

Short communications

Passerine birds preyed by the four-lined snake *Elaphe quatuorlineata*: some remarks on the predatory tactic and the relevance of avian prey for reproductive female snakes

FRANCESCO M. ANGELICI*, ERNESTO FILIPPI**, LUCA LUISELLI**

* Dipartimento di Biologia Animale e dell'Uomo, Università di Roma «La Sapienza», viale dell'Università 32, I-00185 Roma, Italia.

** Dipartimento di Biologia Animale e dell'Uomo, Università di Roma «La Sapienza», via A. Borelli 50, I-00161 Roma, Italia.

Birds are occasional prey of several snakes in the Italian peninsula, including both viperids and colubrids (Angelici *et al.*, 1994). Recent studies also demonstrated that ornithophagy and arboreal habits by snakes are not correlated, that means that birds and their eggs are dietary components not more important for arboreal than for terrestrial snakes (Shine, 1983; Luiselli & Rugiero, 1993). Birds are occasionally preyed not only by semi-arboreal snakes but also by strictly terrestrial snakes, such as *Natrix natrix* (Luiselli *et al.*, 1996a), *Vipera ammodytes* (Luiselli, 1996), and *V. aspis* (Luiselli & Agrimi, 1991). Among the palearctic snakes, the four-lined snake *Elaphe quatuorlineata* is the principal predator of birds: in fact, depending on the population, from about 15% to about 80% of the whole spectrum of prey of this snake is constituted by birds and their eggs (e.g. see Capizzi *et al.*, 1995).

During a long-term ecological research on snake ecology in a hilly territory of central Italy (Mounts of Tolfa, Latium, central Italy), we made a series of field observations on bird-eating by four-lined snakes and on the relevance of avian prey for the reproductive female snakes. In this paper we present the data on this issue. Data given here were collected between spring 1991 and autumn 1995 in Rota, a ruderal locality of the Mounts of Tolfa (about 150 m a.s.l., 42°08'N, 12°00'E), characterized by Mediterranean-temperate climate with cold winters (normally without snow covering) and hot and dry summers. The data were collected during the course of a thesis research by one of the authors (Filippi, 1995).

Food items were obtained from living snakes: the animals were captured by hand, and squeezed in the abdomen to obtain any ingested remain (see Luiselli & Agrimi, 1991, for the methods employed). The total number of animals examined in relation to month of

capture is given in Table 1. The given number is cumulative of both individuals captured once and individuals captured multiply. The various animals examined were individually recognized because they were permanently marked by «ventral scale-clipping» throughout the study period (Luiselli *et al.*, 1996; Filippi *et al.*, 1996). The reproductive status of the females was determined by the mass-length ratio.

The statistical analyses were done with a STATISTICA (version 4.5, per Windows) microcomputer package, all tests being two tailed and with α set at 5%. Passerine birds (genera *Sylvia*, *Passer*, *Serinus*, *Carduelis*) constituted one of the main prey type of the four-lined snakes in the Mounts of Tolfa (for a list of the species preyed see Capizzi and Luiselli, 1996). Birds were preyed significantly more often (i) in springtime (April to June) than in the rest of the year also taking into account the different samples of animals examined in the various months (χ^2 test, $df = 1$, (April-June versus July-October), $p < 0.001$;

Table 1 - Numbers of snakes examined (NS), and numbers of birds found in snake stomachs (NB), in relation to season and sampling effort (SE, i.e. number of days per month spent in the field between spring 1991 and autumn 1995). The months of November, December, January, February and March are excluded because snakes do not feed in these periods. For more details, see text.

Month	NS	NB	SE
April	32	3	32
May	34	18	44
June	33	7	40
July	32	1	24
August	0	0	24
September	32	1	20
October	42	2	14

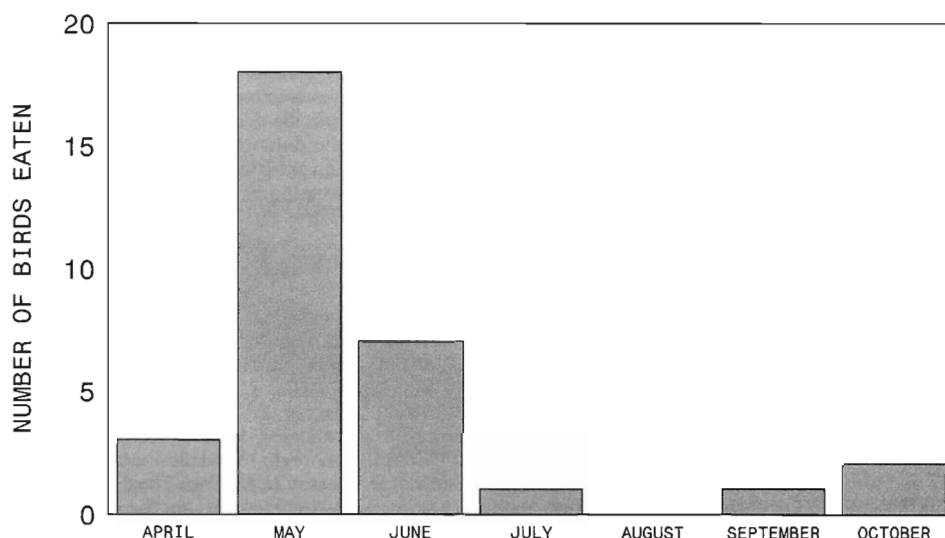


Figure 1. Numbers of birds eaten by snakes in relation to month. Note that in April-June the snakes fed upon birds more often than in the rest of the year. This difference is statistically significant (see text for more details).

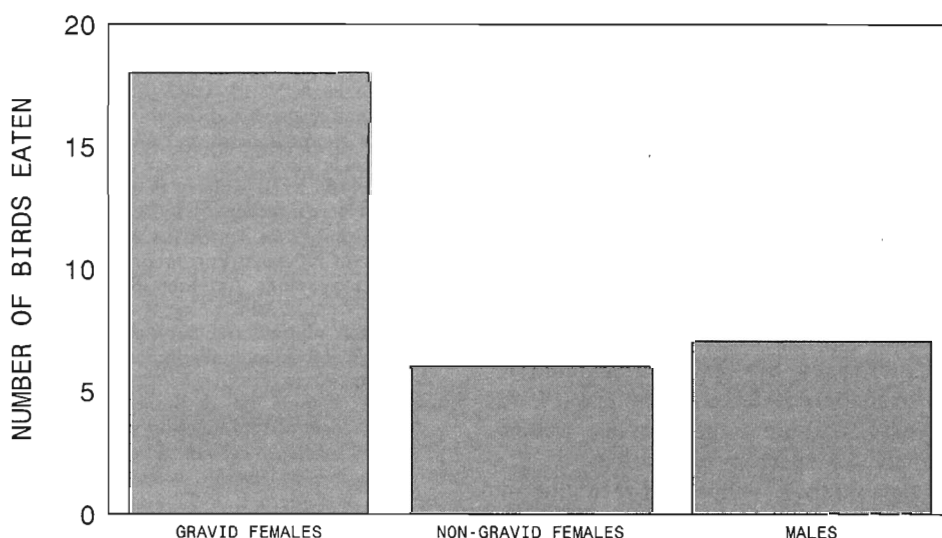


Figure 2. Numbers of birds eaten by *Elaphe quatuorlineata* gravid females, males and non-gravid females in the territory of the Mounts of Tolfa. The difference between gravid females and the other two categories of individuals is statistically significant (see text for more details).

see Table 1 and Figure 1), and (ii) by gravid females than by males or non-gravid females (χ^2 test with $df = 1$, $p < 0.001$ in all pairwise comparisons, see Figure 2). Point (i) could be explained by considering that the nesting period of most passerine birds in the study area occurs during the spring months, when the snakes could be able to easily found the nests other than the adults. Point (ii) could be explained by considering that the gravid female snakes are very stationary during pregnancy (Filippi *et al.*, 1996), and thus, for

reconstructing their fat reserves necessary for reproduction to take place, they need to feed on «easily catchable» prey, as passerine birds probably are (e.g. see Shine, 1983).

We observed a case of hambush predation by a four-lined snake upon a male Tree sparrow *Passer montanus* at 14:33 h of June, 28, 1995. The finding was made along the banks of the stream «Fosso Verginese», when this site was surveyed for snakes. We encountered a gravid female snake (total length:

146.5 cm; weight: 881 g) motionless at the borders of a pond (about 2 x 1 m surface), where two Tree sparrows were wetting. The snake attacked one of the sparrows after hambushing for about 3 minutes, and then swallowed its prey without suffocation.

This latter behaviour is quite atypical, as the four-lined snake is known to suffocate its prey before swallowing (Bruno & Maugeri, 1990). It is possible that this peculiar behaviour might depend on the small size of the sparrow. Our unpublished observations on captive *Elaphe* snakes suggest that these snakes always suffocate large prey (e.g. *Rattus norvegicus*) but usually swallow the prey still alive when it is small sized (e.g. *Apodemus sylvaticus*).

Can we hypothesize that four-lined snakes usually wait for «wetting» birds staying in hambush at the borders of small ponds? Our data on this issue are obviously too scarce for stressing firm conclusions. However, we should notice that gravid and moulting four-lined snakes may spend several hours in water of ponds and streams during the hottest daylight hours (Filippi *et al.*, 1996), and thus is arguable that they can encounter avian prey during these phases.

The data given at above indicates that four-lined snakes are potential threat for passerine bird populations, especially in springtime when sparrows (genus *Passer*) nest. In this regard, it has been demonstrated that mortality rates of adults tend to increase during the breeding season (April to August) from about 2-3% per month to about 5% per month for reasons independent on predation (Summers-Smith, 1988). If we consider that (i) snakes are low-energy predators which feed at very irregular time intervals (Luiselli & Agrimi, 1991) and that (ii) four-lined snakes are characterized by very low population densities even in favourable habitats (Filippi, 1995; Rugiero & Luiselli, 1996), we suggest that they cannot be serious threats for sparrow populations at all, although more data on the percentage of predation in relation to bird population size and number of nests in the snake «familiar area» are required before firm conclusions can be stressed.

Acknowledgements - We thank Brenda Bolton, Paola Enrico, Fatima Evangelisti, and Matthew Fforde for helpful field-work and discussion on the predation of snakes upon birds.

Riassunto - In un'area dell'Italia centrale (monti della Tolfa, Lazio) sono stati raccolti alcuni dati sulla predazione del cervone *Elaphe quatuorlineata* su uccelli Passeriformi. Viene descritto un inconsueto comportamento predatorio da parte di una femmina gravida di cervone su un passerone mattugio *Passer montanus* adulto durante il bagno. Viene dimostrato che gran parte degli eventi predatori del cervone a carico dei Passeriformi si verifica durante i mesi primaverili, e che sono soprattutto le femmine gravide a condurre attività predatoria a carico degli uccelli.

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