

Microplastics and its Effects on the Endemic Species of the  
Galápagos Islands

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**Abstract:**

The Galapagos Islands has the highest levels of endemism than anywhere else in the world. Some of the most well-known endemic species are the Galapagos Giant Tortoise, the Galapagos Penguin, the Flightless Cormorant, the Marine Iguana, the Galapagos Fur Seal, and the Galapagos Sea Lion. Many of these species feed directly on the fish found off the coast of the Islands. The problem is that these fish species are ingesting these tiny particles called microplastics. Microplastics are consumed by fish and larger organisms by mistake thinking that it is plankton. The fish are then consumed up the food chain which causes bioaccumulation. The endemic species of the islands are then eating these microplastic filled fish which then in-turn means that they have microplastics in their systems. Microplastics can be very toxic to the organism that are ingesting them, and serious action needs to be taken to preserve the natural beauty of the Galapagos Islands.

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### **Introduction to the Galápagos Islands**

The Galápagos Islands are volcanic islands that are located on the equator, off the coast of Ecuador, see Figure 1. There are 18 large islands, 3 small islands, and over 100 rocks. Of these islands, only four of them are inhabited by humans (World Wildlife, 2020). The islands are continuously changing due to volcanic eruptions that have happened in the past as well as eruptions that are happening now. Each of the islands can be split up into four habitat zones depending on the temperature, elevation, and amount of rainfall. The first of the four zones are known as the littoral zone (World Wildlife, 2020). The littoral zone is the area near the shore where you will find mangroves and other salt tolerant plants. The next zone is known as the arid zone. This zone is what most of the islands are comprised of, ranging from 80 to 200 meters in elevation (World Wildlife, 2020). The arid zone consists of most of the diversity on the islands. The next zone is known as the humid zone. The humid zone will have a fog that allows the vegetation at these elevations to maintain moisturized. There is said to be a transition zone between the arid and the humid zone. The transition zone consists of a combination of the plant species found in the two zones. See Figure 2 for a visual view of these zones. The islands of the Galápagos are a product of mantle plumes. Mantle plumes rise because they are hotter and less dense than the surrounding rock. These plumes rise about ten centimeters per year.

### **Endemic Species of the Galápagos Islands Overview**

The Galapagos Islands has the highest amount of endemic species than anywhere else in the world. According to the Galapagos Conservancy (2020), 80% of the land birds that are on the islands, 97% of the reptiles and mammals, and 30% of the plants are endemic to the islands. Some of the endemic species you might see on the Galapagos Islands are, the giant

tortoises, the marine iguana, the flightless cormorant, the Galapagos penguin, the Galapagos fur seal, and the Galapagos land iguana.

### **The Galapagos Giant Tortoise**

The Galapagos Islands is home to one of the two groups of tortoises that live in the world today. On the islands there are fifteen species of Giant tortoises across the archipelago. The tortoises are native to many of the bigger islands as well as to the major volcanoes on Isabela Island. The giant tortoise spends almost sixteen hours of its day resting depending on the temperature as well as food availability. When the temperature is hotter the tortoises tend to be more active early in the morning and in the late afternoon when it is cooler. When the temperature is cooler, they will be active in the middle of the day. Tortoises are able to survive without food and water for long periods of time, so when water is available, they will stock up, and in times of drought they will be resting for long periods of time (Galapagos Conservancy, 2020). Tortoises tend to breed in the warmer months and then nesting/laying their eggs within 4-5 months after mating. When laying their eggs, the amount of eggs laid depends on whether it is a saddleback tortoise or a dome tortoise. Male tortoises are also able to communicate through groans, but the females are unable to communicate.

### **Marine Iguana**

The Marine Iguana of the Galapagos Islands is the only lizard in the world that goes in the sea (Galapagos Conservancy, 2020). The marine iguana finds its food in the sea and then comes back on shore to warm up from the coldness of the water. When it comes to adapting to its environment the marine iguana has really evolved to be almost perfect for its environment. They have a short nose that helps them feed on algae, a flat tail that helps them propel through the water, a special gland that allows them to get rid of extra salt consumed from feeding on

algae, and of course, its legs that allow them to walk on land (Galapagos Conservancy, 2020).

The marine iguana's main food source is algae, but when El Niño events occur there is a lack of algae, so the iguanas tend to become shorter and thinner, as well as some have been found to be consuming in-land vegetation. The colors of the marine iguanas vary depending on how mature they are as well as the time of the year. Breeding season causes the males colors to get more vibrant.

### **The Flightless Cormorant**

The flightless cormorant is the only species of cormorant that is unable to fly. These flightless birds are only found on Fernandina Island and Isabela Island, due to the colder waters. Because they don't have many predators, flying was not an ability that was really a use for them, so they had evolved stronger legs, to be better at swimming. The flightless cormorant mainly feeds on eels, octopus, and fish, so they have been affected by the El Niño occurrences (Galapagos Conservancy, 2020).

### **The Galapagos Penguin**

The Galapagos penguin is the only penguin that lives at the equator and are mostly only found on the islands of Fernandina and Isabela, because of their cooler waters. They keep cool by swimming in the cool waters during the day and then sleeping on land at nights when it is cooler. To prevent sunburn on their feet, they will hold their flippers over them. The Galapagos penguins will breed throughout the year and then lay their eggs under lava. When feeding, the penguins mostly feed on small fish, but there have been fluctuations of their food during El Niño years (MarineBio, 2020).

### **The Galapagos Fur Seal & Sea Lion**

The Galapagos sea lion can be found on the rocky shores of the islands and are usually some of the first mammals you will see. They feed mainly on fish. The male sea lions can be very aggressive and territorial if you come into their harem. A harem consists of female sea lions and their pups (Animal Corner, 2020). The male sea lion will protect its harem from the sea from any predators as well as any other sea lions. The Galapagos fur seal tends to be confused with the sea lion, but can be found in the rockier, shaded areas on the shores of the islands. The difference between the two tends to be that fur seals are smaller in size, have larger front flippers, have a larger fur coat, and have ears that come out of their head more. The fur seal primarily feeds on fish and squid. Like the sea lions, fur seals also have harems, but they are usually being protected on land instead of in the water (Galapagos Conservancy, 2020).

### **Microplastics Overview**

Microplastics are small pieces of plastics that can come from larger pieces of plastics that have broken down overtime. Microplastics is any plastic that is less than five millimeters long, see figure 3 (National Ocean Service, 2020). Microplastics have two broad classifications: Primary microplastics and secondary microplastics (Wikipedia, 2020). Primary microplastics are plastics that are deliberately produced at a small size for things like cosmetics. These plastics are used and then sent through the water system where they do not breakdown. Secondary microplastics come from larger pieces of plastic that break down over time due to sunlight. The sources of where microplastics come can be found in sewage treatment plants, cosmetics, clothing, packaging and shipping, fishing industry.

### **History of the Endemic Species of the Galápagos Islands**

The way that the species of the Galapagos Islands had arrived at the islands is something that is so fascinating by many people. The islands of the Galapagos were formed by the eruptions of underwater volcanoes. These islands had no life forms on them when they first came up from the sea. When species arrive to the islands, there are two main ways for them to arrive to the islands: by air and by sea (Galapagos Conservancy, 2020). Most species that had arrived by sea are believed to have floated to the islands on rafts. The species that are believed to have arrived by rafts are mostly reptiles. Plants that are adjusted to salty water are also thought to have arrived by sea. Species like sea turtles, penguins, sea lions and penguins, could have just swam to the islands with the help of the strong currents that can help to carry them. Species that had arrived by air were carried by the wind. Many of the species that arrived by air were plant seeds such as dandelions as well as many small insects. Sea and land birds also would have just flown to the islands, but land birds tend to struggle more with long distance flights, so the wind must have helped to carry them on their long journey to the islands.

### **Effects of Microplastics on Marine Life**

There is said to be 51 trillion microplastics in our oceans today (UN News 2017). The problem with microplastics compared to macroplastics, is that marine animals that filter their food such as fish and whales can mistakenly ingest these microplastics thinking they are plankton. As these microplastics are ingested by the smaller organisms, the amount of microplastics will continue to accumulate as you work your way up the food chain. Chemicals and pollutants that are found in our waters are more attracted to the plastic particles than the surrounding water. The chemicals and pollutants end up attaching themselves to the surfaces of

these microplastics which is then later ingested by fish and other organisms. The organisms are now ingesting these pollutants, which can also lead to more problems as you climb up the food chain.

### **Effects of Microplastics to the Galápagos Islands & its Endemic Species**

Microplastics and plastic pollution is something that is affecting marine life as well as eventually effecting our own health. The Galapagos Islands have the highest level of endemism in the world. Many of these endemic species rely on the currents that bring their food source to them. These currents are also bringing them these microplastics that their food sources are ingesting. Many of the tourists who visit the islands as well as the people that live on the islands are very conscious about recycling, being eco-friendly, and not littering. So, this raises the question on how all of these plastics are making it to the shores of the islands. Most of the plastics and microplastics that are coming to the Galapagos islands are coming from the coast of South America (Sebille, 2019).

There is currently an ongoing study going on in the Galapagos Islands by two 2017 graduates who are studying microplastics and how they arrive to the Galapagos islands. The two graduates are doing a fish-gut analysis for microplastics in fish as well as survey on macroplastics (Nick Dunn, 2017). The fish-gut analysis was done on fish that were caught off the coast of the islands. They cut open the intestines and the stomach of the fish and place the contents in sodium hydroxide, which breaks down organic matter. This then allows them to look at the other undigested contents through a microscope to see if they can find any microplastics. This is still an ongoing study, but it really is a great way to see how much microplastics are being ingested by the fish off the coast of the Galapagos Islands.

So, the real question is how is fish off the coast of the islands effecting the endemic species of the islands? Well, one of the most common food sources for many of the endemic species of the Galapagos Islands is fish. The endemic species may not be directly eating these plastics themselves, but they are eating the fish that could have high contents of microplastics in their systems. The microplastics can also be toxic to the birds and animals that are consuming them.

### **Potential Solutions**

Most of the solutions when it comes to stopping the consumption of microplastics comes from us stopping the use of plastics on land. One way of stopping microplastics from entering our waters is to reduce and refuse the use of single use plastics. Whether it is refusing a plastic bag at the grocery store or refusing a straw when you go out to eat, anything can help to lessen our single-use plastic consumption. Try switching to reusable products such as stainless-steel water bottles, or reusable straws, or reusable grocery bags. Another way of stopping microplastics from entering our waters is by helping out with beach clean ups or any kind of pollution clean ups. This helps stop the pollution that could be entering our waters from entering. You can also avoid using any products that already contain microbeads such as face washes, toothpaste, and bodywash. This stops the entering of the primary microplastics into our waters (Brian Hutchinson, 2014). The people of the Galapagos Islands are collectively spreading awareness of now allowing many plastics on their islands. There are many beach cleanups happening on the islands as well as trying to reduce the amount of single use plastics on the islands. Fisherman on the islands have also found ghosted fishing nets and different plastics bottles from all over the world in their oceans (Environment Programme, 2018). According to

the Environmental Programme, Ecuador has joined the Clean Sea campaign. This can help the Galapagos Islands, because much of the litter that is coming to them is coming from the shores of Ecuador.

### **Conclusion**

The Galapagos Islands are an amazing place with such high levels of endemism. The islands are being affected by many things whether it is climate change or invasive species, but one of the hardest obstacles the islands is facing is microplastics. Microplastics are broken down from larger plastics. Trying to get rid of these microplastics is something that there is still very little research on. Because there is so little research on the topic it is very hard to say how badly this will affect the islands, but this is defiantly something that is going to have a negative effect on the endemic species of the islands. One of the problems is figuring out how to extract these microplastics from the oceans before they are fed on by the organism which then bioaccumulates up the food chain. The main way to slow down the consumption of these microplastics is to start from the source. There needs to be less plastics being produced and used, as well there needs to be more efforts focused towards cleaning up these larger plastics, so they never turn into microplastics.



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