



Diurnal Activity in the Cuban Treefrog, *Osteopilus septentrionalis* (Anura: Hylidae), Associated with an Unusually High Prey Density in Western Cuba

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Seasonal and daily variation in temperature determine activity in amphibians and their prey (Wells 2007). However, in some cases diurnal activity in amphibians may be a response to the activity period of their insect prey rather than a physiological response to environmental factors (Carey 1978). Daily activity patterns have been little studied in Cuban anurans and researchers have focused mostly on reproduction (Valdéz and Ruíz García 1980; Díaz and Cádiz 2006; Alonso et al. 2007; Rodríguez et al. 2012).

The Cuban Treefrog (*Osteopilus septentrionalis*) is native to Cuba, the Cayman Islands, and the Bahamas, and has become established in several West Indian islands, Central America, Hawaii, and Florida, USA (Meshaka 2001; Henderson and Powell 2009). In Cuba, these frogs inhabit almost all terrestrial ecosystems, including anthropogenic

habitats, at elevations from sea level to 1,974 m (Díaz and Cádiz 2008; Henderson and Powell 2009). The diet of *O. septentrionalis* has been well studied in Cuba, but even more so in non-native populations (Meshaka 1996a; 2001; Owen 2005; Glorioso et al. 2012; Kaiser et al. 2016; García-Padrón 2021). The species typically is nocturnal (Henderson and Powell 2009) and, despite some reproduction-related activities that may occur during the day (e.g., calling, Peters 1974; froglet movements, Kaiser et al. 2016), only a few records document diurnal foraging activity (Kaiser et al. 2016; Hernández-Peraza and de Armas 2022). Herein we present a third record of diurnal feeding activity in adult *O. septentrionalis*.

We measured snout-vent lengths (SVL) of all frogs collected at the Centro Nacional de Entrenamiento



Fig. 1. An adult female Cuban Treefrog (*Osteopilus septentrionalis*) preying on House Flies (*Musca domestica*) by day in a bathroom at the Centro Nacional de Entrenamiento Espeleológico “Antonio Núñez Jiménez,” El Moncada, Viñales Municipality, Pinar del Río Province, Cuba (left). Notice the fly near the lower left corner. Stomach contents comprised entirely of House Flies obtained by flushing the stomach of the Cuban Treefrog (right). The inset shows a live fly from the same site. Photographs © T.M. Rodríguez-Cabrera (left and inset) and L.Y. García-Padrón (right).

Espeleológico “Antonio Núñez Jiménez,” El Moncada, Viñales Municipality, Pinar del Río Province, Cuba (22.54442°N, 83.84316°W; elev. ~140 m asl), to the nearest 0.02 mm with a caliper, obtained dietary information by stomach flushing (Solé et al. 2005), and estimated the volume of each prey item using the formula for an ellipsoid (Biavati et al. 2004).

At about 0900 h on 23 April 2022, we observed an adult female *O. septentrionalis* (82.44 mm SVL) actively foraging on the floor of a bathroom (Fig. 1). Foraging activity ceased around 1130 h and the frog immediately thereafter took shelter behind the toilet tank, where we later found four more inactive treefrogs, including three in the toilet tank. We captured and flushed the stomachs of all five individuals, but only that of the frog observed foraging contained prey items. It contained 77 House Flies, *Musca domestica* (Diptera: Muscidae) (Fig. 2), with a total volume of 2,451.5 mm³.

At 1000 h on 25 April 2022, we observed another female *O. septentrionalis* (80.62 mm SVL), preying on *M. domestica* on a kitchen sink (Fig. 3). We captured the frog about 20 min later and flushed 43 House Flies with a total volume of 1,369 mm³. Despite similar body sizes, we ruled out the possibility of both incidents involving the same individual because of unique color markings.

Most amphibians are generalist predators (Wells 2007), and presumably consume any prey encountered in proportions similar to those observed in their habitats (Simon and Toft 1991). The House Fly is a diurnally active species that is particularly abundant where garbage and animal and human wastes serve as reproduction and feeding grounds (Dahlem 2003; Srinivasan et al. 2006; Schou et al. 2013). In El Moncada, *M. domestica* is considered a nuisance, and its numbers have increased considerably because of waste products associated with a nearby chicken farm (feces, dead animals, and broken eggs). Diurnal predators, such as the Cuban

Green Anole (*Anolis porcatius*), the Cuban Brown Anole (*Anolis sagrei*), and some birds frequently prey on flies in this locality, but this is the first time a nocturnal predator such as the Cuban Treefrog has been observed shifting its activity to exploit this abundant food resource.

Cuban Treefrogs are bimodal foragers, employing both sit-and-wait (e.g., Meshaka 2001) and active foraging strategies. We observed both frogs using an active foraging mode, moving short distances in order to capture flies. The sit-and-wait foraging mode seems to be less effective than the active foraging mode when capturing diurnal prey, since exposure to potential predators (e.g., humans) can be detrimental to the survival of the species (Gray et al. 2021; authors, pers. obs.). In this case, foraging by day apparently allows Cuban Treefrogs to consume large numbers of prey in relatively short periods of time. Diurnal feeding activity might be more frequent than previously thought (Kaiser et al. 2016; Hernández-Peraza and de Armas 2022; this study).

House Flies are associated with many pathogens that can cause diseases, including typhoid fever, cholera, dysentery, and infantile diarrhea, and are known to transmit a variety of parasitic worms (Levine and Levine 1991; Dahlem 2003; Srinivasan et al. 2006). Our observations corroborate the benefits of *O. septentrionalis* to humans by consuming non-native invasive invertebrates, such as American Cockroaches (*Periplaneta americana*), land snails (*Praticolella griseola*) (García-Padrón 2021), and House Flies.

Meshaka (2001) listed seven life-history traits that make *O. septentrionalis* a successful colonizer: (1) High fecundity and long breeding season, (2) short generation time (tadpoles to adults), (3) wide physiological tolerances, (4) large body size, (5) potentially superior competitive ability for food and reproduction, (6) broad trophic niche and a generalist diet, and (7) ability to coexist with humans (Meshaka 1996a, 1996b, 1996c, 2001; Owen 2005; Glorioso et al. 2012;



Fig. 2. A second adult female Cuban Treefrog (*Osteopilus septentrionalis*) preying on House Flies (*Musca domestica*) by day in a kitchen at the Centro Nacional de Entrenamiento Espeleológico “Antonio Núñez Jiménez,” El Moncada, Viñales Municipality, Pinar del Río Province, Cuba. Notice the high density of flies around the frog. The right photograph shows the moment when the frog captured a fly. Photographs © L.Y. García-Padrón.

Kaiser et al. 2016; Mancina et al. 2016; García-Padrón 2021; Hernández-Peraza and de Armas 2022), to which we add: (8) facultative diurnal activity (Peters 1974; Kaiser et al. 2016; this study), and (9) bimodal foraging mode (sit-and-wait and active) (Hernández-Peraza and de Armas 2022; this study). This array of life history traits allows the Cuban Treefrog to acclimate to worldwide human-mediated disturbances, such as urbanization and climate change, and also to be a useful ally against potentially harmful invertebrates.

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