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ARTICLES

NOTES ON SOME ASPECTS OF THE ECOLOGY OF THE HUSAB SAND LIZARD, *PEDIOPLANIS HUSABENSIS*, FROM NAMIBIA

PETER CUNNINGHAM[1], THEO WASSENAAR[2] & JOH HENSCHEL[2]

[1]*Environment & Wildlife Consulting, Namibia, P.O. Box 90717, Windhoek, Namibia, E-mail: pckkwrc@yahoo.co.uk*
[2]*NEMRU, Gobabeb Training and Research Centre, P.O. Box 953, Walvis Bay, Namibia*

INTRODUCTION

Biodiversity loss is one of the world's most pressing crises. Many species are declining to critical population levels, important habitats are being destroyed, fragmented, and degraded, and ecosystems are being destabilised through a variety of factors including direct human impacts (Millenium Eosystem Assessment 2005, IUCN 2010). In the central Namib Desert of Namibia, such impacts are currently caused by a significant increase in uranium mining and exploration activities, to such an extent that the area has become known as the Uranium Province (SAIEA 2010).

Western Namibia – including the Namib Desert – is a mosaic of habitats, often with sharp boundaries and disjunct populations. Approximately 60 endemic or near-endemic reptile species (i.e., 23% of all species and 50% of all Namibian endemics) occur in this region. Lizards, especially the genus *Pedioplanis*, show the greatest endemism and/or species radiation (with approximately 35% endemism within the Namibian fauna; Griffin 1998).

This paper provides basic ecological data on the central Namib endemic Husab Sand Lizard (*Pedioplanis husabensis*), which is potentially directly affected by uranium mining, especially since its known area of distribution is confined to the core of the Namibian Uranium Province (Berger-Dell'Mour & Mayer 1989). The objectives of the study were to collect basic ecological data of a little known and understudied species prior to full-scale mining operations planned for the general area.

STUDY AREA

The study area comprised the area surrounding the planned Swakop Uranium Mine (prior to the mining license being granted, this mine site was called Husab Mine), but not exclusively limited to the expected footprint of the mine. The roughly triangular study area extended from the Husab geological camp (south-eastern boundary) towards the Khan River (northern and northwestern boundary). The eastern boundary included the boundary fence of the Namib-Naukluft National Park (Fig. 1). This study area was deemed to be ecologically meaningful for the assessment of potential impacts, considering the known distribution and biology of *P. husabensis*.

The central Namib in general, and specifically our study area, is heavily influenced by the cold Benguela Current and associated coastal climate with mean annual temperatures ranging between 18 and 22 °C and average and median annual rainfall less than 50 mm with southerly and westerly winds being typical (Mendelsohn et al. 2002). The dominant soils are petric gypsisols and calcisols and the main vegetation type is Central Desert (Mendelsohn et al. 2002) or Central Namib (Giess 1971), with the dominant vegetation structure being sparse shrubs and grasses. The plains of the Central Namib are normally bare, but after localised winter rains become covered with scattered clumps of *Mesembryanthemum* species and *Stipagrostis obtusa* and *S. ciliata* grasses (Giess 1971, Wassenaar & Mannheimer 2010). Average plant production and the variation in plant production are extremely low with a low overall terrestrial diversity and average to high terrestrial endemism (Mendelsohn et al. 2002). Reptile diversity is moderately high, with 41 to 60 species occurring in the area, although 25 to 28 of these are endemic (Mendelsohn et al. 2002).

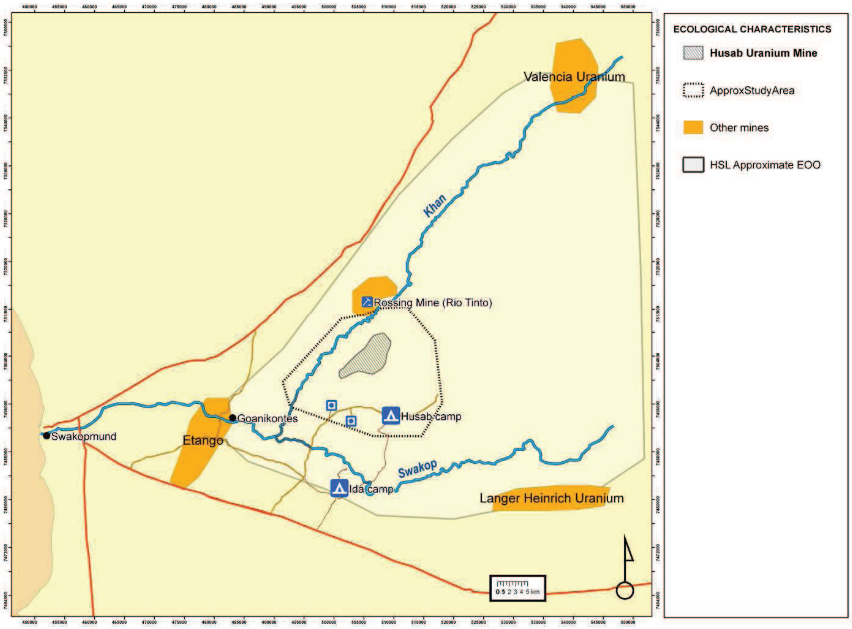

Figure 1: Approximate extent of occurrence (EOO) of Husab Sand Lizard, with the study area, relative to the location of the planned Swakop Uranium Mine. The approximate locations of other mines (planned and operational) are provided for reference (after Wassenaar et al. 2010). Note that the latter are not drawn to scale.

The habitats covering the largest part of the study area were described as part of an Environmental Impact Assessment for the mine (Wassenaar & Mannheimer 2010). Typical habitats are the Khan River, three plains habitats (gypsite plain, grassy gravel plain [Fig. 2-left] and hard undulating plain), rocky valley drainages, plains drainage channels, broken rocky pink granite, broken rocky black metamorphosed sediments, marble intrusions in broken rocky terrain (Fig. 2-right), and koppies and ridges on plains. The latter included ridges consisting of mostly marble rock with relatively high habitat diversity, as well as more simple metamorphosed sediments of the Khan group. It is especially the marble ridges that are relevant to this study, both those occurring as inselbergs on the plain, and those that occur as intrusions into broken granite and meta-sediment rocky terrain (Fig. 2-right).

Figure 2: Left) Sparsely vegetated grassy gravel plains typical of most of the Swakop Uranium area with the Husab Mountain in the background. Right) Vegetated marble ridges extending down towards the Khan River and occurring as an intrusion into widespread exposed broken rocky granite and metasediment terrain. Note the drilling rigs on the horizon in the background.

The Husab Sand Lizard (*Pedioplanis husabensis*) (Fig. 3), first described by Berger-Dell'Mour & Mayer (1989), is a restricted range endemic lizard species (100% of the taxon's range is within Namibia) that occurs in the general area of the confluence of the Swakop and Khan Rivers (Berger-Dell'Mour & Mayer 1989, Branch 1998, Griffin 2003).

Very little is actually known about the basic ecology and or actual habitat requirements for this species. Except for this study, probably the most comprehensive to date, and the study conducted by Berger-Dell'Mour & Mayer (1989) in the Rössing Mine area, even reference to the distribution of the species are limited to 'grey literature' (e.g., Griffin 2005, Cunningham 2007, Conradie & Branch 2009, Wassenaar & Mannheimer 2010). Habitat requirements are broadly and vaguely, described as "stony substrates" (Griffin 2003) and "rocky desert with expanses of flat rock on exposed bedrock being preferred" (Branch 1998) while Alexander & Marais (2007) provide general habitat and basic ecological data for the genus.

Figure 3: *Pedioplanis husabensis* in typical marble boulder dominated habitat in the Husab area.

According to the Namibian Nature Conservation Ordinance of 1975, the conservation and legal status for *P. husabensis* is viewed as "endemic" and "secure" and proposed as "protected" under the new Parks and Wildlife Management Act (In Prep.) (Griffin 2003). *Pedioplanis husabensis* is furthermore viewed as "threatened" by the 'Uranium Rush' (SAIEA 2010). Its total known range at this stage is probably less than 5,000 km^2 (Wassenaar et al. 2010), which would put it in the "endangered" category according to the IUCN Red List Categories and Criteria (IUCN 2001).

METHODS

Fieldwork was conducted from sunrise to sunset over a period of 5 days between 18 and 22 November 2010, with more emphasis on the early morning and late afternoon as these were noted to be the periods of most *P. husabensis* activity. Transects were conducted on foot, varying in length and direction, traversing as many habitats as possible throughout the study area.

Although the study focused on *P. husabensis*, all other reptiles especially all species in the genus *Pedioplanis* (e.g. *P. inornata* and *P. breviceps*) encountered along the various transects were identified and their geographic coordinates plotted using a hand held GPS. The *P. inornata* in the study site had the coloration patterns of the northern form, which is thought to be a distinct parapatric species of the nominate taxon in the south (Berger-Dell'Mour & Mayer 1989, Makokha et al. 2007, Conradie & Branch 2009). This "northern Plains Sand Lizard" occurs in western central Namibia, has been found to be genetically distinct (Conradie *Pers. Comm.*), but has yet to be formally described and named. Here we refer to it as *P. inornata*.

To ascertain basic habitat and ecology requirements for *P. husabensis* the following data were gathered at each point where an individual *Pedioplanis* spp. was sighted: habitat type (according to Wassenaar & Mannheimer 2010), date and time of observations, temperature (°C measured using a hand held thermometer at 1 m above the soil surface, wind direction and strength (still/breeze/moderate/strong - estimated), cloud cover (clear, light cloud, overcast, rain), substrate (plate rock, rocky [rocky, rock and gravel, rock and sand], gravel [gravel, gravel and rock, gravel and sand], sandy [sand, sand and rock, sand and gravel] as the majority type within 100 m radius of actual sighting), scale of roughness of the rock surface (scaled from 1 to 5, with 1 being flat and 5 very rough), vegetation (bare, sparse, open, vegetated, well vegetated - estimated), closest plant (measured by pacing the distance to the closest perennial species), closest rock/boulder (measured by pacing the distance to the closest suitable shelter), activity as one of five activity classes (basking, sit-and-wait, moving, foraging/hunting, other) and relative position observed (open, concealed, sun, or shade).

Individuals were captured using an active capture technique ('reptile noosing'), identified *in situ*, photographed, standard measurements taken with Rabone plastic callipers (e.g. snout-vent and tail length in mm), weighed with a Pesola spring balance (g) and released unharmed at the site of capture.

A rapid plant species composition assessment was conducted in habitat favoured by *P. husabensis* using the "step point" method (conducted while walking the survey transect): the closest plant to the observer's foot was identified at 10 m intervals following a 1,000 m transect. Population density was estimated using the various transect lengths (paced) and observational widths (3 m to each side). A rough estimate of population numbers was determined through extrapolation using the above estimated density and preferred habitat size.

Differences in habitat variables, between species and categories were tested for using One-Way Analysis of Variance (ANOVA).

RESULTS

The combined length of all the transects was 69,380 m of which 46.6 % was spent searching for *P. husabensis* in potentially suitable habitats – e.g. koppies and ridges on plains and marble intrusions in very uneven eroded stony and rocky valleys. A total of 13 *P. husabensis* individuals were encountered, all on the habitat classified as Marble intrusions into Broken Rocky Terrain which resulted in an encounter rate of 1/1,080 m or 1.54 individuals.ha^{-1}. Using this density estimate, a simple (i.e. with low confidence) extrapolation to the total area of the Marble intrusions habitat contained within the study area (159.66 ha) gives a total population of ~103 individuals. Only three *P. inornata* individuals were encountered, all of which occurred on the Pink and Black Broken Rocky terrain. Nine individuals of *P. breviceps* were encountered on four habitat types of which the majority were observed on Grassy Plains or Hard Undulating Plains. No *P. inornata* or *P. breviceps* were observed in association with *P. husabensis* or in the habitat type favoured by the latter.

Nine of the 13 *P. husabensis* individuals encountered were captured, measured and weighed. Mean snout-vent and tail length were 47.7 ± 4.6 mm and 116.9 ± 19.9 mm respectively, and mean weight was 3.2 ± 0.8 g (Table 1). Tail length differed significantly between the three *Pedioplanis* species (ANOVA: F = 7.43; df = 2; p = 0.006) as did snout-vent-length (F = 5.61; df = 2; p = 0.02). Too few data were available to analyse differences in mass.

Table 1: Body measurements of the three *Pedioplanis* species encountered and captured in the Husab area.

Species	n	Total length (mm)	Range of Total length	Tail length (mm)	Range of Tail length	Weight (g)	Range of Weight
P. husabensis	9	47.7±4.6	42.5 to 53.5	116.9±19.9	78 - 147	3.2±0.8	2 to 4.5
P. inornata	2	47	47	113±2.8	111 - 115	3	3
P. breviceps	7	38.4±7.2	26 to 46	80.1±20.3	56.5 - 108.5	1.1±0.4	1 to 2

The majority of the *P. husabensis* sightings were made between 10:00 and 12:00 and at a mean ambient temperature of 25.7 ± 1.9 °C (Table 2).

Pedioplanis husabensis and *P. inornata* were exclusively associated with rocky substrate and rough terrain while *P. breviceps* were mainly associated with gravel substrate and flat terrain (Table 2). *Pedioplanis husabensis* were never observed far from potential shelter – on average 0.9 ± 0.2 m from a suitable rocky refuge (Fig. 4) and 1.5 ± 1.3 m from perennial vegetation (Table 2). There were significant differences in the distances the three *Pedioplanis* species were observed away from potential rocky shelter (ANOVA: F = 6.14; df = 2; p = 0.008) and from vegetation (F = 3.82; df = 2; p = 0.04).

Table 2: Habitat and environmental data for all three *Pedioplanis* species as observaed during November 2010 in the Husab area.

Species	n	Temp (°C)	Closest rock (m)	Closest plant (m)
P. husabensis	13	25.7 ± 1.9	0.9 ± 0.2	1.5 ± 1.3
P. breviceps	3	23 ± 3.6	0.5	2.3 ± 1.5
P. inornata	9	26.1 ± 2.3	6.1 ± 6	4.6 ± 3.9

Pedioplanis husabensis and *P. breviceps* individuals were mostly observed foraging (69% [n = 13] and 56% [n = 9] respectively), while all the observations (n = 3) of *P. inornata* were made whilst the lizards were basking. Without exception, all observations of all three species were made with individuals being in the open in full sunshine.

Other species observed on the same habitat as *P. husabensis* include *Agama anchietae*, *Rhoptropus afer*, *R. boultoni* and *Trachylepis hoeschi* with *R. afer* favouring the more open areas with smaller boulders or plate rock while *R. boultoni* were mainly encountered in areas with large boulders. *P. husabensis* seemed to favour the intermediate areas which are vegetated with a combination of medium and large boulders with suitable refuge (Fig. 4).

Figure 4: Typical broken grey marble ridge with medium/large boulders with numerous cracks and crevasses used as refuge by *P. husabensis* in the Husab area.

DISCUSSION

The holotype of *P. husabensis* with a snout-vent-length of 59.3 mm and tail length of 116 mm is larger than the mean 47.7 ± 4.6 mm and 116.9 ± 19.9 mm (n = 9) measured during this study although the mean tail length is similar. Too few data were collected to statistically compare the body measurements of the three *Pedioplanis* species although significant differences were seen in tail length. Although the two closely related species are morphologically similar, Berger-Dell'Mour & Mayer (1989) describe field-distinguishable superficial differences in lower eyelid and tympanic shield shape and size, body colouration, and gular scale counts between *P. husabensis* and *P. inornata*. However, the gravel/sand open habitat-dwelling *P. breviceps* captured in the current study were smaller than the *P. husabensis*. This difference could be a requirement necessitated by habitat preference.

Desert animals seldom stray from their "activity patterns" except in response to seasonal changes with many diurnal ectotherms being active from soon after sunrise to around noon (Lovegrove 1993). Although most lacertids typically show a bimodal activity pattern (e.g. Pérez-Mellado 1992), *P. husabensis* were observed to be active mainly during the mornings without an afternoon peak in activity. Although the current study's design – i.e. lack of correction for search effort – does not allow a confident conclusion about diurnal activity patterns (fewer observations were made in the midday hours), the pattern conforms to that of many desert lacertids (Cunningham 2011) and is probably real. As with many other reptiles, morning activity might be advantageous to *P. husabensis* as energetic costs of foraging activities are lower during the mornings (Pérez -Mellado 1992) or, simply because afternoon temperatures are too high (Cunningham 2001). The thermal characteristics of the white/grey marble dominated habitat favoured by *P. husabensis* could also play a role. However, the small sample size and season during which fieldwork was conducted limits the ability to generalise.

Pedioplanis husabensis occurred at a much higher frequency (1,080 m.sighting^{-1}) and at higher population densities (1.54 individuals.ha^{-1}) on marble ridges than *P. inornata* (0.39 individuals.ha^{-1}) and *P. breviceps* (0.36 individuals.ha^{-1}) in their primary habitats. However, in the current study *P. husabensis* was only recorded on marble intrusions – essentially two pockets – located within the broken rocky terrain. The characteristics of at least the pink granites broken rocky terrain are for all intents and purposes very similar to those of the marbles. During the mine EIA survey (Wassenaar & Mannheimer 2010), *P. husabensis* was also recorded on two marble ridges to the east of the Swakop Uranium Mine site (Joh Henschel & Mycke Matengu Pers.Obs.), but the nature of the surrounding habitat was not recorded. Berger-Dell'Mour & Mayer (1989) describe *P. husabensis* as inhabiting the Husab Mountain as well as the lowest parts of steep slopes along the Khan River and its many tributaries while *P. inornata* are found on the upper flatter sections. They do not however refer to the geology preferred by *P. husabensis,* except to note that the boundary line is the "last flat limestone hills [most likely the Marble rocks] on both banks of the Khan" (Berger-Dell'Mour & Mayer 1989). The two pockets of *P. husabensis* found on marble ridges during the current study may therefore represent isolated pockets or populations inhabiting the "boundary line" area as suggested by Berger-Dell'Mour & Mayer (1989). *Pedioplanis husabensis* individuals were also found on isolated marble outcrops and ridges on the opposite side of the Khan at the Rössing Mine (Pallett et al. 2008) and further to the northeast along the Khan River in the Valencia area (Cunningham 2007).

From our results it thus appears that *P. husabensis* is an extreme habitat specialist, selecting not only marble substrates, but specifically marble surrounded by other bare rock types. This conclusion is however based on 13 individuals, but concurs with the earlier observations by Conradie & Branch (2009) who noted the occurrence of *P. husabensis* on light-coloured, vegetated quartzite ridges surrounded by schist. It is not unknown for lizards to show this high degree of habitat specialisation (Goodman et al. 2008).

Although the surface roughness and substrate use are similar between *P. husabensis* and *P. inornata*, these closely related species were never recorded on the same habitat. *Pedioplanis inornata* appears to inhabit the sparsely vegetated broken terrain (Black and Pink Gramadoelas) around the better vegetated marble ridges as favoured by *P. husabensis*. This finding clearly supports the observation that these two species exist parapatrically (Berger-Dell'Mour & Mayer 1989), but also suggests that the scale at which the separation occurs is as fine as the difference between light marble substrates and other rock types – much finer than previously suspected. *Pedioplanis husabensis*' affiliation to marble is interesting, because the factors that resulted in this are not immediately apparent, but could include habitat structure (e.g. ridges are better vegetated attracting more potential prey or cracks and crevasses serve as refuge from predators or thermoregulation); food preferences or competition between related *Pedioplanis* species (e.g. *P. inornata* may confine *P. husabensis* to their range and habitat).

Other factors such as physiological differences between the two species in their tolerance of extreme temperatures and long periods without food may be as important (Sinervo et al. 2010). Although most lacertids typically show a bimodal activity pattern (e.g., Pérez-Mellado 1992), the activity patterns that we recorded certainly suggest that *P. husabensis* prefers to be active in the cooler part of the day before 13:00, indicating a potential issue with ambient temperature.

These issues may be elucidated with more information on densities and population sizes, and on changes in these, because it should permit a finer understanding of the species' relative performance, and thus better management plans. Unfortunately it is not possible to extrapolate the low numbers of individuals that we recorded to confident population size estimates, nor is the delineation of habitats sufficiently detailed. More data, collected over a larger area and a longer period and ground-truthed at an appropriate spatial scale are needed for this.

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THE HERPETOFAUNA OF SCHAAPEN ISLAND, LANGEBAAN, SOUTH AFRICA

MARCEL WITBERG

3 Scepter Crescent, Protea Heights, Brackenfell, 7560, South Africa. E-mail: witbergm@absamail.co.za

INTRODUCTION

Langebaan is a small West Coast town, approximately 100 km north of Cape Town, found on the edge of the Langebaan Lagoon. The 41 ha Schaapen Island is one of seven islands situated within the Langebaan Lagoon (Fig. 1) and is home to large colonies of shore birds. The inshore rocky island was named Schaapen Island by seafarers after they found sheep on the island, which were left there by the natives in the area to prevent the predators from getting to their sheep. The island has little soil and sparse vegetation (West Coast Strandveld) covering it. It is a bird sanctuary and is off limits to the general public.

A herpetofaunal assessment project was conducted on 5 March 2011 and 18 April 2011 on Schaapen Island. The assessment, an essential component of international obligations and compliance with the biodiversity legislation of the country, involved the gathering of information on reptiles and amphibians through active searching on the island. The main aim was to identify species found on the island as there is an extreme shortage of information in this regard and such information is important for the conservation management of the island. The only apparent species list that exists is for the West Coast National Park (WCNP), which encompasses the islands, but no detailed species list exists for the islands of the lagoon.