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Short Communication

Observations on parental care in the glass frog *Hyalinobatrachium orientale* (Anura: Centrolenidae) from Tobago, with comments on its natural history

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While relatively few anurans are known to have parental care, the behavioral diversity involved is impressive (reviewed in McDiarmid 1978, Crump 1995, 1996, Lehtinen and Nussbaum 2003). The most common form of anuran parental care is egg attendance (Lehtinen and Nussbaum 2003), in which a parent remains with an egg mass at a fixed location (Crump 1995). Several species of glass frogs (Centrolenidae) attend their eggs. For example, Jacobson (1985) found male *Hyalinobatrachium* (= *Centrolenella*) *fleischmanni* attending egg masses in Costa Rica; this behavior also is known in *H. valerioi* and *H. colymbiphyllum* (McDiarmid 1978, but see Greer and Wells 1980). Cisneros-Heredia and McDiarmid (2007) claimed that most *Hyalinobatrachium* exhibit parental care and this behavioral feature also was used as a putative synapomorphy for the subfamily Hyalinobatrachinae (Guayasamin *et al.* 2009). However, other species of glass frogs seem to lack these behaviors (e.g., *Espadarana* [= *Centrolenella*] *prosoblepon;* Jacobson 1985). It is unclear how common egg attendance is among the 146 described species of glass frogs (Frost 2011), because relatively few studies have attempted to document this behavior. To provide more data on this issue, we describe egg-attendance behavior in a glass frog (*Hyalinobatrachium orientale* Rivero 1968, see also Murphy *et al.* 2012) from the island of Tobago, West Indies. Because few data are available on the natural history of this species, we also report on clutch characteristics and tadpole behavior.

On 25 July 2010 at 19:00 h we observed three different males calling from leaves above an unnamed stream in the Tobago Forest Reserve

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(11°17'14" N, 60°35'39" W; near milepost 6.5 Km on the Roxborough-Parlatuvier road). The males were found adjacent to egg masses (Figure 1). In one case, a male was attending six different egg masses simultaneously. Because the developmental stages of the eggs differed (ranging from Gosner Stages ~14–22, Gosner 1960), it is likely that these clutches were from different females. A seventh egg mass already had fully hatched (Figure 1A). Each of two other males were attending a single egg mass. These males were commonly seen on top of, or otherwise in direct contact with, the egg masses. This observation suggests that the males actually were attending the eggs and were not coincidentally found in their proximity. However, removal experiments would be necessary to ascertain the functional significance of these behaviors. In all cases, the males continued to call as they attended the eggs. The height above the stream at the oviposition site varied from approximately 1–3 m. We returned to the site during the following day and did not find males associated with these egg masses; thus, egg attendance may be primarily nocturnal. Specimens collected are deposited in the Zoology collection at the University of the West Indies, St. Augustine, Trinidad.

In total, we found 12 egg masses. The average clutch size was 28.3 ± 4.2 SD (range: 21–36). Eleven of these egg masses were found on *Heliconia* leaves over-hanging small streams in primary or secondary forest. One egg mass was found inside a curled up unidentified tree leaf (Figure 1).

In 2011, along a branch of the King's Bay River (west of Speyside; 11°17'08" N, 60°32'35" W), glass frog eggs, embryos and tadpoles were found on a fallen *Heliconia* leaf near the streamside. Prodding the developing tadpoles with forceps resulted in the explosive hatching of the tadpoles from the egg capsules. When explosively hatching, these tadpoles (Stage 25, total length approximately 11.0 mm) could propel themselves up to distances of 40 cm (about 36 times their own body length). These tadpoles, which have not been fully described, were bright green in color and transparent; yolk was still present in the gut.

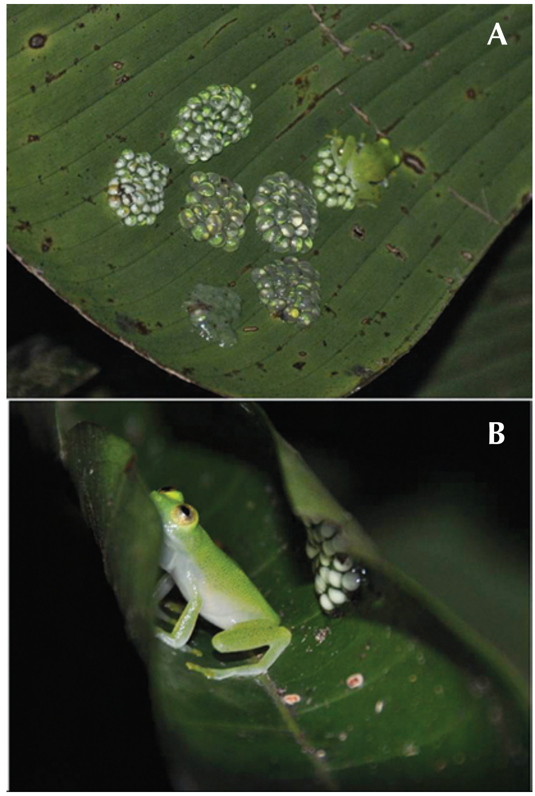

Figure 1. Male *Hyalinobatrachium orientale* (UWITT. 2010.24.1.2) attending seven egg masses on a *Heliconia* leaf (**A**) and a single egg mass (UWITT.2010.24.1.4) in a curled up leaf (**B**). Oviposition sites were above a small stream in the Tobago Forest Reserve. Photos by RML.

Current taxonomy suggests this species is found in four disjunct populations (three in Venezuela and one in Tobago; AmphibiaWeb 2011). To our knowledge, no data are available on the occurrence of parental care in the Venezuelan populations, but if these really are the same species as those occurring on Tobago, they might be expected to exhibit this behavior. Future observations on the duration and frequency of parental care, as well as its influence on hatching success would be useful.

Other examples of tadpoles or embryos that can hatch rapidly typically do so in response to threats from predators or pathogens (*Agalychnis callidryas,* Warkentin 1995, 2000, 2001; *Hyperolius spinigularis,* Vonesh 2005). Hawley (2007) also presented egg-hatching data for *Teratohyla pulverata* that suggested some degree of hatching time plasticity in response to threats. Our observations on explosive hatching in tadpoles of *Hyalinobatrachium orientale* also suggest this possibility. We recommend that future work should attempt to test these observations experimentally.

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