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Chemical marking behaviour in the psammophiine snakes *Malpolon monspessulanus* and *Psammophis phillipsi*

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Abstract. In colubrid snakes of the subfamily Psammophiinae a "self-rubbing" behaviour is kn own that serves as a preliminary to chemical marking of conspecifics, nest and hunting routes, and most notably, marking of a genuine territory. We here review this behaviour and the organoid structures probably related to it.

Psammophines, a colubrid subfamily of mostly African snakes, consisting of 8 genera with about 44 species, are characterized by a tiny, quasi filiform and 3-4 Sc short hemipenis (Bogert 1940), and in both sexes, by a valvular nostril enabling "self-rubbing" (De Haan 2003a). Moreover, a lack of significant sexual dimorphism in tail length seems to be generalized in this clade. However, some species show tails slightly longer in females. Impressed by the research and tempting hypothesis of Dunson et al.(1978), several colleagues reported that in psammophines *"self-rubbing"* or *"self-polishing"* or *"grooming"* serves to limit evaporative water loss through the skin.

In fact, this behaviour serves as a preliminary to chemical marking of conspecifics, nest and hunting routes, and most notably, marking of a genuine territory (for certain Montpellier snake males in may-june, see Darevsky 1956, De Haan 1982-2003a). So, the Montpellier snake seems to be the only snake being territorial and additionally the most social one, though seemingly only during its 4-6 weeks lasting mating period. At other times (and always being an opportunistic predator), it also proved to be rather cannibalistic, much more than apparently less social but equally opportunistic *Psammophis phillipsi*.

Two "self-rub" systems are to be distinguished (De Haan 1982): M (like *Malpolon*, terrestrial) and P (like *Psammophis*, terrestrial + arboreal). The P-system permits a snake to perform self-rubbing not only on firm ground but also when balancing on branches. In both systems a watery, colourless secretion, containing proteins and fatty acids comes from a special nasal gland. It is leaving from an outlet situated on the external side of the so-called *narial valve* having closed the nostril. The secretion is applied 'gracefully' to the belly and tail, where it quickly dries to form a transparent film, ready for being scraped off and left behind as slightly sticky particles.

A male territory, chemically marked upon substrate between visual landmarks and optically surveyed by the marking individual, can easily be entered by females. An entering male, however, is quickly bitten away or tired out in a 1-3 hour lasting ritual combat. The territorial male mostly wins and during the rest of the spring a loser rarely dares another intrusion as soon as reminded of his defeat by linguovomerally retasting secretion particles left by the landlord. Certain losers, however, may be gathered in. They serve as "vassals" guarding the landlady when the lord is marking around and are ready to replace him every way if he should perish.

The 'territorial female' Montpellier snake, protected by a male which not only successfully fought with other males, but also hunts *with* her or *for* her and does not take food for himself, uses her perfumed cloacal scent gland secretion to rub with her hind-part, tail held upwards, one of the flanks of 'her' male as soon as a conspecific outsider female gets nearby or touches him. Such a rubbing equals a direct chemical marking of a conspecific and results in a peaceful, immediate retirement of the newcomer female (De Haan 1999, 2003a).

Understanding these three ways of rubbing helped to discover (so far only in psammophines), periodically present, extrabuccal, infralabial secretion outlets (ILOs) in snakes. No study has yet analysed the ILO-secretion or revealed the type and location of its source, but behavioural observations on *Psammophis phillipsi* showed that it is used with a fourth way of rubbing, viz. head moving with the ILOs pressed onto a conspecific

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individual, most visibly done by a female to a male.
Obviously, it substitutes for functions of both the special nasal and the cloacal scent glands, when the related rubbing behaviours, especially the cloacal scent rubbing with the snake's hind-part, are inhibited by lack of firm substrate. This is usually the case in central Africa between twigs and stems some meters above ground, where *P. phillipsi* frequently moves or rests in balance.
ILOs were found in psammophines which, even if desert dwelling, may move easily upon stems and twigs, viz. in representatives of the P-system self-rubbing genera ***Dromophis*** and ***Psammophis,*** as well as - surprisingly - in the Malagasy ***Mimophis***, the latter still being one of the six M-system (terrestrial) self-rubbing genera (De Haan 2003 a and b).
The following synopsis is proposed as an aide-mémoire on the organoid structures found within the psammophine snake group, and being subject here and in the following article in this volume:

1. On the head of the snake
PP Parietal Pit(s): sporadically present sense-organ-like pit(s) [see following article]
NVO Narial Valve Outlet: 'self-rub' secretion outlet upon closed nostril
ILO Infralabial Outlet(s): secretion outlet(s) periodically present/absent in 4th or 5th infralabial shield

2. On the hind part of the snake
CSO Cloacal scent Outlet: two secretion outlets next to cloaca

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3 types of *secretion outlets* **serve chemical marking**, of which
2 are permanent (NVO and CSO),
1 is periodical (ILO).
4 patterns of *rubbing behaviour*, of which
2 (self-rub) patterns are preliminary (via NVO) to chemical marking,
2 other patterns serve direct chemical marking (via CSO, resp.ILO).
(For further details see De Haan 2003-a)

Concerning the PPs (Parietal Pits)**:**
their function is unknown, and moreover, they are
'only' *sporadically present* (see DeHaan 2003-b).