SHORT COMMUNICATION

Inverted roles: Spider predation upon Neotropical velvet worms (*Epiperipatus* spp.; Onychophora: Peripatidae)

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ABSTRACT: Velvet worms are ancient predators with Cambrian origins that occasionally prey on Ctenid spiders. Here we report the opposite case: wolf spiders (*Ctenus* spp.) feeding on *Epiperipatus* spp. in Colombia and Costa Rica. Apparently the worms could not expel their defensive adhesive, and the efficacy of the spider venom suggests that onychophoran nerves and muscles are biochemically equivalent to those of insects.

Key words: Predatory behavior, Neotropical invertebrates, spider venom and onychophorans.

RESUMEN: Papeles invertidos: arañas depredadoras de gusanos de terciopelo neotropicales (*Epiperipatus* spp.; Onychophora: Peripatidae). Los gusanos de terciopelo (Onychophora) son antiguos depredadores de origen cámbrico que ocasionalmente consumen arañas cténidas. Aquí informamos el caso contrario: arañas (*Ctenus* spp.) alimentándose de gusanos onicóforos (*Epiperipatus* spp.) en Colombia y Costa Rica. Aparentemente las presas no lograron expulsar su red defensiva y la eficacia del veneno de araña sugiere que los nervios y músculos de los onicóforos son bioquímicamente equivalentes a los de los insectos.

Palabras clave: Comportamiento depredador, invertebrados neotropicales, veneno de araña y onicóforos.

Velvet worms are ancient predators with a fossil record that extends 515 million years to the Cambrian (Monge Nájera & Ho, 1999; 2000). It is unknown how –and if– they hunted under water in tidal mudflats, but the adhesive net they currently use for defense and to hunt does not function in seawater (Monge-Nájera, Barrientos & Aguilar, 1993; Concha et al., 2015). They are eaten by birds and snakes and even fish during Amazon floods (Monge-Nájera, Barrientos & Aguilar, 1993), and in turn they prey on spiders (Read & Hughes, 1987; Dias & Lo-Man-Hung, 2009). Here we report two cases of the opposite interaction: Ctenid spiders feeding on onychophorans in Colombia and Costa Rica.

The observations were done in two reserves, Tamá and La Selva. Parque Nacional Natural Tamá, Colombia (7° 02' - 7° 27' N, 72° 02' - 72° 28'W) has an unknown biodiversity of onychophorans and is covered by tropical cloud forest, Andean forest and paramo (MAVDT, 2008). La Selva Biological Station, Costa Rica (10°25'19"N, 84°00'54" W) has onychophorans of the genus *Epiperipatus* and includes primary and secondary lowland rainforest (McGlynn & Kelley, 1999).

At 19:00 hours, January 27, 2011, the first author photographed a female wolf spider (*Ctenus* sp.) eating an immobilized velvet worm, *Epiperipatus* sp. (Peripatidae, Figure 1).

The spider held the worm against a leaf and was eating the rear end. The skin of that part had already been digested and a dark band, possibly the intestine, was partly visible. The worm's body was twisted, so the rear end's ventral side was upwards. In the front part there were some markings (perhaps wounds), a drop of urine in the fourth right leg and no signs of defensive glue expelling. The antennae were bent downwards, suggesting that the animal was dead (Figure 1).

The other case was observed by Joseph Warfel in La Selva, near May 2003 or 2004. The spider (*Ctenus* sp.) was feeding on a dead *Epiperipatus* sp., about 1.5 m above ground (Figure 2). Some external digestion is seen in the middle of the body.

Fig. 1. Female wolf spider (*Ctenus* sp.) externally digesting an *Epiperipatus* sp. in Colombia. Photograph by R. Franco.

Fig. 2. Ctenid spider feeding on an *Epiperipatus* sp. in Costa Rica. Photograph by J. Warfel.

Like spiders, velvet worms have external digestion, which has the evolutionary value of reducing body weight and functioning under water (Hernández-García, Martín & Castro, 2000). We do not know why the spiders started digestion of these prey in the middle of the body instead of the rear or head.

Why do onychophorans hunt dangerous predators such as Theraphosid and Ctenid spiders (Read & Hughes, 1987; Dias & Lo-Man-Hung, 2009) and are feared by Opiliones (Cook, Smith, Proud, Víquez, & Townsend, 2013)? Perhaps the amount of nutrition justifies the risk and these particular onychophorans, which hunt at night guided by olfaction and touch, were unlucky and attacked too large prey (see an informal report by Read, 1985). But the absence of expelled defensive adhesive in both cases suggests that the worms were attacked by surprise.

The chemical composition and action of *Ctenus* venoms are poorly known (Okamoto et al., 2009) but the efficacy of the spider's venom suggests that the worm's nerves and muscles are biochemically equivalent to those of insects, which are only distantly related to velvet worms.

Curiously, velvet worms have inspired an unexpected number of cartoons (Monge-Nájera, & Morera-Brenes, 2015) and there is one imagining a different outcome of a worm/spider encounter (http://goo.gl/gXTsw8). We hope this note inspires others to record any cases of predation related to these poorly known worms.

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