

Anthropogenic Effects on the Ecosystem and Biodiversity

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It's no secret that our planet is declining due to human actions, but this reality did not fully resonate with me until I got the opportunity to go to Puerto Rico and see the damage firsthand. Throughout the week, we observed and learned about many environmental issues but the one that impacted me the most as a pre-veterinarian student, was marine biodiversity loss caused by coral bleaching. Seeing the effects of global warming up close was both disheartening and eye-opening. At the same time, it was reassuring to learn that there are dedicated efforts underway to help restore these ecosystems. This experience felt especially personal because it made me reflect on similar environmental challenges closer to home. For example, one of the most widely discussed issues in recent years has been the alarming decline in bee populations, which, like coral reefs plays a critical role in maintaining biodiversity.

Anthropogenic activities have contributed the most to the decline in coral populations as well as marine biodiversity loss. Things like overfishing or destructive fishing, harvesting coral or brightly colored fishes for aquariums and jewelry, pollution and the warming climate are all practices that pose serious harm to marine ecosystems. Throughout the duration of our semester and while in Puerto Rico, we focused heavily on climate change and pollution. Pollutants such as sediments, nutrients, chemicals, insecticides, oil and debris can enter the water in a plethora of ways. They can then increase nutrient levels of the water and promote rapid algae growth which takes over the coral reefs (NOAA).

Coral reefs play a vital role in maintaining the stability of marine ecosystems. They provide habitat for nearly 25% of all marine species, many of which rely on reefs as breeding grounds or nurseries. In addition to supporting biodiversity, reefs help protect shorelines by absorbing wave energy, reducing coastal erosion and damage. In addition, they contribute to nutrient recycling which maintains the water quality and supports productivity of seagrass beds and mangroves. All these points make coral reefs essential to the overall health of marine environments (How Do Coral Reefs Affect).

While we were in Puerto Rico, we had an amazing opportunity to visit a coral nursery called Iser Caribe in La Parguera. They are determined to restore not just coral reefs but the whole ecosystem surrounding them, with a goal of restoring 5 acres of reef in Puerto Rico alone. To achieve this, they utilize both sexual and asexual reproduction. For sexual reproduction, they collect coral gametes and fertilize them in a lab setting to grow new, genetically diverse corals. For asexual reproduction, they cut bits of live coral into fragments, glue them to a cement puck

and then put them in climate-controlled tanks to encourage them to grow. Once the corals are grown and ready to be released, they plant them on degraded reefs where they can grow and eventually help restore the reef ecosystem as a whole (Coral Reef Restoration).



Figure 1: Up close image of coral



Figure 2: Coral fragments in climate-controlled tanks.

In addition to corals, they also grow 3 different species of sea urchins and Caribbean king crabs (Coral Reef Restoration). We got the opportunity to sit and listen to Stacey Williams, who is a cornerstone of coral reef restoration in that area, discuss the importance of not only restoring the reefs themselves but the entire ecosystem that surrounds it. A major focus of this effort is maintaining a balance between corals and algae. Herbivorous species play a critical role in this process by grazing on algae, which would otherwise compete with corals for space and sunlight. If algae overgrow, they can block light and hinder coral growth (Beebe). By maintaining populations of organisms like sea urchins and herbivorous crabs, they can help control algae levels and support the long-term recovery and stability of coral reef ecosystems.



Figure 3: Caribbean King Crab.

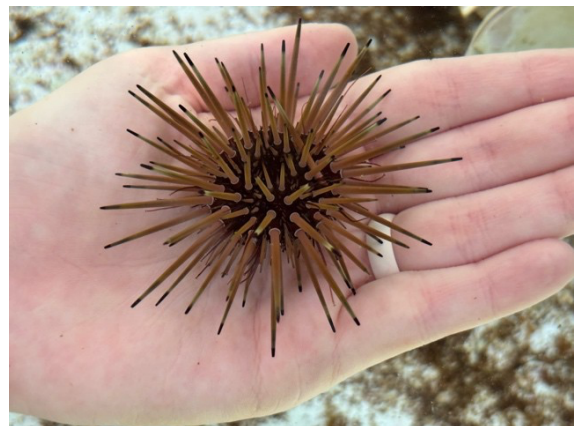


Figure 5: Sea Urchin



Figure 4: Iser Caribe employee showing us Caribbean king crabs in nurseries.

Similar to the issues we saw while in Puerto Rico, the Midwest and many other places around the world are seeing a steep decline in pollinator populations, specifically bees. Bees are essential to biodiversity, as they support the reproduction of many plant species that humans and animals depend on to survive. They are also a focal point for agricultural systems by enabling crop production. Much like the coral reefs we studied, the decline in bee populations is largely driven by human activities including habitat loss, climate change, and pesticide use. All of which disrupt these fragile ecosystems.

Habitat loss is one of the greatest threats to pollinators. As more areas become industrialized, deforestation continues to worsen, native landscapes are replaced with concrete or asphalt, and monoculture farming expands into nearly every available space. This leaves the small but essential organisms that support our ecosystems with few safe places to live. Pollinators such as native bees, caterpillars that turn into butterflies, moths, and even soil-dwelling organisms like worms that help with soil aeration rely on their natural habitats to survive. Many of these species hibernate in the leaf litter that accumulates after fall. This thick layer of dead plant material acts as an insulating barrier, helping them endure cold temperatures (Wheeler, Justin, et al). Without it, their chances of survival drop significantly. In recent years, this issue has become even more concerning due to the growing trend of maintaining perfectly manicured lawns, which often involves removing the very habitats these species depend on.

Pollution and excessive pesticide usage are also threats to pollinators. With a sudden change in temperatures and precipitation patterns, the distribution of plants and their flowering times has changed significantly (Phillips Taft, Morgan). This means that plants can flower before bees come out of hibernation, leaving them with little nectar sources when they do emerge. Combined with habitat loss, this forces pollinators to travel longer distances under increasingly harsh environmental conditions, placing additional stress on already vulnerable species. The widespread use of pesticides further exacerbates the problem at hand, particularly neonicotinoids, which have become increasingly common in modern agriculture. These chemicals can persist in the soil for months, and while they may not always kill bees outright, they can have serious sublethal effects. It has been shown that exposure causes weakened immune systems, disrupted navigation, and

delayed development. All of which have cascading and potentially devastating impacts on entire colonies (Phillips Taft, Morgan).



Figure 6: Bee in
Leaf Litter
(Trev4
Photography)

Although bees often have a negative reputation, many people would likely reconsider their view if they understood the consequences of their extinction. If bees were to go extinct, the world as we know it would change dramatically. Many plants that produce fruits, vegetables and even coffee would be gone, as they rely almost entirely on bees for pollination and reproduction. Bees are responsible for pollination of around 70 out of 100 crop species that feed the entire world (Phillips Taft, Morgan). Without them, food production would quickly decline, leading to widespread food shortages and potentially an economic crisis. A reduced food supply would likely drive prices up significantly, which could trigger widespread instability. Beyond human impacts, the loss of bees would also disrupt entire ecosystems. Herbivorous animals would lose vital food sources, and in turn, carnivorous animals that eat those herbivores would also decline. While this would not cause an immediate apocalypse, it would lead to a major and cascading loss of biodiversity over time.

As we saw with coral reefs and marine ecosystems, it's not too late to try and reverse the damage we have caused. To restore pollinator populations, such as bees, there are changes we can make on both large and small scales. On a large scale, we can reduce industrialization and implement stronger protections on lands like forests and national parks. We can also stop using harsh pesticides for crops and instead utilize natural predators to control pests that damage crops. Additionally, we can focus harder on climate change and restoring earth's ozone layer. On a smaller scale, we can focus on making our lawns more pollinator friendly. We can do this by either leaving the leaf litter on our lawns through the winter or just relocating the piles of leaves to garden beds. Not only does this protect hibernating organisms, but it also improves soil quality. We can also make sure to plant specific flowers that would give pollinators a nectar source nearby when they become active in the spring.

Although the large-scale changes are not in the control of any one single person, my professor, Dr. McConnell, taught me that even one small change can make a difference. If every single person on this Earth made one small change every day, it could make a huge impact. However, this requires people to care, and people can't care about what they do not understand. My professor also shared a quote with our group that I want to end with, as it has been so impactful: "We only protect what we love. We only love what we understand. We only understand what we are taught" (Jacque-Yves Cousteau). My only goal in writing this was to inspire people to become educated about our Earth, so if nothing else, I hope you feel inspired to make one small change.



Figure 7: Bee collecting nectar from flower. (AJ)

Citations

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