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Subcommittee on National Parks, Forests and Public Lands and the Subcommittee on Insular Affairs, Oceans and Wildlife of the House Natural Resources Committee joint oversight hearing on *How to Constrict Snakes and Other Invasive Species.*

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Invasive species, habitat loss, and climate change are the three most important and pervasive factors affecting global environmental change. Increasing attention is being spent on estimating risks and determining impacts of invasive wildlife. In the United States, Burmese pythons have been thrust to the forefront of this battle. The most important lesson we have learned from our fight with pythons is that preventing establishment of invasive species is more effective than battling the crisis once it occurs. It is crucial that we take a comprehensive approach to preventing establishment of invasive species that looks beyond snakes (and other reptiles) to consider all species of animals and plants that have the potential to be invasive. This approach should recognize, first, that most alien species are not invasive but require care and cultivation to survive, and second that those species that are invasive—like the Burmese python—are likely to have restricted geographic distributions. Our efforts will be most effective when they target specific invasive species in particular locations where they are likely to cause problems.

There are other invasive wildlife species threatening Everglades National Park (ENP) and ecosystem restoration in the Everglades, and it is important that we do not forget about them. Many of these species such as island apple snail, jeweled cichlid, Asian swamp eel, purple swamphen, and Cuban treefrog do not evoke the same type of fearful reactions as giant snakes do, yet any one of them could have devastating effects on Everglades ecosystems. One problem is that it is not possible to predict with certainty which invasive species might cause negative impacts on native ecosystems and when it is evident that damage is occurring, it is often too late to take action to ameliorate negative impacts. For example, we now know that occurrence of Cuban treefrogs decreases the probability of occurrence of native green and squirrel treefrogs. Unfortunately, it is also now too late to eradicate them.

The attention lavished on Burmese pythons and other invasive species is justified by threats they pose to south Florida ecosystems. In south Florida, Burmese pythons primarily consume birds and mammals including two federally endangered species, the Key Largo woodrat and the wood stork. In Everglades National Park the presence of pythons has been related to the absence of marsh rabbits and Florida muskrats. We are very concerned about impacts of pythons on Everglades fauna, and the difficulties involved in removing a large cryptic predator from a large expansive wetland wilderness area (Fig. 1).

The pet trade is the source of the Burmese pythons that have established a breeding population in south Florida. The vector for establishment of Burmese pythons is unknown but is likely a combination of factors including intentional releases of pets,

accidental escapes from captivity, and destruction of holding facilities by storms. There is no preponderance of evidence to confirm the dominance of any single vector.

An initial study of python genetics by Timothy Collins and Barbie Freeman of Florida International University (FIU) found low genetic diversity in the established population. This finding could have been the result of using a relatively low number of microsatellite genetic markers, a freely intermixing population of pythons, or low genetic diversity of the founding population (i.e. snakes sold in the per trade). The low genetic diversity found in the FIU study does not provide incontrovertible proof for any specific vector of release of Burmese pythons. Additional genetic studies are needed to not only to better discern differences in established populations, but also to examine whether new incipient populations are of different genetic origin than those already established.

Most of the more than 40 species of alien reptiles established in Florida today are confined to urban or otherwise man-made habitats such as backyards and canals. In contrast, whereas some Burmese pythons have been found in urban and rural areas, most have been found in natural areas including Everglades National Park, Big Cypress National Preserve, Crocodile Lake National Wildlife Refuge, the Everglades Water Conservation Areas, and Rookery Bay National Estuarine Preserve. Within these areas Burmese pythons can be found in both natural and artificial habitats (Fig. 2) with the majority encountered in artificial habitats such as roads, levees, and canals. This pattern of distribution is most likely due to characteristics of these artificial habitats, which make them accessible to human searchers and offer increased visibility of pythons. In addition to visual searches, we have been radio-tracking pythons in Everglades National Park for the past three years and we have learned that pythons are certainly not confined to artificial habitats but instead can be found throughout the Everglades landscape (Fig. 3).

Radio-tracking of Burmese pythons that are also implanted with temperature loggers has provided information on habitat use, movements, extent of invasion, and thermal biology. Burmese pythons are habitat generalists capable of long distance movements across the landscape (Fig. 4). These pythons used combinations of habitats including marshes, tree islands, hardwood hammocks (forests), mangrove swamps, rivers, bays, ponds, canals, levees, and roads to meet their life history requirements. Habitat requirements that we have been able to identify include exposed areas for basking (they use the sun's energy to warm themselves) (Fig. 2); elevated areas for nesting; and crevices, dense clumps of vegetation, burrows, and similar features for hiding. Diet samples from Burmese pythons suggest that pythons forage wherever they occur, in both aquatic and terrestrial habitats.

From our radio-tracking we know that most pythons are not visible to searchers most of the time and that pythons in natural habitats are very hard to find without radio-transmitters. This makes estimating population size very difficult and makes population estimates potentially misleading. About 350 pythons have been removed from ENP and surrounding areas in each of the past two years (Fig. 5). It would be remarkable for any snake study to capture as much as 10% of the population. In south Florida, this gives us ballpark estimate of at least thousands of Burmese pythons.

Burmese pythons are dietary generalists. In south Florida pythons eat birds (23 species), mammals (15 species), and alligators (Table 1). Birds recovered from python intestinal tracts have been as small as a house wren and as large as a wood stork. In addition to wood storks, other wading birds eaten by pythons in ENP include snowy

egrets, great egrets, great blue herons, little blue herons, and limpkins. Burmese pythons have been tracked and sighted in the vicinity of wading bird rookeries and are known to be predators on wading birds in their native range. Pythons have also been found in the habitat of the federally endangered Cape Sable seaside sparrow.

Mammals are the most frequently consumed prey item in our diet samples. Although Burmese pythons eat primarily small mammals, they have consumed prey as large as a bobcat and white-tailed deer. The consumption of small mammals by pythons causes us great concern. A 9-10 foot Burmese python would likely have consumed 90-100 small mammals to reach that size. Burmese pythons have eaten federally endangered Key Largo woodrats near Crocodile Lake National Wildlife Refuge on north Key Largo—five woodrats were found in the intestinal tracts of four pythons. In Everglades National Park the presence of marsh rabbits and Florida muskrats in the diet of pythons has been correlated with these species' disappearance from natural areas. Diet studies provide us with our best tool for evaluating direct impacts of Burmese python; however, quantification of the number of specific prey items is not always accurate because remains are largely digested when they are recovered from the lower GI tract.

Marsh rabbits were once observed abundantly along the southern end of the main ENP road during the 1970s and 80s; they are absent now. There are so few marsh rabbits left that we are even starting to find them less frequently in python stomachs. In spite of our intensive effort to locate Florida muskrats as part of an inventory of mammals in ENP, the only muskrats that have been seen in ENP in the past three years have come from the stomachs of pythons. In other areas of the Everglades and Big Cypress where we do not find pythons we do find both marsh rabbits and Florida muskrats. I caution the reader, however, that whereas these observations imply that Burmese pythons are impacting native species, they do not prove a cause-and-effect relationship. If we wait until we have clear proof of damage to natural areas and native species it will likely be too late to undo the damage.

We recognize that eradication of Burmese pythons from south Florida is no longer an achievable goal. Objectives of python management in south Florida include population control (reduction and containment) and protection of key ecological resources such as endangered and disappearing species and wading bird rookeries. As in any pest control program the approach to removal will include multiple methods and should be integrated and science-based. While we have made progress in development of useful tools to remove pythons— for example, traps (Fig. 6) and using pythons to find other pythons (Judas snakes) during mating season (Fig. 7)—it is probably accurate to say that any one particular tool will not be a silver bullet. Rather, it is more likely that certain tools used in combination will be most effective. The mortality of Burmese pythons in south Florida after a record cold spell in early January 2010 offers hope that nature, combined with science, will help us accomplish our objectives of population control and protection of vulnerable resources. It is time to provide the Department of the Interior with the resources for an integrated, focused effort aimed at controlling pythons and finding and removing new invasive species before they become established.

This effort at removing Burmese pythons should integrate existing methods (e.g., hunting, trapping, Judas snakes) in space and time to remove pythons and protect key resources, while continuing to develop new methods. Although our scientific toolbox may no longer be empty, it requires constant evolution and development; we welcome

new ideas. To date, no systematic, comprehensive effort has been supported to battle pythons. The support of such a concerted effort should be a high priority. It is imperative to nip incipient populations of Burmese pythons and other invasive species in the bud before they become established.

To that end, early detection and rapid response (ED&RR) efforts will increase the likelihood that invasions will be addressed successfully while populations are still localized and not too large to be contained and eradicated. Components of ED&RR include early detection through surveillance (using active and passive detection techniques), and rapid removal by hand capture, trapping, and lethal measures as appropriate. Active detection networks are established by personnel trained in identification, capture, and handling of invasive species. Active techniques include both direct (visual or acoustic surveys) and remote (camera traps) methods. Passive detection networks are comprised of individuals who fortuitously detect non-native species as they conduct other activities. Passive techniques are an important supplement, but do not replace active methods. Multiple methods of removal will also be necessary. Moreover, ED&RR is less expensive than intensive programs to remove already established species or the potential costs when species are not eradicated.

Major questions in ED&RR and control efforts are how do we measure progress and how do we determine success? Here we can borrow from the adaptive management approach used in Everglades restoration. That is, we can develop indicators of potential impacts wrought by invasive wildlife species, performance measures to operationalize those indicators, and specific numerical targets by which we can assess success. For example, the indicator for new invasions could be number of newly established inasive species, and the associated performance measure would be number of newly established invasive species per year, and the target for success would be zero. Indicators for control of Burmese pythons could be related to population size (measured by encounter rates) or impacts on native species (measured by, for example, numbers of marsh rabbits along the main ENP road). However, additional research is needed to develop reliable performance measures and to set realistic targets.

There has been considerable news coverage and public education about Burmese pythons, bringing the issue of invasive exotic animals to the attention of both the general public and decision makers. This attention should be focused on fighting invasive species, not on fighting the pet, aquaria, and nursery (for plants) industries. Our approach should treat all types of wildlife equitably while focusing on specific species in areas where they are likely to be a problem.

Dedicated effort and resources are needed now if the threat of Burmese pythons and other invasive species in the Everglades and across the Unites States is to be reduced:

- <u>Legislation:</u> This is not my arena so I offer observations and not recommendations. The problem of invasive wildlife is so important and pervasive that it calls for the development of specific legislative tools. Providing the U.S. Fish and Wildlife Service with authorization and resources to conduct quantitative risk assessments, to screen wildlife imports for invasive species, and to determine geographically based risks of invasive species would help to focus and initiate efforts.
- <u>Coordination with and among states:</u> Many of our invasive wildlife problems will affect individual states or groups of states. Hence coordination is essential for

success. Actions to be taken include facilitation and support of statewide resources for responsible pet ownership and disposal (e.g., establishment of hotlines/website), support of statewide early detection networks and rapid response teams, and eradication of incipient populations of animal invaders. Florida can serve as a model for how to accomplish these actions.

- Coordination with pet and aquaria industries: I recognize that pet and aquaria industries make important economic and social contributions to society, as do biological diversity and ecosystem integrity. I identify two important steps to establish coordination and cooperation. First, foster responsible pet ownership and provide opportunities for disposing unwanted pets. Second, coordinate geographically based risk assessments to focus on specific taxa in specific locations to maximize protection of natural resources while minimizing impacts to the industry.
- Investments in research: We need to conduct quantitative risk assessments for wildlife species as the first step in identifying species that pose a threat of invasion. We need to increase investments in invasive species ecology to, among other things, identify weaknesses of the invasive animals and plants that can be exploited to assist eradication or control. Further research is needed to augment our understanding and our ability to communicate the existing and potential impacts of invasive species on natural systems. We also need to increase resources to support research, development, implementation, and monitoring of control programs for priority species such as Burmese pythons and purple swamphens.

Burmese pythons and other invasive wildlife species pose real threats to conservation of biological diversity and ecosystem integrity. Preventing establishment of such species is the only guaranteed effective approach to reducing their impacts. After prevention, early detection and rapid response (ED&RR) is the critical next line of defense, and in small localized populations offers at least a chance of eradication. Once an invasive species is firmly established, substantial resources may have to be invested to reduce and contain the population and to prevent damage to natural resources. In south Florida, dealing with existing threats from invasive species, and especially preventing new invasions, will require substantial new and sustainable resources and unprecedented partnerships. Committing resources now is our best chance of minimizing future impacts and costs.