

Ecological notes on two colubrid snakes (*Coluber viridiflavus* and *Elaphe longissima*) in a suburban habitat (Rome, central Italy)

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THE colubrid snakes *Coluber viridiflavus* and *Elaphe longissima* are among the most conspicuous elements of the snake fauna in Mediterranean central Italy. They are known to inhabit a wide variety of habitats, from mixed forests to evergreen 'macchia' vegetation, and from grasslands to cultivated farmland (Bruno & Maugeri, 1977; Agrimi, 2000; Cattaneo & Capula, 2000). In addition, these species can also be found in suburban and urban areas (Bologna et al., 2003; Rugiero, 2003).

Published data on several aspects of the population ecology of these two species in Mediterranean central Italy are quite abundant for such disparate habitats as agro-forest (e.g., see Capizzi et al., 1995; Capizzi & Luiselli, 1996; Luiselli & Capizzi, 1997) and mixed oak forest (Rugiero et al., 2002). However, there are no data published as yet on the population ecology of these snakes in suburban areas. Our aim in this paper is to address some notes on the ecology of these two species in a suburban habitat situated near Rome, one of the largest towns in Italy.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1998	-	-	-	-	-	-	-	-	2455	2277	2190	-	6922
1999	-	-	1315	140	2545	1270	549	-	390	110	-	-	6319
2000	275	-	290	1304	652	573	-	-	180	315	-	-	3589
Total	275	-	1605	1444	3197	1843	549	-	3025	2702	2190	-	16830
Sampling effort	0.016	-	0.095	0.085	0.189	0.109	0.032	-	0.179	0.160	0.130	-	

STUDY AREA AND METHODS

The study area was situated at the southeastern peripheral border of Rome (Latium, central Italy), between two busy main roads ('via Prenestina' and the urban zone of 'Tor Bella Monaca'). It was a grassy area used for grazing and cultivation, with a small artificial canal crossing the grassy fields. The canal banks were vegetated with dense, spiny bushes of *Rubus ulmifolius*.

Table 1. Field effort (in minutes) divided by month and by year at the study site.

The field study was carried out between September 21st, 1998, and October 21st, 2000. Ninety days were spent in the field (25 in 1998, 32 in 1999, and 33 in 2000), for a total of 280.5 man-hours of research (115.4 in 1998, 105.3 in 1999, and 59.8 in 2000; see Table 1 for details).

Unfortunately, we were unable to conduct any field surveys during February, August and December (Table 1). All captured specimens were individually marked by ventral scale clipping, and then measured to snout-vent length (to ± 0.5 cm) and sexed by examining the shape of the cloacal region. We also recorded dietary data via forced regurgitation of the ingested bolus (Luiselli & Agrimi, 1991), although limited this to only a small number of specimens to avoid excessive disturbance to the few snakes inhabiting the study area.

To assess monthly activity of the two species, we followed the same statistical procedures of Seigel (1992) and Rugiero et al. (1998). We first determined the relative sampling effort per month by dividing the number of minutes spent in the field each

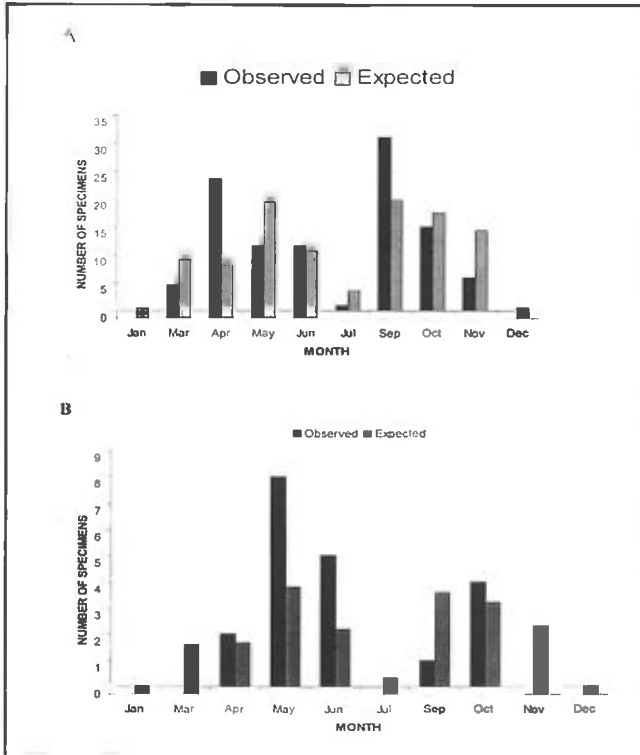


Figure 1. Observed and expected month-by-month frequency of occurrence of the two species of snakes at the study area, in relation to sampling effort. A: *Coluber viridiflavus*; B: *Elaphe longissima*.

month by the total number of minutes in the field during the entire research period. Using a null hypothesis of equal activity among months, we then generated the expected number of snakes active each month by multiplying the total number of snakes found active during the study by the relative sampling effort for each month.

Finally, observed and expected values were compared by using a χ^2 test. Statistical analyses were done by using the PC package 'Statistica' (for Windows, version 5.0), with all tests being two-tailed and alpha set at 5%.

RESULTS AND DISCUSSION

We found only two snake species at the study area: *Coluber viridiflavus* and *Elaphe longissima*. In total, we captured 37 *C. viridiflavus* (18 males, 13 females, 6 subadults), and 15 *E. longissima* (8 males, 6 females, 1 subadult). 37.8% of the marked *C. viridiflavus* were recaptured at least once (46.1 % of females, 38.9 % of males, and 16.7 % of subadults). The maximum number of recaptures (7) was for an adult male. With respect to *E. longissima*, we recaptured just two males and one female, i.e. 20% of the total marked sample.

In both species, males were significantly longer than females (87.5 ± 12.73 cm versus 79.28 ± 7.57 cm in *C. viridiflavus*; Student *t*-test with $df = 35$, $p < 0.05$; 102.57 ± 8.71 cm versus 93.05 ± 2.38 cm in *E. longissima*; *t*-test with $df = 13$, $p < 0.05$).

The observed and expected, month-by-month frequency of occurrence of the two species in relation to sampling effort is presented in Fig. 1. *Coluber viridiflavus* had two significant peaks of activity: April and September (in both cases the observed frequencies significantly exceeded the expected frequencies at $p < 0.05$, χ^2 test); *Elaphe longissima* had just a single activity peak during May–June observed frequencies significantly exceeded the expected frequencies at $p < 0.05$, χ^2 test).

Data recorded on the diet of the two species are presented in Table 2. There was an apparent partitioning in the food preferences between species, with *E. longissima* eating only small mammals and *C. viridiflavus* eating mainly lizards and, to a lesser degree, small mammals. However, the number of prey items recorded for both species was clearly too small to be sure.

Six out of 12 *C. viridiflavus* and two out of five *E. longissima* (captured in 2000) had the tail broken or injured (this type of data was not recorded in the previous years). In addition, five *C. viridiflavus* (13.5 % of the sample) and three *E. longissima* (20 % of the sample) were injured also along the body.

The summarized main patterns of population ecology for the two species in diverging habitats of Mediterranean central Italy are presented in Appendix 1. As can be seen, the two species were quite constant in much of their characteristics in each of the various habitats, although some relatively minor differences emerged in terms of adult sex-ratios and activity peaks. Given the apparent uniformity among habitats in the various population parameters examined, it is difficult to assess whether the urban environment had any notable effect on the population ecology of these two species. However, the proportion of urban specimens with injuries is relatively high, and it is thus unfortunate that such data were not collected

Type of Prey	Prey items in <i>C. viridiflavus</i>	Prey items in <i>E. longissima</i>
Reptilia, Lacertidae		
<i>Lacerta bilineata</i>	5 (33.3%)	-
<i>Podarcis sicula</i>	3 (20%)	-
<i>Podarcis muralis</i>	2 (13.3%)	-
Mammalia		
<i>Rattus norvegicus</i>	1 (6.7%)	5 (83.3%)
Muridae undetermined	4 (26.7%)	
<i>Talpa</i> sp.		1 (16.7%)
TOTAL	15	6

Table 2. Summary of diet data recorded for *Coluber viridiflavus* and *Elaphe longissima* from the study area. Percentages of total diet composition are also presented for both species.



Adult males of *Coluber viridiflavus* (top) and *Elaphe longissima* (below) from study area. Photographs © Lorenzo Rugiero.

for the other conspecific populations presented in Appendix 1. It is noteworthy that high injury rates (represented by specimens with broken tails) were also found in two *C. viridiflavus* populations inhabiting coastal 'macchia' and an agroforest habitat (Capula et al., 2000); however, in our urban area the frequency of specimens with broken tail was much higher than in either of the two above-mentioned areas (22.6% [$n = 53$] and 11.8% [$n = 34$] respectively), and it is thus likely that exposure to predation in such modified, unnatural sites is very high. It is probable that feral cats, which are very abundant in our urban study area, represent the most important predators of snakes in this community.

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APPENDIX I. Summarized patterns of population ecology of *Coluber viridiflavus* and *Elaphe longissima* in various habitat types of Mediterranean central Italy.

Habitat	Adult Sex-Ratio	Body Size	Activity	Diet	Reference
<i>Coluber viridiflavus</i>					
Urban	About 1:1	Males > Females	Bipeaked (April, September)	Lizards, and mice as secondary prey	This study
Bushy pastures	Skewed towards Males	Males > Females	Single peak (April-May)	Lizards, and mice as secondary prey	Capula et al., 1997
Oak Forest	About 1:1	Males > Females	???	Lizards, and mice as secondary prey	Rugiero et al., 2002
Mountain forest	Skewed towards Males	Males > Females	Single peak (April-May)	Lizards, and mice as secondary prey	Filippi & Luiselli, 2003
Agro-forest	About 1:1	Males > Females	???	Lizards, and mice as secondary prey	Capizzi & Luiselli, 1996
<i>Elaphe longissima</i>					
Urban	About 1:1	Males > Females	Single peak (April-May)	Mice	This study
Oak Forest	About 1:1	Males > Females	???	Mice, and birds and lizards as secondary prey	Rugiero et al., 2002
Mountain forest	Skewed towards Males	Males > Females	Single peak (April-May)	Mice	Filippi & Luiselli, 2003
Agro-forest	Skewed towards Males	Males > Females	???	Mice, and lizards as secondary prey	Capizzi & Luiselli, 1996