

Inverting the Food Web: The Predation of an Adult Colubrid Snake, *Sibynophis triangularis*, by the Scorpion *Heterometrus laoticus* in the Sakaerat Biosphere Reserve

Jack Christie¹, Everett Madsen¹, Surachit Waengsothorn¹, Max Dolton Jones^{1, 2,*}

¹Sakaerat Environmental Research Station, Nakhon Ratchasima, Thailand.

²Suranree University of Technology, Nakhon Ratchasima, Thailand.

*Corresponding author, e-mail: maxdoltonjones@gmail.com

Abstract:

The predation of vertebrates by large tropical invertebrates is a rare phenomenon in nature, though not unprecedented. Scorpions in particular are evolutionarily equipped to take on such a task. Despite the hunting strategy and primarily insectivorous diet of scorpions, they are known to opportunistically prey upon small vertebrate prey such as lizards, frogs and birds. Herein, we describe the observation of an adult Asian forest scorpion (*Heterometrus laoticus*; Scorpiones; Scorpionidae) predating upon an adult triangle many-toothed snake (*Sibynophis triangularis*; Squamata: Colubridae). Although the opportunistic predation on snakes by scorpions has been documented, we believe this to be the first record of the genus *Heterometrus* predating on a snake. Furthermore, we also believe this to be the largest documented prey snake in terms of total length for any scorpion species. This observation may have implications on subsequent studies looking at predator-prey interactions within habitats suitable for both small colubrid snakes and large invertebrate species.

Keywords: Scorpionidae, Colubridae, Thailand, prey, trophic cascade

Introduction:

The interactions between vertebrates and invertebrates, particularly within the trophic

system they occupy, is a well-researched and understood topic (Belovsky & Slade 1993; Murkin & Batt 1987; Nordberg *et al.* 2018). This particularly pertains to the predation of invertebrates by larger vertebrate predators. However, there are far fewer instances of invertebrates consuming vertebrate prey items within the available literature. Scorpions are primarily fossorial ambush predators, emerging from their burrows and lying in wait at the entrance for unsuspecting prey to wander too close (Williams 1987). Scorpions typically exhibit an insectivorous diet, with the exception of a few species (Williams 1987), and have been known to prey on frogs, birds, lizards and even snakes (McCormick & Polis, 1982). The genus *Heterometrus* is made up of large-bodied scorpions that phenotypically exhibit large powerful chelae, giving them the evolutionary tools to subdue vertebrate prey (Durale & Vyas 1968). We encountered the following observation of an Asian forest scorpion, *Heterometrus laoticus* (Scorpiones: Scorpionidae), during such an attempt.

Observation:

At 10:04am on the 26 September 2018, we came across the active predation attempt of a triangle many-toothed snake (*Sibynophis triangularis*; Squamata: Colubridae) by a large Asian forest scorpion (*Heterometrus laoticus*). The observation took place within the Sakaerat Biosphere Reserve (SBR) in northeast Thailand at 14.4589°N, 101.8867°E. The snake was



Figure 1, *Heterometrus laoticus* capturing *Sibynophis triangularis* in the Sakaerat Biosphere Reserve, Thailand (Photo: Everett Madsen).

observed first and only after a few moments did we see the scorpion which had a secure grip on the snake (Figure 1). We estimate the scorpion to be approximately 110 – 130mm in total length (TL) and the snake to be between 550-650mm TL.

The scorpion was gripping the snake with both chelae at the midbody, periodically adjusting its grip one chela at a time, while pulling small pieces of flesh off the dorsolateral region of the snake with its chelicerae (Figure 2). The snake was alive and alert but was unable to resist the predation; there was also blood visible where the scorpion had gripped the snake. We departed the area at 10:21am. At 11:41am, we returned to find the scorpion and snake in the same location and the scorpion still had the snake secured at the midbody with its chelae. At 11:50am the scorpion began dragging the snake into a nearby burrow likely due to the

disturbance of the observers. The scorpion entered the burrow and subsequently pulled the snake into the retreat site until only a small portion of the snake could be seen. We then departed a second and final time at 11:52am.

Discussion:

Identification of the species involved was done following the observation using photo and video documentation made at the site. Among the three species of the snake genus *Sibynophis* that occur in Thailand (Cox *et al.* 2012), we concluded the prey item to be *S. triangularis* due to the black triangular nuchal spot bordered laterally by a cream stripe extending to the labials, a vertebral row of small black spots anteriorly becoming white more caudally, and its whitish ventral surface with small black spots on the edges of the ventrals and subcaudals (Cox *et al.* 2012; Chan-Ard *et al.*

2015, Chiaccio *et al.* 2017). Amongst the four species of *Heterometrus* scorpions found in Thailand, we determined ours to be *H. laoticus* based off its smooth carapace without granules, and its smooth manus of the pedipalp with apparent punctae (Kovařík 2004).

We have described the active predation attempt and part of the subsequent consumption of a large vertebrate prey item by *H. laoticus* in northeast Thailand. While known to occasionally prey on vertebrates, they are generally small and rarely consist of snakes; with no documented vertebrate prey greater than 200 mm in total length (McCormick & Polis, 1982). This snake, at an estimated 550-650 mm TL, is larger than any other documented vertebrate prey of scorpions. Morphologically, *H. laoticus* is highly adapted to such an occurrence exhibiting large, powerful chelae enabling it to take advantage of small snake species as prey (Gwee 1996). The long, slender bodies of even moderately sized colubrid snakes are likely easily grasped and held in place by *H. laoticus* individuals



Figure 2, *Heterometrus laoticus* actively predating on *Sibynophis triangularis* (Photo: Everett Madsen).

(Lilywhite 2014). Additionally, species of the genus *Sibynophis* may be particularly vulnerable as their thin, comb-like teeth are likely ineffective against the scorpions thick chitinous exoskeleton (Zaher *et al.* 2012).

A poorly documented species, only a few specimens of *S. triangularis* have been discovered within the SBR, however this is the second documented instance of this species falling prey to a large invertebrate predator. Chiaccio *et al.* (2017), discovered an individual being preyed upon by a centipede from the genus *Scolopendra*. These observations were opportunistic and further research, using *S. triangularis* as a focal species, is needed to gauge the prevalence of such events.

Sibynophis triangularis is thought to consume primarily skinks and other insectivorous squamates (geckos, blind snakes, etc.) (Mohapatra 2010). *Heterometrus* predation upon snakes such as *S. triangularis*, if frequent, could be removing an important pressure from those insectivore populations. The unprecedented size of the prey snake in this observation indicates that invertebrate predation on vertebrates may be more common than previously thought; with vertebrates at substantial sizes remaining susceptible to predation by large invertebrate predators such as *H. laoticus*. Interestingly, by predating on *S. triangularis*, the scorpion may be reducing the pressure on other insectivorous taxa in the area. A high density of other insectivores may reduce prey density through trophic cascading and result in an increase in direct competition between *H. laoticus* and the insectivores *S. triangularis* typically preys upon (Sih *et al.* 1998). However, as Finke (2005) showed, complex trophic interactions with multiple intraguild predators do not always yield predictable results. Intraguild predation between *H. laoticus*, *S. triangularis* and other species may add complexity to the food web, stabilizing and dampening the effects of any single predator on the ecosystem due to the antagonistic effects of different predator prey

interactions (Finke 2004). Further studies aimed at understanding this and similar interactions could attempt to quantify and better understand these effects.

Acknowledgements:

We would like to thank the staff and director of the Sakaerat Environmental Research Station whom have allowed us to base our field work out of. Furthermore, we would like to thank the Wildlife Reserve Singapore group for sponsoring the work conducted in the biosphere reserve allowing us to continuously provide internship opportunities to national and international individuals.

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