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Husbandry, behaviour and captive breeding of the Nama padloper, *Homopus* sp.

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Introduction

The Nama padloper (*Homopus* sp., formerly known as *H. bergeri*) is the least studied species of the southern African genus *Homopus*. The life history of this species is virtually unknown. *Homopus* sp. is endemic to the southwestern part of Namibia. The area of distribution of the species as it is known is limited to the vicinity of Aus and areas in the adjacent "Sperrgebiet" between Aus and Lüderitz (BRANCH 1998). However, this does not necessarily mean that the species does not occur in other areas in the region. *Homopus* sp. lives very secretively in rocky habitat according to farmers in the Aus region (pers. comm.), and appears to be active only after rare thunderstorms (BONIN *et al.* 1996, MÜLLER & SCHMIDT 1995). The habitat is characterised as semi-desert and receives an average rainfall between 10 and 100 mm per year, depending on the exact location, with a peak between February and June (MÜLLER & SCHMIDT 1995, RICHTER 1983). Low temperatures in the area during that time of the year can cause the precipitation to fall as snow (MÜLLER & SCHMIDT 1995, pers. comm. with farmers). Due to the cold Benguela Current along the coast of Namibia, the area receives foggy nights frequently. Average maximum temperatures increase moving inland, due to the decreasing influence of the Benguela Current.

In 1995 a captive study was initiated in order to gather information about the biology of *Homopus* sp., and to investigate possibilities for captive breeding. The restricted dimensions of the area of distribution of *Homopus* sp. emphasise the fundamental vulnerability of the species. Therefore, gathering information for developing sound management programmes, and creating *ex situ* "assurance colonies", may be considered useful.

Materials and methods

A group of three male (initial straight carapace length [SCL] 73 mm [mass 59 g], 73 mm [mass 60 g] and 88 mm [mass 80 g]) and two female (initial SCL 95 mm [mass 146 g] [female 1] and 105 mm [mass 192 g] [female 2]) *Homopus* sp. was obtained on 24 March 1995 for husbandry and breeding purposes. The origin of the specimens is the Aus area in southwestern Namibia. The largest male was found dead between rocks on 28 March 1995, possibly as a result of overheating. In the beginning of September 1997, a third female (initial SCL 90 mm) was obtained, and added to the existing group. The tortoises were released in an outdoor enclosure measuring 250 × 340 cm in Windhoek (Namibia), mimicking the natural habitat of the species. In the enclosure both sites in shade and sun were available at all times. Approximate air temperature and relative humidity in the enclosure were measured opportunistically, by means of standard analogous household equipment. Piles of rocks provided shelter, and 20%



Figure 1. Nama padloper *Homopus* sp. All photographs: A. SCHLEICHER.

of the enclosure was protected against heavy rain by the wall of the adjacent house. This part remained dry. Plants indigenous to the area of distribution of *Homopus* sp., such as *Aloe* spp., other succulents and grasses, had been planted in the enclosure. The soil consisted of a mixture of sand and fine gravel. The enclosure was positioned in such a way that qualitative observations on activities of the tortoises could be made from the house.

As the tortoises were kept outdoors throughout the year, they experienced Windhoek's climatic conditions, including rains peaking earlier in the year (November to April), higher rainfall, and generally higher day temperatures compared to the Lüderitz region, which is the natural range of the species. However, in order to imitate southwestern Namibian "late" rains, the enclosure was sprayed twice weekly, or when the hygrometer showed values below 40% relative humidity, during the Windhoek dry winter season (May to September). A water bowl was available constantly. Also, during dry spells in summer, the enclosure was sprayed twice weekly by means of a misting system, in order to imitate the desert fog.

Throughout the year, the tortoises were presented an herbivorous diet three times weekly, consisting of grasses, succulents, grape leaves, clover and small amounts of endive, lettuce, dried grasses and flowers. Additionally, soaked chicken food was fed (Growing Mash, Foodmaster, Windhoek, Namibia), which is composed of chopped

Figure 2.
Colour variation in
Homopus sp.
Note specimen with
supernumerary scutes
on the right.



oats, wheat, seeds of sunflower and cotton, field hay, bran, maize, etc.). Food was offered in the morning between 9:00 and 11:00 hrs, just before the sun started to shine in the enclosure. Occasionally, dried fallen leaves from trees and shrubs (*Schinus terebinthifolius*, *Brunfelsia pauciflora*, *Sambucus candensis*, *Streptosolen jamesonii*, *Tecoma stans*, Vitaceae spp. and *Portulacaria afra*) in the vicinity of the enclosure were available to the tortoises, as were small quantities of maize porridge. Furthermore, five times per month cucumber, zucchini, yellow beet and pumpkin was offered.

Within a maximum of six days after oviposition, eggs were transferred from the outdoor enclosure to a wet type incubator (temperature fluctuating between 28–32.5 °C during incubation, relative humidity 80–90%) described by BUDDE (1980). Eggs were placed on top of dry vermiculite to optimise gas exchange, in separate open plastic containers. Air temperature and relative humidity were measured permanently, by means of an analogous household thermometer and hygrometer. Incubation period was defined as the period of time between transferring of eggs to the incubator, and hatching.

Figure 3.
Plastral view of male (left)
and female (right)
Nama padlopers.





Figure 4.
Mating *Homopus* sp.
in their enclosure.

Hatchlings were removed from the incubator when no yolk sac was visible anymore. They were kept individually in indoor enclosures (40 × 45 × 50 cm) on newspaper during the first two weeks. Decoration consisted of wood and stones, arranged in such a way that a rock crevice was present as a hiding place. The hatchling enclosures were illuminated by two fluorescent lights (Osram Lumilux, 18 W) and a spot light (Osram Concentra PAR, 80 W) (switched via a dimmer) provided a local heat source. A water bowl was present permanently. The enclosures were misted every day. Straight carapace length of tortoises was measured monthly by means of sliding calipers, and tortoises' mass by means of a spring balance with an accuracy of 2 g (Soehnle, Murrhardt, Germany). Shell width and height were measured incidentally, by means of sliding calipers. Diet was similar to that of the adult tortoises, although a calcium/vitamin additive (Calsup and Beefee Powder, Sanvet [Pty] Ltd., Silverton, South Africa) was added approximately once a month. From February 2000 on, hatchlings that hatched in summer were transferred to largely shaded outdoor terrariums measuring 130 × 80 × 40 cm after eight weeks of indoor husbandry. All captive-bred specimens reaching sexual maturity were housed separated from the adults to prevent inbreeding. During the winter months, hatched specimens kept indoors were transferred to a sunny outdoor meshwire cage (78 × 48 × 30 cm) for 1–2 hrs per day.

Results

It was observed that *Homopus* sp. hid in rock crevices when inactive. Tortoises fed during activity periods in the morning at feeding time, and in the late afternoon. Several tortoises (male/male and male/female assemblages) shared retreats, and fighting among males has never been noticed during permanent daytime observation of the colony. Shortly after placing the specimens in captivity, they fed on the diet provided. Straight carapace length, carapace width and shell height of the females on 18 February 1999 were respectively 111.5 × 89.0 × 47.0 mm (mass 260 g) (female 1), 110.0 × 85.0 × 44.5 mm (mass 230 g) (female 2) and 96.5 × 78.5 × 41.0 mm (mass 158 g) (female 3).

In summer (November to April), general activity levels were highest during clouded days and days with thunderstorms. In winter (end of May to mid-August) activity decreased, although the tortoises did not become completely inactive. Tortoises remained in their shelters during the day, when temperatures during the night dropped below 0 °C and when day temperatures did not rise above 20 °C. When the enclosure was sprayed in winter, to imitate southwestern Namibian "late" rains, activity level of the tortoises increased, and oviposition occurred. Despite of the water bowl that was present in the enclosure, the tortoises also drunk rainwater from stones and pits. Immediately after the tortoises had been released in the enclosure on 24 March 1995, nearly continuous mating behaviour was observed during the activity periods of the tortoises in morning and late afternoon.

Two adult females together (female 1: largest SCL and female 2: second-largest SCL) produced up to six clutches of single eggs per year, with a peak in May to October. The period between two clutches of female 2 was found to be 43 days (Table 1). The periods between the other clutches remain unknown, as the eggs were found in the enclosure without noticing oviposition, disabling to determine which egg resulted from which female. All but one of the eggs were laid at sites under overhanging rock slabs, in hollow rocks or under small shrubs. The remaining egg was deposited on bare soil. The sizes of two eggs that were measured were 37.0 × 26.0 mm and 41.0 ×



Figure 5. Hatchling Nama padloper.

28.0 mm, both with a mass of 18.0 g. The time-span between oviposition and hatching could be determined in one egg, and was 106 days. Incubation period, defined as the number of days between transferring an egg to the incubator and hatching, averaged 99 days. Hatching success was 75%. Average hatchling SCL was 35.5 mm, carapace width 31.5 mm and shell height 19.1 mm. Average hatchling mass was 11.3 g. After 26 months (July 1997: SCL 68.5 mm, mass 56 g) first mating activity of the oldest (male) juvenile was observed. The next two hatchlings showed slower growth after approximately 100 days, when compared to the oldest hatchling. The fourth hatchling died after 108 days, presumably caused by overheating, when it had got stuck between rocks. After these incidents all remaining captive-bred tortoises were transferred to the shaded outdoor terrarium in February 2000, to successfully prevent further deaths from overheating. Later, captive-bred tortoises were separated to prevent inbreeding.

Table 1. Successful breeding results of captive *Homopus* sp. between 1995 and 2001.

Hatchling number	Oviposition	Hatching date	Incubation period ²	Size hatchling (mm)	Mass hatchling (g)
1	15.07.1995	29.10.1995	106	27.0 × 27.0 × 21.0	9
2	29.05.1997	18.09.1997	112	38.0 × 33.0 × 18.0	12
3	04.09.1997 ³	12.12.1997	99	40.0 × 33.0 × 18.0	12
4	28.03.1998 ³	29.06.1998	93	37.0 × 33.0 × 18.0	12
5	05.07.1998 ³	17.10.1998	104	36.0 × 31.0 × 22.0	10
6	28.09.1998 ³	12.12.1998	—	33.5 × 29.5 × 17.5	10
7	21.10.1998 ³	01.02.1999	103	37.0 × 34.0 × 19.0	14
8	10.01.1999 ³	07.04.1999	87	36.0 × 33.0 × 22.0	10
9	20.07.1999 ³	14.11.1999	117	34.5 × 26.5 × 20.5	10
10	31.08.1999 ³	21.12.1999	112	38.0 × 34.5 × 28.5	12
11	16.09.1999 ⁴	17.12.1999	92	38.0 × 33.0 × 22.0	12
12	26.10.1999 ³	01.02.2000	100	36.0 × 33.0 × 20.0	12
13	26.10.1999 ³	21.12.1999	—	36.0 × 32.0 × 18.0	10
14	26.10.1999 ³	06.02.2000	103	36.0 × 33.0 × 18.0	11
15	28.07.2000 ³	14.11.2000	119	41.5 × 36.0 × 21.5	12
16	05.08.2000 ³	30.11.2000	117	36.0 × 33.0 × 19.0	12
17	27.09.2000 ³	08.01.2001	103	36.0 × 33.0 × 20.0	10
18	29.09.2000 ³	02.01.2001	95	35.0 × 29.0 × 19.5	8
19	02.04.2001	31.07.2001	120	41.0 × 34.0 × 20.0	14
20	12.07.2001	11.11.2001	132	38.5 × 34.0 × 20.0	13
21	24.08.2001	07.12.2001	105	39.0 × 33.0 × 18.0	8

¹ estimated date of oviposition (± 6 days);

² incubation period defined as the number between oviposition (± 6 days) and the hatchling leaving;

³ egg located in enclosure > 6 days after oviposition;

⁴ two-egg clutch with one deformed egg.

Discussion

Highest general activity level of the captive group of *Homopus* sp. was observed between November and April, matching with the rainy (summer) season in Windhoek. The climatic conditions regarding precipitation in Windhoek are not the same as those in the natural habitat of *Homopus* sp., which receives highest precipitation later in the year, extending into winter. Because plant growth in the natural habitat of *Homopus* sp. depends heavily on the sparse rains (WALTER *et al.* 1984), foraging activity of the species in the wild may extend into the winter season. The suggestion of in situ winter activity is supported by the fact that in Windhoek spraying the enclosure could also induce winter activity. Average maximum winter temperatures are similar in Windhoek and Lüderitz, and can be expected to be higher further inland within the range of tortoises.

Female 1 and 2, and the two males showed reproductive behaviour and egg production, although the specimens were small in comparison to the adult size of 100–150 mm mentioned by BRANCH (1998). Peaking in May to October, egg-laying occurred throughout the year, and was not confined to a limited period as has been found in captive *Homopus s. signatus* (spring) (LOEHR 1997, 1999, PALMER 1994). Continuous egg production may be a characteristic of wild populations of *Homopus* sp. as well, but it may also have been induced by favourable environmental conditions in the enclosure throughout the year, such as relatively high (natural or artificial) precipitation and food availability.

The period of time between two of the clutches was 43 days. All normal clutches comprised single eggs. The relatively large size of the eggs suggests that the species may also lay single eggs in the wild. The only multiple egg clutch contained two eggs, one of which was deformed in shape and smaller. Average incubation period was 99 days. It seems to be a short duration in comparison to *H. s. signatus* (LOEHR 1999), but may have been caused by averagely higher incubation temperatures in Windhoek during hot summer days. Alternatively, a relatively short incubation period could be considered an adaptation to a habitat that provides conditions suitable for incubation only during a limited period of the year.

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