Interactions between prey and predator are key elements of a species natural history, and this knowledge contributes to the development of evolutionary biology and ecological studies. Therefore, antipredator behaviours are important factors in the evolutionary processes of many animals, and they are intrinsically associated with survivorship, increasing capacity to obtain resources, and exploitation of the environment (Lima and Dill, 1990; Downes, 2001; Tozetti et al., 2009). Given their unique tail morphology and that they are venomous, rattlesnakes have attracted considerable attention regarding defence mechanisms in snakes. Besides the rattle, several additional defensive mechanisms are displayed by rattlesnakes, such as hissing, body posture, scent glands, and extended protraction of the tongue as a warning signal (Campbell and Lamar, 2004). A few species (e.g., *Crotalus molossus* and *C. polystictus*) also use an open-mouth threat or move the head in a provocative way (Armstrong and Murphy, 1979; Campbell and Lamar, 2004).

One additional defensive behaviour is head concealment, which also occurs in a number of unrelated non-venomous and venomous snakes (Bustard, 1969; Greene, 1973), and has been documented in several instances as a result of human or predator interactions with rattlesnakes: *C. atrox* (Cowles, 1977; Meinzer, 1993; Cornett, 2001; Sherbrooke and Westphal, 2006), *C. viridis* (Duvall et al., 1985; Alcock, 1998), and *C. ruber* (Rubio, 1998). Medica (2009) recorded head-hiding and saltation as defensive behaviours of a male *C. scutulatus scutulatus* from California and head-hiding of a female specimen from Nevada. This type of saltation behaviour was also documented for *C. s. scutulatus* from Arizona, and *C. s. salvini* from Puebla and Veracruz (Armstrong and Murphy, 1979; Bartholomew and Nohavec, 1995).

Neck flattening is another type of defensive behaviour that has been reported for both sexes of *C. scutulatus salvini* and a male of *C. s. scutulatus*, where the neck (immediately posterior to the head) spreads laterally and the cervical spine is straight and aligned with the head (Glenn and Lawler, 1987; Brown et al., 2000). Neck flattening is different from the body flattening observed in *C. s. scutulatus* in which an adult flattens its head and trunk against the substrate and elevates its tail without rattling, and also differs from the bloating of the neck or body regions recognized as stereotyped behaviour in several rattlesnakes including *C. scutulatus* (Armstrong and Murphy, 1979; Glenn and Lawler, 1987). Whereas, in *C. durissus* a dorso-ventral flattening has been documented (Benicio and Martins, 2018).

The Tzabcan rattlesnake, *Crotalus tzabcan*, is a large snake (up to 1600 mm), endemic to the Yucatán Peninsula (Lee, 1996). Despite the relatively wide distribution of *C. tzabcan*, little is known about its Natural History and behaviour. Campbell (1998) described the defensive posture in specimens from Belize and El Petén (Guatemala) as dramatic, with almost half of the anterior body raised off the ground and held vertically with the neck curved into a sharp crook with the head facing the adversary. While the posterior part of the body is in a large, open coil, except for the tail and rattle, which are raised vertically, in about the centre of the coil.
While conducting a study on *C. tzabcan* autecology, we found a juvenile male (snout–vent length 680 mm, tail length 55 mm) moving in leaf litter of dry forest near Chichén-Itzá, Yucatán, Mexico (20.678925° N, -88.567719° W, WGS84, 35 m a.s.l.) on 15 July 2015. When we approached to take pictures, the snake coiled, flattened its body and hid its head in the centre of its coil, but without rattling, and remained in this position approximately three minutes before beginning to move again (Fig. 1A). When we relocated the snake and positioned it to take additional photos, it spread the neck immediately posterior to the head several times (Fig. 1B) and then flattened the rest of its body against the substrate while backing up without rattling, or without elevated the body or attempted to bite, and always facing directly toward us. Two additional juveniles from the vicinity of Chetumal, Quintana Roo, Mexico, were observed performing the same neck flattened behaviour.

When threatened, rattlesnakes typically rely on crypsis before mounting behavioural defences (Putman and Clark, 2015). To humans, crypsis in rattlesnakes (e.g., *Sistrurus miliarius*) is less effective when the snake is stretched out and moving, and the rattlesnake is more likely to respond defensively when is encountered stretched out on open trail than when coiled. However, it must also be taken into account that intrinsic factors

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**Figure 1.** Defensive behaviour of a juvenile *Crotalus tzabcan* at Chichén-Itzá, Yucatán, México: A) displaying a complete head hiding, body flattening, and coiling behaviour; B) displaying a neck flattening behaviour. Photos by Rubén A. Carbajal-Márquez.
(e.g., body temperature, size, experience) affect the defensive response (Glaudas, 2004; Glaudas et al., 2005). When finding the juvenile *C. tzabcan* moving in the leaf litter in a stretched out position, it seems that it influenced to display non-aggressive defensive behaviour, being less perceptible by not rattling; or it could have been influenced by previous experiences with humans since Chichén-Itzá is a tourist site. It has been documented in other pitvipers like *Agkistrodon piscivorus*, that they habituate to handling by humans and their behavioural responses become increasingly passive (Glaudas, 2004).

Head concealing behaviour and remaining in this position for a prolonged period of time may be a mechanism to avoid direct head injuries by predators. Head flattening followed by body flattening, is not unique to rattlesnakes, and may function to create the illusion that a snake is larger than it actually is, causing a predator to misjudge its ability to subdue its prey (Tozetti et al., 2009). This neck and body flattening display, along with head hiding described above for *C. tzabcan*, appear to be defensive behaviours and probably have important survival value, particularly in juvenile specimens, since many predators direct their attack specifically at the heads of snakes (Bustard, 1969; Greene, 1973). The knowledge of venomous snake defensive behaviour is limited, with the majority of these behaviours only described as anecdotes (Glaudas, 2004). Further research is necessary to understand how pitvipers react to predators, including human confrontations. Since field experiments are commonly logistically difficult, greater understanding maybe can be achieved by future research in field with species with large populations and in laboratory in the case of rare species.

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