

Mouth-gaping Behavior in the Bell Glass Frog, *Cochranella nola* (Anura: Centrolenidae) in Southeastern Peru

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The Bell Glass Frog (*Cochranella nola*), like other species in the family Centrolenidae, is arboreal and occurs almost exclusively in riparian vegetation at high elevations (Villacampa et al. 2017). This species was thought to be endemic to Bolivia until 2013 when it was found in the Amazonian foothills of the Puno Region in southeastern Peru (Lujan et al. 2014) and later reported in the Manu Biosphere Reserve by Villacampa et al. (2017). The Bell Glass Frog is classified as Near Threatened on the IUCN Red List (Cortéz et al. 2004) due to its habitat seemingly declining in both quantity and quality (Lujan et al. 2014). Herein we report the first observation of *Cochranella nola* displaying mouth-gaping behavior.

At 2237 h on 11 April 2019, an adult was found on a leaf 70 cm above the ground in secondary forest (-12.802573°S, -71.403664°W; WGS 84; elev. 525 m asl) at the Manu Learning Center Reserve (MLC) and taken to the MLC facilities. The MLC is a research station owned and operated by the Crees Foundation and located within 643 ha of secondary lowland tropical forest in the cultural zone of the Manu Biosphere Reserve in southeastern Peru. The next morning the frog was placed in a glass terrarium, where later that day, at approximately 1650 h, I confirmed its identity. Roughly 10 min after the examination, at 1703 h, the frog began exhibiting mouth-gaping behavior. The entire display lasted about 2 min after it was first noticed.

As described by Folly et al. (2019), each mouth-gaping event (duration 1–13 sec) consisted of three phases: mouth closed, mouth completely open, and mouth partially open (Fig. 1). The individual remained in place and in the same position and engaged in no additional behaviors. Because this behavior is known to be utilized as a defensive strategy (Toledo et al. 2011), the display was likely induced by my handling of the individual, causing it to behave as if it were being attacked.

Previously reported glass-frog defenses include cloacal discharge of odoriferous secretions, crouching down, and elevation of and puffing up the body (Escobar-Llaso and Rojas-Morales 2012); noxious secretions (Rueda-Almonacid 1994); biting during parental care (Drake and Ranvestel 2005); and death feigning (Toledo et al. 2010). Mouth-gaping in centrolenids has been reported only once by Barbosa (2015), yet it has been widely documented in several species of anurans (Toledo et al. 2011). This visual display attracts a predator's attention, intimidates it, and hinders the sequence of attack, therefore aiding the frog to avoid subjugation (Toledo et al. 2011).

Aside from a few cases, Toledo et al. (2011) state that mouth gaping usually is accompanied by defensive vocalizations. However, the individual in this observation did not emit any sounds during the opening and closing of its mouth. Toledo and Haddad (2009) provided a possible explanation

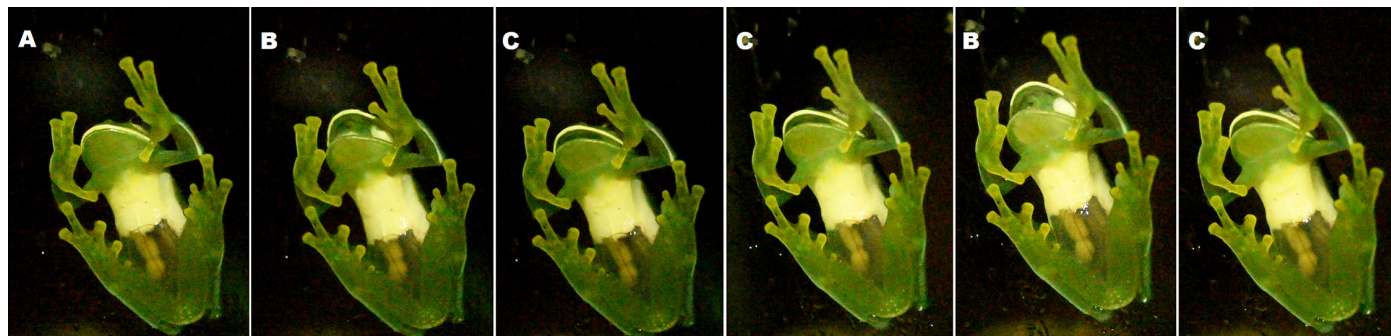


Fig. 1. Stop-motion images taken from a 0.6-sec video showing an adult Bell Glass Frog (*Cochranella nola*) displaying mouth-gaping behavior: (A) Mouth closed, (B) mouth fully open, and (C) mouth partially open. Video by Cristina Arrivillaga.

when they found a positive relationship between the duration of anuran distress calls and snout-to-vent length, indicating that only larger frogs produce defensive vocalizations that are long and loud enough to be successful against predators. Consequently, *C. nola* might have to rely on defensive strategies other than agonistic calls due to its small size (SVL 22.1–30.1 mm; Villacampa et al. 2017) resulting in ineffectual calls insufficient for deterring a predator (Folly et al. 2019). Toledo et al. (2011) also suggested that this behavior originated in species that shrieked defensively, with smaller descendants losing that ability while retaining the mouth-opening behavior.

Because mouth-gaping has only been reported once previously in glass frogs (Barbosa 2015), I suggest that this behavior is probably unusual and therefore rarely documented in centrolenids.

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