Introduction

The Burmese python (Python molurus bivittatus) (Figure 1), native to Southeast Asia, are an established invasive species in south Florida. This species has the potential to adversely affect this new environment. The presence of Burmese pythons is especially problematic because the vast expanses of suitable habitats (both disturbed and undisturbed) and subtropical climate of the Greater Everglades may ease the species to thrive. The purpose of this project is to provide scientific support to develop control measures for Burmese pythons and to evaluate impacts of pythons on native biological diversity through radio telemetry and habitat utilization, thermal biology, gut content analysis, and reproduction.

Radio telemetry and habitat utilization

Little ecological information exists for Burmese pythons in their native range. Therefore, it is important to learn more about the distances and timing of pythons’ movements, as well as which habitats they are utilizing.

Methods

• Since December 2005, we surgically implanted 37 Burmese pythons each with 2 radio transmitters.

• The snakes were released in Everglades National Park (ENP) (e.g. Figure 2).

• Pythons are tracked weekly via fixed-wing aircraft (Figure 3) and on the ground (Figure 4) to check health and presence of additional pythons.

• Translocated pythons made long distance movements (up to 78 km), especially during periods of high water, and have shown tremendous dispersal abilities.

• Tracking pythons on the ground led researchers to breeding aggregations of pythons, allowing removal of more than 20 additional pythons from the Florida population.

• We gained valuable data on habitat use through aerial and ground tracking (Figures 2-4).

Gut content analysis

Burmese pythons are large generalized predators that consume a wide variety of vertebrates in their native range. It is important to assess which Everglades species are at risk of predation by this large constrictor, this can be accomplished by examining the gut contents of captive pythons.

Methods

• Gut contents were removed from pythons, cleaned, and examined.

• Bones, teeth, hair, feathers, flesh, and other parts of prey items were separated and dried.

• Mammalian prey species were identified by keying out hair and comparing teeth and bones to skeletons of known species.

• Food remains were sent to the Smithsonian Institute for identification using microstructures on feathers (Figure 5).

Results

• Examination has yielded 455 prey items (Table 1) composed of 349 mammals (Figure 6), 107 birds, 8 amphibia, and 1 unidentified sample. Prey items were absent in 6 samples.

• Pythons have been successful in detecting introvert-tailed muskrat (Notomys alexanderi) in Everglades National Park (ENP), a species researcher have not directly observed in 10 years, and may be more prevalent than depicted in ENP as 60 individual muskrats have been found in python gut samples.

• Two federally endangered species, including 4 Key Largo woodrats (Neotoma floridana), and one pygmy wood rat (Myodes merriami), have been found in python gut samples. The American Alligator (Alligator mississippiensis), federally threatened, lizards (Anoles spp. and Gila peruviana) and white ibis (Eudocimus albus), which are species of special concern in Florida, have also been identified from gut contents in pythons.

• Based upon what is known of the diet of Burmese pythons in their native range and in Florida, it is believed that federally protected species such as the Cigar Sabal palm shrimp (Euphilomedusa parviflora) (Florida panther’s highest eaten prey), and American crocodile (Crocodylus acutus) are at risk of predation by Burmese pythons.

Table 1. Prey items eaten by pythons found in Greater Everglades

<table>
<thead>
<tr>
<th>Prey</th>
<th>#</th>
</tr>
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<tbody>
<tr>
<td>Rats</td>
<td>11</td>
</tr>
<tr>
<td>Rodents</td>
<td>16</td>
</tr>
<tr>
<td>Mammals</td>
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</tr>
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<td>Birds</td>
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<td>Reptiles</td>
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<tr>
<td>Fish</td>
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<tr>
<td>Invertebrates</td>
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</tr>
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</table>

Thermal biology

Activity Patterns

Monitoring python body temperatures can help us understand activity patterns and habitat use to develop more effective control methods. To maintain body temperatures within preferred ranges, pythons thermoregulate by moving among various microhabitats. Continuous measurements of snake and environmental temperatures allow researchers to determine when snakes are active and which microhabitats they are using.

Energetics

Temperature data can also provide insight into python feeding frequencies and energetic requirements to help estimate pythons’ predatory impacts on native species. Since reptiles’ metabolic rates are dependent on temperature, mathematical models can be developed to predict pythons’ energetic requirements based on body temperature. The models use temperature, snake mass, and other factors affecting energetic requirements of pythons (i.e. food processing, growth, reproduction, and locomotion) to estimate metabolic rate and thus, the number and type of prey items needed by the snake. When python models are run, they will provide estimates of predation levels that can be combined with diet analyses (described above) to better predict impacts of pythons on native fauna. Using these data, we hope to provide information on python thermal biology, behavior, and activity that will assist in a better understanding of their overall ecology and development of effective population controls.

Methods

• Radio-telemetered pythons were surgically implanted with Onset Computer Tidbit temperature data loggers set to record temperature every 30 minutes (Figure 7).

• Data loggers were installed in ENP and downloaded monthly to record environmental temperatures in standing water bodies, as well as in terrestrial habitats using biophysical models of pythons (Figure 8).

Results

• During most winters and early spring, pythons maintain body temperatures between 20-33°C and rarely dropped below 15°C (Figure 9).

• In January of 2010 we experienced record low temperatures resulting in the deaths of 9 of the 10 telemetered pythons in the field at the time of the cold spell but 59 of 90 (66%) of non-telemetered found in the field after the cold snap were alive.

Reproduction

Methods

• Pythons removed from Everglades National Park (ENP) and nearby areas have been necropsied allowing us to study their reproductive status.

• Pythons have been successful in detecting round-tailed muskrat (Neofiber alleni) remains from python gastro-intestinal tract (Figure 10).

• Based upon what is known of the diet of Burmese pythons in their native range and in Florida, it is believed that federally protected species such as the Cape Sable seaside sparrow (Cordilis flavirostris), which is species of special concern in Florida, have also been identified from gut contents in pythons.

• Based on data from 8 pythons, average clutch size in Florida is 36, most recorded 85 and worldwide record is 107.

• Two federally endangered species, including 4 Key Largo woodrats (Neotoma floridana smalli) and the Key Largo cotton rat (Sawtoothed), have also been identified from gut contents as prey.

Summary

A multi-faceted approach is required to effectively control the expansion of, and ecological damage caused by, Burmese pythons in South Florida. Only through a combination of methods can we hope to achieve success in controlling this invasive species and understanding its effects on the endemic biodiversity of the Greater Everglades Ecosystem. For each of these areas, revision and improvement of methods is expected as data collection and data analysis proceeds.

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