

The Burmese Python: An Invasive Species Who Eats to Its Heart's Content

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In Florida, many invasive species have been able to successfully establish and spread due to ecological and climate factors (Reed et al. 2012). The Burmese python, *Python molurus bivittatus*, is an invasive species that has spread throughout Southern Florida after its introduction in the mid-1980s (Dorcas et al. 2012, Walters et al. 2016). Climate can over-predict and under-predict where the snakes can spread, so distinguishing other ecological factors is important to understand the Burmese python's spread potential (Quansah et al. 2017). Burmese pythons are negatively impacting the environment in Southern Florida because they are generalist predators with the ability to eat many different types of prey, are habitat generalists that can live in many types of habitats, and have a lack of predators (Reed et al. 2012). An invasive species that has established and spread through its invasive range may have a small impact or a great impact on the surrounding environment. *Python molurus bivittatus* is one invasive species that has a large impact in its invasive range, Southern Florida. Since the snakes can eat most prey, the effects of its invasiveness can be seen on the environment through the loss of native animals in Florida (Reed et al. 2012). By understanding where the Burmese pythons are invasive, the traits that make them invasive, and the ways in which the snakes are impacting the environment, methods can be created to control the Burmese pythons' populations in Southern Florida. Although Burmese pythons are negatively impacting the environment through their eating habits, Burmese pythons, a generalist predator and habitat generalist, have spread throughout Southern Florida. While the general public overlooks the Burmese python's ecological impact, the species needs to be managed through tracking and harvest programs.

Understanding the traits that allow Burmese pythons to spread successfully is important to understanding why the species is invasive. Identifying climates that Burmese pythons are native to allows for a potential identification of where the snakes could spread to. The Burmese python inhabits areas across South and Southeastern Asia, regions with weather patterns that can result in below-freezing temperatures (Rodda et al. 2009). The snakes' native range also has regions of tropical and warm temperate zones (Quansah et al. 2017). Since the snakes come from regions with such climates, scientists have inferred that they could possibly spread northward from Southern Florida (Rodda et al. 2009). Quansah et al. (2017), conversely, found that during a particularly cold winter in their invasive range in Florida, many Burmese pythons died. The cold winter was associated with the numerous deaths of the Burmese python, as well as other possible ecological factors (Quansah et al. 2017). If the snake deaths were solely due to cold intolerance, then the possibility of the Burmese python's spread in the U.S. may be limited to warmer climates such as Southern Florida (Quansah et al. 2017). However, considering other factors besides temperature and climate is necessary to understand the spread potential of Burmese pythons.

Both the climate and habitats in Southern Florida are suitable for Burmese pythons, which are currently invasive in this area (Walters et al. 2016). Burmese pythons select more than one habitat during a single day (Walters et al. 2016). The type of habitat Burmese pythons will select depends on what they are looking for—elevated, drier habitats to nest successfully, or broad-leafed habitats to be close to prey (Walters et al. 2016). Preferences of habitats like the broad-leafed forests over open water habitats—which Burmese pythons tend to avoid altogether—help to further understand where Burmese pythons will or will not spread (Walters et al. 2016). The climate in Southern Florida, based on dryness and temperature, is suitable for the Burmese python, as the species has spread considerably throughout that region (Rodda et al. 2009). The spread of the snakes was possible due to the habitats available to them in Southern Florida and the region's climate, comparable to Burmese pythons' native range (Rodda et al. 2009). While climate and habitat preferences can partially predict where Burmese pythons inhabit, it is not the sole factor in determining where they are invasive.

Traits such as habitat preference, dietary preference, and low vulnerability to predators also determine where they will be invasive. As habitat generalists, Burmese pythons in their native regions live in areas with varying weather patterns and temperature unlike other python species (Reed et al. 2012). The ability to live in multiple habitats allows Burmese pythons to spread across vast regions with some variation in climate. Contrary to Reed et al. (2012), Walters et al. (2016) argue that, given the choice, Burmese pythons prefer broad-leafed forest land cover, but they will still inhabit cypress and coniferous forests. Thus, Burmese pythons can invade and spread to multiple areas. The Burmese python is also a generalist predator (Reed et al. 2012). Many species of diverse taxonomic groups have been documented in the Burmese python's diet, indicating its ability to eat prey available to them in most habitats and during most of the year (Dorcas et al. 2012). In addition to a broad diet, few animals prey on the Burmese python in the invasive range due to the snakes large size and maturation at a young age (Reed et al. 2012). The American alligator, a predator of the Burmese python, is also the prey of the Burmese python (Reed et al. 2012). The Burmese python has been eaten by the American alligator, but the population of the snakes is not negatively affected because the snakes can also eat the alligator (Reed et al. 2012). There is an equal opportunity for the alligators to prey on the snakes and snakes to prey on the alligators (Reed et al. 2012). The lack of predation upon the Burmese pythons allows the snakes to invade without a serious threat to their population size. A thorough analysis of the Burmese python's invasive traits and native background enables understanding of its ecological impact in Southern Florida.

The Burmese python's geographic range and abundance throughout Florida is directly correlated negative affects mammal populations (Dorcas et al. 2012). The Burmese pythons is an invasive species that is destructive because its eating habits suggests that this species is changing the Everglades National Park's food web. The Burmese python has one major ecological impact: declining animal populations. The *Python molurus bivittatus*'s high degree of generalism in its diet allows this species to impact many mammal populations in Southern Florida. This trait promotes the Burmese python in the invasive range (Reed et al. 2012). Holbrook and Chesnes (2011) and Dorcas et al. (2011) both observed mammal population reductions using roadside counts. Based on these roadside counts, Holbrook and Chesnes (2011) found that significantly fewer mammals were seen in the Everglades National Park compared to previous years. As the Burmese pythons have persisted and spread in the Everglades National Park, they continue to eat more individuals of various mammal populations, to which the lack of mammal sightings in the park can be attributed (Holbrook and Chesnes 2011). Similar to Holbrook and Chesnes (2011), Dorcas et al. (2011) conducted road surveys for mammal sightings. Contrary to Holbrook and Chesnes (2011), Dorcas et al. (2011) used previous data of road surveys before Burmese pythons were established and after their population dramatically increased. By comparing the mammal abundance before and after Burmese pythons established, Dorcas et al. (2011) demonstrated a clearer view of how these snakes have affected the native species living in the Everglades National Park; the snakes' diet allows them to eat many of the native species. The factors causing the rapid decline of mammals are influenced by the spatial variation of Burmese pythons throughout the park, timing of the snakes' increase in numbers, the snake's generalist dietary habits, lack of adaption to the Burmese python as a predator, and the shared habitats with Burmese pythons (Dorcas et al. 2012). Several of these factors caused by the presence of the Burmese pythons pose a threat to mammal populations and avian species in the Everglades National Park.

The Burmese python's dietary generalism as well as its rapid increase and shared habitats with the native species pose a serious threat to mammal and avian species populations in the Everglades National Park (Dorcas et al. 2012). Burmese pythons in the Everglades National Park are driving the decline in mammal populations such as the marsh rabbit (McCleery et al. 2015). Additionally, in other sites where the snakes are not prevalent, mammalian predation upon the marsh rabbits are prompting their decline (McCleery et al. 2015). Most previous reports of the decline of mammalian species are consistent with the lack of predation by mammals on marsh rabbits in the Everglades National Park; the snakes are the main predators eating marsh rabbits and other mammalian species who previously ate marsh rabbits (McCleery et al. 2015). The Burmese python has a direct impact on mammalian predators

by predation and indirect by eating many prey in the park (McCleery et al. 2015). McCleery et al. (2015) identified predation by the snakes on marsh rabbits after the rabbits were ingested by the snake due to the radio transmitter attached to the rabbit. The Burmese python's traits as a large predator which constantly feeds on various sized prey can speak to the decay of marsh rabbits noted by McCleery et al. (2015).

The threat to avian species by the Burmese python follows the same pattern as the threat to marsh rabbit species. Burmese pythons are forcing the decline of many bird species in the Everglades of various taxa (Dove et al. 2011). Many of the bird populations, especially ground-dwelling birds, in the Everglades National Park are vulnerable to the predation by the snakes due to their lack of evolution alongside a predator like the Burmese python (Dove et al. 2011). Dove et al. (2011) identified twenty-five bird species consumed by the snake in the Everglades National Park. The decline of the various avian species and mammal species is noteworthy and calls for the control of the Burmese python. Ultimately, comprehending why Burmese pythons are not only invasive but also how they cause a negative impact will give a better picture as to how the snakes have been so successful in Southern Florida and how to stop further spread.

Due to the Burmese pythons' large ecological impact on the environment in Southern Florida, controlling their species in this region is critical to diminish their ecological effect upon animal populations. The use of citizen science programs and harvest programs to capture various individuals of the snakes' population are methods to control the Burmese python in the invasive range (Falk et al. 2016). The public in Southern Florida was surveyed to determine if they believed that Burmese pythons are a serious concern (Harvey et al. 2016). Those individuals who have personal experience with the snakes, like seeing them regularly, indicated concern with the spread of the Burmese python (Harvey et al. 2016). Those who have not seen them regularly were more likely to not believe in the ecological impact of the Burmese python (Harvey et al. 2016). Knowledge and messages from conservation agencies also played a role in the amount of exposure individuals received to understand the invasive species effect on the natural environment and why there should be concern (Harvey et al. 2016). Agencies should increase the public's knowledge of the Burmese pythons characteristics and low detectability to potential hunters involved in harvest programs so so that the commitment to control the Burmese python population will be understood (Harvey et al. 2016). However, citizen science programs are limited in controlling Burmese pythons (Falk et al. 2016). The citizen scientists captured the snakes in August and winter, when detection of the Burmese python is relatively easier than other months (Falk et al. 2016). The amount of hours the citizen scientists must also put into the search effort can also hinder the program's abilities to improve awareness of snake spread and removal (Falk et al. 2016). Other methods may be more effective in controlling the snakes' population in Southern Florida.

A combination of implementing radio-satellite markers, establishing quarantine areas where the snakes are abundant, and increasing control mortality on roads may help decrease the spread of the Burmese python. By using radio-satellite markers attached to the Burmese python, controlled harvesting can be achieved especially due to the low detectability of the snakes in the invasive range (Hunter and Hart 2013). Understanding the Burmese python's movement and spread throughout Florida with the trackers will give conservation agencies a better picture of where they are most abundant to target control the snakes' population (Hunter and Hart 2013). The markers will ultimately track spread of invasion and help to decrease the snake's population size in a regulated manner (Hunter and Hart 2013). Similarly, quarantining an area with a large abundance of the snakes will allow for controlled hunting and removal (Bonneau et al. 2016). In addition, controlled removal of Burmese pythons by levees and roads should help stop their spread to further Northern regions of Florida, but having a way to track the snakes' path as well will cause a more significant decrease in their population (Bonneau et al. 2016). Using various methods to track and control the Burmese python will allow for the ecological impact on native animal populations of Florida to decrease. The Python molurus bivittatus affects the environment in Florida negatively through their predation upon native animal species, lack of predators, and ability to live in many types of habitats (Reed et al. 2012). Indicating these characteristics and understanding climate's impact on the Burmese python furthers the understanding of the snake's spread potential (Quansah et al. 2017). The combination of climate, habitat selection,

lack of predation, and unfussy eating habits results in a higher degree of comprehension of the Burmese python's consequences on the natural environment (Reed et al. 2012). As an invasive species, Burmese pythons eat a wide range of mammal populations and avian populations in the Everglades (Dorcas et al. 2012). The snakes' ability to be a generalist predator helps it succeed in its invasive range with no signs of a decrease in rate of spread (Reed et al. 2012). The snakes' prey have not been able to evolve and adapt to this new predator, resulting in a severe decline in their populations (Dove et al. 2011). By understanding the Burmese pythons' diet, efforts can be made to inform the Everglades National Park and conservation agencies so that the snake populations can be better controlled (Dove et al. 2011). The use of harvest programs and citizen science programs are useful but limited. Therefore, markers to track the spread of the snakes will be useful to create controlled removal and to see the environmental impact of the snakes in Southern Florida decrease.

Note: Eukaryon is published by students at Lake Forest College, who are solely responsible for its content. The views expressed in Eukaryon do not necessarily reflect those of the College.

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