

Notes on the behavior of the Spectacled Salamander *Salamandrina terdigitata* (LACÉPÈDE, 1788)

The Spectacled Salamander *Salamandrina terdigitata* (LACÉPÈDE, 1788), is a terrestrial, mainly nocturnal Italian endemic whose behavior is still poorly known. In particular, STRÖTGEN (1927), NAVIGLIO (1971), BRUNO (1973) and HOUCK & ARNOLD (2003) provided some information on mating, and LANZA (1967), BRUNO (1973) and CORSETTI (1994a, 1994b) reported on the unkenreflex behavior. Here we report our anecdotal observations on agonistic and unkenreflex behaviors as well as a postural, so far unreported behavior of the Spectacled Salamander.

Nocturnal field recordings were carried out during November and December, 1996 at San Rocco, outskirts of Terni, Umbria, central Italy, at about 200 m a.s.l., and from October, 2003, to December, 2004 at Ciccopano, Lepini Mountains, Latium, central Italy, at about 680 m a.s.l.. In both localities, salamanders were observed close to water bodies where salamanders oviposit. On occasion we recorded the salamanders' behaviors using an analog photo camera or a VHF-C camera, and then analysed the films in the laboratory.

In the Spectacled Salamander males have longer tails and are somewhat more slender and broad headed than females (VANNI 1980). However, there are no distinct external characters to discriminate between sexes. Based upon the observation of several hundred salamanders, we presumed to be males those individuals which presented the above features and/or which we never recorded in water (according to VANNI 1980 and LANZA 1983, only females show an aquatic phase).

Social interactions. Behaviors involving couples of presumed males were: (1) firmly kept, sometimes reciprocal, bites at head, flanks, limbs and tail (observed several times); (2) repeated attempts to turn the opponent upside down by jerks and twists (observed several times); in one instance, one of the two was recorded motionless, belly up, while the other one stood by; (3)

quick opening and shutting of the mouth, followed by the flight of the other (observed once); (4) jerky waving of tail and hips while either facing or chasing the opponent (observed several times); and (5) displaying the ventral side of the tail by the chased individual (observed once). Behaviors involving a presumed male and a female were: (6) waving of tail and hips by the male in close vicinity to the female (observed once); and (7) pursuing of the female by the male (observed twice).

As an example, we report a sequence of about 33 min, recorded at San Rocco on December 25, 1996. The dyad consisted of two male individuals of different bodysize.

20:48'06" hrs: each of the two firmly bites at a hind limb of the opponent; the larger one (A) tries to turn the smaller (B) upside down;

20:49'22" hrs: both release one another at approximately the same time;

20:49'28" hrs: (A) again firmly bites at the right hind limb of (B) which unsuccessfully attempts to escape;

20:51'57" hrs: (B) bites at mid length of the tail of (A); then

20:54'27" hrs: releases its bite; then

20:56'27" hrs: again unsuccessfully tries to bite on the hip of (A); then

20:57'00" hrs: achieves biting on the latter salamander's tail root; then

20:57'12" hrs: releases its bite and again unsuccessfully attempts to escape;

21:18'15" hrs: (A) releases its grip from the limb of (B), which it had held for nearly 29 minutes. Then (B) moves away, while (A) rests in the same place.

Bites were often associated with jerky waving of tail and hips and attempts by the larger individual to turn the opponent belly up.

Some of the behaviors reported here, as e.g. biting and struggling, are probably aggressive, while others, as displaying the under surface of the tail, waving of hips and tail and mouth opening are of a less clear meaning to us, although the latter two might refer to threat.

Several newts and salamanders, the color pattern of which is cryptic dorsally and aposematic ventrally (as is *Salamandrina* and many *Triturus*), turn belly up with either agonistic or sexual aims when an in-



Fig. 1: *Salamandrina terdigitata* (LACÉPÈDE, 1788) in stand up posture.

truder approaches and their colorations also function in sex recognition (PARKER 1969; GRILLITSCH 1984). Only once we recorded an individual turned belly up in the presence of another one, but we cannot say whether or not it had overturned spontaneously or it had been by the opponent. In fact we frequently recorded attempts to overturn the opponent by one of the contenders, so the belly up position might represent the surrender as well. On the other hand, bites were directed to various parts of the opponent's body, and obviously the biting of the salamanders was not aimed towards a particular part of the body as e.g., the snout in plethodontids (HALLIDAY 1990; POUGH et al. 1993). MITCHELL et al. (1991) report that certain territorial urodela struggle by slight-

ly striking or biting at either the snout or the tail of the opponent, but we could not determine whether or not our salamanders were behaving territorially (i.e. defending a particular area [NOBLE 1939]) or were using that area exclusively [PITELKA 1959]). The larger *Triturus vittatus* (GRAY, 1835), *T. cristatus* (LAURENTI, 1768) and *T. marmoratus* (LATREILLE, 1880), show aggressive territorial defense in the breeding season (HALLIDAY 1990), but apparently in *S. terdigitata* there is not a well defined mating season (BRIZZI et al. 1985).

We neither observed behaviors that we could interpret as marking of the territory with cloacal scent nor males facing each other while "standing with extended limbs, open mouth and tail curled dorsally, as if displaying to a predator", which were reported by NAVIGLIO (1971).

Unkenreflex. We observed the unkenreflex behavior (LANZA 1967) frequently in the last nine years. If disturbed, as e.g. by the observer's improper management (once by violent treatment by a young, domestic cat, at San Rocco), the salamander curled its body dorsally to a variable degree as far as forming a loop. In doing so, the salamanders displayed in part the ventral color pattern of their body (usually black-and-white patched) and the ventral bright red pattern of tail and limbs. The salamanders could hold this position for up to a few minutes. The individual which was aggressed by the cat raised the body and turned the chest up. The cat picked the salamander up in its mouth twice, each time spitting it out and thereafter ignoring it. Two adult cats, which we spotted in the site, and to which we offered several salamanders, ignored them constantly.

The unkenreflex should be understood as a defensive behavior in accordance with the assumption that in animals, unpalatability is generally associated with aposematic coloration and displaying the latter has probably a warning meaning (GUILFORD 1988; WICKLER 1991). In fact it is well known that several salamanders possess poisonous or unpalatable skin secretions (POUGH et al. 2001). Nevertheless LANZA (1967) uttered doubts about the effectiveness of this function in *S. terdigitata*, probably because the Spectacled Salamander does not possess developed parotid glands. Moreover, SAVI

(1823) did not record any negative effect on a rabbit, a cat, a cock and a turkey, which he forcibly fed with this salamander. However, the young cat to which we offered these salamanders refused them after tasting one twice, and we speculate that both the adult cats, which ignored the salamanders they were offered, probably had experienced their taste on preceding occasions. Also, one of us (DA) experienced eye smarting and lip numbness upon accidental contact with his own fingers after handling specimens of the Spectacled Salamander (cf. also SAVI 1823). This suggests that *S. terdigitata* does produce noxious secretions.

Thanatosis was frequently observed in disturbed salamanders, as e.g. when they were quickly turned belly up, but sometimes it also occurred spontaneously, as e.g. when the salamander dropped down while climbing a steep wall. Following such accidents, salamanders kept motionless from a few seconds up to a about a minute, either in the normal or in the overturned position.

The "stand up" behavior (fig. 1). Seven times at Ciccopano, during the night, we came across motionless individuals which were standing up on their hind limbs, apparently supported by their tails. At the time we spotted these salamanders the orientation of their bodies was independent of our positions. In this posture, the ventral colour pattern was displayed; however we did not record any other salamanders or potential predators near them. Salamanders kept this posture for several minutes even if closely approached by us. As far as we know, the "stand up behavior" was not previously reported for the Urodela. Because our sightings were accidental, we cannot state if this behavior is connected with either intra- or inter-specific communication involving coloration and/or with defense.

At the time this paper was completed, MATTOCCIA et al. (2005) proposed to split what was currently referred to as *S. terdigitata* into two species. In this perspective, all the information here reported should be referred to *S. perspicillata* (SAVI, 1821).

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Report of molluscivory in *Atractus carrioni* PARKER, 1930

Atractus carrioni PARKER, 1930 is a neotropical snake endemic to the Loja Valley, southern Andes of Ecuador (SAVAGE 1960). The genus *Atractus* comprises fossorial and semifossorial snakes which primarily prey upon earthworms, although arthropod larvae, adult insects, acari, plant matter and snake scales have also been found in their digestive tracts (DUELLMAN 1978; HOOGLMOED 1980; CUNHA & NASCIMENTO 1983; PEREZ-SANTOS & MORENO 1990; MARTINS & OLIVEIRA 1999; CISNEROS-HEREDIA unpublished). Since our knowledge on the ecology of most species of the genus is very poor information on the diet of *A. carrioni* and the first report of molluscivory for the genus are provided here.

Two adult male *A. carrioni* (deposited at the Fundación Herpetológica G. Orcés, FHGO) were collected 5 km east of the city of Loja, Loja Province (ca. 79°09'W, 03°59'S, 2300 m a.s.l.) on 01 May 1993 by J.-M. TOUZET. Analysis of their digestive tracts revealed the presence of terrestrial slugs (Mollusca, Pulmonata). Specimen FHGO 652 (snout-vent length [SVL] = 315 mm, tail length [TaL] = 45 mm) contained four slugs in the stomach and one partially-digested in the intestine, and specimen FHGO 650 (SVL = 325 mm, TaL = 50 mm) had two slugs in the stomach. The mean length of all seven slugs was 7.8 mm (range 6.5–9.5 mm), mean width was 3.3 mm (2.5–4.5 mm).

The genus *Atractus* is part of a clade of small semifossorial xenodontine snakes that feed on soft-bodied invertebrates ("goo-eaters"). This clade is divided into a lumbricophagous subclade that includes *Atractus* along with *Adelphicos*, *Chapinophis*, *Chersodromus*, *Geophis*, *Ninia*, and

Omoadiphas; and a molluscivorous subclade of *Dipsas*, *Sibon*, and *Sibynomorphus* (CADLE & GREENE 1993; CAMPBELL & SMITH 1998; FERNANDES 1995; KÖHLER et al. 2001). Species of the molluscivorous subclade have particular morphological adaptations for eating snails and slugs (PETERS 1960). *Atractus carrioni* does not seem to have any adaptation for slug predation, and predation upon unshelled mollusks is interpreted as opportunistic, and probably occurs in other lumbricophagous species especially when slugs are an abundant resource like in the habitat of *A. carrioni*. This opportunistic pattern is also seen in molluscivorous species, e.g. a specimen of *Dipsas elegans* BOULENGER, 1896 (*oreas* complex) collected at the Cumbaya Valley (next to the city of Quito, 2350 m a.s.l.) in 28 April 2004 regurgitated an earthworm 60 mm long.

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