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Taking advantage of the massive emergence of the odonate *Sympetrum flaveolum* as a trophic resource for *Zootoca vivipara*

Manuel Fabio Flechoso¹, Javier Morales¹, Miguel Lizana¹ & M^a Isabel González²

¹ Departamento de Biología Animal y Ecología. Universidad de Salamanca. Campus Miguel de Unamuno. 37007 Salamanca. C.e.: fabioflechoso@hotmail.com

² Cl. Héroes de la Independencia, 1. 2º A. 42200 Almazán. Soria.

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RESUMEN: Se describe la inclusión en la dieta de *Zootoca vivipara* de un nuevo orden de insectos, los odonatos. La cita tuvo lugar en unas pequeñas lagunas localizadas en el norte de Palencia donde dos adultos de *Z. vivipara* se estaban alimentando de tenerales del odonato *Sympetrum flaveolum*.

The viviparous lizard (*Zootoca vivipara*) is an Euro-Asian reptile with a very broad geographic distribution, ranging from western Europe (Cantabrian range and Ireland) to the island of Sakhalin and Hokkaido in the Pacific Ocean. In terms of latitude it is found from the north of the Mediterranean peninsulas to the north of Scandinavia in the Arctic Polar Circle (Dely & Böhme, 1984). In the Iberian Peninsula, the northern populations represent the south-western limit of the species distribution (Pérez Mellado, 1997; Galán *et al.*, 2010; Arribas, 2011). In the Pyrenees, it reaches even more than 2400 masl in Andorra (Amat & Roig, 2003), while in the Cantabrian range it reaches 2000 masl due to the scarcity of favourable biotopes at elevated altitudes. In the central-eastern sector of the Cantabrian

region there are many populations at low altitudes and even in coastal areas (Bea, 1985). By contrast, in the western sector of Asturias and in Galicia it is found in higher, interior zones and exhibits a more discontinuous distribution. Furthermore, in Catalonia this lizard only occurs between 1700 and 2400 masl (Llorente *et al.*, 1995). It often occupies peat bogs, the edges of ditches and grassy zones and brambles, damp meadows, the edges of beech forests, and other formations characterized by high substrate moisture and a good grassy or bushy plant cover (Castroviejo *et al.*, 1970; Grenot & Heulin, 1990).

The link between *Z. vivipara* and environmental humidity seems to have a physiological basis since the rates of water loss due to lung-skin evaporation are higher in

this species than in other Lacertidae (Grenot & Heulin, 1990). The diet of *Z. vivipara* is strictly carnivorous and mainly comprises Araneae, Homoptera, Collembola and Isopoda (Avery, 1962; Pilorge, 1982; Braña, 1984; Heulin, 1986), although in some populations, such as the one found in Finland, there is a predominance of Diptera (Itämiies & Koskela, 1971). In Asturias, according to the analysis of 57 specimens with 270 preys, the diet consists of Araneae (29.63%), Homoptera (19.26%), Orthoptera (8.52%), insect larvae (7.03%), Opilionidae (2.96%), Coleoptera (2.96%), Gastropoda (2.96%), Isopoda (2.22%), Heteroptera (1.48%), Hymenoptera (1.48%), Lepidoptera (0.74%), Oligochaeta (0.74%) and Acaridae (0.37%) (Braña, 1984). As well as in Finland, in a Pyrenean population the most consumed prey were Diptera (imagos) (34.7%) and Araneae (26.6%), followed by Homoptera (12.0%), adult Lepidoptera (7.7%) and larvae (6.1%), Coleoptera (2.7%), Heteroptera (2.5%), Hymenoptera (2.0%), Stylommatophora (1.7%) and Orthoptera (1.6%) (Roig, 1998; Roig *et al.*, 1998).

It is known that juveniles have a less diverse diet than adults as the former do not eat large prey due to morphological constraints. At the other extreme, adult males could sporadically use up larger prey than adult females and immatures. As the reproductive season progresses, *Z. vivipara* increases the diversity and amount of prey consumed (Avery, 1962, 1966; Roig, 1998; Roig *et al.*, 1998).

Sympetrum flaveolum, the yellow-winged darter, is a species of small-medium (32-37 mm) dragonfly (Odonata, Anisoptera) that is readily identifiable because its wings normally display patches of saffron yellow on their proximal parts. Like other species of the genus, males have red bodies while females are yellowish.

Both sexes are similar in size. Although it is widely distributed throughout Europe, in the Iberian Peninsula is scarce and highly localized. In southwestern Europe it prefers higher lands (Dijkstra & Lewington, 2006). It lives close to shallow bodies of stagnant water with a fair amount of vegetation that heats up quickly, and may even dry up in the summer. Breeding is confined to stagnant water, usually in peat bogs. Its flying period lies between the end of May and October, maximum abundance being observed in August (Dijkstra & Lewington, 2006). Like other species of Odonata, *S. flaveolum* requires a certain amount of time after its transformation from larva to imago for its wings and body to acquire the necessary consistency and rigidity to allow flying. This period of time varies between a few hours up to days and specimens in this state are known as teneralis.

In the present work our observations were made in the municipality of Cervera de Pisuerga (Palencia, North Spain) around two small ponds located in the Natural Park of Fuentes Carrionas-Fuente Cobre, (1660 masl). The UTM grid (Datum ETRS89) is 30T UN66 (Figure 1). The habitat was a bog without medium-tall shrubs and abundant clumps of sphagnum (peat moss), grasses and *Erica tetralix*.

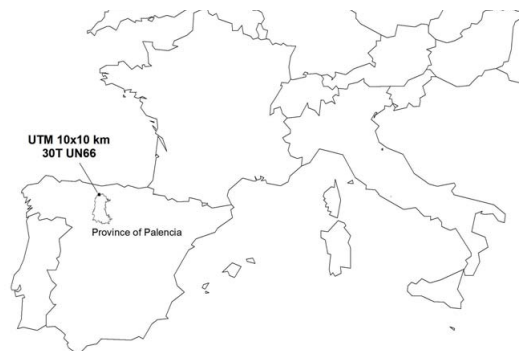


Figure 1: Location of the study site.

Figura 1: Localización del lugar de estudio.

Most specimens were found at a distance of less than 10 m from water surface. In August 2014, we observed several adult specimens of *Z. vivipara* of which at least two (a male and a female) were feeding on teneral of *S. flaveolum* (Figure 2). At the same time, a massive emergence of teneral resting on the surrounding vegetation was taking place. This predatory behaviour was observed over approximately 2 h. The fact that *Z. vivipara* predate on this Odonata is interesting since predation on dragonfly imago by this species of lizard was not previously reported. Intriguingly, predation only took place on dragonflies, which are larger than damselflies (Odonata, Zygoptera), even though the latter were fairly abundant, in particular teneral of *Lestes dryas*. It is suggested that dragonfly predation would be due to the insects search for good energy sources and the fact that the prey were teneral imago, unable to fly and hence easy for the lizards to catch. It could be suggested that this prey type is only hunted on days on which dragonfly imago do not have hardened wings and bodies since when these gain greater consistency it is possible that the lizards would



Figure 2: Adult male of *Z. vivipara* feeding on teneral of *S. flaveolum*.

Figura 2: Macho adulto de *Z. vivipara* depredando sobre un teneral de *S. flaveolum*.

be unable to swallow such large prey. One would thus be witnessing a case of a species taking advantage of an ephemeral but locally very abundant trophic resource.

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Primeras observaciones en vida silvestre de temperaturas ambientales y su influencia en la emersión de neonatos de *Crocodylus acutus* en la estación biológica Nancite, Costa Rica

J. Manuel Aranda-Coello^{1,2}

¹ Instituto Internacional en Conservación y Manejo de Vida Silvestre, Universidad Nacional, Heredia 1350-3000, Costa Rica. C.e.: m.aranda.coello@gmail.com

² Red Mesoamericana y del Caribe para la Conservación de Anfibios y Reptiles (MesoHERP).

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Entre los factores ambientales que influyen en los cambios fisiológicos en los cocodrilos se cree que la temperatura es el más importante, debido a que activa o deprime funciones de algunos sistemas corporales que determinan respuestas del comportamiento individual o colectivo (Smith *et al.*, 1984; Yang *et al.*, 2008). La temperatura corporal en los cocodrilos está influenciada por la radiación solar y la conducción de calor a través del agua, de forma que pueden utilizar los gradientes de temperatura que se producen entre el sol y la sombra, el agua superficial tibia y el agua profunda fría para alcanzar la temperatura corporal óptima (Grigg *et al.*, 2000; Huchzermeyer, 2003). Sin embargo, esta temperatura corporal está sometida al intercambio de calor entre el animal y su ambiente (e.g., se emplea el agua como un recurso para el calentamiento durante los períodos de

temperatura baja y para sumergirse cuando el animal está demasiado acalorado), y está forzosamente influenciada por la temperatura del aire y la conducción de calor a través del agua (Webb *et al.*, 1991; Zug, 1993).

El cocodrilo de río o americano, *Crocodylus acutus*, es una especie de gran tamaño, que puede alcanzar tallas superiores a los 4 m. Se distribuye por las costas del Atlántico y el Pacífico de México, Centroamérica, norte de Sudamérica, diversas islas caribeñas y el sur de Florida en los Estados Unidos (Ernst *et al.*, 1999; Alvarez del Toro & Sigler, 2001). El objetivo del presente trabajo es determinar la influencia de la temperatura del aire y del agua en la emersión de neonatos de *C. acutus* en vida silvestre.

El estudio se llevó a cabo en agosto de 2012, en el estero de la Estación Biológica Nancite (EBN) de Costa Rica, ubicado entre