

Egg attendance behaviour of an Amazonian poison frog *Ameerega hahneli* (Anura: Dendrobatidae)

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The neotropical family Dendrobatidae includes nearly 200 species known as ‘poison frogs’ (Frost, 2020). Poison frogs lay their eggs in arboreal nests, e.g. leaves on bushes, leaf litter and phytotelmata (Grant et al., 2006; Lötters et al., 2007; Stynoski et al., 2015). After oviposition, the parents attend and take care of the eggs during development until the tadpoles hatch (Weygoldt, 1987; Grant et al., 2006). Once they hatch, the adult male or female will typically transport the tadpoles on their backs to a location where each tadpole will complete metamorphosis (Grant et al., 2006; Pyron & Wiens, 2011; Hime et al., 2020). For several dendrobatid species, information on phylogenetic relationships (e.g. Pyron & Wiens, 2011; Grant et al., 2017), ecology (Toft, 1995), natural history (Haddad & Martins, 1994), and behaviour (Hödl et al., 2004; Pašukonis et al., 2014) has been

well-documented. However, detailed information on egg attendance and parental care is still scarce for most species. Here we describe our observations on egg attendance of an Amazonian species of poison frog, *Ameerega hahneli* (Boulenger, 1884).

Between 14 and 19 May 2020, we monitored the egg attendance behaviour of a single male *A. hahneli* in a relictual forest in the municipality San José del Fragua, Caquetá, Colombia (1.352876, -75.971376, WGS84; 466 m a.s.l.; Fig.1). We observed clutch attendance during the night using red light to reduce disturbance. On 14 May 2020 at 19:17 h, we observed a male of *A. hahneli* attending an egg mass, which was composed of 22 eggs containing tadpoles (Fig. 2A), deposited on the surface of a leaf at 50 cm above the ground. We captured the male to measure its body length

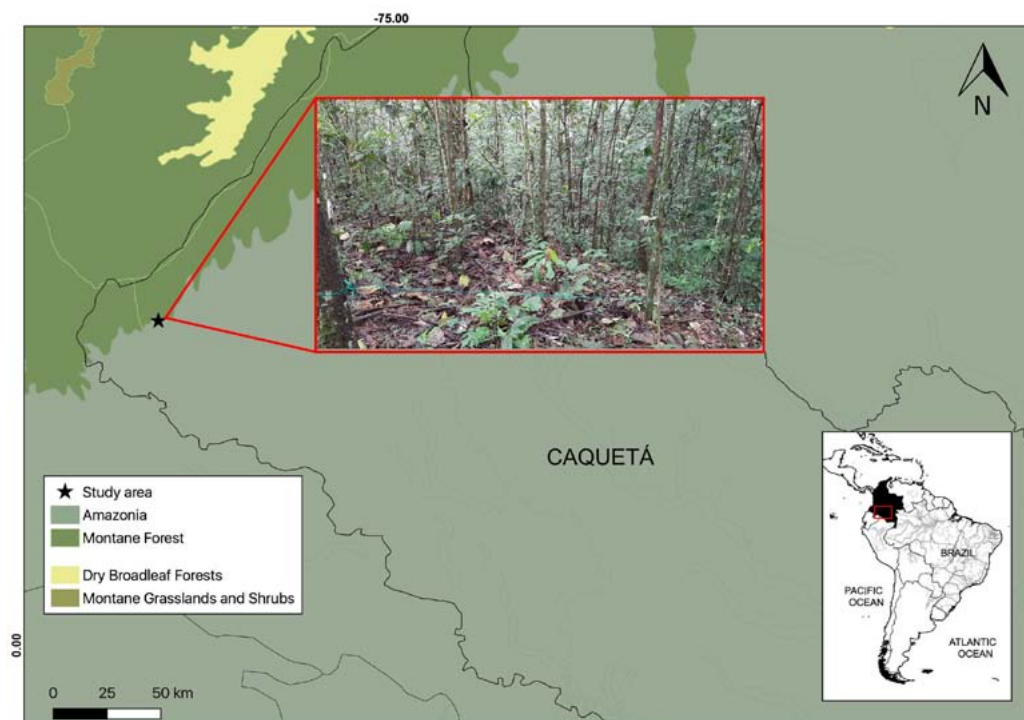


Figure 1. Ecoregions of Colombia, adapted from Dinerstein et al. (2017), showing the location of the study area (black star)

Table 1. A detailed description of egg attendance behaviour of a male of *A. hahneli* over a five-day period

Date	Behaviour	Time	Figure	Observation
15 May	The male was attending the clutch.	07:00 h	2A	-
	The male left the clutch and withdrew from the site.	10:47 h		-
	The male returned to the base of the plant where the clutch was located and remained for 41 minutes.	13:14 h	2B	-
	The male left the clutch again and returned at 14:15 – 16:56 h, perching on a leaf one meter away from the clutch.	14:15 – 16:56 h		During that time, it emitted a territorial call composed of five notes (see Rodríguez & Duellman, 1994). Other individuals of <i>A. hahneli</i> also began to vocalise. Afterwards, the male jumped three times and stopped calling.
	The male positioned itself at the base of the plant where the clutch was located and stopped calling.	17:52 h		-
	The male was quiet for five minutes on another leaf near the clutch and called back for four minutes.	18:12 h		The male began to climb the plant (see video, YouTube , 2020).
	The male moved several times, touched the clutch, and the tadpoles began to move quickly for approximately one minute and male turned again.	18:22 h		We continued monitoring until 22:00 h.
16 May	The male was not attending the clutch.	09:00 h	-	We also did not see the male or other individuals of this species around the study site.
	The same individual of <i>A. hahneli</i> approached the base of the plant where the clutch was located.	14:45 – 15:46 h	-	-
	The male started to climb another branch and made several movements as it climbed.	15:48 h	-	-
	It started to rain and the male took refuge at the base of a leaf.	16:02 – 16:40 h	-	-
	The male started calling.	16:41 h	-	-
	The male emitted a courtship call composed of three notes (see Rodríguez & Duellman, 1994).	16:49 h	-	-
	The male started calling again at intervals.	16:59 – 18:05 h	-	-
	The male continued climbing towards the clutch.	18:07 h	-	-
	The male jumped to the leaf where the clutch was located.	18:10 h	-	The male turned its body in several directions but always stayed next to the clutch.
The male placed its belly on the clutch and the tadpoles began to move quickly.	18:25 h	-	Three minutes later, we captured the male and corroborated with the photo marking that it was the same individual that was attending the clutch the previous day.	
The male continued attending the eggs.	22:00 h	-	We continued monitoring.	
17-19 May	The egg attendance behaviour was repetitive for three more days until the tadpoles hatched.		2C	Only on 17 May did the male not attend the clutch site.

with a digital caliper (SVL = 24 mm). Also, we took ventral and dorsolateral photographs as a non-invasive method for individual identification (Díaz-Ricaurte et al., 2019). After measurement, the male was released next to the clutch where he remained and we monitored egg attendance behaviour for five days until tadpoles hatched from the eggs (Table 1). Our observations suggest that the male left the clutch at dawn to forage during the day and returned to attend the eggs in the afternoon and during the night. When the male returned to attend the eggs, it emitted territorial and courtship calls composed of five and three notes, respectively (see Rodríguez & Duellman, 1994; Twomey & Brown, 2008); and most calls were emitted at sunset.

Egg attendance is one of the modes of amphibian parental care that enhances the chances of survival (Trivers, 1972). This behaviour benefits offspring by protecting them from predation and dehydration (Weygoldt, 1987), and has been documented in other lineages (e.g. Kluge, 1981; Juncá, 1996; Bickford, 2004; Delia et al., 2013 & 2020). For poison frogs who attend their eggs during development, the final step is the transportation of tadpoles to water shortly after hatching (Weygoldt, 1987). Unfortunately, we did not observe the moment of hatching nor the male taking the tadpoles to water. We think that the male transported them on his back as previously observed in other individuals of the same species (Fouquet, 2003; Lötters et al., 2007).

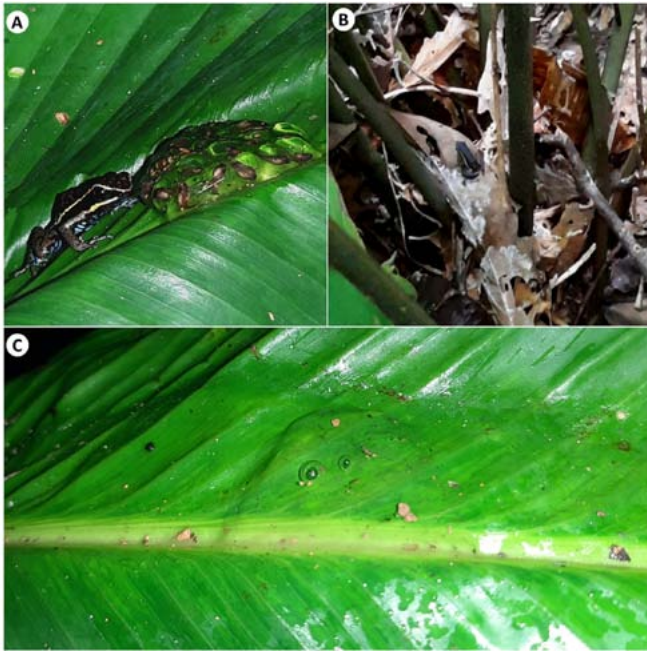


Figure 2. Egg attendance behaviour by a male of *A. hahneli* - **A.** Male in attendance of the egg mass, **B.** Male returning to the plant where the clutch was located; **C.** Remains of the egg mass, tadpoles hatched and male departed

We offer a description of a detailed observation of egg attendance in *A. hahneli* showing that males of this species offer partial egg attendance until hatching, corroborating previous findings of Fouquet (2003) and Lötters et al., (2007). An experimental evaluation of the survival of embryos during development with or without parental attendance would be of interest in determining the value of this behaviour.

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