



WATER-BUG (*Abedus* SP.; BELOSTOMATIDAE) PREDATION ON THE CRITICALLY ENDANGERED *Atelopus varius* (BUFONIDAE) AT LAS TABLAS PROTECTED ZONE, COSTA RICA

Depredación por el Chinche de Agua (*Abedus* sp.; Belostomatidae) sobre el Críticamente Amenazado *Atelopus varius* (Bufonidae) en la Zona Protectora Las Tablas, Costa Rica

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ABSTRACT

Atelopus varius was believed to be extinct in Costa Rica until the rediscovery of a population within the Las Tablas Protected Zone (LTPZ) in 2008. This rediscovery represented a research and conservation opportunity, including contributing new information about the species' natural history. There are few reported species that prey on *A. varius*. This report presents a new predation record by a species of water bug (*Abedus* spp.) on an adult harlequin frog (*A. varius*). This is only the second confirmed predator for the species. These water bugs have been reported to prey on anurans during reproductive seasons, but in this case, the event occurred on *A. varius* out of their reproductive season. The effects of water bug predation on the only known reproductive population of this Critically Endangered species needs to be assessed to consider appropriate conservation measures to prevent further decline of the species.

Keywords: Extinction, harlequin frog, trophic ecology.

RESUMEN

Atelopus varius se consideró extinto en Costa Rica, hasta el redescubrimiento de una población en la Zona Protectora Las Tablas (ZPLT). Este hallazgo representa una oportunidad de investigación y conservación, incluyendo contribuir nueva información acerca de la historia natural de la especie. Hay pocas especies reportadas que depredan *A. varius*. Este reporte presenta un registro de depredación del chinche de agua (*Abedus* spp.), sobre un adulto de Sapo Arlequín (*A. varius*), como el segundo depredador confirmado de la especie. Usualmente, los chinches de agua depredan anuros durante su época reproductiva, pero este evento ocurrió fuera de la época reproductiva de *A. varius*. Los efectos de la depredación de chinches acuáticos sobre la única población reproductiva conocida de esta especie Críticamente Amenazada necesitan ser evaluados para considerar acciones de conservación.

Palabras clave: Ecología trófica, extinción, rana arlequín.

The variable harlequin frog, *Atelopus varius* (Lichtenstein and Martens, 1856), was considered extinct in Costa Rica after severe population declines during the 1980s and 1990s (Lips, 1999; Pounds *et al.*, 2010). By coincidence, a reproductive population of the species was rediscovered in 2008 in the Las Tablas Protected Zone (González-Maya *et al.*, 2013). This small surviving population represents a unique opportunity not only for management and conservation efforts of the species but also a second chance to expand our understanding and knowledge of a species that was thought to be extinct. Although the harlequin frog is one of the most well-known species of the *Atelopus* genus (Löters, 1996; La Marca *et al.*, 2005), there are still many aspects of their biology, ecology, and natural history for which we know nothing.

Predators upon *Atelopus* species are poorly known, and it is expected that these toads are not frequently preyed upon given their aposematism and presence of neurotoxins (Pounds and Crump, 1987; Löters, 1996). The only confirmed predation event previously known on *Atelopus varius* was by the Fire-bellied snake, *Erythrolamprus epinephelus* (Cope, 1862). The event was photographed by Michael

and Patricia Fogden (Minden Pictures, 2015). Herein, we report an additional observation of confirmed predation on the Critically Endangered *Atelopus varius* by a water bug of the genus *Abedus* (species unknown), in the Las Tablas Protected Zone, Costa Rica.

Monthly surveys of the variable harlequin frog population were conducted at Las Tablas Protected Zone during a sixteen-month period, (from September 2011 to February 2013) along a 2 km section of the Cotón river. On July 11, 2012 (08° 56' N, y 82° 49' W, 1337 m.a.s.l.), a predation event was observed during a population ecology survey. The water bug was captured and identified using a taxonomic key for the Nepoidea superfamily (Romero and Ari, 2013). The harlequin frog was easily identified by its morphology and color pattern (Savage, 2002), however as little is known of this genus of water bug in the region there is uncertainty about which species of *Abedus* was observed.

The water bug, *Abedus* genus (25.9 mm body length; Fig.1), was observed preying on an individual of *Atelopus varius* (SVL = 30 mm; Fig. 2a) near the shoreline of the river. The Harlequin Frog was seen at 11:55 h, in a small pool on the edge of the Cotón River, seized by a water bug

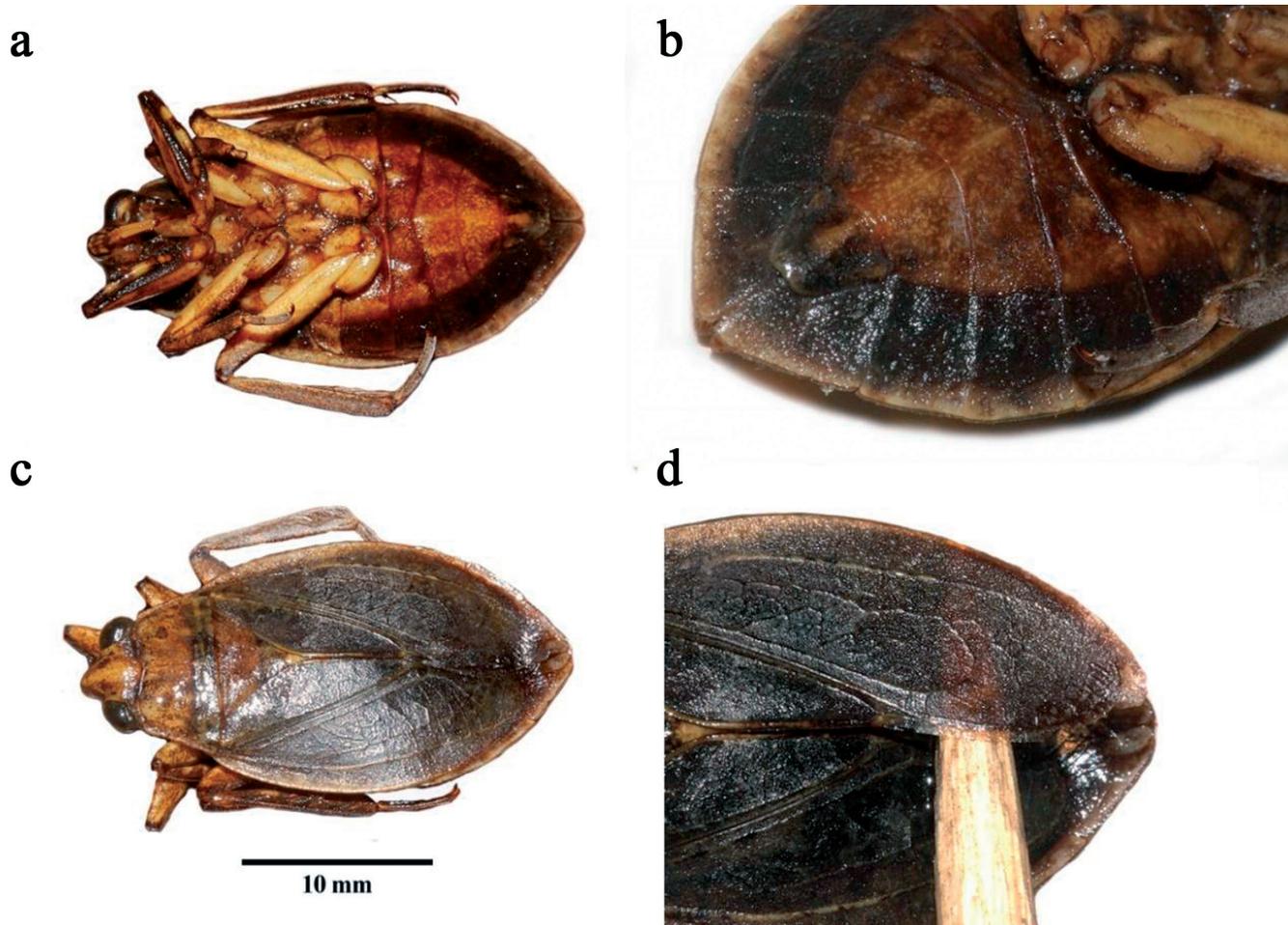


Figure 1. Water bug of the *Abedus* genus (Belostomatidae) collected in the Cotón River, Puntarenas, Costa Rica. **a:** Ventral view; **b:** detail of abdominal sclerites V-VI without longitudinal fold; **c:** dorsal view; **d:** detail of absent membrane.

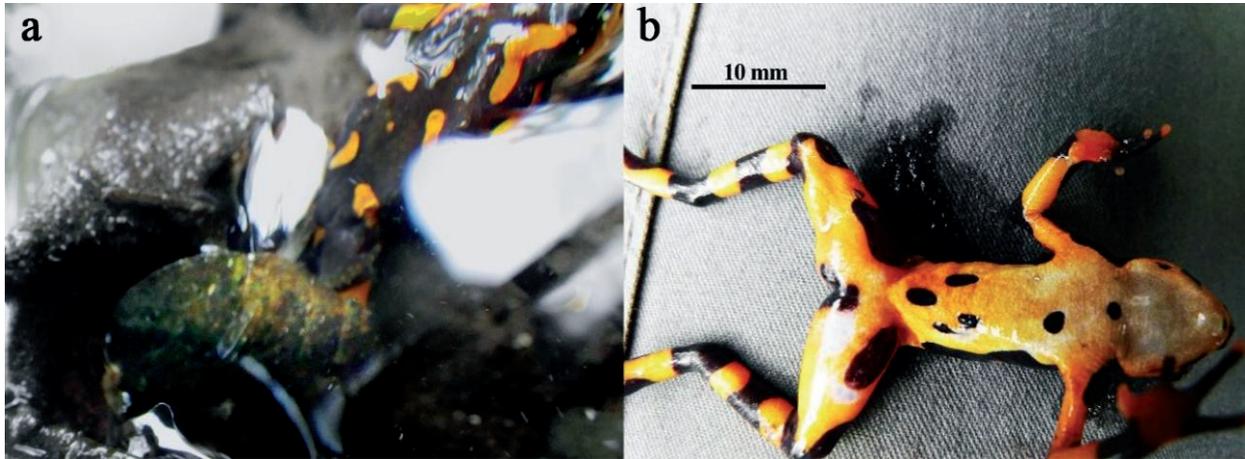


Figure 2. Water bug of the *Abedus* genus preying upon an individual of the critically endangered Variable harlequin frog *Atelopus varius* in the Cotón river, Puntarenas, Costa Rica. **a:** Individual of water bug preying upon an individual of Variable harlequin frog; **b:** The toad died after being collected.

by the right lower limb. The frog died a few minutes after being observed (Fig. 2b). The predation event did not occur during the reproductive season; therefore, few harlequin frog individuals were near the water at the time of predation.

Given the scarcity of documented predation events, *Atelopus* predators are still poorly known. Other events that were previously considered as predation only included the larvae of the fly *Notochaeta bufonivora* Lopes and Vogelsang, 1953 feeding on harlequin frogs (Pounds and Crump, 1987). However, a more accurate term for the ecological relationship between the fly and the *Atelopus* would be parasitism, not direct predation. Therefore, our predation record can be considered as the most recent documented event, and the water bug as the second known predator for the species.

Water bugs have raptorial forelegs to prey upon aquatic animals such as amphibians (Toledo, 2005; Ohba *et al.*, 2008) and these belostomatids have been widely reported as predators of postmetamorphic anurans (Toledo, 2003; 2005). Most predation events by water bugs on anurans occur during the reproductive season when the frogs are more exposed and closer to water (Haddad and Bastos, 1997; Toledo, 2003; 2005). Our observation did not occur during *Atelopus varius*' reproductive season in Las Tablas Protected Zone, which is documented to occur from October to January (RSV and DAGH, *pers. Obs.*). Despite continuous surveys of this harlequin frog population, there have been no further observations of predation, both during and outside of the frog's reproductive season.

Given that water bugs are commonly recorded as predators for many anurans (Brodie and Formanowicz, 1983; Cabral Eterovick and Sazima, 2000; Toledo, 2003; Toledo, 2005; Vonesh and Warkentin, 2006), and despite this could be an opportunistic behavior, it is nevertheless necessary to quantify the effect of this predator-prey relationship over all the life cycle stages of the harlequin frog.

Since the harlequin frog is classified as Critically Endangered on the IUCN Red List of Threatened Species (Pounds *et al.*, 2010), we consider that it is important to understand the effects of predators on their population dynamics in order to consider conservation or management actions.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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