Euscorpius

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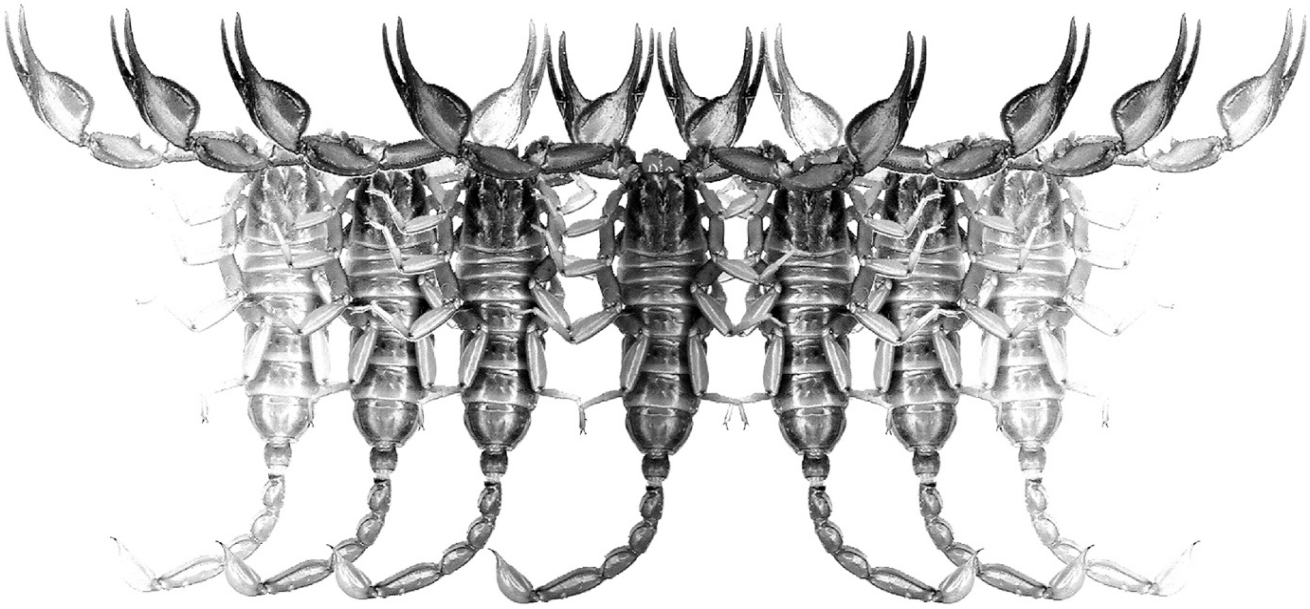

Amphibians and reptiles as prey of *Heteroctenus junceus* (Scorpiones: Buthidae), with a summary of vertebrate predation by scorpions in the West Indies

Tomás M. Rodríguez-Cabrera, Ernesto Morell Savall & Rolando Teruel

December 2021 — No. 342

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Derivatio Nominis

The name ***Euscorpius*** Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

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Publication date: 1 December 2021

http://zoobank.org/urn:lsid:zoobank.org:pub:54681FD9-9875-4042-9424-20E50EB9ECA9

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Amphibians and reptiles as prey of *Heteroctenus junceus* (Scorpiones: Buthidae), with a summary of vertebrate predation by scorpions in the West Indies

Tomás M. Rodríguez-Cabrera[1a], Ernesto Morell Savall[3] & Rolando Teruel[1b, 2]

[1] Instituto de Ecología y Sistemática, Carretera de Varona # 11835, e/ Oriente y Lindero, Reparto Calabazar, Boyeros, La Habana 11900. CUBA.
E-mails: tomasmichel.rodriguez@gmail.com [a], teruel@ecologia.cu [b]
[2] Grupo de Sistemática y Ecología de Artrópodos Caribeños. Calle 200 # 3759, e/ 37 y 45, Reparto Versalles; La Lisa; La Habana 13500. CUBA. E-mail: teruelrolando6@gmail.com
[3] Edificio 4, Apto 7, e/ Oquendo y Silverio, Rpto Virginia, Santa Clara, Villa Clara 50100. CUBA.
E-mail: ernestomorell68@nauta.cu

http://zoobank.org/urn:lsid:zoobank.org:pub:54681FD9-9875-4042-9424-20E50EB9ECA9

Summary

Vertebrate predation by scorpions has been scarcely documented in the literature. Contrary to large scorpions of the genera *Centruroides*, *Hadrurus*, *Opistophthalmus*, and *Pandinurus* from North America and Africa, which are capable of subduing even small rodents and bats, West Indian scorpions of the genera *Centruroides*, *Heteroctenus*, and *Tityus* seem to limit their prey to amphibians and reptiles. Herein we present new cases of a frog (*Osteopilus septentrionalis*; Hylidae) and three lizards (*Anolis allisoni*, *A. ophiolepis*, and *A. sagrei*; Dactyloidae) preyed upon by *Heteroctenus junceus* (Herbst, 1800), at the time we summarize all cases of vertebrate predation by scorpions in the region.

Introduction

Scorpions feed mostly on other arthropods, but the larger species sometimes include small vertebrates in their diets as well (for reviews see McCormick & Polis, 1982, 1990; Valdez, 2020). However, only five out of the 159 species (3%) of scorpions occurring in the West Indies have been reported preying upon vertebrates (Table 1). Contrary to some large scorpions from North America, Central America and Africa (e.g., *Centruroides* Marx, 1890, *Hadrurus* Thorell, 1876, *Opistophthalmus* C. L. Koch, 1837, *Pandinurus* Fet, 1997), which are capable of subduing even small rodents and bats (for reviews see McCormick & Polis, 1982, 1990; Espinal et al., 2020), in the West Indies vertebrate preys include only frogs (*Eleutherodactylus* Duméril & Bibron, 1843) and lizards (*Anolis* Daudin, 1802, *Pholidoscelis* Fitzinger, 1843, *Sphaerodactylus* Wagler, 1830); see Armas (2001), Rodríguez-Cabrera et al. (2020a), Teruel (2005), and Teruel et al. (2020). West Indian scorpions reported as predators of vertebrates belong to the genera *Centruroides*, *Heteroctenus* Pocock, 1893 (formerly under *Rhopalurus* Thorell, 1876; see Esposito et al., 2017), and *Tityus* C. L. Koch, 1836, all in the family Buthidae C. L. Koch, 1837, some of them with total lengths frequently exceeding 100 mm (Armas, 1988, 2001; Rodríguez-Cabrera et al., 2020a; Teruel & Kovařík, 2012; Teruel et al., 2020). Herein we report new events of predation on a frog (Hylidae) and on three species of anoles (Dactyloidae) by the Cuban endemic scorpion *Heteroctenus junceus* (Herbst, 1800), at the time we summarize all cases of vertebrate predation by scorpions in the region.

We detected most predation events while searching for scorpions by day and night, either by turning rocks over or with the help of ultraviolet light, respectively. We identified the prey items *in situ* to the lowest taxonomic rank possible. Datum for all coordinates is WGS 84.

Results

At about 2130 h of one night (date unrecorded) during the rainy season of 2015, we found a large adult female *H. junceus* (>90 mm total length) preying upon a frog *Osteopilus septentrionalis* Duméril & Bibron, 1841 (~30 mm SVL), near the wall of Minerva dam (22°25'58.1"N 79°47'35.4"W; 75 m a. s. l.), Santa Clara Municipality, Villa Clara Province. When first seen, the frog showed no signs of digestion, suggesting that it was captured a short time before, probably during the evening hours. Vegetation in the area is secondary grassland and disturbed "cuabal" (dry evergreen thorny thicket on serpentine-derived soil).

One another night (date unrecorded) during the rainy season of 2015, we observed a large adult female *H. junceus* (~90 mm total length) preying upon an adult male *Anolis allisoni* Barbour, 1928 (~80 mm SVL), on the wooden wall of a rustic building at La Piedra village (22°31'05.1"N

Prey	Predator	Source
AMPHIBIA		
Anura: **Eleutherodactylidae**		
Eleutherodactylus coqui	*Tityus obtusus*	Steward & Woolbright (1996); Villanueva-Rivera et al. (1999); Joglar (2005); L. O. Nieves in Henderson & Powell (2009)
Eleutherodactylus patriciae	*Tityus quisqueyanus*	Armas & Abud (1992)
Eleutherodactylus planirostris	*Heteroctenus junceus*	Rodríguez-Cabrera et al. (2020a)
Anura: **Hylidae**		
Osteopilus septentrionalis	*Heteroctenus junceus*	This paper
REPTILIA		
Squamata: **Dactyloidae**		
Anolis allisonii	*Heteroctenus junceus*	This paper
Anolis porcatus	*Centruroides gracilis*	N. Morales *in* Armas (2001)
Anolis sagrei	*Heteroctenus junceus*	Teruel et al. (2020); this paper
Anolis ophiolepis	*Heteroctenus junceus*	This paper
Squamata: **Sphaerodactylidae**		
Sphaerodactylus elegans	*Heteroctenus junceus*	R. Regalado *in* Armas (2001)
Sphaerodactylus torrei	*Heteroctenus junceus*	Teruel & Armas (2012)
Squamata: **Teiidae**		
Pholidoscelis lineolatus	*Heteroctenus princeps*	Armas & Abud (1992)
Pholidoscelis sp. (as *Ameiva* sp.)	*Tityus crassimanus*	Teruel (2005)

Table 1. Summary of vertebrate species reported as prey of scorpions in the West Indies, from the literature and this work.

Figure 1. Partially digested *Anolis ophiolepis* found being preyed upon by an adult female *Heteroctenus junceus* at Loma La Carrera; the scorpion fled as soon as we turned the rock over.

Figure 2. *Heteroctenus junceus*, the largest species in the genus and one of the largest scorpions in the West Indies, male (2a) and female (2b).

Figure 3. Live individuals of the species of amphibians and reptiles reported here as being preyed upon by *Heteroctenus junceus*: *Osteopilus septentrionalis* (3a), *Anolis allisoni* (3b), *A. sagrei* (3c), and *A. ophiolepis* (3d).

79°44'35.6"W; 70 m a. s. l.), 2 km NE of La Quinta and 4 km W of Vueltas, Camajuaní Municipality, Villa Clara Province. When first seen, soft tissues of the abdomen and neck of the lizard were partially digested.

During scorpion surveys realized between 2008 and 2018 we observed eight events of predation by large adult females *H. junceus* (>80 mm total length) on juveniles and females *Anolis sagrei* Duméril & Bibron, 1837 (30–40 mm SVL), in an area of about 1.5 km^2 just north of Minerva dam (central point: 22°26'04.2"N 79°48'17.6W"; 80–100 m a. s. l.), Santa Clara and Camajuaní Municipalities, Villa Clara Province. These cases were always observed during daytime searches under rocks. Vegetation in the area is secondary grassland and disturbed "cuabal" (dry evergreen thorny thicket on serpentine-derived soil).

On 9 September 2020, at mid-morning, we found an adult female *H. junceus* (80 mm total length) preying upon an unsexed individual of *Anolis ophiolepis* Cope, 1861, under a rock at Loma La Carrera (22°25'59.2"N 79°51'26.5"W; 150 m a. s. l.), ~3.5 km ESE of Callejón de los Patos, Santa Clara Municipality, Villa Clara Province. When first seen, soft tissues of the posterior half of the lizard were partially digested (Fig. 1). The scorpion fled as soon as we turned the rock over. Vegetation in the area is secondary grassland with isolated bushes and trees.

Discussion

With a maximum total length frequently exceeding 100 mm in both sexes, *Heteroctenus junceus* (Fig. 2) is the largest species in the genus, as well as one of the largest scorpions in the West Indies (Teruel & Armas, 2012; R. Teruel, unpublished data). Dwarf geckoes of the genus *Sphaerodactylus* have been repeatedly documented as preyed upon by this scorpion, but anoles and frogs had been documented only once each (Table 1). The only other species of scorpion listed as predator of vertebrates in Cuba is *Centruroides gracilis* (Latreille, 1804) (another buthid, with a maximum total length of 150 mm; see Teruel & Kovařík, 2012), which was reported by Morales (*in* Armas, 2001) preying upon *Anolis porcatus* Gray, 1840, even though, no details on size or sex of both predator and prey were therein specified.

The frog and the three species of *Anolis* reported here as prey (Fig. 3), co-occur with *H. junceus* across much of the Cuban archipelago, including urban environments (Teruel & Armas, 2012; Rodríguez et al., 2013). This scorpion is a sit-and-wait and largely nocturnal predator, which forages both at the soil level and on the vegetation, and feeds mostly on arthropods (insects, centipedes, spiders, whip spiders, and other scorpions including conspecifics), but also on small frogs and lizards (Armas, 2001; Teruel & Armas, 2012; Barro & Cherva, 2013; Teruel & Toledo, 2014; Rodríguez-Cabrera et al., 2015a, 2020a, 2020b; Teruel et al., 2020). The lizards reported here were preyed in different scenarios, but mostly under rocks by day, where they might have entered looking for shelter while the scorpions were resting. An alternative explanation for the female scorpion preying on an adult male *A. allisoni* in a rustic wooden building at night, is that the anole could be active under an artificial night light, i.e., anoles frequently do this in anthropogenic habitats, taking chance of an easy catch of insects attracted by the lights (for reviews see Perry & Fisher, 2006; Perry et al., 2008), coinciding in time with the normal foraging period of the scorpion.

It is noteworthy that in most recorded predation events by *H. junceus* on vertebrates, the predators were females (Teruel & Armas, 2012; Teruel et al., 2020; this paper). Females of *H. junceus* are usually larger and stouter than males (to 8 g), and probably in a greater need of storing reserves in order to nourish their embryos (litter size in this species may reach of up to 72 pulli; see Rodríguez-Cabrera et al., 2015b). As observed here, this scorpion is capable of preying on relatively large lizards, such as adult males of *A. allisoni*, with a maximum SVL exceeding 90 mm and a body mass frequently exceeding 10 g (Schoener, 1988; T. M. Rodríguez-Cabrera, unpublished data).

Acknowledgements

We thank Yosvani Vicet for field assistance and Luis F. de Armas for the critical peer-review of an early draft of the manuscript.

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