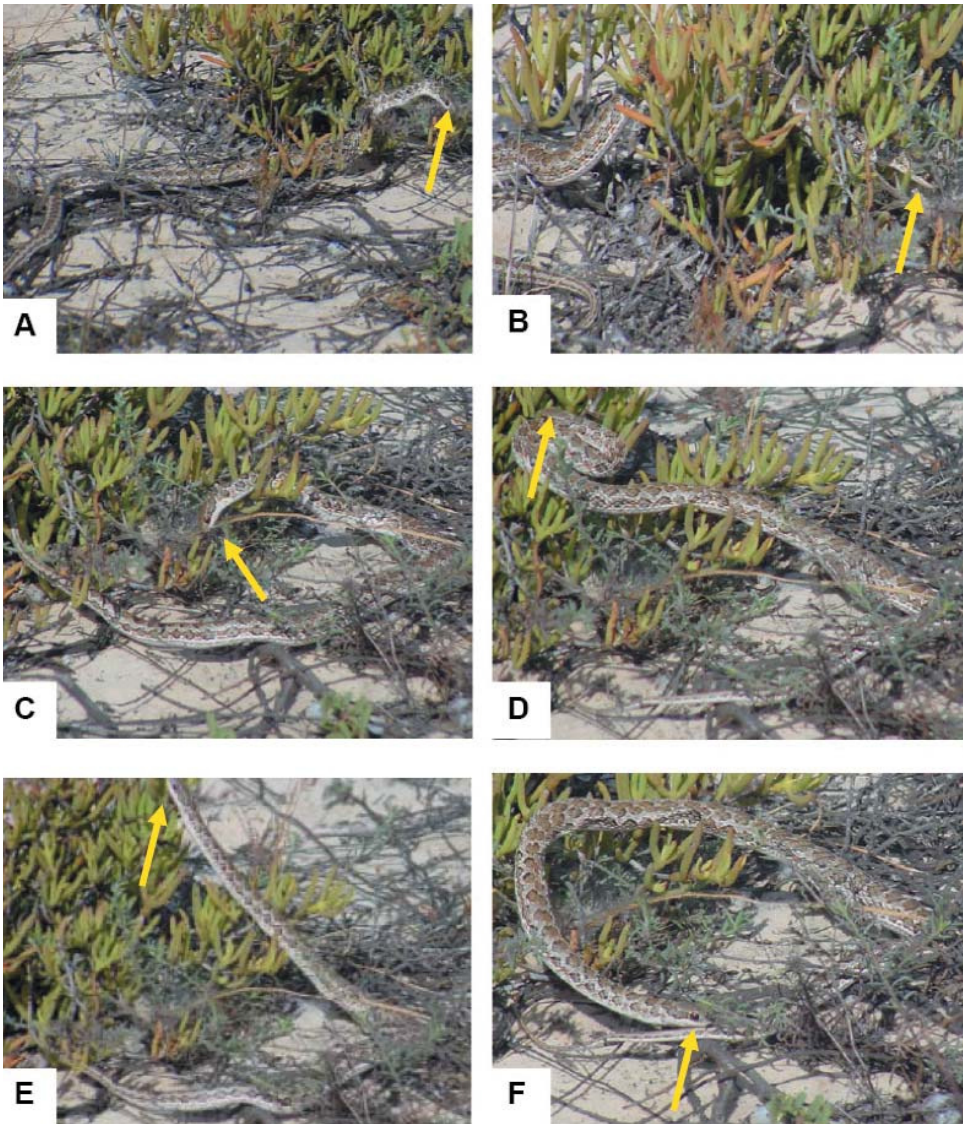
Self-rubbing and substrate marking by the Rhombic Skaapsteker, *Psammophylax rhombeatus rhombeatus* (LINNAEUS, 1758)

As part of a larger radiotelemetric study investigating the spatial ecology of Rhombic Skaapstekers, *Psammophylax rhombeatus rhombeatus* (LINNAEUS, 1758), focal observations of radiotransmitter-equipped snakes were made in order to document behavior exhibited in a natural setting. Here we report observations of a female snake (snout-vent length 44.3 cm; tail length 14.4 cm) in a sandveld habitat at the Farm Steenboksfontein Nature Reserve (32°10'27.9"S, 18°18'

57.2”E), Western Cape Province, South Africa on 22 October 2006. The snake was first observed at 08.43 h (ambient temperature 23.5 ºC; relative humidity 67%) moving in circles and pausing briefly to tongue-flick in various directions. It then rubbed first the right, then the left side of its body with its snout, zig-zagging its head along the lateral and ventral surfaces of its body — “self-rubbing (also referred to by some authors as self-polishing/grooming/stroking), as previously described for *Malpolon monspessu-*



Figs. 1A - 1F: Sequential photographs taken over a 15 minute period of female *Psammophylax r. rhombeatus* (Linnaeus, 1756) rubbing and nudging surfaces of a *Euphorbia burmanni* bush.
The snake maintained each of the positions illustrated for extended periods, rubbing its snout repeatedly across the substrate while remaining otherwise motionless.

lanus (HERMANN, 1804) (DE HAAN 1982) and *Psammophylax r. rhombeatus* in captivity (STEEHOUDER 1987). The snake then continued moving, pausing frequently to jerk its head and tongue-flick in all directions.

After weaving itself through and over the branches of a bush and crossing an open expanse of sand, the snake entered a nearby *Euphorbia burmannii* bush (Figs. 1A-1F). It continued to travel in circles through and in the bush while nudging its snout repeatedly onto the plant surface, in much in the same manner as it had rubbed itself earlier. It continued moving in this erratic manner through the habitat, occasionally turning its head (without moving the rest of its body) and opening and closing its mouth (without tongue flicking). When crossing patches of open sand the snake paused after only a few centimeters of forward movement and it moved its head up and down and side to side, either tongue flicking rapidly (3-4 times with each head movement) or opening and closing its mouth (2-3 times with each head movement) without tongue flicking. At 09.18 h the snake began self-rubbing the length of its right side again. It then continued rubbing against the vegetation (as in Figs. 1A-1F) for an additional 25 min.

Representatives of seven of eight psammophiid genera (not yet observed in the monotypic *Dipsina*) have been documented exhibiting such self-rubbing behavior, in which a nasal gland secretion is applied to the vent and body of the snake via an external narial valve (DE HAAN 2003; DE HAAN & CLUCHIER 2006). Two types of secretion self-application have been described in psammophiids. In both the snakes apply the secretion from anterior to posterior in one swift, connected movement without pausing. In the "M" method, used by *Malpolon* and other terrestrial species, secretions are applied to the venter and one flank in a single movement, whereas the "P" method, used by more arboreal *Psammophis* species, involves the application of secretion by alternating nostrils used to mark and switch sides, even moving to under the venter entirely, during a single movement towards the tail (DE HAAN 1982). In accordance with its terrestrial activity patterns, *Psammophylax* exhibits the more common (previously recorded in five out of seven species observed) "M" system (DE HAAN 1982, 2003; STEEHOUDER 1987). The Rhombic Skaapsteker has previously been reported to display this behavior immediately following a feeding event (STEEHOUDER 1987); however, this was probably not the case in the present instance because no prey bulge was noted in the snake, and prey (chiefly lizards for this species in the Western Cape; COTTONE 2007) activity was very low at this time of day. In addition, the extended duration of this behavior while moving throughout the habitat would not be conducive to the digestion of a new meal.

Although the investigatory behaviors observed were superficially similar to those typical of prey tracking, it seems unlikely that this was the case given that these actions were accompanied by self-rubbing, frequent mouth opening without tongue flicking, and long periods of repeated rubbing of single spots on the plant surface. DE HAAN (2003) suggested that psammophiids exhibit chemical marking for a variety of reasons including: marking hunting and nesting routes on substrates, marking conspecifics, and marking territory limits. One or more of these functions may have been served by the observed behavior or, given that these observations coincided with breeding season for the Rhombic Skaapsteker, the substrate marking may have served to attract actively searching males (which, in contrast to females, exhibited significantly longer distance movements at the study site, COTTONE 2007). Interestingly, the event described in this account took place in an area in which the focal snake had yet to be tracked, which was approximately 25 m distant from the area it had utilized during the previous week.

Among snakes the only other known cases of externally secreting cephalic glands occur in the genus *Echis* (Viperidae) and in the Typhlopidae (BORGIOLI & LANZA 1986; INEICH & TELLIER 1992; MASON 1992); however, the functional role of chemical secretion in these separate lineages has yet to be unambiguously determined. Finally, while the grooming system of psammophiids has been known for some time, this account represents the first report of a non-captive, free ranging psammophiid engaging in the behavior. Further field and experimental re-

search is required before more robust hypotheses clarifying the biological role of chemical marking in psammophiids can be formulated.

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REFERENCES: Borgioli, G. & Lanza, B. (1986): The head epidermal gland-like bodies of Typhlopidae (Reptilia: Serpentes); pp. 353-358. In: Roček, Z. (Ed.): Studies in herpetology, Prague (Charles University), pp. xxviii + 754. Cottone, A. M. (2007): Ecological investigations of the Psammophiidae (Squamata: Serpentes).- MS Thesis, Villanova University, pp. 163. De Haan, C. C. (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.- Bulletin de la Société Herpétologique de France, Paris; 23: 35-49. De Haan, C. C. (2003): Extrabuccal infralabial secretion outlets in *Dromophis*, *Mimophis*, and *Psammophis* species (Serpentes, Colubridae, Psammophiini). A probable substitute for ”self rubbing“ and cloacal scent gland functions, and a cue for a taxonomic account.- Comptes Rendus Biologies, Paris [Elsevier]; 36: 275-286. De Haan, C. C. & Cluchier, A. (2006): Chemical marking behaviour in the psammophiine snakes *Malpolon monspessulanus* and *Psammophis phillipsi*; pp. 211-212. In: Vences, M. & Köhler, J. & Ziegler, T. & Böhme, W. (Eds.): Herpetologia Bonnensis II. Proceedings of the 13th Congress of the Societas Europaea Herpetologica, Bonn (Societas Europaea Herpetologica), pp. 262. Ineich, I. & Tellier, J. M. (1992): Une glande supralabiale à débouché externe chez le genre *Echis* (Reptilia: Viperidae), cas unique chez les serpents.- Comptes Rendus de l’Académie des Sciences, Paris; (Sér. III) 315: 49-53. Mason, R. (1992): Reptilian pheromones; pp. 125-206. In: Gans, C. & Crews, D. (Eds.): Biology of the reptilia. Volume 18 (Physiology E), Hormones, brain, and behavior. Chicago (University of Chicago Press), pp. xiv + 564. Steehouder, T. (1987): Some experiences with the spotted skaapsteker, *Psammophylax rhombeatus*.- Litteratura Serpentium, Utrecht; 7 (4): 175-184.

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