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Predator versus predator: Four-lined Snake (*Elaphe quatuorlineata*) feeding on a Least Weasel (*Mustela nivalis*) in Istria, Croatia

(Serpentes, Colubridae & Carnivora, Mustelidae)

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Predators in general kill their prey efficiently and with a minimized risk of being injured during the capture. Here we describe the first observation of a Four-lined Snake (*Elaphe quatuorlineata*) constricting and finally swallowing a Least Weasel (*Mustela nivalis*), in Istria, Croatia. The weasel, which is also a carnivore, managed to defend itself for more than 15 minutes and to cause some bleeding wounds in the snake's mouth and body. The predation event was documented with photographs and videos.

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Introduction

Snakes use a variety of strategies to subdue their prey animals. Those that feed on small, relatively defenseless organisms like frogs, fishes, or insects (e.g. *Natrix natrix*, Kabisch 1999) usually swallow their prey alive which subsequently dies in the stomach. For more defensive prey such as birds or mammals, venomous snakes have evolved a cocktail of different types of toxins that is usually injected via venomous fangs by a short single strike. Afterwards, the snakes retreat until the bitten animal has deceased. Non-venomous snakes (e.g. boids and larger colubrids sensu lato) strangle larger and defensive prey by violent muscles contractions inducing circulatory arrest (Boback et al. 2015).

The latter strategy is also used by *Elaphe quatuorlineata*, one of the largest snakes of Europe with a total length typically from 120 to 160 cm, up to a maximum of 260 cm, and widespread in the

Eastern Mediterranean region (Böhme & Ščerbak 1993, Schulz 1996). The diet of this non-venomous, diurnal snake consists mainly of small mammals, e.g. mice, rats, voles, and rabbits, but also birds – including eggs – and lizards, but so far no feeding on carnivorous mammals has been reported (Böhme & Ščerbak 1993, Capizzi & Luiselli 1997, Filippi et al. 2005, Zuffi et al. 2010).

Results and discussion

During a student excursion of the Friedrich-Alexander-University Erlangen-Nürnberg to Istria, Croatia T.K. and J.F. noticed squeaking sounds in a small holm oak forest (*Quercus ilex*) next to the San Polo campground (45.01582° N, 13.71524° E, 13 m a.s.l.) near Bale on 31th May 2012. Tracing the sound they encountered a Four-lined Snake curled around a weasel which was identified as a Least Weasel (*Mustela*



Fig. 1. Chronological sequences of the predation event of *Elaphe quatuorlineata* on *Mustela nivalis*. **A.** 9h56 a.m.: The snake gets injured in the lower jaw by the biting weasel (encircled in red; screenshot from video, Supplementary Video 1); **B.** 10h00: weasel gets killed by the tightened constrictions around its head; **C.** 10h12: snake resting with dead weasel in loose constriction; **D.** 10h37: snake after having swallowed its prey.

nivalis) based on its relatively small body size and the uniformly brown tail (versus black tail tip in *Mustela erminea* according to Reichstein 1993). Based on the broad head and poorly contrasting coloration, the snake was probably a fully grown, relatively old specimen, lacking most of the distal part of its tail. The following killing and swallowing process was documented by T.K. and J.F. with videos and photographs using a digital camera (Canon Digital IXUS 100 IS) without manipulating the animals (Fig. 1, Supplementary Video 1):

09h48–09h58: When the observations and filming was started, the head and anterior body of the presumably recently captured weasel was fixed by the bite and the coiling of the snake while the weasel was squeaking and scratching with its hind limbs on the snake's body. Within the next minutes the weasel managed to free its head from the snake's mouth several times and bit the snake in the lower jaw (Fig. 1A) and the body. In the following, the snake took the weasel posteriorly and enhanced its constrictions around the weasel's neck. The biting resulted in bleeding injuries of the weasel's mouth and most likely on the lower jaw and on the body of the snake.

10h00–10h05: The squeaking of the weasel faded out while being tightly constricted around the head and fixed by the snake's mouth posteriorly (Fig. 1B).

10h05–10h24: The snake loosened its bite and the presumably dead weasel did not show movements anymore. The snake untightened its constrictions and moved the anterior body slowly around (Fig. 1C).

Ca. 10h31–10h37: The snake started to swallow the weasel head first and completed this process within the next six minutes (Fig. 1D).

Although Least Weasels are the smallest carnivores of the world, they are often considered as strong fighters capable of killing prey multiple times of their own body weight (Reichstein 1993). The observations described here is possibly the first documentation of a Least Weasel as prey of a Four-lined Snake, although Böhme (1993) reported on the predation of *Mustela* sp. by the related and slightly smaller *Zamenis longissimus*. However, snakes apparently feed relatively rarely on mammalian predators, presumably because of their low density in an ecosystem and because of the great risk of getting injured by the sharp claws and teeth of a carnivorous animal (Mukherjee & Heithaus 2013). With a duration of about half an hour the killing process of the weasel took rather long and appeared somewhat inefficient, giving the weasel the chance to scratch and bite the snake. The reason for this is unknown, but might be caused by the relatively cool temperatures on the forest floor in the morning resulting in a suboptimal activity level of the snake.

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Supplementary material

Supplementary Video 1: Youtube video (T.K. and J.F.): <https://www.youtube.com/watch?v=7enClOK0AgE&feature=youtu.be>

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