The Environmental and Economic Impacts of an Invasive Species in South Florida

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Abstract

For decades, invasive species have continued to enter our environment, creating several issues. In order to effectively prevent these effects from getting worse, a closer look needs to be taken at both the economic and environmental issues caused by invasive species. This paper aims to bring awareness to the public and policymakers of the harmful impacts that invasive species have on our planet. With specific research on the chosen species of iguanas (*Iguana iguana*) in South Florida, this project highlights the damage iguanas are doing not only to the environment and economy but also to our infrastructure. Recent research and experimentation have brought to light the issues that iguanas cause, such as eating away at the surrounding areas of foundations of different buildings, roads, and bridges, which increasingly are becoming less structurally safe. There have been some advances in the right direction with newly proposed bills for infrastructure, but it is still a long way from directly targeting the problem. This review paper calls attention to these issues currently faced as the threat of these invasive species is expected to continue.

Keywords: Invasive species, Florida iguanas, infrastructure, Iguana iguana, climate change, regulations, invasion mitigation

1. Introduction

An invasive species is an organism that is not native to a specific area or ecosystem (National Wildlife Federation, “Invasive Species”, n.d.). In the United States alone, there are approximately 4,300 invasive species (U.S. Fish and Wildlife Service, 2012). Invasive species are usually taken from their natural habitat, where their abundance is relatively controlled, and brought to an ecosystem that is vulnerable to their life history strategies and usually does not have their natural predators. This off-sets the predator-prey relationships in the food chain (National Geographic, 2012). Vertebrata invasive species can cause severe negative impacts on their new environment because they can prey on native species and compete for food or other resources, which can lead to food and space competition between different organisms. These invasive species can even carry disease to these environments, which pose a threat to the native ecosystems (Ricciardi, 2013). Furthermore, invasive species are usually considered r-selected species, meaning that they have high reproduction rates and can adapt easily to new environments. These distinctive characteristics make them extremely dangerous as they can influence and harm almost all environments they are introduced into (Ricciardi, 2013).

An invasive species is usually introduced into a new ecosystem from accidental releases, people housing them as pets, and on shipping containers from around the world. This paper specifically focuses on the iguana (*Iguana iguana*) in South Florida (National Geographic, 2012). Iguanas are invasive in South Florida and pose a threat to the environment (Fig.1). They were originally brought over to the US as pets, yet were released due to the difficulty of caring for them. The iguanas are known to dig up areas around the foundations and supporting structures of seawalls, bridges, and buildings to lay their eggs. This further affects Florida's infrastructure and ecosystems as it could reduce the effectiveness of systems that prevent flooding such as embankments and seawalls. The purpose of this review paper is to provide insight into the struggles of mitigating the iguana invasion in South Florida.

Figure 1. Photos of the Florida green iguana (*Iguana iguana*) taken in June and July of 2021. A) A single iguana in a garden in Hollywood, FL. B) A different individual iguana climbing on a fence in Hollywood, FL. C) Multiple iguanas on a waterfront deck in El Portal, FL.

1.1 Florida Iguana Invasion

The iguana is native to Central America, South America, and the Caribbean islands. This cold-blooded species prefers to live in tropical climates and is herbivorous, consuming leaves, flowers, and fruit (National Geographic, 2012). Iguanas have no natural predators in South Florida, can grow up to 1.8m in length, and can weigh over 6.8kg (Florida Fish and Wildlife Conservation Commission, FWC, 2021). Their preferred habitat is near the water as they are strong swimmers. Iguanas were brought to the United States as pets, yet have mainly been released due to the difficulty of caring for them during hurricanes and other natural disasters (FWC, 2021*)*.

Iguanas have species-specific needs in order to survive. Iguanas can live anywhere from 12-20 years and prefer to live in extremely warm and humid climates (National Geographic, 2012). When temperatures reach below 10°C, iguanas go into a hibernation state in which they become limp and immobile. This can be dangerous as one may believe that the iguana is dead, yet they are just relatively frozen so once the weather warms up, they defrost and continue with their lives (Townsend, et al., 2003). Iguanas also show their agility and speed as they can run up to 33.8km/h. Additionally, iguanas lay their eggs from 0.6-1.8m underground and can lay up to 40 eggs at a time (Townsend, et al., 2003). Iguana eggs are not exposed to many predators because they are underground, but occasionally some eggs that do not hatch end up being consumed by raccoons and snakes.

Iguanas are invasive in South Florida and are increasingly becoming more dangerous to the environment. Primarily, iguanas pose a threat to the native wildlife because they destroy native crops and plants, which can cause a bottom-up effect in the food chain (Townsend, et al., 2003). This increases the competition for food and resources between iguanas and other species in the environment, which can ultimately lead to a lack of overall food. Likewise, the iguana has recently been observed feeding on flowering plants that are essential to butterfly survival, specifically the Miami Blue Butterfly (*Cyclargus thomasi bethunbakeri*; Bakkalapulo, 2018). These butterflies have faced critical endangerment due to iguanas in 2018 and they needed human intervention in order to be reintroduced in

their native habitat (Bakkalapulo, 2018). It is still likely that these butterflies could become critically endangered again, as the increase in the iguana population poses a great threat.

Due to the iguana's preference to burrow near water and underground, iguanas pose huge threats to the infrastructure of South Florida. They are known to dig in areas around the foundations and supporting structures of docks, bridges, and buildings to lay their eggs. This further affects Florida's infrastructure as it could reduce the effectiveness of systems installed that prevent and control flooding, such as levees and dams (Smith, et al., 2008). As seen in Figure 2, the burrowing of the iguanas near the over-water patio could cause significant structural issues and become unsafe to use. Some of the damage that these iguanas are causing includes increasing the number of people displaced from their homes as well as increasing the threat of flooding in an already flood-prone region (Chakraborty, et al., 2014). This invasive species is harming the environment for the local wildlife as well as humans, and regulations have been implemented to help combat the effects of their damage.

Figure 2. Photograph of burrowing damage, shown in blue circles, done by invasive green iguanas (*Iguana iguana)* to lay their eggs near a waterfront home in El Portal, FL, 2021.

2. Methods

For this review paper, articles from the past 15 years were identified after using Google Scholar as a search engine. The following keywords were used either separately or in combinations to determine relevant articles for this review paper: infrastructure, invasive species, iguana, florida iguana invasion, regulation, iguana removal, infrastructure bill, *Iguana iguana*, climate change, invasion mitigation. Using these keywords, the non-peer-reviewed articles were also found by using the Google search engine. This project focused on invasive animal species in South Florida, 26.3014° N, 80.6327° W (Fig. 3). Additionally, the pictures in this review paper of iguanas and the damage they have caused were taken by the author in El Portal, FL, at a lake-side house and in Hollywood, FL in a home-garden.

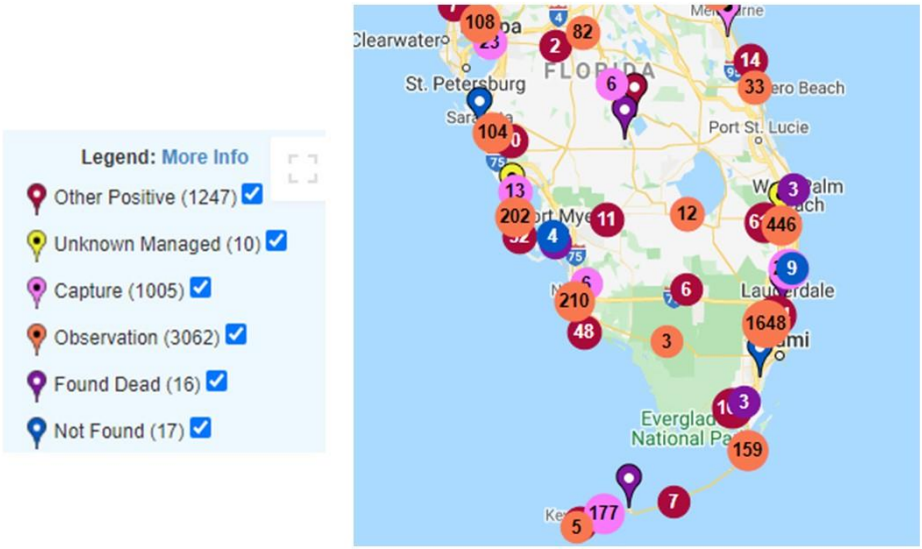

Figure 3. A map sourced from the Early Detection & Distribution Mapping System (2021) of South Florida and the recent green iguana (*Iguana iguana)* populations that have been recorded thus far during 2021.

3. Results

3.1 Regulation

While iguanas continue to harm our ecosystems and infrastructure, there have been some developments in regards to removal of the species. For example, in South Florida, iguanas are protected solely by animal anti-cruelty laws. These laws are in contradiction with the recommendations of the FWC who urge landowners to remove iguanas from their private property.

Removing iguanas while remaining compliant with exhaustive anti-cruelty regulation can prove to be difficult. For instance, to "humanely" kill using a pellet gun, the iguana must be killed using a single shot to the head (Bryan, 2018). However, many cities do not allow these guns to be fired on private property (Bryan, 2018). Another problematic removal method is decapitation. This involves hunting down the iguana and swiftly using a shovel to behead the reptile, which is known to have impressive agility and speed (National Geographic, 2012). If more than one swing is taken at an iguana, it is considered animal cruelty and there could be a fine of up to $5,000 (Bryan, 2018). Lastly, captured iguanas must be handed over to pest and critter control for eradication and control purposes, yet a permit is required to possess live-captured iguanas, which are difficult to obtain (Bryan, 2018). These strict regulations on controlling the iguanas continuously prove to be burdensome as these animals are posing threats to not only the environment but also to the economy.

Environmental Limitations

In addition to the strict regulations for killing iguanas, there are also lengthy limitations that differ among cities in Florida on the proper removal of the deceased animal. For instance, once an iguana is humanely killed, it is prohibited to dispose of the iguana's body in a road or waterway (Geggis, 2018). Depending on different cities, it may also be illegal to put the animal remains in the trash. In the city of Hallandale Beach, in order to remove a deceased iguana, homeowners must contact a private pick-up service (Bryan, 2018). Conversely, in the city of Davie, dead animals including iguanas can be placed in the trash (Bryan, 2018). Lastly, in the city of Hollywood, the city considers iguanas to be "domestic animals" and does not let homeowners put them into the trash (Bryan, 2018). This leaves three additional options in all cities, the burial of the animal at least 1m underground, cremation at a pet cemetery (for a fee), or hiring a local critter removal company to discard the carcass (for a fee; Bryan, 2018).

Economic Limitations

Despite the issues faced by city regulations regarding iguana removal, another pressing concern involves the United States economy. With the U.S. facing hardships in the maintenance of regulations and the funding for infrastructure (Nallathiga, 2013), combined with these rapidly burrowing iguanas (FWC, 2021), the expediting of many more infrastructural issues will be encountered in the years to come. As current infrastructure is mainly outdated and maintenance costs are on the rise (Nallathiga, 2013), civil engineers are advocating for change due to the rise in safety concerns. These concerns include structural corrosion and failure that affects the drinking water (Council on Foreign Relations, CFR 2021), which poses a risk to the public's health (CFR, 2021). This can cause major issues for not only the health of the public but also can cause structural failure to important and frequently used public highways, bridges, and buildings. Both permanent or temporary closures of these resources for maintenance or conservation would create complications with transportation and traffic control (CFR, 2021). Attempts are currently being made to help combat the need for federal aid to help maintain infrastructure, such as President Biden's American Jobs Plan (FACT SHEET: The American Jobs Plan, 2021), yet it lacks the focus on targeting invasive species and their effect on the environment.

Regardless, President Biden has proposed $600 billion in funding to improve the infrastructure of airports, bridges, highways, roads, and even water systems (FACT SHEET: The American Jobs Plan, 2021). The American Jobs Plan mainly targets the working class as the major idea is to create more jobs in America. This would greatly help the issue currently faced with the deterioration of infrastructure due to invasive species. Yet the inconsistencies in this plan begin when the majority of this allocated money will go towards training workers, manufacturing facilities, and research (FACT SHEET: The American Jobs Plan, 2021). Furthermore, this plan predominantly illustrates how funding will be used to create jobs which will hopefully help fix the problems with our infrastructure. Although this shows the great potential of the plan as a step in the right direction, it is not enough to target the specific issues of eliminating the threat of invasive species. As of August 10, 2021, part of this infrastructure bill has passed through the senate, yet there is no guarantee that it will help target these specific issues of invasive species.

4. Discussion

With the extensive regulations on iguana removal, there are a few solutions that have yet to be proposed. For example, using a fast-acting poison that only affects iguanas in areas that are being targeted could easily help decrease population and growth. An example of this can be found in Antarctica, where invasive rodents were eradicated. To accomplish this, scientists created a rodenticide bait containing brodifacoum to help remove the species (Springer, 2016). An unintended consequence of this solution, if used in Florida, could be the poison entering the water supply, which might pose a risk to human health. A commonly proposed solution is human-introduced species. Human-introduced species can specifically target a category of animals, such as the iguana, yet once the iguana population becomes diminished, this newly introduced animal or plant could become harmful for other species as well. For example, one of the only animals that are predators to iguanas are eastern racer snakes *(Coluber constrictor)*, which are endemic to South Florida (Oxley, 2018). This poses an issue not only because they are extremely dangerous animals, but iguanas and racer snakes live in two completely different environments (Oxley, 2018). This would make it hard for the snakes to target all iguanas, as the iguanas live not only in parks and rural areas, but in residential areas as well, where the snakes cannot thrive. This technique has been used on several islands where there were feral cats which were responsible for playing a big part in the disappearance of many native and global species. By human-introduction of rats into the area, the cats became more likely to target rat species rather than native plants or animals (Nogales, et al., 2004). These rats were also poisoned, which killed the cats after they consumed the rats (Nogales, et al., 2004).

Other than proposed environmental solutions, there are also economic propositions that could fight the negative effects of iguanas. As discussed earlier in this paper, attempts are being made to help increase funding for infrastructure maintenance and projects (Nallathiga, 2013). However, in order to directly tackle the issues that infrastructure and the environment face, policymakers need to change their focus to include adding new job categories that focus more on invasive species and their effects on the environment. This would greatly help when proposing new budgets and legislation for the maintenance and protection of infrastructure as it would include a section dealing with invasive species.

Future studies should include focusing on how climate change could affect the range of the iguanas. Currently they have a lower temperature tolerance of 7°C, restricting them to South Florida (National Geographic, 2012). An

increase in local and global temperatures (Zaval et al., 2014) could increase their range across Florida and nearby states. This change in distribution could cause more widespread environmental and economical issues in new areas.

5. Conclusion

The rapid damage of iguanas in South Florida continues to damage and affect infrastructure security and wildlife conservation. Mitigation of these invasive iguanas will bring massive improvements in the environment. Full removal of the species will make sure that burrowing, which affects structural components of infrastructure, is reduced, yet it will not be able to fix the current damage. The downside to not changing anything about the problems created by invasive species is that they will continue to harm the ecosystems in which they live. This could also potentially force already problematic structural issues to become even more dangerous and hazardous to humans as well as wildlife. Differences in regulations across three different South Florida cities make killing and disposal of iguanas a lengthy and tiresome process. These added barriers make it complicated for residents to adhere to the calls of the FWC to eliminate the iguana population. With current proposed bills for infrastructure development, it seems as if there have been advances but it is not directly targeting problems that invasive species generate. To reduce this problem, new job categories should be introduced to specifically study the issues that invasive species cause. With this newly introduced job category and its research, when bills are drafted, policymakers will have more background on the source of many infrastructure problems. As recent invasive iguana populations are on the rise, threats to the environment and the economy will grow. All in all, an increase in resources for invasive species damage mitigation will result in a reduced inverse effect on the environment all while increasing public awareness.

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