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Crested Newts *Triturus carnifex* (LAURENTI, 1768), form the bulk of the diet in high-altitude Grass Snakes *Natrix natrix* (LINNAEUS, 1758), of the central Apennines

(Caudata: Salamandridae; Squamata: Colubridae)

Kamm-Molche - *Triturus carnifex* (LAURENTI, 1768) - als Hauptbestandteil der Nahrung von Hochgebirgs-Ringelnattern - *Natrix natrix* (LINNAEUS, 1758) - im Zentralapennin

(Caudata: Salamandridae; Squamata: Colubridae)

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KURZFASSUNG

Wir berichten über die Zusammensetzung der Nahrung von Ringelnattern *Natrix natrix* (LINNAEUS, 1758), einer isolierten Population im Bereich eines Hochgebirgs-Gletschersees im Naturreservat 'Montagne della Duchessa' im Velino Massiv (Apenninen). Die Körperlänge der Weibchen lag (statistisch nicht signifikant) geringfügig über der der Männchen. Bei einer Wiederfangrate von 50%, zeigte ein allgemeines MANOVA-Modell mit der Kopf-Rumpf-Länge (KRL) als Kovariate, daß kein Geschlecht bevorzugt wiedergefangen wurde.

Nahrungsobjekte waren ausschließlich Amphibien. Abgesehen von einer Larve der Erdkröte *Bufo bufo* (LINNAEUS, 1758) in einer männlichen Natter von 37,0 cm KRL, wurden ausschließlich adulte Kamm-Molche *Triturus carnifex* (LAURENTI, 1768), als Nahrungstiere festgestellt. Sehr wahrscheinlich liegt dies daran, daß diese Molche im Untersuchungsgewässer die bei weitem häufigste Amphibienart darstellen. Es wird vermutet, daß *T. carnifex* auch für andere Ringelnatterpopulationen im Hochgebirge des Zentralapennins eine bedeutende Nahrungsquelle darstellt.

ABSTRACT

We report on the prey composition in Grass Snakes *Natrix natrix* (LINNAEUS, 1758) of an isolated population inhabiting a high-altitude glacial lake at the Duchessa Mountains Natural Park, in the Velino Massif (Apennines). Females were slightly longer than males, but the difference was not statistically significant. Although 50% of the specimens captured and marked were later recaptured, a general MANOVA model revealed that the numbers of recaptures were not dependent upon sex, with snout-vent-length (SVL) as the covariate. Prey items were only amphibians: apart from a tadpole of the Common Toad *Bufo bufo* (LINNAEUS, 1758), found in a male snake of 37.0 cm SVL, all the other fed specimens had eaten upon adult Warty Newts, *Triturus carnifex* (LAURENTI, 1768). It most likely depended on the unusually high abundance of newts at the study lake, where they are by far more abundant than any other amphibian species. It is concluded that *T. carnifex* are probably an essential prey source for other isolated high-altitude grass snake populations of the central Apennine massifs.

KEY WORDS

Reptilia: Squamata: Serpentes: Colubridae, *Natrix natrix*, food habits; Amphibia: Caudata: Salamandridae: *Triturus carnifex* as prey, feeding ecology, high-elevations, central Apennines, Italy.

The feeding ecology of the Grass Snake *Natrix natrix* (LINNAEUS, 1758), was studied in several areas of both their Italian range (e.g., LUISELLI & RUGIERO 1991; FILIPPI et al. 1996; LUISELLI et al. 1997) and elsewhere (e.g., GISLÉN & KAURI 1959; KABISCH 1974, 1999; BESHKOV & DUSHKOV 1981). However, no data are available on the prey composition of those small isolated populations which are linked to the lakes and ponds of the highest altitudes of the Apennine Massif (approximately 1,700-2,000 m a.s.l.). In this note, we report on the diet of an isolated Grass Snake population living at a high-altitude glacial lake in the Mount Velino massif.

Grass Snake diet was studied at a single locality (Duchessa Lake, 1788 m a.s.l.; 42°10' N, 13°20' E), where a small, isolated population inhabits the edge of a glacial lake situated beyond the wooded zone, at least 8-10 km from the closest conspecific population (FILIPPI & LUISELLI 2000). The study area is situated inside a protected territory

(Duchessa Mountains Natural Park). The lake is 100,000 m² in size, 1-4 m deep, depending on the season (PETRICCIONE 1993), partially colonized by aquatic vegetation (*Ranunculus trichophyllus*, *Eleocharis palustris*), and has a muddy bottom and rocky banks. Warty Newts *Triturus carnifex* (LAURENTI, 1768) are extremely abundant in the lake, whereas Common Toads *Bufo bufo* (LINNAEUS, 1758), and green frogs (*Rana* sp.) are very rare (FILIPPI & LUISELLI 2000). Abundant populations of introduced fishes are also found in the lake.

Surveys for snakes were conducted during April to September 2000, as a part of a larger ecological study on the snakes of this area (FILIPPI & LUISELLI 2002). All snakes were measured regarding snout-vent length (SVL, precision ± 0.5 cm), and tail length, sexed, and individually marked by ventral scale-clipping. Then their belly was palpated until regurgitation of ingested food occurred (see LUISELLI & RUGIERO 1991; FILIPPI et al. 1996).

In total, 12 specimens (8 males, 4 females) were captured and marked, 50% of which (i.e., 6 specimens, five males and one female) were later recaptured at least once. Females were longer than males ($\bar{x}$ = 62.2 ± 28.9 cm SVL [n = 4] versus $\bar{x}$ = 51.4 ± 17.6 cm SVL [n = 8]), but the difference was not statistically significant (one-way ANOVA: $F_{1,10} = 0.665$, $P = 0.434$). A general MANOVA model with SVL as the covariate revealed that none of the sexes was preferentially recaptured ($F_{1,9} = 0.844$, $P = 0.382$). Prey items (n = 9) were found in six males and one female: apart from one *B. bufo* tadpole found in a male of 37.0 cm SVL, all the other fed specimens had eaten upon adult Warty Newts *T. carnifex*. Two snakes (a female of 87.5 cm SVL, and a male of 66.0 cm SVL) had two newt specimens each in their stomachs. So, newts accounted for 88.9% of the prey items of this high-altitude *N. natrix* population.

In conclusion, our Grass Snake population did not differ from the other conspecific populations studied at lower elevations (e.g., LUISELLI & RUGIERO 1991; FILIPPI et al. 1996; LUISELLI et al. 1997) in terms of its general preference for amphibians (accounting for 100% of its diet at Duchessa Lake, despite introduced fish being available, and more than 70% in other sites), but in terms of its preference for newts, which are rarely preyed upon by Grass Snakes at lower elevations. The high proportion of newts in the diet most likely depended on the fact that newts were by far the most abundant amphibian species at the study lake and thus a convenient food source for the local Grass Snake population. We think that *T. carnifex* is probably an essential prey source also for other high-altitude Grass Snake populations of the central Apennines, as these newts may be the most abundant amphibians in many ponds and glacial lakes of this region (e.g., at Campo Imperatore Valley, Gran Sasso d'Italia, etc).

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