REPEATED SUCCESSFUL BREEDING OF THE RED STRIPED SAND SNAKE *PSAMMOPHIS SUBTAENIATUS SUDANENSIS*, AND SOME REMARKS ON THE 'POLISHING BEHAVIOUR' OF THIS SPECIES.

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INTRODUCTION

The genus *Psammophis* (sixteen species) commonly called 'Sand Snakes', is found in Africa and Asia, especially in steppe and savannah area's. They are quiet, yet lively animals that chase their prey with high speed. They possess enlarged grooved teeth in the maxillary just in front of and just behind the eye. There is no certainty about their danger to man. The venom is very toxic to prey animals: an adult mouse dies within a couple of minutes when firmly chewed on. Some people have the opinion that their venom could be harmful to man, advising the same precautions as usual for 'real venomous' snakes. Other people point out, that these rear fanged snakes are seldom able to administer a harmful bite. Personally I have been bitten repeatedly by the smallest of my two adult specimens (about 100 cm long), without any symptom of toxication or inflammation. Pitman notes that no one was reported to suffer from a bite by *Psammophis subtaeniatus sudanensis* in Uganda, though

bites were frequently reported. (See also Sleijpen, 1984).
The specimens in my possession are not aggressive, and will only try to bite when they are very hot and handled. They are easy to catch and to handle. Still, they are somewhat shy, certainly during the first weeks of their encagement, and will go wildly around the cage when frightened.
When touched (by hand or by another snake) they show characteristic jerking movements, as if they do not like to be touched; a behaviour known in several other species of snakes.

CHARACTERISTIC BEHAVIOUR

Regarding my experience with *Psammophis subtaeniatus sudanensis*, I can say that they are very attractive terrarium pets. Not only are they handsome, but they also show interesting behaviour. When they are not basking in the hottest places in the cage, even liking temperatures of 45°C or more, they crawl around, search their cage, dig (throwing sand away with the head furiously), and are instantly alert when they spot their keeper. Characteristic is the fast, horizontal wave-like movement of the neck area, lasting some seconds the head and the rest of the body remaining motionless. I have noticed this behaviour repeatedly with the young snakes, seldom with the adults. Characteristic too is the 'polishing behaviour'. On this kind of behaviour with *Malpolon* spp. and *Psammophis* spp. De Haan wrote an interesting article (De Haan, 1982): "In short, the perfectly carried out polishing act of *Malpolon monspessulanus* consists of two series of about one hundred practically identical 'up-and-down' movements of the head along almost the entire ventral side of the body, during which a colourless, fast drying glandular liquid, secreted via a very small exit

located on the outside of the nasal flap, is applied to ventral and caudal scales, in a zigzag trace that almost immediately becomes invisible. The ventral side of the body partially turns in a vertical position to ease this application. If the first series of polishing movements is carried out by the left nostril, then the second series is carried out by the right one, or in reverse. The interval between the series is seldom longer than ten seconds.
During each series the polishing nostril is in continuous contact with the skin, during about 90 seconds with 100 movements of the head over a little more than 200 scales, all this at a body temperature of 33 to 36^{0}C.
A satisfactory explanation for this behaviour has not yet been found, in spite of the fact that the secretion of the nostril gland has been analysed for the greater part, and though it has become clear that every specimen of *Malpolon monspessulanus*, regardless of age or sex, will polish whenever it has warmed itself up thoroughly, several times a day, and at lower temperatures always directly after sloughing, and often shortly after swallowing prey.
The polishing act of *Psammophis sibilans* takes place under the same circumstances as indicated above, but consists in one single series of very complex movements during at the most 50 seconds, whereby it is very striking that the head (and part of the frontal part of the body) moves over to the other (left or right) half of the body up to 17 times, alternatingly. The left nostril thereby touches part of the right lateral scales, or alternatingly the right nostril the left lateral scales, polishing with a vigorous 'wipe' in the direction of the tail each time a new piece of the ventral side of the body, which lifts itself for this purpose in a vertical arch like a little wave".

To the above remarks I add, that my *Psammophis subtaeniatus* specimens carry out the polishing act very much the same as *Psammophis sibilans*, though not daily, sometimes a bit careless, half finished, at times scattered over the day, but in any case shortly after sloughing. Incidentally their polishing behaviour looks like that of *Malpolon*, but I would describe it as follows (referring to fig.1): *Psammophis subtaeniatus* pushes the snout over the lateral and ventral sides of the body from the neck to the tail, by turning right and left, lifting the body somewhat laterally. The ventral side

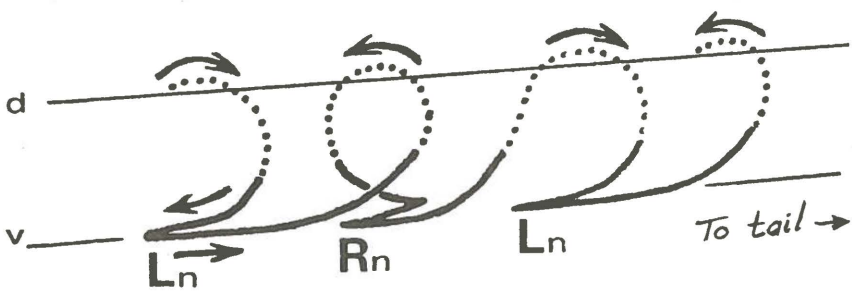

Fig. 1. *Psammophis subtaeniatus* schematic representation of part of the polishing act. Between the lines d (dorsal) and v (ventral), part of the snake's body must be imagined. The fat continuous lines symbolize the route of the snout with contact between body and nostril. The dotted lines symbolize the route of the snout without contact between body and nostril. The arrows indicate the direction of the movement. Ln = left nostril; Rn = right nostril. (Fig. by A.M. Steehouder).

gets a wipe backwards and forward every time, much more elaborated than that described for *Psammophis sibilans*. To illustrate this, some body postures of polishing snakes are pictured in fig. 2 and 3 (after De Haan).
The specimen of *Psammophis condanarus indochinensis* in my possession carries out the polishing act in exactly the same way as *Psammophis subtaeniatus*, under the same circumstances.

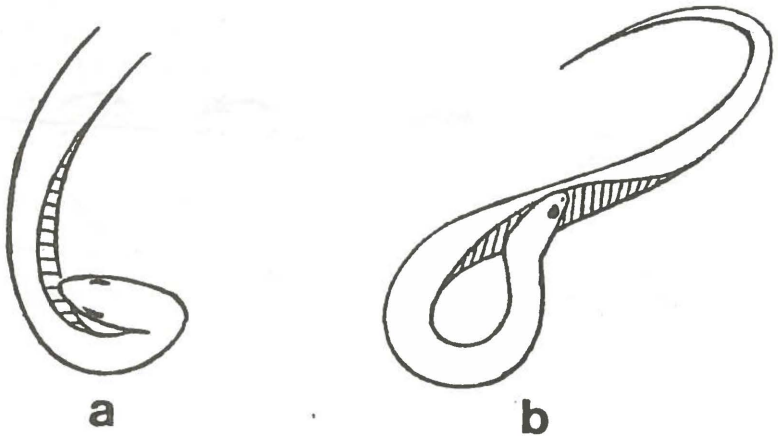

Fig. 2. *Malpolon monspessulanus*, drawing of the polishing act during one of two series of polishing movements, viz. the series of the left nostril in continuous contact with the belly and the tail,
a) during the first movement, seen from above;
b) during about the 30th movement, seen obliquely from aside. (After De Haan, 1982).

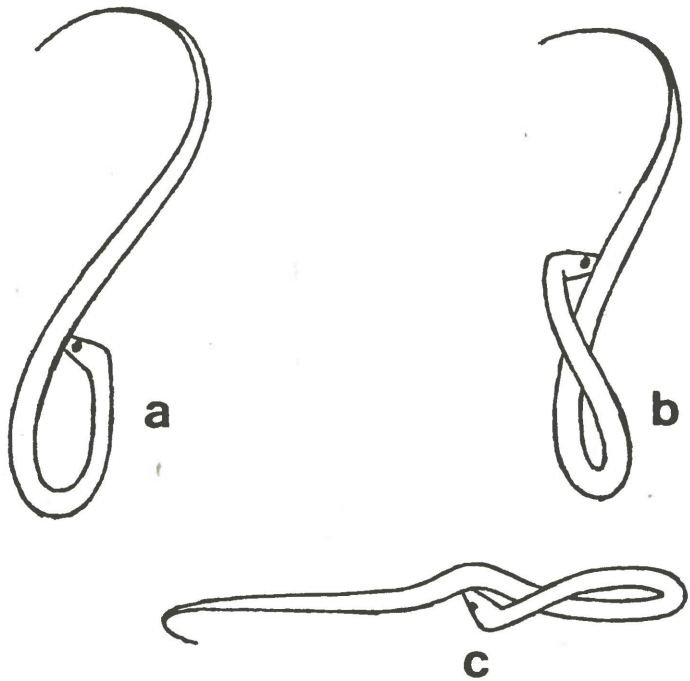

Fig. 3. *Psammophis sibilans*, drawing of the polishing act during the only series of complex movements, during which the nostrils are alternately in contact with the body,
a) during the 5th complex movement, seen from above: the left nostril in contact with the belly, halfway through a ventral stroke;
b) during the 6th movement, seen from above: the right nostril almost at the end of a ventral stroke, and consequently near the right lateral scales;
c) = b, but seen from the side, so that the wave-like bending of the body is visible. (After De Haan, 1982).

HUNTING BEHAVIOUR AND FEEDING HABITS

In April 1982 I bought my first specimen of *Psammophis subtaeniatus*, a male. In October 1982 a female was obtained. Both specimens were imported at the same time. At first, the male was hardly bigger than the female, but he grew so fast that now, January 1984, his girth is about three times it was in 1982, and his length has increased some 25% to 130 cm. It is a stout snake.
Both animals eat mice throughout the year. Periods of food refusal do not occur except once during a four week period when the female fasted during the second pregnancy in one season.
Prey is chased with great speed and taken behind the head. If necessary it is held by a couple of tight windings of the frontal part of the body. The big male does not bother to do this anymore since it is strong enough to hold the prey in its jaws. Prey is held until it is killed by the venom, which lasts only a couple of minutes. The toleration with regard to other snakes seems great. I kept my male specimen for some time with a male *Malpolon monspessulanus*, which dominated fully, so strongly even that the *Malpolon* 'forbid' it to eat, by positioning itself between the *Psammophis* and the prey, sometimes threatening, by placing its frontal body part over that of the *Psammophis*.
I also kept my *Psammophis* together with a small specimen of *Elaphe bimaculata* and, later, with *Elaphe schrenki*, without any trouble. Admittedly, I have never kept them with much smaller snakes. Regarding the eagerness of the female when I held one of her own young to the window of her terrarium, I expect that small snakes would be swallowed.

SPECIES AND SUBSPECIES

According to the data given by Pitman (1974), my

specimens must belong to the subspecies *Psammophis subtaeniatus sudanensis*. I note that the shape of the head (in profile) of the male does not agree with the description Pitman gives for this subspecies, but looks more like Ugandan *Psammophis sibilans sibilans*. The exact determination of *Psammophis* species is one of the most difficult problems of African snake taxonomy. There seems to be a lot of intermediate populations of *Psammophis sibilans sibilans* and *Psammophis subtaeniatus*.

MATING

I first observed mating activity in January 1983. The male was advancing over the back of the female (in the way that is known for several species of snakes) in the direction of the head.
Attempts to mate were observed several times during the following months, sometimes day after day.
The first copulation I observed, took place on 20 June 1983. It was performed almost unperceivably, while the animals were lying still. This proved to be the normal way of mating. It was very remarkable that during copulation the cloacas were not in contact, and that the hemipenis, which is worm-like and very thin (see fig. 4), is outside both

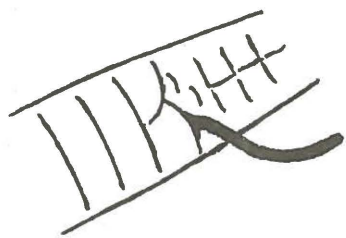

Fig. 4. Right hemipenis of *Psammophis subtaeniatus*. (Fig. by A.M. Steehouder).

of the bodies, visible over a distance of more or less 1.5 cm. The male is then lying on the back of the female, that is lying with the belly down in a normal way.
At the time of the first successful copulation, the animals were housed in a terrarium of 100x50x 70 cm (lxwxh), with a substratum of sand and ceramic granules as used for hydro culture, heated by two lamps of 100 W together. Daily temperatures in winter ranged from 24°c near the ground to 32°C under the lamps. In summer (especially that of 1983) daily temperatures were much higher: from 30-42°C. In winter night temperature is 16°C minimum.
Mating took place all through the year, apparently not influenced by season. Changing of circumstances, namely a much cooler terrarium after the first egg laying, did not influence the frequency of copulating. Copulations took place on the ground as well as in the branches, in the morning as well as in the evening. Two days after the first egg laying, the animals were copulating again.

THE FIRST EGGS

Pitman (1974) indicates that the eggs of *Psammophis sibilans* in Uganda are laid from November to January, after which the incubation period is about three months. There is no data on *Psammophis subtaeniatus* concerning egg laying, but I assume that there is no significant difference between these related species as far as reproduction period is concerned.
At the end of July 1983 the female refused food. During the first days of August she started to swell and nervously search the terrarium, digging more than usual. On the 4th of August she sloughed. From 9 August on, swelling became so strong that

the skin between the scales was strongly visible and the eggs were clearly marked out. On 12 August early in the morning I found four eggs scattered around the terrarium. The female was lying in the branches about 60 cm above the ground, and continued to simply drop the eggs at irregular intervals. The twelfth, last egg was laid at about 16.00 hours. I managed to catch some of the eggs, others fell to the ground - undamaged.
All the time the female remained very quiet, almost motionless hanging in the branches, while the male was lying more or less beside her watching the surroundings, for instance directing his head to the photographer. When I carefully removed the eggs he reacted by following my hand with his eyes, giving me the strong feeling he was protecting his 'wife'.
After the last egg, the position of the animals did not change for a couple of hours. The day after the laying the female accepted a mouse.
As mentioned above, two days later copulation took place (14 August). I noticed copulations almost daily in the following weeks.

THE SECOND LITTER

After I had placed the animals in another, cooler, terrarium mating stopped for some days, the animals being somewhat more at ease. After some days it all started again. About 10 October it became clear that another series of eggs was to be laid. From 14 October on the female became restless and started to dig again. She became terribly thin, especially in the neck. I gave her a calcium injection and, orally, a multivitamin. I also placed her alone to prevent further copulations.
On 19 October eleven eggs were laid, which were slightly smaller than the first eggs (about 30x15 mm) and these were laid in a sheltered corner

where temperatures were high.
The female was very thin now. She had refused food during four weeks.
Some hours after the laying, she took a mouse, and during the following weeks she ate so much that she grew fatter than she had ever been. After six weeks I placed her back with her mate. Mating was not renewed until the end of December, when successful copulations were observed.

INCUBATION

In both cases the eggs were immediately taken away and put in an incubator. The first litter was incubated on a layer of moist synthetic fibrous material as used for aquarium filters, at temperatures between 27 and 30^{0}C. Air humidity was high. There was no air replacement except when the top glass cover was lifted.
On the 22nd day I opened one egg that was dried up a little and had changed colour. It appeared to be infertile.
After about five weeks the eggs had clearly grown and become heavier. They were also whiter. Most of the eggs started to get a kind of 'belly', probably caused by the fact that they were absorbing more moisture from the underside than elsewhere. This phenomenon is also described by Rösler (1983). I do not know to what extent it has influenced the development of the eggs, But I think it not impossible that it has had a negative influence.
Some eggs had somewhat transparent stains.
On the 54th day I opened an egg which looked bad. It contained a dead, but fully developed embryo.
On the 77th day (28 October) all eggs appeared bad I carefully opened one egg, in which appeared to be a live and fully developed hatchling. I left the membrane intact and placed the egg back in the incubator. 24 Hours later, the hatchling had

broken the membrane and was looking out of the shell. After a further 24 hours it left the egg. It was about 25 cm long.
After due considerations I opened all the eggs in the same manner, leaving the membrane intact. It would probably have been better if I had opened the membranes as well, for two hatchlings appeared to die of suffocation.
One of the hatchlings had not absorbed the yolk and died at the end of November, despite force-feeding.
In the end I was not fully happy about the method of incubation. The shells were too hard and the eggs did not do too well. For the second series of eggs I chose another method: the eggs were placed in a small hole in wet sand, and carefully covered with 'lumps' of wet sand. This method proved to be much better. There was no need to add water, shells were softer, there were no 'bellies', and temperature was more constant (30^0C).
These eggs hatched unexpectedly fast: after 63 days there were seven hatchlings, the next day another three. One egg had dried up. These hatchlings were longer than the first (about 30 cm), They were fatter, and had hatched completely on their own. They were more active too.
Though other causes are not to be excluded, I find it plausible that the better quality of the second batch of hatchlings was due to the better incubation method.

THE HATCHLINGS

All hatchlings were directly transferred from the incubator to a small terrarium (50x40x60 cm), heated by a 60 W spot, with variable temperatures at daytime, and night temperatures of 16^0C minimum.
At first, they were not very aggressive or shy.
One of the hatchlings simulated death when touched

during the first day. This was not repeated later on.
One of the hatchlings from the first clutch stayed in its shell even though it had been opened, and appeared to have kept a long umbilical cord, which was tied around the animal with a kind of knot at the end. I carefully worked the knot through the loop with a darning needle, after which the cord hung loose. I placed the animal in the cage without further treatment. The next day the cord was gone. Between 17 and 27 November the hatchlings from the first series of eggs sloughed for the first time, three to four weeks after the opening of the eggs. The young snakes from the second series of eggs sloughed for the first time between 4 and 10 January, two to three weeks after hatching.
The young snakes usually lay rather scattered around the cage, some under stones and sphagnum, others high in some artificial plant, near the lamp, by day as well as by night.
As they refused food in the form of earth-worms, crickets and until recently newborn mice, I proceeded to force-feed them with raw chicken, horse meat, and for a short time Nutri-soja (a lactose-free diet food for babies and adults), using a catheter. Exact measuring of quantity of food is a problem with this method. I prefer force-feeding with small strips of horse meat or beefhart, though this involves more work, but the snakes seem to live well on it.
Of the first twelve eggs, ten good ones gave eight hatchlings of which five are still alive. Of the second eleven eggs, ten good ones gave ten hatchlings all of which are still doing well.
According to Pitman, young of *Psammophis sibilans* in the wild feed on newborn mice. Assuming that there is little difference with regard to food between *Psammophis sibilans* and *Psammophis subtaeniatus*, I sometimes wonder why captive born

young *Psammophis subtaeniatus* so persistently refuse this food. Force-feeding is very unsatisfactory. I am happy to say, after about ten weeks, some have started to eat small nestlings, while the others are still only taking pieces of nestlings. I believe the nestlings that are available are still too large for them.

REFERENCES

Arndt, W. (1981). Afrikanische Sandrenn-Nattern im Terrarium. Herpetofauna (Ludwigsburg), Vol. 3 (15): 25-26.

Haan, C.C. de (1982). Description du comportement de 'frottement' et notes sur la reproduction et la fonction maxillaire de la Couleuvre de Montpellier *Malpolon monspessulanus*. Remarques comparatives avec *Malpolon moilensis* et *Psammophis spp*. Bull. Soc. Herp. France, No. 23: 35-49 / Errata: No. 25: 69.

Pitman, C.R.S. (1974). A Guide to the Snakes of Uganda. 2nd Ed. Wheldon & Wesley, Codicote. Pp. i-xxii, 1-290, pl. A-AC.

Rösler, H. (1983). Ervaringen met de gecko *Hemitheconys caudicinctus* (L.). Lacerta, Vol. 42 (1): 8-11.

Sleijpen, F. (1984). Poisonous or not? Litt. Serp. Vol. 4 (2): 42-57.