

The status of *Heleophryne rosei* Hewitt (Anura: Leptodactylidae) on Table Mountain and recommendations for its conservation

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Heleophryne rosei has one of the most restricted distribution ranges of any southern African amphibian. Ecologically the species is poorly known. New and important information on the life history of *H. rosei* has been accumulated and is presented. A distribution survey of *H. rosei* populations on Table Mountain was undertaken in order to determine where and in what numbers the species occurred, and whether any concern should be expressed for its continued survival. The findings of this survey are presented and although no obvious decline in numbers is indicated, the status of *H. rosei* should be considered as rare and vulnerable. Some protective measures are proposed.

Heleophryne rosei het een van die mees beperkte verspreidingsgebiede van alle amfibieë in Suider-Afrika. Ekologies gesproke is die spesie relatief onbekend. Nuwe en belangrike inligting is versamel en word voorgelê. 'n Verspreidingsopname van *H. rosei*-bevolkings op Tafelberg is gedoen om vas te stel waar en in watter getalle die spesie voorkom en of sy voortbestaan enige rede tot kommer verskaf. Die bevindinge van die opname word gegee en hoewel daar geen merkbare afname in getal aangedui word nie, moet die status van *H. rosei* as raar en kwesbaar beskryf word. Enkele beskermingsmaatreëls word voorgestel.

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Introduction

The genus *Heleophryne* Sclater is endemic to South Africa and has the distinction of being the only leptodactylid genus occurring on the African continent. Lynch (1971) considers *Heleophryne* to be the most primitive member of the family Leptodactylidae and a Gondwanaland relic. Of the four species (*H. rosei*, *H. purcelli*, *H. regis*, *H. natalensis*) currently recognized (Boycott 1982), *H. rosei* is undoubtedly the most vulnerable because of its extremely restricted distribution and relatively low population numbers. Its listing in the South African Red Data Book for reptiles and amphibians is rare (McLachlan 1978).

H. rosei was described from two adult specimens and full-grown tadpoles collected in Skeleton Gorge, Table Mountain, Cape Province (Hewitt 1925). During the next nine years one more adult and three juvenile specimens were collected. This enabled Du Toit (1934) to examine six *H. rosei* specimens for his revision of the genus. Thirty years later Poynton (1964) carried out the second revision of the genus and examined eight *H. rosei* specimens. It is not surprising that several authors have regarded the adults of *Heleophryne* as rare (Rose 1929, 1950, 1962; Cochran 1961; Van Dijk 1961). This apparent rarity could be attributable to their extremely secretive habits as suggested by Rose (1929) and Gow (1963). However, considering the remoteness and inaccessibility of the habitat of *Heleophryne* in general, it is more likely that through a combination of these factors they have acquired an aura of mystery and elusiveness.

A distribution survey of *H. rosei* populations on Table Mountain was undertaken as part of a distribution survey of amphibians in the Cape Province conducted by the Cape Department of Nature and Environmental Conservation.

The findings of this survey are presented. We have also compiled an account of what is known of the life history of *H. rosei*. This is incomplete but is included as it comprises new and valuable information. It is important to understand the species and its specialized requirements in some detail before conservation proposals can be made.

Habitat description

In the Cape Province the genus *Heleophryne* is confined to mountainous terrain with high rainfall (600 mm to 300 mm p.a.) and clear, swift-flowing, perennial mountain streams. The distribution of *Heleophryne* in the southwestern and southern Cape is limited to Acocks' (1975) Macchia, False Macchia and Knysna Forest veld types (Boycott 1982). Recently the Council for Scientific and Industrial Research published a 'Vegetation Map of the Fynbos Biome' (Moll, Campbell, Cowling, Bossi, Jarman & Boucher 1984). In this publication the habitat is described as Wet Mountain Fynbos and Mesic Mountain Fynbos. These vegetation types occur on sandstone and quartzite mountains.

The disjunct distribution of ghost frogs in South Africa is doubtless due to their specialized habitat requirements. Our survey of *H. rosei* has confirmed that they are indeed very selective in respect of habitat. On Table Mountain the species occurs in moist, wooded ravines and valleys with perennial surface water. Characteristically the streams are fast flowing and steep with many cascades and waterfalls. Vertical, wet, moss-covered, rock faces bordering such streams are typical *Heleophryne* micro-habitat.

Life-history notes

It has often been argued that the more specialized a species becomes, the more vulnerable it is to environmental

change. The unique tadpoles of *Heleophryne*, originally described and illustrated in detail by Rose (1929), are characteristically torrent adapted. The tadpoles possess a large suctorial mouth which affords purchase on the substrate in swift-flowing mountain streams. It is not unusual to see these tadpoles climbing smooth, vertical, rocks or even waterfalls along the watercourse. The tadpoles are often very useful in locating populations.

Restricted as they are to cold mountain streams, the tadpoles undergo relatively slow development. It has been suggested that the larval life is comparatively long and that the tadpoles spend at least two seasons in the streams before metamorphosis is completed (Rose 1926; Wager 1965; Boycott 1982). As in *H. purcelli*, the tadpoles of *H. rosei* complete their metamorphosis and leave the streams in March/April/May prior to the onset of winter rains. Those tadpoles still in their first year have by this time grown sufficiently strong to cope with the impending torrents. The tadpoles are algal feeders which use the numerous rows of labial teeth to rasp algae off submerged rocks. The distinctive 'feeding trails' left on submerged surfaces are useful indicators of the presence of a *Heleophryne* population. Overturning submerged rocks in these areas usually reveals the tadpoles.

The adult frogs are also very specialized. The frog is squat, and the head and body are depressed, thus allowing for effective concealment in narrow crevices and under stones (Figure 1). The dorsal pattern is cryptic, rendering the frogs difficult to see. The fingers and toes terminate in large, spatulate, friction pads that facilitate purchase on vertical rock faces and in swift-flowing streams. The hindfeet are extensively webbed and this provides for strong swimming. Despite the long hindlimbs the frogs are poor jumpers.

The eggs and oviposition sites of one member of the genus, *H. purcelli*, have been described by Visser (1971) and Boycott (1972). However, the eggs of *H. rosei* have never been discovered. According to Hewitt (1925) the type female is 'distended with eggs which are large and



Figure 1 *Heleophryne rosei* Hewitt — an adult female specimen from Skeleton Gorge, Table Mountain (AM A 574).

yellow' and although no dates accompany his description, the types were collected in December 1924 according to the Albany Museum register (P. Skelton *in litt.*).

Rose (1926, 1950, 1962), basing his hypothesis on the dissection of an adult female and the occurrence of small tadpoles in the habitat, speculated that the breeding season of *H. rosei* occurred during the winter months. He surmised further that the eggs were laid out of water, and that the tadpoles developed to an advanced stage within the egg capsule, and then wriggled into or were washed into the water by the winter rains for the completion of metamorphosis. The fact that virtually all of the Cape Peninsula anurans are winter breeders probably influenced his views. However, it is unlikely that the breeding season of this species would occur at that time of the year when mountain streams become raging torrents. Eggs and newly hatched larvae would have little chance of survival under such conditions.

The breeding seasons of *H. purcelli* and *H. regis* commence after the rainfall peaks in the south-western and southern Cape Province when river flow is reduced (Boycott 1982). It was suggested that in this way survival of larvae is further enhanced. Any stream that has water at the driest time of the year will certainly be perennial. Such a strategy would ensure that eggs would not be deposited in temporary streams. This is an important consideration because the tadpoles of *Heleophryne* are obliged to spend a period in excess of 12 months in their aquatic environment before completing metamorphosis. It is unlikely that the breeding season of *H. rosei* would differ markedly from that of *H. purcelli* and *H. regis* since *H. rosei* is exposed to very similar environmental and climatic conditions.

Boycott (1982) has described in some detail the development of secondary sexual characters in *Heleophryne*. These include the development, in males, of nuptial pads and dorsal skin folds and in males and females, the development of spines or asperities on the surface of the skin. These characteristics have been found to be most useful in determining the sex of specimens and as indicators of breeding activity, at least in *H. purcelli* and *H. regis*.

The type specimens of *H. rosei* were collected in the month of December and the female was gravid (Hewitt 1925). It is not surprising therefore, that Hewitt (1925) was presented with an opportunity of describing the asperities on the surface of the skin in both specimens. Boycott's (1982) description of the asperities in *H. rosei* concurs with that of Hewitt and both noted that these dermal protruberances are far more conspicuous and prevalent in males.

In August 1978, during the course of our survey, we visited Skeleton Gorge to establish whether *H. rosei* were active during a mid-winter rain-storm. On this occasion, in the space of 2 h, eight specimens were observed of which four were collected. These all subsequently proved to be males, three adults and one subadult. All displayed asperities on the surface of the skin that were clearly at an emergent stage. The asperities take several weeks to attain peak development (Boycott unpublished data). Two months later, in October, a gravid female specimen was collected and in early December of the same year, a tape recording of the call of *H. rosei* was made. With the

knowledge that has now been accumulated it seems safe to conclude that the breeding season of *H. rosei* is also influenced by the rainfall pattern of the area and is restricted to that time of the year when stream flow on Table Mountain is reduced, i.e. spring and summer.

H. rosei survey

At the commencement of the survey *H. rosei* had been recorded from four localities; Skeleton Gorge, 'Above Newlands', Wynberg Cave (Poynton 1964) and Platteklip Gorge (Du Toit 1934). The species was known only from eight adult specimens when Poynton (1964) carried out the second revision of the genus.

Because *Heleophryne* tadpoles are so distinctive and can be found at any time of the year we carried out a tadpole survey rather than attempting to survey the distribution of adults. The survey was conducted in April and May before the commencement of the winter rains, thereby avoiding unnecessary investigation of temporary streams.

By systematically visiting suitable localities the presence or absence of tadpoles was recorded. Where present, a series of tadpoles was collected. The survey commenced in the type locality, Skeleton Gorge. From Skeleton Gorge we carried out a systematic search for *H. rosei* tadpoles in all the streams that were flowing on the east-facing slopes of Table Mountain, northwards to Dark Gorge on the slopes of Devil's Peak and southwards to Constantia Nek (Figure 2). The south-facing slopes from Constantia Nek to Llandudno Corner were also investigated. The west-facing slopes of the mountain from Llandudno Corner along the Twelve Apostles to Kloof Nek fall into the rain shadow and perennial water on these slopes is non-

existent. No surveys were carried out along these slopes because the habitat was considered unsuitable for *H. rosei*. The only locality visited on the north-facing slopes was Platteklip Gorge mainly because of Du Toit's (1934) record but also because of own optimism. Several localities on top of the mountain were also visited.

An attempt has been made to accumulate additional information gathered by other parties during the last decade pertaining to *H. rosei* and its distribution on Table Mountain. Some people have given freely of their personal observations. In presenting our results we have incorporated these observations.

Results

Tadpoles of *H. rosei* were found to occur at seven localities (Figure 2). These were Window Gorge, Skeleton Gorge, Nursery Ravine, Cecilia Ravine, the Original Disa Stream, Disa Gorge and the upper reaches of Disa Stream. Adult specimens were recorded from five localities; Window Gorge, Skeleton Gorge, Nursery Ravine, Wynberg Caves and Grotto Caves. The species is presently represented in South African museums by 16 specimens.

H. rosei is found in the streams on the wetter, east- and south-facing slopes of Table Mountain between Window Gorge and Cecilia Ravine and in those flowing into Orange Kloof off the Back Table (Figure 2). The total area to which *H. rosei* is confined is probably no more than 7 or 8 km². Although it is likely that large tracts of indigenous forest once covered these slopes, very little remains at the present time. The most extensive expanse of indigenous forest remaining occurs in Orange Kloof. The largest population of tadpoles was found in Disa Gorge. The Original Disa

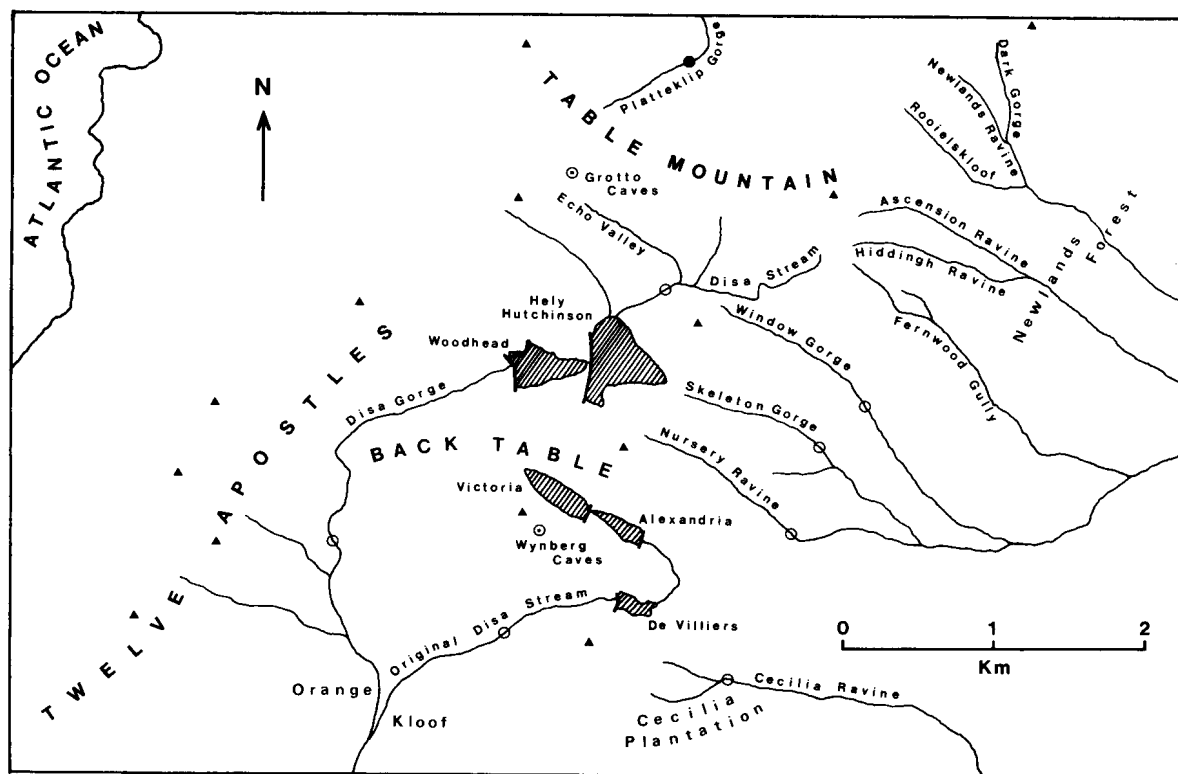


Figure 2 Map of Table Mountain showing localities visited during *H. rosei* survey and place names mentioned in the text. ○ = localities from which *H. rosei* tadpoles have been recorded; ● = Du Toit's (1934) locality for *H. rosei*; ◎ = caves; ▲ = peaks above 750 m.

Stream also supports a healthy tadpole population at present. Both streams flow into Orange Kloof and this region undoubtedly supports the largest number of *H. rosei* specimens on the mountain. It would not be unreasonable to consider this area as constituting the centre of the species' distribution range which would serve as a refuge for the species during unfavourable climatic conditions. This area, however, does not include Skeleton Gorge, the type locality.

Discussion

Movement of adults

Adult specimens were first recorded from the Wynberg Caves by Gow (1963) and more recently by Passmore & Carruthers (1979). Two adult specimens received from Dr J. Loveridge had been collected from a locality on the south-facing slopes above Echo Valley in the vicinity of the Grotto Caves. These two localities are situated a considerable distance from the nearest perennial stream (Figure 2), which indicates that the adults of *H. rosei* are not dependent on the presence of perennial water for emigration from one locality to another but can easily move over land. Similar behaviour patterns have been observed in *H. purcelli* and *H. regis* where specimens have been found kilometres from the nearest permanent stream or river.

Expansion of the habitat

There is little doubt that adults are capable of moving a considerable distance from streams. Whether individuals are successful in establishing viable populations at other localities, however, depends on a number of factors. Expansion of the habitat during wetter cycles almost certainly occurs. Du Toit (1934) recorded a metamorphosing *H. rosei* tadpole from Platteklip Gorge, on the north-facing slopes of the mountain and Loveridge's two specimens were found within 700 m of this gorge. During the survey this locality was investigated on several occasions but no sign of *H. rosei* was found here. However, this locality has been substantially altered by the construction of a main road and the planting of exotic plantations. Rose (1926) was in possession of some tadpoles that had been '... taken on the opposite side of Table Mountain ...' but unfortunately did not provide any detailed locality data. One can only assume that they might have been collected from this locality.

Threats to the habitat

The habitat of *H. rosei* has undeniably been reduced by man. Table Mountain is a sensitive ecosystem and uncontrolled fires and over-exploitation have taken their toll. The survival of *H. rosei* is placed under additional stress owing to climatic fluctuations. Some of the streams frequented by the tadpoles are devoid of perennial surface water for three out of five seasons, according to Mountain Club members who know the mountain well. In our experience certain sections of the streams in Skeleton Gorge, Nursery Ravine and Cecilia Ravine are reduced to mere surface trickles and subterranean streams at the end of the summer. Five reservoirs were constructed at various points on the Back Table at the beginning of the century to

provide Cape Town with its water supply (Figure 2).

The construction of Woodhead and Hely Hutchinson reservoirs on what must formerly have been suitable *H. rosei* habitat is bound to have affected the population numbers of *H. rosei* in Disa Stream. Similarly the construction of De Villiers reservoir and possibly even Alexandria and Victoria reservoirs probably also affected the numbers in the Original Disa Stream. However, the main threat to *H. rosei* posed by these reservoirs is no longer one of the past but is very much one of the future. If the outflow from these reservoirs were to be halted during a dry period, or even at the end of a normal dry summer as a result of man's demands, then the Original Disa Stream and Disa Gorge would be deprived of the perennial water so vital to the survival of the tadpoles.

One of the greatest threats to *H. rosei* would be the uncontrolled infestation of exotic vegetation and thoughtless forestry practices along the perennial watercourses that characterize the habitat of the species. The planting of exotic poplar trees in Cecilia Ravine has virtually rendered the entire watercourse uninhabitable for the tadpoles. The only tadpoles found in Cecilia Ravine were found along a 20-m stretch above a well established poplar plantation. The stream has been reduced in volume owing to the construction of a weir upstream to supply the forest station with a source of fresh water. That part of the stream flowing through the poplar plantation has been reduced to a number of stagnant pools, most likely as a result of the extensive clogging of the watercourse by dead and decaying poplar leaves. The 20-m stretch in which the tadpoles were found varied in depth from 2 cm to 7 cm and it was only along that section of the stream flowing between the weir and the first poplar trees that the tadpoles were in evidence. Considering the extended development of *Heleophryne* tadpoles, the population in Cecilia Ravine is without doubt the most vulnerable on the mountain. We do not hold out much hope for this population which, if not already extinct, will by now probably be seriously depleted.

Some people have expressed concern about this species being threatened by over-collecting (C. Gow pers. comm.). However, our experience has shown that although the tadpoles are quite easily found, the same is certainly not true of the adult frogs. The fact that very few adults have been collected is somewhat reassuring.

Conservation proposals

From a conservation point of view we should concern ourselves with that part of a species' distribution range where suitable habitat would survive the most catastrophic climatic and environmental changes, as such habitat would certainly serve as a refuge for the species. These areas must be identified and should be managed as high priority conservation areas for the species concerned. Such a policy cannot be over-stressed especially when dealing with species like *H. rosei* that have a very restricted distribution range. The centre of a species' distribution range does not always incorporate its type locality; in such cases it is imperative that the type locality be incorporated within the conservation area. This is the case with *H. rosei* as its type locality does not fall into the same area considered, from

the results of our survey, to constitute the centre of its distribution range, namely Orange Kloof.

Although not initiated as a result of any specific or direct concern for *H. rosei* some measure of protection exists for the species. Like all other amphibians this species is protected in the Cape Province by the Cape Provincial Nature Conservation Ordinance. Furthermore, albeit accidental but most fortunate, Orange Kloof is situated within the boundaries of forest land protected by the Department of Forestry and the type locality is situated in land protected by the National Botanic Gardens.

Table Mountain is part of the Cape Peninsula Nature Area and a recent development has been the establishment of a management committee. This has been established to co-ordinate the activities of the many bodies involved in landownership on the mountain and the rest of the Cape Peninsula. On Table Mountain these include the Cape Town City Council, the Department of Forestry and the National Botanic Gardens to name a few. Hopefully this development will ensure co-operation from all parties in promoting conservation and management principles on Table Mountain.

Unwise forestry practices as have occurred in Cecilia Ravine and above Newlands Forest must be avoided, the control and eradication of exotic vegetation is an important prerequisite for the continued survival of *H. rosei* on Table Mountain. Strict control of the outflow, which should be continuous, from the reservoirs on the Back Table is of utmost importance. The stocking of streams and reservoirs with exotic fish should be prohibited as these fish will undoubtedly prey upon the eggs and larvae of the amphibian fauna.

McLachlan (1978) suggested that consideration be given to introducing this species to other Cape Peninsula streams in order to increase its range. We do not agree with this suggestion as our fieldwork, which incorporated a survey of other streams on the Cape Peninsula, revealed that no other suitable streams existed. However, we do suggest that serious consideration be given to conducting translocations on Table Mountain as there are other suitable areas on the mountain.

If a translocation programme of *H. rosei* tadpoles was approved (and we feel it is justified), we would suggest that tadpoles be introduced in large numbers to Newlands Ravine, Rooielskloof, Ascension Ravine, Hiddingh Ravine, Fernwood Gully and Cecilia Ravine. It would be imperative that this be done prior to the commencement of the winter rains and only after careful monitoring over a few years of the suitability of these streams.

Our conclusions are that the species is rare and vulnerable and in order to improve the conservation status of *H. rosei* on Table Mountain human intervention should be considered. We feel that *H. rosei* could only benefit from the implementation of a translocation programme. Table Mountain ghost frogs probably have one of the most restricted distribution ranges of any amphibian in the world and it would be a great tragedy if their continued survival were not ensured. Their presence further emphasizes the uniqueness of Table Mountain as an area of outstanding zoological and botanical interest.

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