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Bio 330

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The Effects of the Invasive Burmese Python on the Florida Everglade Ecosystem with reference
to The Brown Tree Snake of Guam

Abstract

Invasive species are among one of the biggest threats to biodiversity in the United States. Not only are they costing the United States billion of dollars, but they are negatively affecting native ecosystems. *Python bivittatus* or burmese python is a newer invasive species that was predominantly introduced to Florida through the live pet trade and is the only snake to successfully colonize an area larger than 1000 km². *Boiga irregularis*, brown tree snake, is an established threat that has already caused the extirpation of many species of birds since its arrival to Guam in 1949. We investigate how the burmese python impacts the Florida ecosystem compared to how the brown tree snake has already impacted Guam's ecosystem and the conservation issues with managing the burmese python. The brown tree snake caused the decline of many native bird species and the burmese python caused the decline of many mammal species either through direct or indirect causes. Conservation efforts have been put into effect for the burmese python but still need some fine tuning.

Introduction

One of the most significant threats to biodiversity, not only in the United States but also globally is invasive species. About \$120 billion is spent annually to manage invasive species in America. Invasive species have many negative effects on the ecosystem and the native flora and

fauna. Habitat alteration, increased competition, decrease of native predator predation, trophic cascade and native species extirpation are just a few effects that invasive species have on the ecosystem and its organisms (Dorcas, et al. 2011).

One of the largest snakes in the world, the *Python bivittatus* or burmese python can grow to lengths about 5 meters. They are extremely popular as pets, with more than 300,000 pythons being imported into the United States between the years of 1979 and 2009. Originally the pythons were only kept as pets, but due to irresponsible pet owners, some were released into the wild. It is now estimated that over several thousand square kilometers of southern Florida are inhabited by these snakes, while it is the only exotic snake to have successfully colonize an area greater than 1000 km². Most of the Everglades National Park (ENP) and Big Cypress National Preserve (BCNP) are infested with the burmese python (Reed, et al. 2012).

The clutch size of the burmese python is known to be about 100 eggs, the second largest of all egg-laying snakes (Reed, et al. 2012). The dietary habits of these snakes include mammals, amphibians, lizards, snakes, birds, fish, and occasionally the American alligator (Dove, et al. 2010, Dorcas, et al. 2011). The types of organisms that these snakes eat become a problem when they start to eat endangered species. There have been reports of Burmese pythons eating species that are listed under the US Endangered Species Act, like the *Neotoma floridana smalli* or Key Largo woodrat and the *Mycteria americana* or wood stork. More than 40 prey species have been documented as prey items for the Burmese python while there are hundreds more options to also choose from (Dorcas, et al. 2011).

The species of snake that is going to be compared to the Burmese python is the *Boiga irregularis* or Brown tree snake. It was introduced in 1949 due to being accidentally transported to Guam shortly after World War II. It now inhabits every habitat that Guam has to offer. This

species of snake is different than the average snake. They are mainly nocturnal, skinny, and longer at about 3 meters in length. The diet of the Brown tree snake consists of small rodents, birds, and small pets. Since their arrival, this snake has caused the extirpation of 13 of the 22 native bird species of Guam and the extirpation of many other lizard and bat species. The average clutch size of the Brown Tree Snake is 3-8 eggs with the occasional 12 eggs (Rodda and Savidge, 2007).

Both are invasive species, while the Brown tree snake is an established threat since 1949 (Rodda and Savidge, 2007) the Burmese python is a relatively new threat to Florida (Reed, et al. 2012). The Brown tree snake has already shown what an invasive species can do to the ecosystem, but the Burmese is becoming just as destructive. The question is, how destructive is the Burmese python, a relatively new threat, to the Florida ecosystem compared to the Brown tree snake, an established threat, to Guam's ecosystem. With a better understanding of how destructive Burmese pythons are, a plan to better manage these snakes can be constructed.

Analysis

First, the amount of area that each invasive snake invaded was examined (Figure 1). For the brown tree snake, in around 40 years, has managed to spread throughout the entirety of the Guam. Starting in the 1950s, they were originally introduced at the mid southern tip of Guam. They moved north eastward until eventually reaching the northern tip by the year 1982 (Savidge, 1987). With the Burmese python, there was no specific location where they were originally appeared. But it can be assumed it that it was the ENP was the original point of entry because they are established through the entirety of the ENP. The Burmese python spread about 60 km north all the way up the Fakahatchee Strand Preserve State Park (FAK) (McCleery, et al. 2015).

Next, we compared the overall predation that each snake had on the native fauna (Figure 2). With the Brown tree snake, a study done by bird baited traps being placed throughout Guam tested the predation rates of the different predators on the island. The different predators examined during this study was the Brown Tree Snake, Monitor lizards, and rats. The average amount of bird baited traps in each location was 22 traps per location. The average predation by snakes on bird baited traps was 79.95% while Monitor lizard and rat average predation on bird baited traps was 5% and 15% respectively (Savidge, 1987).

In a similar study, but with the burmese python, the predation risk of marsh rabbits from different predators over a 300 day period was examined throughout sites in southern Florida. Marsh rabbits were captured from an offsite location, radio tagged, and released into field sites. One site was in ENP where pythons were established and another control site in the Greater Everglades Ecosystem (GEE) region where pythons are rarely or never seen. In the ENP site, the predation risk by pythons had an exponential curve, getting as high as a 1.0 predation risk by the 300 day mark. Mammalian and avian predation risk stayed at a constant low risk at <0.1 predation risk throughout the 300 day period. In the site with little to no python's, the mammalian predation risk had a logistic curve topping off at 0.6 after 100 days. Avian predation risk also had a logistic curve but it topped off at 0.2 after 75 days. Reptilian or none-python predation risk had more of a gradual rise but maxed at <0.2 and did not continue past 200 days (McCleery, et al. 2015).

Dorcas et al. (2011) did a survey where the overall mammal population was studied with the rise of python observations. He first examined the temporal variation of the populations of rodents, rabbits, opossum, raccoons, foxes, coyote, bobcat, panther, and deer. He examined the number of mammal observations per every 100 km in pre-python ENP (1996-1997) to

established python ENP (2003-2011). It was discovered that all but three species number of mammal observations per 100 km declined with an average decline of 0.775 observations per 100 km. The species that increased in observations were the rodents, coyote, and panthers with an average increase of 0.013 observations per 100 km (Figure 3) (Dorcas, et al. 2011).

In a spatial variation study, all the same mammals were surveyed in 100 km increments over three study sites. The core site was the ENP, peripheral site consisted of four sites and was sites that were directly next to the core site, and the extralimital site consisted of two sites and was sites that were farther away or not directly next to the core site. All but three mammal's observations increased as they got farther away from the core site with an average increase of 0.13 observations per 100 km in peripheral sites and 0.95 observations per 100 km in extralimital sites. The coyote, bobcat, and panther all increased but very slightly in extralimital sites with an average decrease of 0.01 observations per 100 km (Figure 3) (Dorcas, et al. 2011).

Discussion

Overall, both snakes are devastating to the ecosystems they inhabit. The Brown tree snake led to the extinction of 13 native avifauna species of Guam (Rodda and Savidge, 2007) while the Burmese python has led to the decline of several mammal species either directly or indirectly (McCleery, et al. 2015, Dorcas, et al. 2011). Pythons act as apex generalist predators and can directly prey on organisms or have a top-down pressure on populations (Dorcas, et al. 2011). Although Guam is indeed an Island and Florida is a peninsula we are seeing very similar effects taking place. Due to the localization of the pythons in the southern tip of Florida, it appears the snakes are spreading in a similar pattern. The snakes have very little predators at the time and a rather large abundance of prey.

Throughout Guam, for a rather extended period of time the brown tree snakes were able to take full advantage of the islands resources. The lack of predation on the snakes left them able to colonize quite rapidly. The only thing holding back the brown tree snake would be the small clutch size. But even with the small clutch sizes, the tree snake was able to colonize the entire island of Guam and is highly unlikely for the species to be eradicated from the island. This is due to the lack of conservation efforts to control the brown tree snakes at the beginning of the snakes arrival to Guam. One conservation effort that has been relatively successful has been controlling the snakes population by eliminating the snake from certain areas of the island and decreasing its spread (Wiles, et al. 2003).

The Burmese python is possibly even more dangerous to the Florida everglades ecosystem, than the Brown tree snake was to Guam's. Because of the pythons lack of predators, large clutch sizes, and amount of available food, the python is able to flourish in southern Florida. These snakes will most likely be limited in their range due to climate reasons, however they are still continuing to spread into new territories each day. It is difficult to enact certain conservation efforts due to the fact this snake can reproduce multiple times with large clutches in there possible 30 year lifespan (Reed, et al. 2012). A conservation effort that could be put into effect could be snake traps. An issue with that is that it is a lengthy process to find the design that attract the snakes into the traps and find the right locations to put them (Reed, et al. 2011). There are a few more issues that make the control of these snakes much more difficult to deal with. Unlike in Guam, where the tree snakes are visible for the most part, the Florida Everglades are marshy grasslands with plenty of water and tall grasses that allows these pythons to maneuver around huge pieces of land undetected. This as a result of there great camouflage and their ability to swim fairly well. Florida is also much bigger than Guam, this has been another, one of the

more difficult problems in the fight for the control of the species. The sheer size of the territory that these pythons can occupy, far exceeds the available manpower currently present in this operation

It is imperative that a significant plan for control and removal of the burmese python be present in the next 5 to 10 years. Beyond this point it maybe that there will indeed be irreversible damage, like species extinction. Fortunately, conservationists and wildlife biologists attacked this problem right away as opposed to what happened in Guam, where they ignored the snake's presence until it was too late for many of the islands inhabitants.

One really important method for handling this problem and so many other problems like this is education. Through educating not only pet owners about the impacts of releasing their pets into the wild, educating the younger demographic on this issue should be focused too. By enlightening people to the importance and the overall impact they have on the native ecosystem, they can work to prevent and possibly reverse this issue in the future.

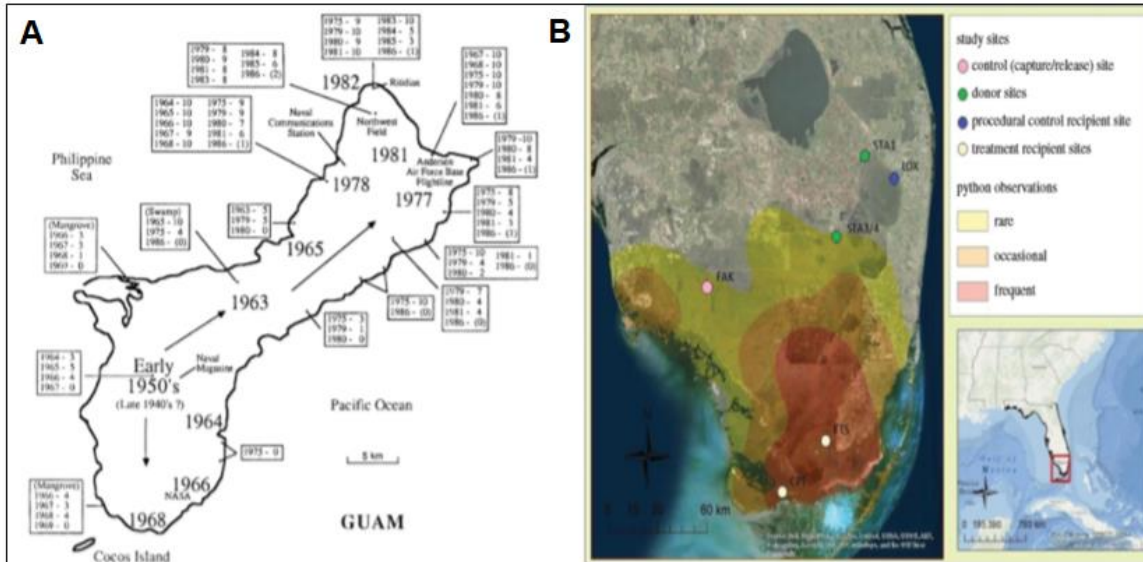
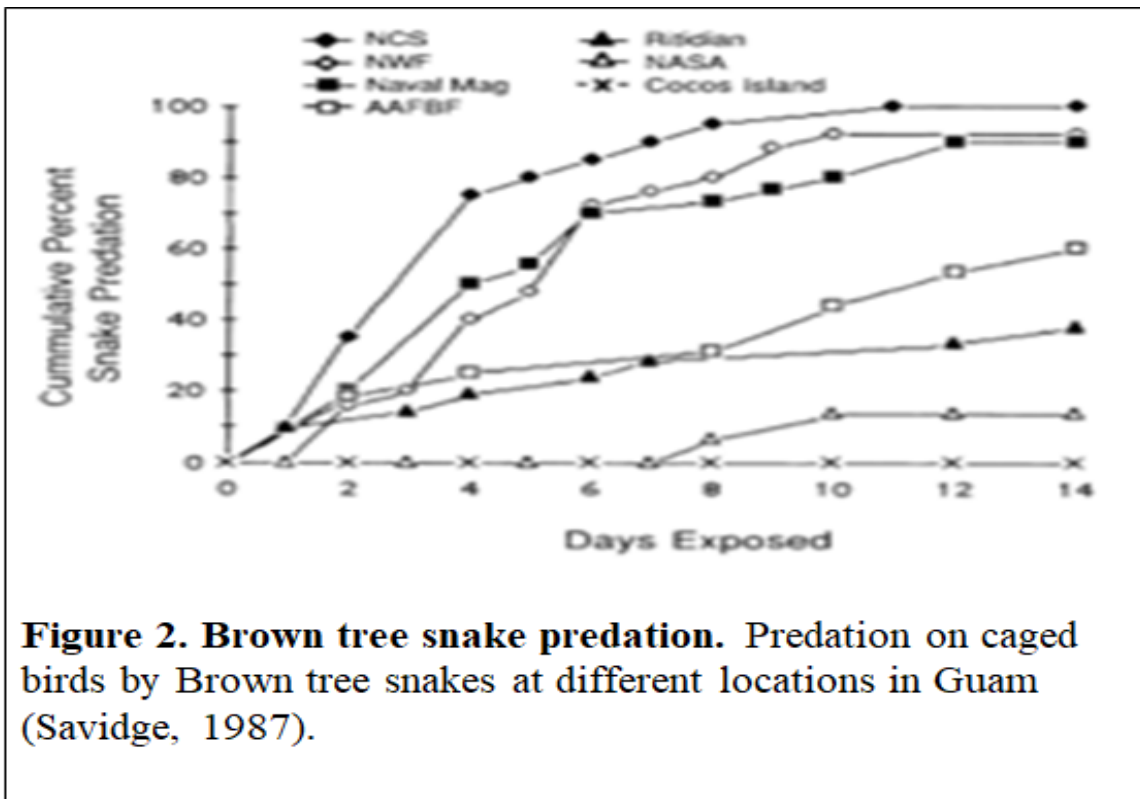
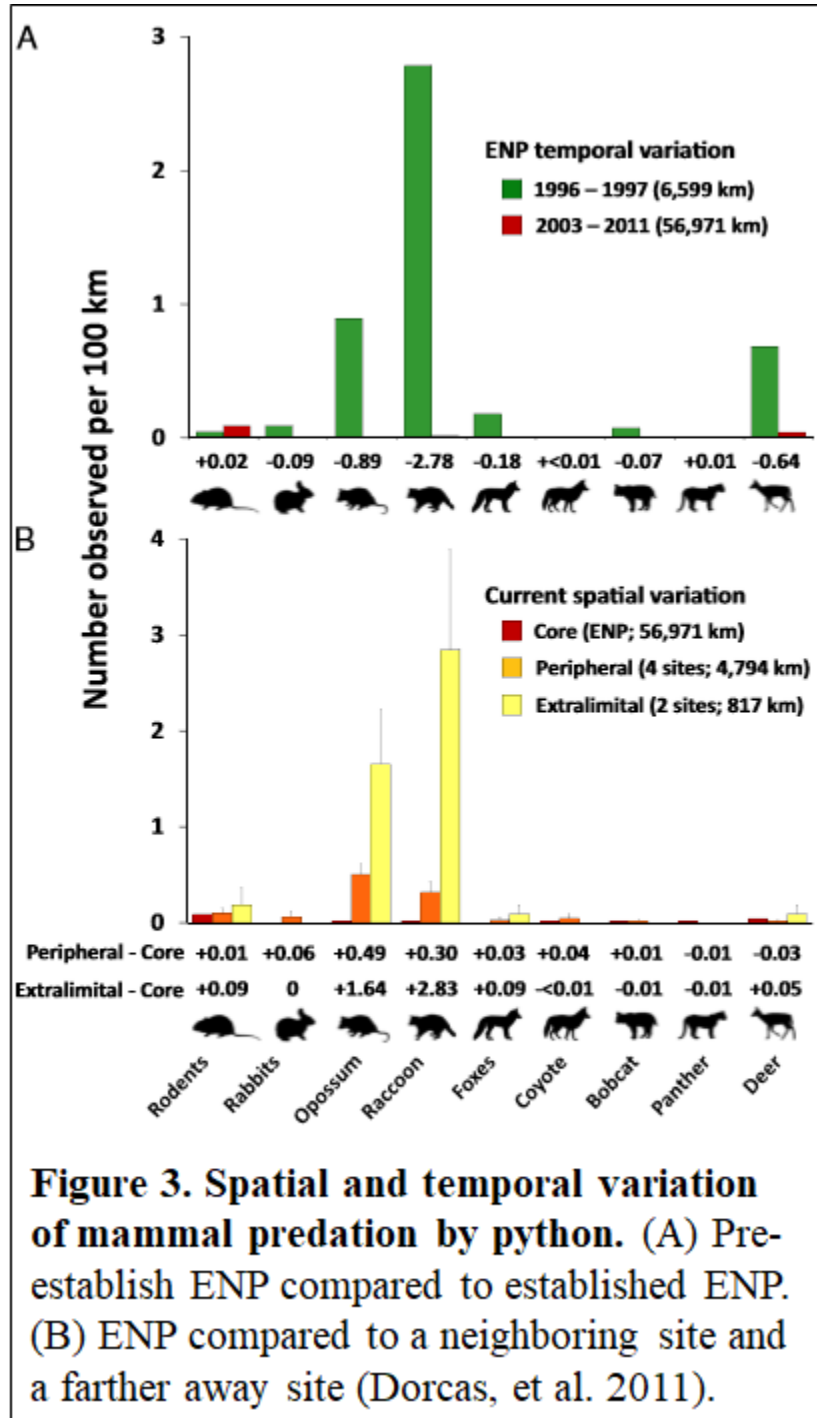


Figure 1. Distribution of Snakes. (A) Spread of the Brown tree snake in Gaum. (B) Spread of the Burmese python throughout southern Florida (Savidge, 1987; McCleery, et al. 2015).





Literature Cited

- Dorcas, M. E., Willson, J. D., Reed, R. N., Snow, R. W., Rochford, M. R., Miller, M. A., ... & Hart, K. M. (2012). Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. *Proceedings of the National Academy of Sciences*, **109**(7): 2418-2422.
- McCleery, R.A., Sovie, A., Reed, R.N., Cunningham, M.W., Hunter, M.E. and Hart, K.M., 2015. Marsh rabbit mortalities tie pythons to the precipitous decline of mammals in the Everglades. *Proc. R. Soc. B*, **282**(1805): p.20150120.
- Reed, R. N., Willson, J. D., Rodda, G. H., & Dorcas, M. E. (2012). Ecological correlates of invasion impact for Burmese pythons in Florida. *Integrative zoology*, **7**(3): 254-270.
- , Hart, K.M., Rodda, G.H., Mazzotti, F.J., Snow, R.W., Cherkiss, M., Rozar, R. and Goetz, S., 2011. A field test of attractant traps for invasive Burmese pythons (*Python molurus bivittatus*) in southern Florida. *Wildlife Research*, **38**(2): pp.114-121.
- Rodda, G. H., & Savidge, J. A. (2007). Biology and impacts of Pacific island invasive species. 2. *Boiga irregularis*, the brown tree snake (Reptilia: Colubridae). *Pacific Science*, **61**(3): 307-324.
- Savidge, J. A. (1987). Extinction of an island forest avifauna by an introduced snake. *Ecology*, **68**(3):660-668.
- Wiles, G.J., Bart, J., Beck, R.E. and Aguon, C.F., 2003. Impacts of the brown tree snake: patterns of decline and species persistence in Guam's avifauna. *Conservation Biology*, **17**(5): pp.1350-1360.