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OBSERVATIONS ON THE NATURAL HISTORY OF PERINGUEY'S ADDER, *BITIS PERINGUEYI* (BOULENGER) (REPTILIA: VIPERIDAE)

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(With three Plates)

ABSTRACT

Reproduction and batch size in relation to other southern African *Bitis* species, as well as tail colouration, fog-water drinking, thermoregulation, activity periods and self-envenomation are discussed.

INTRODUCTION

With the exception of Merten's (1953) and Brain's (1960) discussions of the sidewinding type of locomotion of Peringuey's adder, *B. peringueyi* (Boulenger), and a note by Louw (1972) of captives drinking water sprayed on their bodies, the natural history of this endemic Namib Desert species remains poorly known. Here we discuss a number of aspects of the biology of this adder including reproduction, the genetic basis of its dimorphic tail colouration, fog-water drinking, thermoregulation, activity rhythms, prey capture and the result of self-envenomation.

REPRODUCTION

A female Peringuey's adder was captured in the sand dunes near Gobabeb (23° 33'S, 15° 05'E), South West Africa, on 24 February 1976. The snake appeared gravid and was placed in a 20cm square terrarium for observation. On 1 March 1976, at 18h00 the first of four young was notic-

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ed as it attempted to free itself from the membraneous egg capsuls. All the young accomplished this by vigorously moving the head sideways until the membrane was broken whereupon the young snake crawled out and began sidewinding across the sand in the manner characteristic of the species. By 20h00 the last was born, and all four were free of the membrane. Three of the four shed their entire skin within an hour after birth, but the fourth and the last born, despite persistent efforts, freed only the portion covering its head. Unlike its siblings it never burrowed or attempted to feed, and eventually died a month after birth.

After freeing themselves from the egg case and shedding the first skin, the hatchlings more closely resembled the colour and pattern of the mother (pl. 18). On 5 March one of the brood struck and killed a small (75mm total length) sand-diving lizard, *Aporosaura anchietae* (Bocage), and promptly swallowed it tail first. Thereafter, with the exception of the individual that did not shed, all the young regularly killed and ate these lizards.

Additional information on the reproduction of this species was subsequently given to us by Mr R.W. Patterson of the Transvaal Snake Park. Three females collected near Swakopmund on 17–18 March 1977 produced broods two–three weeks later of seven, ten (nine still-born), and five young. The weights and standard length measurements of the four mothers and the three surviving broods are given in Table 1.

In addition to the females from Swakopmund, which were collected in mid-March, three gravid individuals were found near Gobabeb during February 1977. During the winter months (June to September), none of the eight females that were collected and checked by palpation appeared gravid. These limited observations suggest that the young are born primarily during the summer and autumn months (December to April).

This species of *Bitis* and two others, *B. schneideri* (Boettger) and *B. xeropaga* Haacke, which also live in the arid Namib Desert, seem to have smaller broods than species in more mesic habitats (Table 2). Broadley (1972) recorded litters of four to seven young in *B. caudalis* (A. Smith) collected in semi-arid regions of Botswana, whereas usual numbers are 12–18. He suggests that fluctuations in clutch size may reflect cyclic changes in food supply. With snakes, and other reptiles, the larger females commonly produce the largest broods, and this correlation probably holds for *B. peringueyi* (Table 1). Certainly more ecologically relevant information on the reproductive biology of all species of adders in South Africa is necessary before the ecological and evolutionary implications of a lower reproductive rate of the species in arid regions can be correctly assessed. Brood sizes of southern African species of *Bitis* are summarized in Table 2.

Tail colouration

Isemonger (1968) and FitzSimons (1974) state the colour of the tail tip in this species is black, but in fact, there are two colour variants, as Haacke (1975) later noted. In the brood from Gobabeb, two individuals had black-tipped tails and the other two tan, the same colour as the pale portions of the tail and body. Another series of 12 young had two with black tails and 10 with tan ones. Determination of sex and tail colour of 69 live or preserved snakes shows that this trait is not sex-linked and that

the number of tan-tipped (51) to black-tipped (18) tails closely approximates a 3:1 ratio ($p > ,01$; $X^2 = 1,63$), which is characteristic of non-sexual inheritance by simple dominance (tan dominant to black) in a two allele system. A similar tail dichromatism occurs in *B. schneideri* (Haacke, 1975) and is probably controlled by the same inheritance mechanism.

Fog-water drinking

Louw (1972) described the dorsoventral flattening of this sidewinding adder's body when sprayed with fine water droplets, the subsequent drinking of the drops from its body, and the elevation of the forebody to facilitate swallowing. He regarded this as an adaptation to utilize fog as a source of free moisture. We confirm that this behaviour occurred on many occasions when captive snakes were sprayed, and most readily with those that had neither eaten or drunk recently. Several days after birth, the three hatchlings responded immediately by drinking water sprayed onto their bodies. With them the dorsoventral flattening was extreme, and after drinking, half the forebody was raised vertically to aid swallowing. One 10,5g adult gained 14% body weight (1,5g), and a 2,9g juvenile gained 7% (0,2g) from sprayed water they sucked as it pooled in a crease formed by pressing the rostrum against the lateral body surface.

In the field, we have observed five of these adders drinking condensed fog from their bodies. However, because of their high-moisture lizard diet, (approximately 75% water), the considerable water conservation efficiency of the reptilian kidney and the fact that 10-month captives grew and gained weight while only receiving water from the lizards, *A. anchietae* which they ate, fog-water drinking must be regarded as opportunistic and not obligatory.

Thermoregulation

A behavioral response, not yet observed in nature, but one we noted when captive animals reached high body temperatures (38–40°C), involves postural changes that presumably increase heat loss by radiation and evaporation. This is accomplished by high elevation of the head and anterior body into a "cobra-like" stance with the remainder of the body either above or below the sand. While in this posture, the snakes often elevated the rostrum and turned to face the sun, shading the dorsal surface of the braincase (pl. 19). Occasionally, the mouth was opened and directed into any prevailing breeze thereby increasing the evaporative cooling rate.

Activity periods

Brain (1960) suggested that *B. peringueyi* is ordinarily nocturnal but may also be active on overcast days. Our observations of over 54 individuals during various climatic conditions of the past 18 months indicate that characterization of this species into any one of the three conventional activity categories, i.e., diurnal, nocturnal and crepuscular, is impractical. Depending on the seasonal and daily thermal conditions and the resultant sand surface temperatures, this snake is active during any time of the night and day. On the hottest summer days (December to February) activities are largely confined to the crepuscular and nocturnal hours, but

during the remainder of the year sidewinders are most commonly seen in the daytime.

Two major components of a sidewinder's activities include hunting prey, and movement to new hunting sites. Most hunting appears to be done in synchrony with the diurnal rhythm of the sand lizards, *Aporosaura* and *Meroles*, whose surface activity periods are strictly governed by thermal constraints (Robinson, unpublished, Louw and Holm, 1972). Certainly some hunting occurs at night, but the low nocturnal temperatures during much of the year do not favour it. Snakes observed during the day were usually in stationary hunting positions on dune slipfaces or in the base of dune grass clumps, *Stipagrostis sabulicola*. Tracks and surface active snakes were most often encountered at dusk or at night, and our impression is that movements to new hunting sites often occur at this time of the day.

Prey capture

The dorsal position of the eyes of Peringuey's adder (pl. 20) is unique among species in the genus and is primarily an adaptation for hunting, (see also FitzSimons, 1974). The snake lies buried in the sand with the entire body concealed except for the ocular region. When the lizard is in range, the strike is made, and the prey seized and held in the mouth until sufficiently immobilized to permit swallowing. Normally only the upper half of the snake's body is extended during the strike. This capture technique, frequently observed and filmed by us in captivity, was recently witnessed in the field.

B. schneideri, another sand-dwelling sidewinder in the southern Namib Desert, has its eyes in the usual lateral position. This implies that compared to *B. peringueyi*, less hunting specialization has occurred in the former species, and therefore its divergence from the *cornuta-caudalis* lineage of adders appears relatively recent. Similarity in sidewinding locomotion and subsurface concealment between some populations of *cornuta* and *caudalis* (FitzSimons, 1974) and *B. peringueyi* (Mertens, 1953) are supportive of their phylogenetic relationships and similar adaptations to sandy environments.

Self-envenomation

During this study, three of the many snakes that we handled bit themselves, and within one or two days all three were found dead. A post-mortem inspection of the last to die showed a massive blood clot in the body cavity at the area of the bite. Although the relative toxicity and volume of this species' venom are unknown, and a direct causal relationship is lacking, the implication is that *B. peringueyi* may have a self-lethal venom. This aspect of snake venom research in South Africa and elsewhere is largely unexplored and warrants attention.

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TABLE 1. Number of young, weight and total length of mothers and three broods of Peringuey's adder, *Bitis peringueyi*, from the Namib Desert. Measurements of the young are expressed as a mean and (range).

	Total Length (mm)	Weight (g)	Number of young
Mother (Gobabeb)	244	12,8	
Brood	120,5 (116–123)	1,7 (1,6–1,7)	4
Mother (Swakopmund) . . .	285	—	
Brood	131,3 (128–135)	—	7
Mother (Swakopmund) . . .	275	—	
Brood	125,6 (121–130)	—	5
Mother (Swakopmund) . . .	325	—	10 (9 dead)

TABLE 2. Usual brood size in eight species of adders, *Bitis*, from various habitats in southern Africa.

Species	Usual number of young	Reference
arietans (Merrem)	20–40	FitzSimons, 1974
atropos (L.)	8–15	,,
caudalis (A. Smith)	12–18	,,
cornuta (Daudin)	12	,,
gabonica (Duméril & Bibron) . .	30	,,
schneideri (Boettger)	4	Haacke, 1975 (one brood)
xeropaga Haacke	4	,, ,,
peringueyi (Boulenger)	4–10	This report

PLATE 18

Female Peringuey's adder (total length 244mm) and three of her four young. *Photo Robinson.*

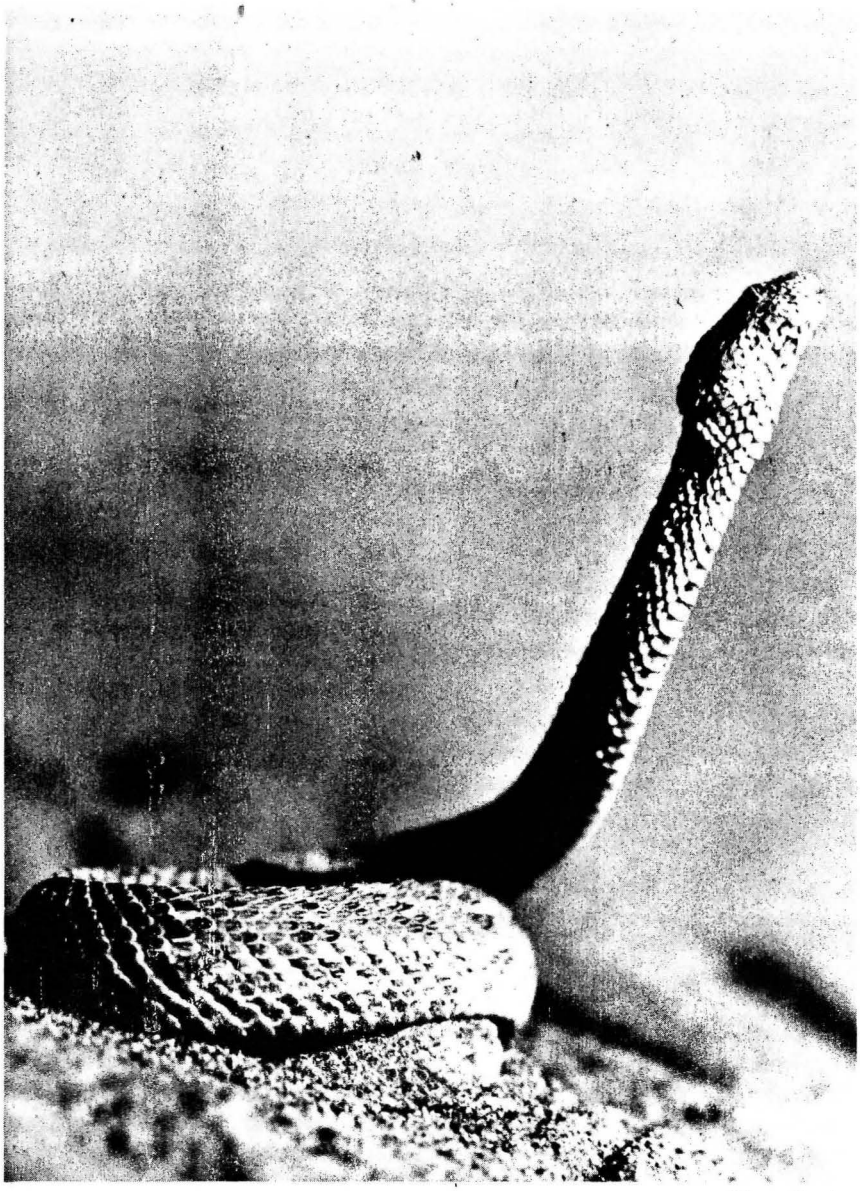

Photo Hughes.

PLATE 19

Cobra-like thermoregulatory posture to enhance radiational and evaporative cooling. Note the head's orientation which shades the braincase.

Photo Hughes.

PLATE 20

The unique dorsal eye position of *Bitis peringueyi*, an adaptation for hunting while concealed beneath the sand.