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Conservation Implications of Predation by Cuban Treefrogs (*Osteopilus septentrionalis*) on Native Hylids in Florida

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Abstract - The Cuban Treefrog, *Osteopilus septentrionalis*, is an invasive, non-native species whose range is rapidly expanding throughout Florida and may be a significant predator of native treefrogs. To investigate the attractiveness of various sized native Green Treefrogs as prey to Cuban Treefrogs, we conducted laboratory experiments where we offered very large Cuban Treefrogs the choice of arthropods (crickets), conspecifics, and Green Treefrogs. We found that all prey types were consumed by the very large Cuban Treefrogs over the course of the feeding trials. When given the choice of crickets or treefrogs as prey, more of the very large treefrogs ate just crickets and crickets were usually consumed before treefrogs. While not indicating a selection or preference for predation on other treefrogs, our trials did show that Cuban Treefrogs will eat both Green Treefrogs and conspecifics and could have a negative impact on native hylids by removing reproductively mature individuals from the population.

Introduction

The Cuban Treefrog, *Osteopilus septentrionalis* (Duméril and Bribron), is believed to have colonized much of south mainland Florida through human-aided dispersal (Meshaka 1996). Since colonization, this treefrog has quickly spread throughout south and central Florida and is beginning to invade areas in northern Florida (Meshaka 2001). Cuban Treefrogs primarily succeed in mesophytic forests and disturbed habitats in Florida. They have several life history characteristics in common with other successful exotics such as high fecundity, the ability to lay eggs year-round, and a broad diet. In addition, they possess the ability to successfully coexist with humans (Meshaka 2001). These characteristics, along with the suitability of the subtropical climate, have led to the Cuban Treefrog becoming an established non-indigenous species in peninsular Florida.

The impact of Cuban Treefrogs on native treefrogs is mainly thought to be due to direct predation (Meshaka 2001). Currently, Cuban Treefrogs significantly overlap with the distribution of the following four native hylids in Florida: *Hyla cinerea* (Schneider), *H. femoralis* (Bosc and Daudin), *H. gratiosa* (Le Cont), and *H. squirella*

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(Bosc) (Ashton and Ashton 1988). Although predation is most likely to be significant in human-modified environments where Cuban Treefrogs are most abundant, researchers may be unknowingly increasing the incidence of predation through use of PVC pipe refuges (O'Neill 1995) in more pristine areas where Cuban Treefrogs are present. PVC pipes are an increasingly popular method used to census treefrogs due to their efficiency and cost effectiveness (Boughton et al. 2000). These artificial refuges attract treefrogs because the pipes provide a moist environment, shelter from the wind, and refuge from extreme temperatures. Although these artificial refuges mimic natural refuges by protecting treefrogs from many native predators (e.g., birds, snakes), in Florida they may expose treefrogs to increased predation by Cuban Treefrogs because the PVC pipes are particularly attractive to this exotic species.

Past data collected from stomach content analysis of wild-caught Cuban Treefrogs indicates that they will readily eat at least two species of native hylids (Meshaka 2001). However, it has not been determined whether Cuban Treefrogs prefer native hylids as prey items or whether a range exists for prey that are suitable for consumption. These additional data are necessary to determine to what extent Cuban Treefrogs could significantly affect the demographics of native frog populations (Butterfield et al. 1997).

With this in mind, the purpose of our study was to investigate how attractive a native hylid (Green Treefrog, *H. cinerea*) of various sizes was as a prey item to Cuban Treefrogs.

Methods

We conducted laboratory experiments where we offered very large Cuban Treefrogs the choice of arthropods (crickets), conspecifics, and heterospecific treefrogs (*H. cinerea*). In addition, we analyzed data on the prevalence of Cuban Treefrogs in PVC pipes used to monitor native treefrogs at a coastal field site in west-central Florida.

Five very large Cuban Treefrogs (mean snout-vent length = 6.7 cm, SE = 0.42) were collected from three locations in St. Petersburg, FL. Each very large Cuban Treefrog was placed in a separate, ventilated terrarium containing a moist layer of sphagnum moss and a water dish. Terraria were kept in a room at 27 °C with a diel cycle of 13 h of darkness and 11 h of light.

In our first experiment, we wanted to determine if the very large Cuban Treefrogs would eat Green and/or Cuban Treefrogs. In addition, we wanted to assess what size range of treefrogs the predators would eat. Every three days, during 8 October–14 December 1999, each of our 5 frogs was given the opportunity to feed during the species' natural

feeding time prior to dusk. The prey treefrogs were categorized into three sizes because these represent prey dimensions found in a previous study on the gut content of Cuban Treefrogs (Meshaka 2001). The small prey range was from 1.5 cm–2.5 cm snout-vent length (SVL), medium prey was 2.6 cm–3.4 cm SVL, and large prey was 3.5 cm SVL or larger. Each very large treefrog was given one prey treefrog at a time in the following order: small Cuban, small Green, medium Cuban, medium Green, large Cuban, large Green.

In our second experiment, we wanted to determine if the very large treefrogs would consume treefrogs if another food source (crickets) was present. We also wanted to see if Green Treefrogs were more likely to be eaten than Cuban Treefrogs. We first released 3 crickets and one small Cuban Treefrog. This was followed by 3 crickets and one small Green Treefrog. Then we released 3 crickets, one small Cuban Treefrog and one small Green Treefrog. Finally we just released one Cuban and one Green Treefrog.

In both experiments, after releasing the treefrog/cricket prey into the terraria, behavioral observations were made for 1 h after dark using a flashlight with a red filter. The terraria were also checked 12 and 24 h after the start of the feeding trial to document the prey items that remained. All remaining prey items were removed after 24 h. Individuals were fed 3 crickets between trials whether they consumed prey during the trial or not.

To determine the potential impact that Cuban Treefrog predation might have in the wild, populations of Green and Cuban Treefrogs were monitored using PVC pipe refugia at Eckerd College in St. Petersburg, FL. The study area is a xeric hammock dominated by cabbage palms and sporadic ground cover. Arrays of three PVC pipes (internal diameters of 2.2, 4.3, and 5.2 cm) were placed at each of 15 stations. Surveys of the 15 stations occurred at least twice each month from 1998–1999. Each survey consisted of visually checking all pipes for treefrogs and removing any present. Captured individuals were identified to species, and the SVL was measured.

Results

All prey types (crickets, Green, and Cuban Treefrogs) were consumed by the very large Cuban Treefrogs over the course of the feeding trials. All of our very large treefrogs consumed at least one Cuban and one Green Treefrog during the study. In our first experiment, 2 of the 5 treefrogs ate a small Cuban Treefrog and 2 of the 5 ate a small Green Treefrog. Four out of 5 of the large Cubans ate a medium Cuban Treefrog, and 2 out of 5 ate a medium Green Treefrog. Only one large Cuban Treefrog was ingested during the study, and none of the large Green

Treefrogs were eaten. Prey treefrogs ranging in size from 1.4–3.6 cm were consumed. The proportion of the maximum prey size to the size of the predator ranged from 35.8% to 58.0% (mean = 46.64%, SE = 4.14%).

When very large Cuban treefrogs were given the opportunity to eat crickets or small Cuban Treefrogs, 3 of the 5 predators ate the crickets and 2 of the 5 ate both. In every case, the crickets were eaten before the treefrogs. The results were exactly the same when very large Cuban treefrogs were given the opportunity to eat crickets or small Green Treefrogs. When very large Cuban treefrogs were given the opportunity to eat crickets, Cuban, or Green Treefrogs, 3 out of 5 ate crickets, 1 ate the crickets and a Cuban Treefrog, and 1 ate the crickets and a Green Treefrog. When there was 1 Cuban Treefrog and 1 Green Treefrog, 3 of the predators ate both, 1 predator ate just the Cuban, and 1 ate nothing.

We found 274 Green and 387 Cuban Treefrogs in PVC pipes during our 2 years of monitoring. Of the treefrogs found in the PVC pipes, 63% of the Green Treefrogs and 55% of Cuban Treefrogs in the palm hammock would be classified as small (1.5 cm–2.5 cm SVL) or medium (6 cm–3.4 cm SVL) and thus are within the range of prey consumed during the experimental trials. In addition, at least 6.5% of Cuban Treefrogs found in our PVC pipes in the palm hammock were within the size range used as predators during the behavioral experiments.

Discussion

Although not indicating a selection or preference for predation on other treefrogs, our trials demonstrated that Cuban Treefrogs will eat both Green Treefrogs and conspecifics. More importantly, knowing the range of prey sizes that the Cuban Treefrog can consume will aid our understanding of their potential impacts on native treefrog species. Our data corroborate Meshaka's (2001) finding that Cuban Treefrogs are capable of consuming prey over half their body size. The fact that Cuban Treefrogs are capable of consuming both subadult and adult Green Treefrogs highlights their potential to negatively affect native treefrog populations. By removing reproductive individuals from the population, Cuban Treefrogs may limit future reproductive output in native treefrog species. Indeed, almost 7% of the Cuban Treefrogs were large enough to consume small-medium sized treefrogs and 63% of the Green Treefrogs found in the palm hammock were classified as being in this size range. Therefore, native Green Treefrogs provide an abundance of prey items that are within the same habitat as Cuban Treefrogs. Consuming such large prey items, however, does not occur without a struggle and thus a greater energy expenditure and possible risk of injury. On some occasions during the behavioral experiments, attempts to consume large prey were unsuccessful. In one trial, the 6.2-cm SVL predator was offered three crickets and a 3.3-cm SVL Green Treefrog. After consuming all

three crickets within 3 min of the initiation of the feeding trial, the very large Cuban Treefrog attempted to consume the Green Treefrog. A two-minute struggle occurred in which the prey was able to escape and survive for the remainder of the experimental trial. The same predator also attacked a 3.2-cm SVL conspecific and was unsuccessful after a struggle that lasted 7 min. These examples indicate that larger prey can be energetically costly and often unsuccessful. Meshaka (2001) also found that conspecifics were readily available in the wild, but not as easy to eat for similar reasons. Christian (1982) found that Western Chorus Frogs (*Pseudacris triseriata* [Wied-Neuwied]) were capable of consuming prey items 1.5 times larger than the largest item encountered in gut contents. So while it was possible for Cuban Treefrogs to consume large native treefrogs, our study supports evidence that natural populations of Cuban Treefrogs primarily feed on insects with opportunistic predation on anuran species (Meshaka 2001). When few insects are available, Cuban Treefrogs may spend more time foraging and consuming native treefrogs and other Cuban Treefrogs.

Our study did not provide any direct evidence that the monitoring method of PVC pipe refuges is enhancing predation of Cuban Treefrogs on native treefrogs. However, the feeding trials did show that predation does occur on Green Treefrogs and that the feeding strategy of Cuban Treefrogs is to consume whatever prey is abundant and easily consumed. Because the PVC pipes attract treefrogs, an abundance of both green and Cuban Treefrogs congregate within the small area of the pipes, and this creates a density of prey items that probably would not occur in the natural habitat. As a result, the PVC pipes may be creating an ideal setting for the sit-and-wait predation exhibited by this exotic species.

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