Ecology of the namtap *Graphiurus ocularis* (Rodentia:Gliridae) in the Cedarberg, South Africa

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A small population of namtaps, *Graphiurus ocularis*, (Rodentia: Gliridae) was studied by mark and recapture methods in the Cedarberg Wilderness Area, for four spring-summer seasons and two winter seasons. Mean population size per breeding season in the 7,75 ha study site was seven adults. At least eight young are available each season for recruitment. As the adults live for four years or more, there are ample young available to replace adult losses. Namtaps eat mostly insects and other arthropods, but do take lizards and birds. They are sympatric with rock rats (*Aethomys namaquensis*) and elephant shrews (*Elephantulus edwardii*). Namtaps can climb vertical rock faces, while rock rats and elephant shrews move horizontally mainly at ground level. Namtaps may be trapped wherever suitable habitat is available and require no special protection by the authorities.
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'n Klein bevolking van namtappe, *Graphiurus ocularis*, (Rodentia: Gliridae) is in die Sederberg-wildernisgebied vir vier lenteseomerseisoene en twee winters deur middel van merk- en hervangmetodes ondersoek. Gemiddelde bevolkingsgrootte per broeiseisoen in die 7,75 ha studiegebied was sewe volwassenes. Ten minste agt kleintjies is elke seisoen beskikbaar vir opname in die bevolking. Aangesien die volwassenes ten minste vier jaar leef, is daar oorgenoeg kleintjies om die natuurlike verlies te vervang. Namtappe eet meestal insekte and ander geleedpotiges, maar ook akkedisse en voëls. Hulle kom in die studiegebied saam met die Namakwa-klipmuis (*Aethomys namaquensis*) en die klaasneus (*Elephantulus edwardii*) voor. Namtappe kan vertikaal teen klipwande opklim, terwyl die klipmuise en klaasneuse gewoonlik horisontaal op grondvlak beweeg. Namtappe kom voor waar geskikte habitat beskikbaar is en het geen spesiale beskerming nodig nie.
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Three species of dormice occur in southern Africa: *Graphiurus murinus*, a small, fairly common, mainly arboreal form; *G. platyops*, a larger species with a markedly flattened skull which lives in the northern rocky areas and *G. ocularis*, known from Little Namaqualand, the southern Cape, the western Karoo, the Orange Free State and the western Transvaal (Figure 1).

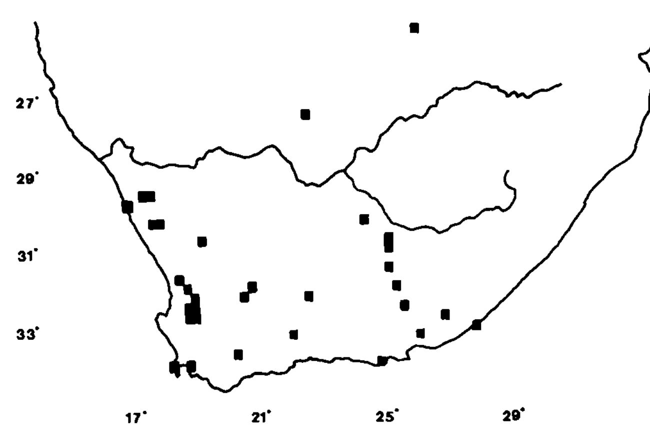

Figure 1 Map showing the distribution of museum records for the namtap, *Graphiurus ocularis*.

G. ocularis is known in the Cedarberg area as a namtap. The origin of the name is obscure, but it may have a Nama origin referring to its ability to disappear rapidly from sight.

The impetus for this study came from the Red Data Book on small mammals (Meester 1976) which listed *G. ocularis* and emphasized that detailed knowledge of this species was lacking. As far as I can determine, no previous study of the namtap has been published.

The namtap possesses characteristics of a small rock-crevice dweller — silver grey colour, thick fur, long vibrissae, flattened skull, relatively slender body and tubercles on the hands and feet, as does the Turkish rock dormouse, *Dryomys laniger* (Spitzenberger 1976).

Namtaps are infrequently caught during routine trapping, due probably to their relative scarcity and occurrence in rocky areas which are difficult to get to, so I selected a study site where they were often seen — the Cedarberg Wilderness Area. The advantage of being able to work in an area where the mice were known to occur was tempered with a restriction on my collecting permit not to remove more than five animals per ten square kilometres. The authorities were understandably loath to permit possible damage to the population which was then unknown in terms of size and reproductive potential.

I decided to live-trap only, using mark-recapture techniques. This permitted trapping in one area for successive seasons, rather than moving to a new site after catching five mice.

The aims of this study were to investigate the biology of the namtap, with particular reference to habitat requirements, population density, feeding and reproductive potential. As the namtap had been suggested as a possible seed predator of the Clanwilliam Cedar, I hoped to be able to make recommendations to the Forestry Department regarding control measures or special measures for its protection if the population of namtaps appeared to be threatened.

Methods

Study site

The 7,75-ha site is situated within the Cedarberg Wilderness Area (32°29'S/19°08'E) south of the Sneeuberg huts. This site is formed by the rocky spur of a low hill surrounded on three sides by sandy plains. The rocks are mostly sandstone of the Peninsula formation. Three habitats are recognizable: (i) the sandy plains on which low (up to 0,5 m) restios (Restionaceae) and proteas (Proteaceae) are dominant; (ii) the slopes of the hill on which isolated large rocks occur. The dominant plants are up to 1 m, mainly proteas although tall restios are common; (iii) areas on the slopes where the rocks occur in large masses (Figure 2) with many vertical and horizontal cracks. The Cedarberg Cedar (*Widdringtonia cedarbergensis*) is found here.

The climate of the area is typically mediterranean with hot dry summers and cold wet winters.

Trapping

Sherman traps (230 × 80 × 80 mm) were used throughout this study, although Willan PVC traps (Willan 1979) were used in the early stages. No difference was found in the trapping success of the two types of trap, but the Willan traps were later discarded as they were too bulky.

Initially traps were set out along trap lines, with traps at 10-m intervals. As soon as it became obvious that the namtaps preferred piles of rocks to more open habitat, the approach was modified by placing extra traps (three to six) at rocky situations along the trap lines.

I trapped for four consecutive breeding seasons (15 visits of three to four nights during the spring and summer months, and 4 visits during the winter months). Usually 70 traps were set each night.

Bait

Namtaps readily took meat, and I found that cooked sausage was an effective bait. After initial trials with various bait combinations, a mixture of lard (pork fat) and oats was determined to be as effective as meat. This lard/oats mixture was used for the rest of the study.

As part of the initial trials, dishes containing one of the following were placed in a hut where namtaps were seen: cooked sausage, honey, peanut butter, raw egg, raw plum. The namtaps ate everything except the peanut butter, which was not touched. Peanut butter does not seem to be a useful component of bait for namtaps. Traps that had previously caught a namtap, and which had not been cleaned, were found to work well as they caught namtaps even without being baited.

Caged animals

While this is not directly part of the reported study, I did have the opportunity to keep various namtaps in captivity. The information obtained about food preferences was useful when deciding on bait for the field study. The animals have a habit of carrying food to their nest, and of defaecating in or near the nest. This encouraged the search for food remains and faeces in likely spots in the field. I was able to see nesting behaviour in captive animals which would not have been possible in the field, as the namtaps nest deep within small cracks under hundreds of tons of rock.

Faecal studies

Fresh faeces were collected for later examination from the first capture of each mouse at each trapping session. Faeces and food remains like pieces of insects, millipedes and fragments of bone were regularly removed from places where namtaps were known to eat. Namtaps were sometimes observed returning on successive nights to these 'pantry areas'. These faeces

Figure 2 Typical rocky habitat of the namtap. The man in the foreground serves as a scale.

were used for the analysis of namtap feeding habits.

Mark and recapture

Each mouse was toe-clipped on first capture. Toe clipping had no discernable effect on retrap success, as freshly clipped mice were recaught the same night, and clipped mice were caught in the same area from year to year. Toe-clipping was always carried out on etherised mice. All animals were measured and weighed to the nearest 0,1 g. Sex of adults was determined by palpating for the baculum.

I used the weighted mean model (Begon 1979) for estimating population size from the capture-recapture data.

$$N = \frac{\Sigma M_i n_i}{(\Sigma m_i) + 1}$$

where M_i is the number of previously marked animals in the population on day i, n_i is the number of individuals caught on day i, and m_i is the number of marked individuals caught on day i. A 'day' was one trapping session. The 95% confidence interval was calculated as N/λ where $\lambda = \Sigma M_i n_i$, N = confidence intervals read from table A1 in Seber (1973) where $m = \Sigma m_i$.

Juvenile estimates for two breeding seasons combine the weighted mean estimate with the size of a litter born in captivity and subsequently released into the study area.

Tracking

After finding that namtaps (*Graphiurus*), namaqua rock rats (*Aethomys namaquensis*) and elephant shrews (*Elephantulus edwardii*) were caught at the same site, and often in the same trap on different nights, I hypothesized that the space resource might be partitioned into two components: vertical and horizontal cracks and steep rock faces used mostly by namtaps, and ground-level horizontal surfaces used by the elephant shrews and rock rats. This spatial separation was suggested by occasional sightings of the three species at night by torchlight.

The hypothesis was tested by dusting animals with pink, yellow, green or blue fluorescent powder (a pigment used in fluorescent paints), and releasing them exactly where they were caught as soon as possible after capture. After half an hour their fluorescing trail was followed using a portable UV light. The trail was marked with enamel paint for accurate surveying the following day. Eleven namtaps, seven rock rats and seven elephant shrews were tracked. Traces of dust could be seen on the animals for three or four days. Dusting had no discernable effect on the animals.

Results

These results are based on 119 captures of 30 namtaps, the total for the entire study! Three or four captures of an individual during a trapping session counted as one capture. One unmarked individual was drowned in a water bucket in the study site during a visit by Forestry researchers.

Habitat preference

Namtaps were trapped exclusively in the rocky habitat. None were trapped in the sandy plains or in the area of isolated rocks. Exceptions are captures within the mountain huts, but as these represent artificial rock piles in a sense, they are regarded as part of the rocky habitat.

Namtaps have to travel across other habitat types to move between the various rock piles. Although there were always traps in these areas, the fact that no namtaps were ever caught indicates that they spend very little time away from the rocky habitats, probably only enough to move from one rocky site to the next.

Graphiurus ocularis is morphologically adapted to living in rock cracks and climbing sheer faces. The hands and feet possess well-developed plantar tubercles and the digits have sharp claws. Namtaps can move rapidly around on rocks, even climbing vertical faces. The Turkish rock dormouse lives in similar habitats and is also capable of moving vertically over rock faces. There is even one sight record of *Dryomys laniger* moving upside down across the roof of a cave (Spitzenberger 1976).

Demography

Animals were classified as juveniles while in their first (nonbreeding) year and as adults thereafter. Weights ranged from 25,6 g (about 8 weeks old) to 96 g in a pregnant female. Adult males weighed 65 – 80 g and adult females (not pregnant) weighed 55 to 75 g.

The two longest intervals between first and last captures were 27 and 20 months. Both these animals were estimated to be 18 months old at the time of first capture. This suggests that namtaps can live to be at least four years old in nature. One captive animal lived for six years.

The male to female ratio is almost 1:1 in our small sample (8 males : 10 females — juveniles not sexed).

The study area was increased slightly after the first season. The results for the first season are not comparable with those for the next three seasons. Estimated population sizes, using the weighted mean model (Begon 1979), were: spring 1979 to summer 1980 — 3 adults (95% C.I. = 1 – 11), 5 juveniles; spring 1980 to summer 1981 — 7 adults (95% C.I. = 3 – 15), 7 juveniles; spring 1981 to summer 1982 — 7 adults (95% C.I. = 3 – 19), 8 juveniles; spring 1982 to summer 1983 — 10 adults (95% C.I. = 5 – 20), 14 juveniles. Confidence intervals reflect the size of the sample, and will be too wide when the sample size approaches the population size (Seber 1973), as it did in this study. Actual numbers of individuals trapped per season were 3, 9, 7, 11, compared to weighted mean estimates of 3, 7, 7, 10.

Population densities in the 7,75 ha study site varied from 1,8/ha (0,9/ha adults) to 3,1/ha (1,3/ha adults). Namtap densities are dependent on the presence of suitable rocky habitat, so these values should be used with caution.

Range

The capture-recapture data are summarized in Figure 3. Each mouse captured at least once in a monthly trapping session was deemed to be present for that month. Every capture of a namtap occurred in the extremely rocky part of the site, even though only approximately one half of the traps were placed in the rocky habitat. All the captures are from 11 sites. Adults were only caught at 9 sites. Recaptures did not occur uniformly, with significantly more namtaps trapped at certain sites ($\chi^2 = 63{,}92$; $P < 0{,}001$). Recaptures ranged from 2 – 18 per site. Although it is difficult to attempt to define the preferred habitat, the more rocky places with horizontal and vertical cracks seem to be characteristic (Figure 2).

Food

Faeces were analysed from 30 captures of 18 mice. No differences could be found in the samples between juveniles and adults, or between males and females. No seasonal variations were apparent.

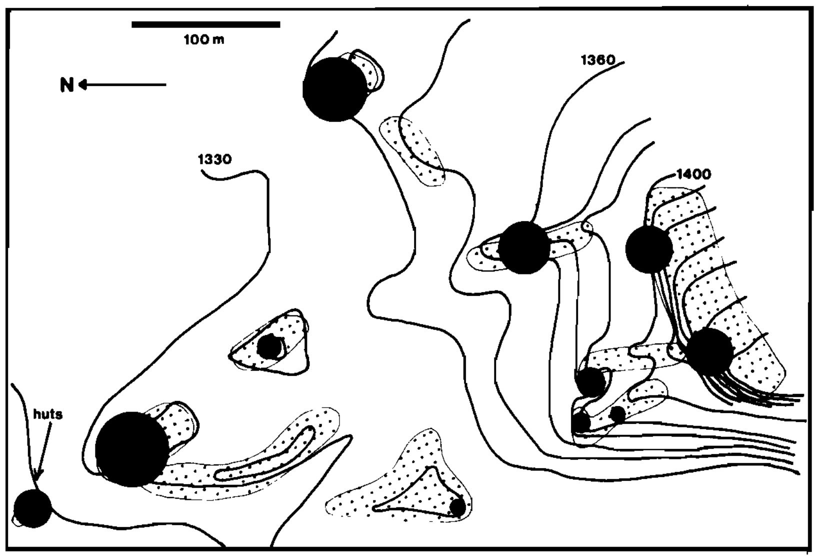

Figure 3 Map of the study site with contours and stippled rocky areas. The solid circles are places where namtaps were recaptured, the size of the circle is proportional to the number of mice captured at each place. Note that all the captures are in rocky areas.

In order to attach some relative measure to the various remains of food items, I estimated the volume of each prey when alive, by assuming that the mean body shape could be represented by a cylinder for purposes of comparison. Care was taken to avoid overestimating the numbers of small insects when these were fragmented. As some items were undoubtedly missed, the results below should be considered as underestimates of soft-bodied prey. Liquid foods like eggs, honey and possibly nectar could not be identified using faecal analysis. In captivity namtaps eat eggs, and a food choice experiment in the field showed that they took egg. Honey bees were identified as prey, and honey was eaten in the field bait trials. It is quite possible that honey is a natural food item. The namtap is also known as a 'heuningmuis' in Afrikaans (honeymouse). There is one record of a namtap entering a beehive and eating the larvae (Van der Westhuizen, pers. comm.).

A few small ticks were found in faeces containing dormouse hair, and as these seem to have been ingested while the mouse was grooming, they have been omitted in the analysis. Figure 4 shows the relative volumes of all identified prey, and Figure 5 is an analysis of the relative volumes of insects, which are numerically the most important food.

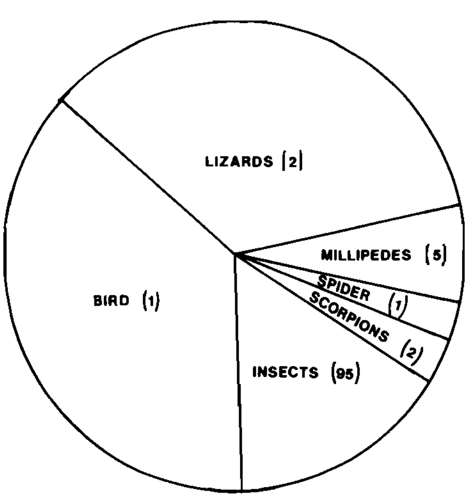

Figure 4 The relative estimated volumes of all known food items consumed by namtaps. The size of each segment is proportional to the volume of the items. The number in parentheses refers to the numbers of items comprising each category.

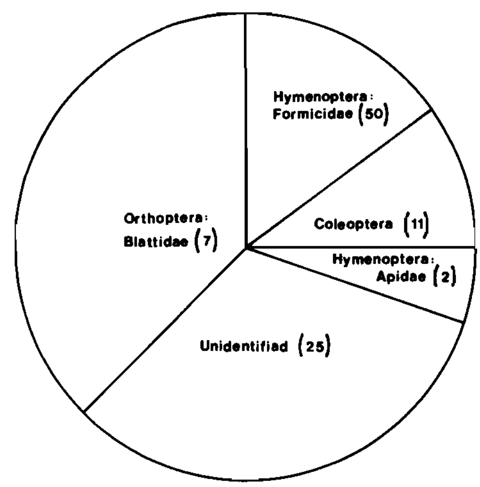

Figure 5 An analysis of the insects taken by namtaps, estimated volumes of each category are proportional to the size of the segment, while the number in parentheses refers to the estimated numbers of insects in each category.

Vertebrates make up the largest volume, although only three vertebrates, one bird and two lizards, comprise this sample. The bird record is a Cape bunting (*Fringillaria capensis*). I trapped five Cape buntings in my mouse traps during the study, which indicates that these birds visit rock cracks and could therefore fall prey to a namtap, especially at night while the bird is sleeping. European dormice are known to eat eggs and birds and sleeping reptiles (Golodushko & Padutov 1961; Angermann 1963; Kahmann & Lau 1972; Gvozdak & Simochko 1977). The two lizards, *Agama atra* and *Mabuya homalocephala* represent common species in the area. These are presumably also taken while they are inactive at night.

Amongst the insects taken, ants (Hymenoptera; Formicidae) are numerically dominant. These are commonly seen at night, often active around protea flowers. *Dryomys laniger* eats mostly arthropods, but is known to take berries (Spitzenberger 1976).

Breeding

Young are born from spring through summer. Four to six young are produced per female, and there is field evidence (weight changes of female namtaps) suggesting that two litters may be produced six to eight weeks apart by each female. For example, one female weighed 85,7 g on 20 September, and was back to 61,7 g by 25 October. On the 23rd of November she was again increasing in weight (81,0 g). She was taken into temporary captivity, giving birth to four young on 1 December, after which her weight returned to 65,9 g. Three young which had just left the nest (25,6 g, 25,6 g and 27,8 g) were recorded at the end of November from the same area where she was often trapped. These were probably young from her first litter. This pattern of a gradual increase in weight followed by a sudden 15 – 20 g drop was noted in females on eight occasions. These were all regarded as evidence of pregnancy and parturition. In three of the four spring-summer breeding seasons, young were caught simultaneously with the earliest trapped pregnant females, indicating that at least one other earlier pregnancy had occurred. These three cases were used to justify three more pregnancies. Thus the total number of pregnancies in the study area was at least 11 during the four seasons (Table 1). Numbers of young produced should be between 44 and 66, taking four and six as the range of known litter sizes. The capture-recapture data indicate 34 young, using the weighted mean estimate. The mean number of adults in the study site was seven. If these lived for two years, three or four young would be needed annually as replacements for the population. If they live for four years, as suggested by the evidence above, only one or two young would be recruited into the study population each year. As a mean of 8,5 (from capture-recapture) or between 11 and 16,5 (minimum pregnancies × minimum and maximum known litter size) young are available each season, it is apparent that there are sufficient young produced to replace the adults. The excess young seem to move to less favoured habitats, where they presumably form a temporary reservoir of animals which can move back into the preferred sites later in the season, or they presumably die during the winter. I have no evidence of neonatal mortality in the field. Details of individual movements and seasonal changes to ranges will be discussed elsewhere.

Table 1 Estimated numbers[a] of namtaps in the study site for four successive seasons[b]

Breeding season	Number of adults	Number of pregnancies	Number of young
1	3	2	5 (8 – 12)
2	7	3	7 (12 – 18)
3	8	2	8 (8 – 12)
4	10	4	14 (16 – 24)

[a]Numbers of adults and young are based on the weighted mean estimate. Numbers of pregnancies are based on known and assumed cases. Numbers of young in parentheses are calculated as number of pregnancies × minimum and maximum known litter size (4 and 6).

[b]The study site was enlarged after the first year.

Tracking: space sharing

Each track was clearly marked in the field using enamel paint. Track segments were recorded to the nearest cm and the nearest 5 degrees horizontally and vertically.

The mean vertical movement on steep rock faces (75 degrees or more from the horizontal) per 10 m travelled for the three species is: *Graphiurus ocularis* $\bar{x}$ = 0,99 m; SD = 0,76; n = 11; *Aethomys namaquensis* $\bar{x}$ = 0,62 m; SD = 1,57; n = 7; *Elephantulus edwardii* $\bar{x}$ = 0,33; SD = 0,6; n = 7. These are significantly different ($P < 0,05$ Kruskal-Wallis test; H = 6,64; df = 2).

Namtaps regularly move on vertical or near vertical rock faces, while rock rats and elephant shrews tend to remain on horizontal or slightly inclined surfaces. The few records of these latter two species moving on steep faces usually occurred when they descended over the edge of a large rock.

Activity

In captivity namtaps are active throughout the year, providing sufficient food is available. They do become torpid for three or four days at a time if food is withheld or if the air temperature drops suddenly. Combinations of little food and a long cold spell cause the namtaps to hibernate for a month or more. Captive namtaps slept during the day, becoming active just after sunset and remaining active until the first light of dawn.

Field observations suggest that free-ranging namtaps have similar activity patterns. Namtaps were trapped throughout the year. The winter months in the Cedarberg tend to have unfavourable weather for dormouse activity, as cold fronts bringing strong winds and rain occur frequently. Snow is not uncommon, and trapping succcesses were limited to a few animals caught during the few hours between one cold front and the next.

In the warmer seasons, animals were seen foraging within 30 min after sunset, and were regularly observed to be active until shortly before sunrise. Namtaps visited the mountain huts at all hours during darkness, provided that the weather was suitable.

Discussion

Although *Graphiurus* was first recorded in 1829 by Andrew Smith (initially believed to be a squirrel) not one field or laboratory study of this animal has previously been published. Much of FitzSimons' (1920) description of the biology of *Graphiurus ocularis* is fanciful.

In the 155 years since its description, more specimens have been added to museum collections, but useful ecological data amount to little more than the observation that the animals could be trapped near rocks or rocky walls. Shortridge (1942) noted that *G. ocularis* could be caught in 'rocky cliffs containing horizontal fissures and amongst natural pylons of large boulders'. Confusion with *Graphiurus murinus* which lives in trees in the more wooded parts of the country caused FitzSimons (1920) to report that 'the natural home of this dormouse is in forest trees' and probably influenced Burton (1965) to erroneously state 'usual food nuts and seeds, but includes numbers of earwigs'. Earwigs were found in large numbers in a nest of *G. murinus* (Hatt 1940). He wrote that the earwigs were responsible for the reddish-brown tinge often found under the chin and on the neck. The reddish-brown tinge frequently seen in specimens of *Graphiurus ocularis* develops even in suckling animals and often occurs high up on the face. This reddish colouration seems to be genetically induced.

Conservation and Research

One of the aims of this project was to quantify the status of the namtap in the Cedarberg Wilderness Area. It would appear from this study and from other trapping I have done in the Cedarberg, near Citrusdal and in the Groot Winterhoek mountains, that although namtaps are not found in great numbers anywhere, they do occupy suitable habitat wherever this is available. They are found in areas where the rocks offer horizontal and vertical crevices, preferably rocky outcrops rising three or more metres above ground level. They are fairly long-lived, and in common with other small-mammal hibernators tend towards the K end of the K-r continuum (Kirkland & Kirkland 1979). However, the namtap has a reproductive potential which would enable it to replace individuals lost to trapping for research purposes. The effort involved in trapping large numbers of namtaps is extreme, and it should not be necessary for the responsible authorities to be overly cautious about permitting future trapping. Even if a researcher could trap every namtap within a 10-ha area, they would soon be replaced by the excess young.

This interesting dormouse deserves further study, particularly in other parts of its range, like the Karoo, where available food, type of habitat and sympatric species may be different. It would be worthwhile to compare estimated population densities in other habitat types to determine if, as I have suggested, availability of suitable rocky habitat is a limiting factor. Hopefully this report will serve as the basis for future long-term monitoring of the namtap population near the Sneeuberg huts.

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