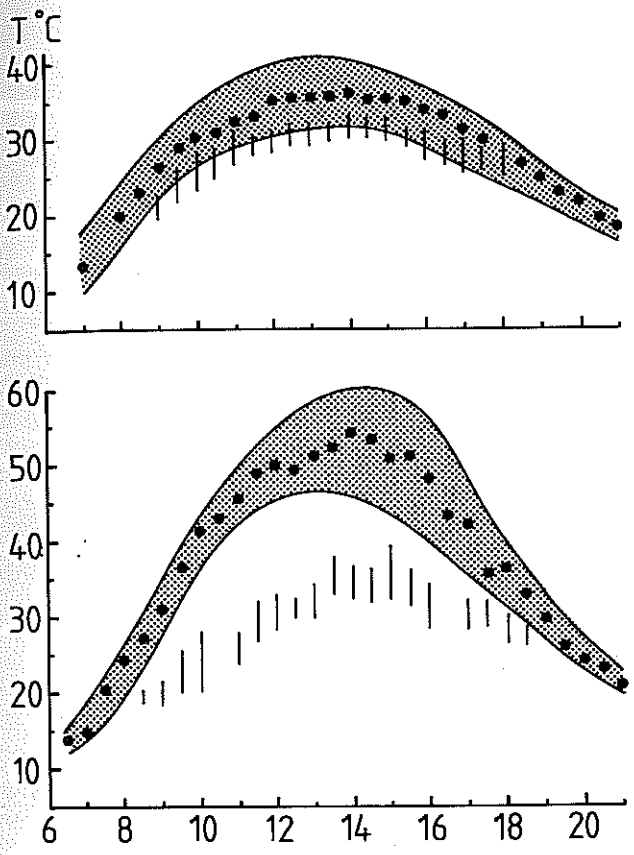

FIGURE 4: Temperature measurements (18.–22. December 1985); Top: Air temperature; Bottom: Ground surface temperature; Shading: Temperature range in the sun (● mean T° C); Vertical lines: Temperature range in the shade

is also apparent from this figure that the ground surface temperatures differ by up to 20° C between shaded and exposed areas. These pronounced differences in temperatures are reflected in the behaviour of *X. princeps* which used all means to reduce the heat load and sought shade during activity.

Burrows

Burrows were sometimes situated on a gravel plain but more often they were found under piled up stones or underneath rocks which formed the roof of the tunnel openings. When there are no suitable natural rocks available they burrowed under concrete platforms at waterpumps (Konkiep valley) or piled up stones used in road works (northern Damaraland). In front of the burrow openings was usually a low mound of material that was dug out of the tunnel.

A single burrow inhabited by three individuals (1 adult ♀, 1 subadult ♀, 1 subadult ♂) was excavated in gravel soil at the Erongo mountains in January 1986. It consisted of a single central nest chamber with two tunnels to the surface (Figure 5). The chamber contained no real nesting material but only an old brittle plastic bag which was half covered by earth. No parasites were found in the burrow; the bottom of the nest chamber was 67 cm below ground surface.

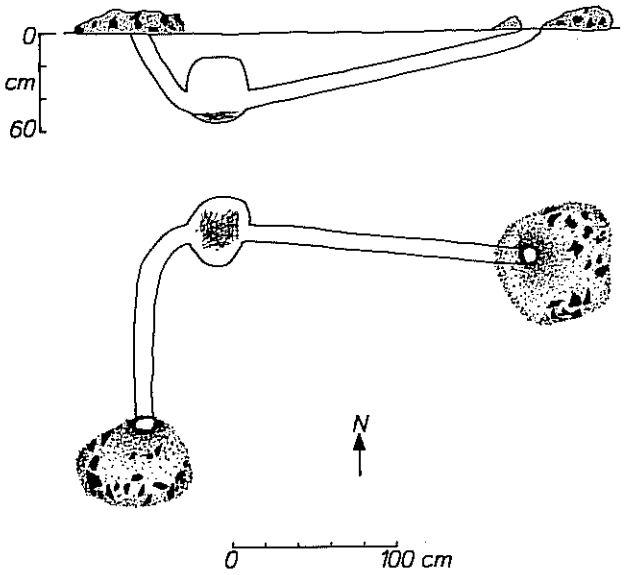

FIGURE 5: Burrow of *Xerus princeps* (Farm Davib Oos, SWA/Namibia)

Inspections of other burrows (as far as was possible under stones and rocks) never implied a much more complicated structure than the one illustrated in Figure 5 apart from a varying number of openings to the surface (from two to five).

The distance between inhabited burrows was at least 80 m (Fish River valley 1974) but usually they were more than 100 m apart. Recordings of air temperature inside and outside burrows were taken in December 1985. The mean values inside the burrows varied between 24.6° C (night) and 31.5° C (day) and were well above the mean minimum night temperature of 9.7° C and below the mean maximum day temperature of 37.5° C outside (Table 1).

TABLE 1: Mean air temperature inside *X. princeps* burrows and outside (18th–22nd December 1985)

cm inside burrow	cm below surface	mean T° C min (night)	max (day)
90–100	27	$\bar{x}$ = 25.7 n = 4 (24–27)	$\bar{x}$ = 31.5 n = 4 (31–32)
60–70	30–50	$\bar{x}$ = 24.6 n = 3 (24.5–25.5)	$\bar{x}$ = 30.6 n = 3 (30–32)
outside		$\bar{x}$ = 9.7 n = 6 (7–12.5)	$\bar{x}$ = 37.5 n = 4 (35–38)

n = Number of recordings, two different burrows

Social structure and reproduction

X. princeps might live singly, in pairs or in family groups consisting of an adult female and her subadult offspring. Table 2 summarizes group sizes observed by the authors and by M. Haupt (pers. comm.)

TABLE 2: Groups of *X. princeps* inhabiting one burrow

ad♂♂	sad♂♂	ad♀♀	sad♀♀	Total	month
–	1	1	1	3	July/August
1	–	2?	–	3	July/August
–	–	1?	–	1	July/August
2 or	2	–	–	2	July/August
1 or	1	–	–	1	July/August
1?	–	1	–	2	November
–	2?	1	1?	4	November
–	1	1	1	3	Nov./Dec.
–	1	1	1	3	January

ad = sexually mature; sad = sexually immature but older than about 8 weeks
Field identification: ad♂ large scrotal testes; sad♂ no well visible testes ad♀ clearly visible mammae; sad♀ minute mammae

One female *X. princeps* gave birth to a single male young after being kept isolated for 48 days. This indicates a gestation period similar to that reported for *X. inauris* of 42–49 days (Zumpt 1970). The eyes of the young opened after 21 days (M. Haupt pers. comm.). The litter size observed in the field varied from 1–3 (9 oservations). No young (younger than about 8 weeks) were seen during the summer month.

Food and feeding habits

X. princeps fed mainly on the ground on the base of grass stems or on grass roots. They feed in typical squirrel-like manner picking up food items by mouth and handling them with the forepaws.

In the mopane savanna in northern Damaraland two specimens were observed feeding for 35 minutes on plant lice and their wax cover on *Colophospermum mopane* leaves. To reach more of this apparently favoured food they climbed first the strong bottom branches of a mopane bush. One climbed to a height of 2 m above ground where the main branches were only about 2 cm thick. While foraging there in squirrel-like manner it frequently sat in the fork of a branch on its haunches but often also lost its balance when reaching out for distant leaves. The long tail seemed to assist in regaining or maintaining balance (Plate 5). *X. princeps* thus cannot be regarded as purely a ground feeder although this was the only such observation throughout the study period.

Flight distance and flight behaviour

When disturbed during its daily activity in the field *X. princeps* hid behind rocks or under bushes and would leave this shelter only when forced to do so by the proximity of the persuer (usually about 5–9 m, exceptionally 1 m only). Then it would make for another shelter some distance away and would wait there if

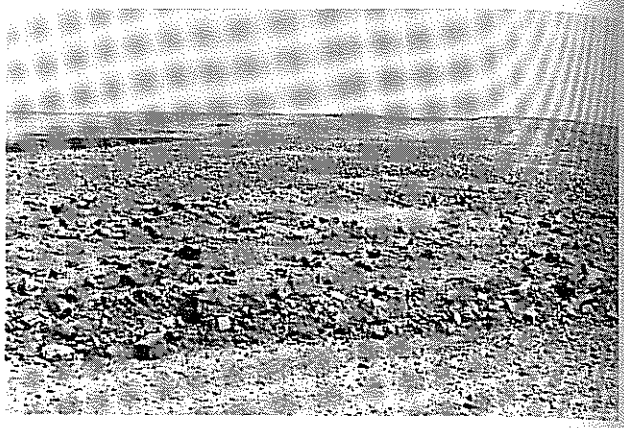

PLATE 1: *Xerus princeps* habitat at Fish River Canyon

PLATE 2: *Xerus princeps* burrow entrance; habitat Konkiep Valley

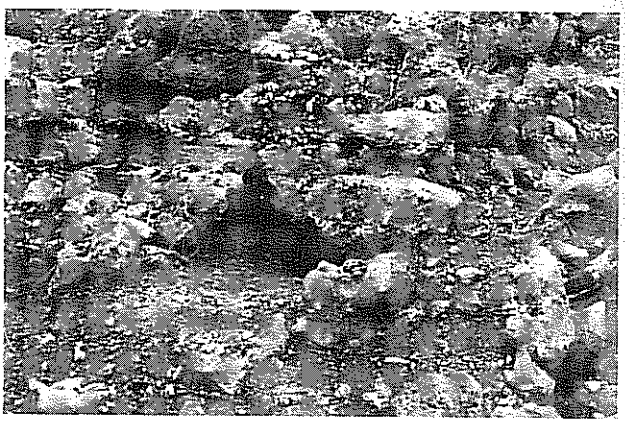

PLATE 3: *Xerus princeps* burrow entrance; habitat Damaraland

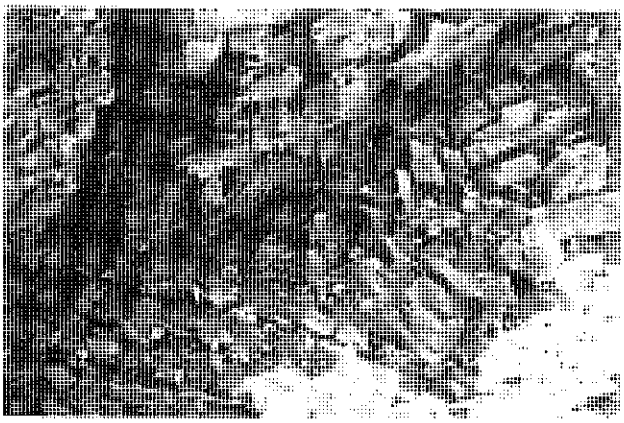

PLATE 4: *Xerus princeps* resting in the shade: habitat Fish River Canyon

PLATE 5: *Xerus princeps* feeding in a Mopane bush

persued further. On one occasion it took some minutes to induce a *X. princeps* to vacate a dense milk bush and run further. Although they seem to flee in the direction of the burrow they were not seen to enter the burrow directly as a means of escape as often happens in *X. inauris*.

CONCLUDING REMARKS

Intensive field observations on *X. princeps* were difficult because of a low population density in certain areas and the rugged habitat they occupied.

The distribution map shows some sympatry hetween the ranges of *X. princeps* and *X. inauris* but although both were found within a few hundred metres in the area around the Erongo mountains no local interaction was observed. The two species are separated with respect to habitat selection, social behaviour and structure of their burrows (Table 3) but the mechanisms which keep them separated when living only 200 m apart (Haim *et al.* 1978) cannot be defined and remain as yet another interesting topic for further studies on this species.

TABLE 3: Obvious differences in habitat and life habits of *X. princeps* and *X. inauris*

	X. princeps	**X. inauris**
habitat	mountains, kopjies, rarely flats; rocks, stones, gravel, rarely sand; sparse vegetation only (grass, bushes)	flat country; sandy, calcareous substrate; sparse to closed; grasscover, bushes, isolated trees
burrow	simple, 2–5 openings	complicated burrow-systems, 2–>100 openings
number of inhabitants per burrow	1–4	1–14 (up to 3 such groups in extensive burrow systems)
social organization	single, pairs or female with offspring; no colonies	rarely single; forming colonies
social contacts	almost none, rarely one might sniff at the other	regular among group members (allogrooming, playing etc.)

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