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Records of *Salamandrina perspicillata* (Savi, 1821) in the Colli Albani (Latium, central Italy), with some ecological notes (Urodela, Salamandridae)

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Abstract. The distribution of the Northern Spectacled Salamander in the Colli Albani (= Albani Hills), together with some ecological aspects at eight sites are reported. In four sites, oviposition took place between February and April, but in the other four it probably started at least in the first half of December. Eggs were deposited into the water of either temporary or perennial spring ponds or inside flooded man-made tuff tunnels. In some sites, which do not undergo summer drought, some larvae surpassed the summer and even the following winter. For one site, length and weight of 52 ovipositing females were recorded and larval development was monitored. A clear relation between larval body size and limb development did not appear.

Keywords. *Salamandrina perspicillata*, Urodela, chorology, phaenology, oviposition, cave-breeding, larval development, larval overwintering

INTRODUCTION

The Northern Spectacled Salamander, *Salamandrina perspicillata* (Savi, 1821), is an urodele endemic to Italy, where it mainly occurs along the Tyrrhenian side, between the sea level and over 1500 m a.s.l. In Latium region, this species is widely distributed (Corsetti & Angelini, 2000). Although this species was reported from the Colli Albani by Bonaparte (1832-1841), it was rediscovered only recently in this area (Angelini & Cari, 2004). In this note we report details about the breeding sites of this species and outline some ecological aspects, namely as oviposition period and larval development.

MATERIALS AND METHODS

The *Salamandrina* sites herewith concerned are placed within the Castelli Romani Regional Park boundaries and its surroundings, which covers most of the Colli Albani (= Albani Hills), province of Rome. The original phytocenosis of this area is represented by mixed deciduous and beech forests, but at present these are widely replaced by chestnut coppice (Bassani, 1980).

From June 2001 to June 2003, we searched for the Northern Spectacled Salamander in all available water sites, which were of the following types: lakes, brooks, permanent ponds, spring ponds, ephemeral small ponds, troughs and flooded tuff tunnels. Tunnels were excavated, mostly at the beginning of the last century, to obtain sheltered water-bodies in spring spots to facilitate water storage and utilization. All these have muddy bottoms, are several metres long and about 1.2 m wide and 1.2-1.8 m high.

Searches were carried out at least once a month, but twice or more times a month during the oviposition season. We recorded the eventual presence of eggs, adult and larval individuals at each site.

Of two populations (Palazzolo and Belle Facce dell'Ariano) we photographed the salamander's ventral pattern, which is unique to each individual and remains invariable all throughout its life (Vanni et al., 1991, 1997). The salamanders' total length (TL) and snout-vent length (SVL) were also recorded by means of a ruler, and their body mass was recorded by a 0.05 g division pesola balance. In the Northern Spectacled Salamander, no field marks are available to distinguish the sexes. However all the individuals we sampled were probably females because they either were captured while submerged [according to Vanni (1980), Lanza (1983), Delfino et al. (1984), Zuffi (1999), only females submerge] or were actually ovipositing or, following subsequent captures within the same oviposition period, showed a markedly deflated abdomen, which suggested that they had probably laid.

From May, 2002, to April, 2003, at the site Belle Facce dell'Ariano, once a month we measured total length and recorded developmental stages of limbs in larval samples. We released both the adults and the larvae at their sites after completing measurements and/or recordings.

RESULTS

We found *Salamandrina* in ten of the 70 water bodies inspected (Table 1). In Table 1 we have grouped in a single site (PA) three water bodies which are 3-15 m far from each other and are probably inhabited by a single population. The closest and farthest sites are placed as far as 160 (CC-LP) and 10500 m (PA – VI) from each other. All these breeding sites are placed in the remainders of the mixed deciduous forest, except MF, which is placed in a garigue.

Table 2 shows the measurements of females in PA and BF. At BF, in both 2002 and 2003, larger females oviposited earlier in the season than smaller ones, although the correlation between first oviposition date and individual size (SVL) is significant for only the 2003 sample ($n = 50$, $r_{Spearman} = -0.41$; $P < 0.01$).

At BF the overall larval length ranged between 12-31 mm (average ± SE = 17.9 ± 0.2 mm, n = 438). At this site, the recording of developmental stages relative to overall larval length resulted as in Table 3. All larvae hatched with non-fingered fore limbs, and some did not develop fingers until 14 mm; in some, balancers were reabsorbed at 13 mm. Rudimental hind limbs, which were recorded between 12 and 16 mm, were absent in some 13-mm larvae. Three-13 mm larvae (recorded in July and November, 2002, and in January, 2003, respectively) showed fully developed, four fingered hind limbs. Larvae with both

Table 1. Breeding sites of *Salamandrina perspicillata* in the Colli Albani. In the temporary sites, the summer drought lasted roughly from July to October. Oviposition dates are the earliest and latest recorded, irrespective to years [in brackets, dates estimated roughly on the basis of the developmental stage of larvae [cf. text] and time required for egg development (Corsetti, 1999a)].

site code	site name and common	altitude (m a.s.l.)	type	water period	surface (m^2)	max. depth (m)	oviposition dates	larval recording dates
			muddy bottom spring-pond +	permanent	1.3	0.07		
PA	Palazzolo, Albano	500	muddy bottom spring-ponds in tunnel +	temporary	0.02	0.05	1 Feb – 20 Apr	late Apr – late Aug
			tunnel	permanent	>19	0.6		
AD	Acqua della Donzella, Velletri	720	tunnel	permanent	>18	0.4	26 Feb – 2 May	late April - winter
BF	Belle Facce dell'Ariano, Rocca di Papa	810	tunnel	permanent	15	0.6	23 Feb – 2 May	late April - winter
CC	Colle dei Corsi, Nemi	570	muddy bottom spring-pond	temporary	2	0.1	16 Mar – 25 Apr	late April - Jul
MF	Monte dei Ferrari, Velletri	660	rocky bottom spring-pond	temporary	1.5	0.1	(mid Nov)	27 Dec
LP	Le Pozza, Nemi	550	muddy bottom spring-pond	temporary	1.5	0.5	(mid Dec)	1 Feb
MP	Monte Peschio, Velletri	800	rocky bottom spring-pond	temporary	2	0.1	(mid Dec)	23 Jan
VI	Valle dell'Inferno, Lariano	440	tunnel	temporary	9.6	0.3	(mid Dec)	20 Jan

Table 2. Measurements of *S. perspicillata* at two sites in the Colli Albani in 2002 and 2003. Increase in length is relative to year 2003 vs 2002. All measures are given in mm.

Site		TL	SVL	SVL increase	SVL increase %
	n	11	11		
PA	x±SE	105.2 ± 2.4	40.5 ± 0.5		
	range	90 - 114	38 - 42		
	n	50	52	14	14
BF	x±SE	98.5 ± 0.9	38.8 ± 0.3	1.4 ± 0.3	3.8±0.9
	range	83 - 113	33 - 43	0 - 4	0 - 10.8

Table 3. Measurements of larvae relative to developmental stage.

Stage	TL (mm)	average±SE	n
balancers	12 - 16	14±0.2	31
reabsorbed balancers	(≥ 13)	18.2	407
non fingered fore limbs	12 - 14	12.5±0.2	8
three-fingered fore limbs	13 - 17	15.3±0.2	50
four-fingered fore limbs	13 - >	18±0.1	356
absent hind limbs	12 - 13	12.5±0.7	2
rudimental hind limbs	12 - 16	13.7±0.2	28
non fingered hind limbs	15 - 17	15.4±0.1	20
three-fingered hind limbs	16 - 17	16.7±0.2	6
four-fingered hind limbs	13 - >	18±0.2	352

fore and hind limbs fully developed (four fingered) were on average 18 ± 0.2 mm long (i = 13-31; n = 352). Starting from August, all larvae, irrespective to size (minimum TL = 14 mm), showed fully developed limbs.

Fig. 1 shows the growth pattern of the BF larval population, from May, 2002, to April, 2003. In the May sample it is evident the occurrence of two different body-sized larval cohorts, of which the left one probably represents the current year larvae, while the right one probably represents the overwintered larvae from the preceding oviposition season. In the June sample, the number of the latter appears markedly decreased, probably because many had transformed. In the following months, the number of large larvae from the current oviposition season (2002) progressively increased and probably several emerged. At sites herewith concerned we never recorded recently metamorphosed individuals.

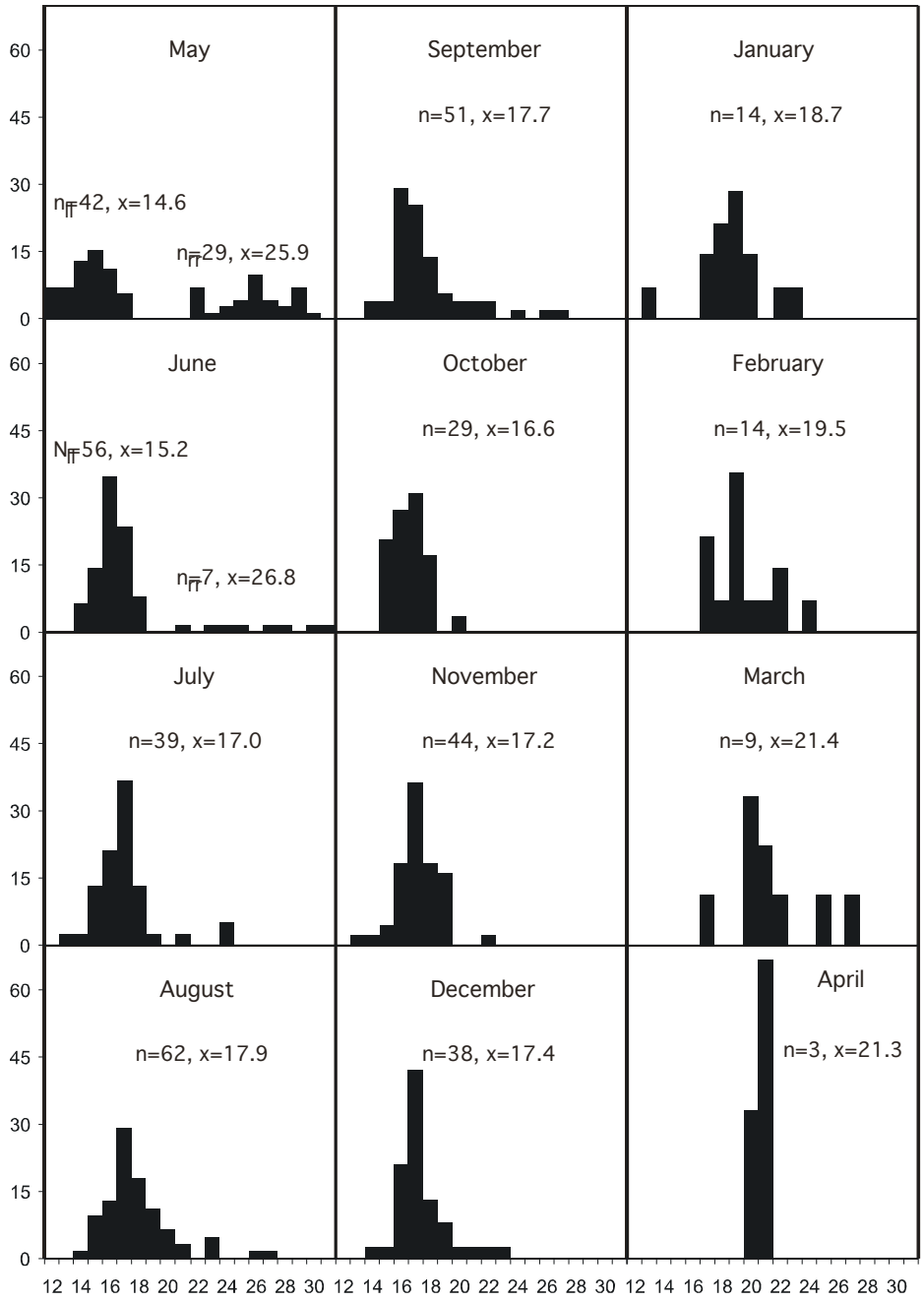

Fig. 1. Larval growth at Belle Facce dell'Ariano (samples from May, 2002, to April, 2003). Larvae are divided in class sizes (TL) of 1 mm (x axis). In the y axis, values are shown as percent of the monthly sample. For the May and June samples, n and mean values are reported for the two cohorts separately. The very small sample of April is reported in graph for convenience.

DISCUSSION

By this note we record eight sites for *Salamandrina perspicillata* in the Colli Albani, to which Angelini & Cari (2004) make undetailed reference. Bonaparte (1832-1841) reported this species from the same area as "intorno il lago di Albano" (around Albano Lake). To our knowledge, the closest site to Albano Lake is Palazzolo; CC and LP are closer to Nemi Lake and AD, BF, MF, MP and VI are placed farther than 6.7 kilometres eastward of this lake. Therefore the species does occur in the southern zone of the Colli Albani.

Still or weakly flowing waters characterise the breeding sites of the Norhtern Spectacled Salamander in the Colli Albani. In this area, this species is almost exclusive of the relatively undisturbed habitat of the mixed deciduous forest (Angelini & Cari, 2004; Angelini et al., 2004). The chestnut coppice, which represents an altered, man-managed habitat, characterised by periodical wood cutting, transit of heavy vehicles, creation of lumber stock areas and other human activities, could likely bring excessive disturbance to the Norhtern Spectacled Salamander's potential shelters and/or to breeding-sites. It is of interest the use of the man-made tuff tunnels for oviposition sites [so far, only Razzetti et al. (2001) have reported cave-breeding in this species]. Surely tunnels do not represent the original habitat of the Norhtern Spectacled Salamander, as do not the troughs built to water livestock, in which this species also lays egg (e. g. Corsetti & Angelini, 2000). Apparently, as concerns to both tunnels and troughs, the man action aimed at transforming the scanty spring water-flows into small, but stable, water bodies, did not create conditions unfavourable to this species.

In four sites (PA, AD, BF, CC), oviposition roughly takes place between early February and early May, as is usually reported for the Norhtern Spectacled Salamander (Lanza, 1983; Zuffi, 1999). But in three (LP, MP, VI), where we recorded larvae as early as 20 January and 1 February (Table 1), oviposition should have started at least in the first half of December and in MF at least in the first half of November [Corsetti (1999 a) reports for populations from the Volsci Mountains a period of 34-58 days for eggs to hatch]. So far, autumnal oviposition has been reported only for some populations from the Volsci Mountain chain (Corsetti, 1994 a, b; 1999 a, b; Corsetti & Angelini, 2000; Angelini et al., 2001).

Larval overwintering, already reported by Barbieri & Tiso (1993) and Angelini et al. (2001), was recorded in both AD and BF. Fig. 1 shows that between July and December most larvae were relatively small, even though in this period all had completed their morphological development. It is possible that in the summer months a considerable slowing of growth in body length occurs in (late) larvae, probably caused by high water temperature together with food shortage and low oxygen water content. It will be of interest to check if larvae which do not emerge in late summer undergo emergence in autumn, or in the next winter or spring.

According to our sampling, a clear relation does not exist between larval body size and limb development (cf. also Antonelli, 1999; Angelini, 2000). Indeed, at BF, all larvae had in-part-developed fore limbs at hatching, but the development of hind limb rudiments, as well as of three and then four fingers in both fore and hind limbs, apparently occurred at disparate body lengths. Such a wide variability contrasts Lanza's (1983) report of successive developmental stages occurring in larvae of regularly increasing size.

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