

Environmental Consequences of the Shark Fin Trade

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### **Abstract**

Many countries legally prohibit the shark fin trade; however, it is still an ongoing problem to protect the lives of one of the ocean's top apex-predator. In Asian countries, there is a high demand for shark fins, especially in Hong Kong and China, as they use the fins to produce shark fin soup. Due to the high demand, sharks are depleting at a rapid rate, and it is affecting the oceanic ecosystems. In order to help this apex predator, policymakers need to become more aware that sharks are an essential species in the marine ecosystem. This thesis seeks to explore the shark fin trade and the effects that it will have on the marine ecosystem in the future. Extensive background research on shark behavior, shark biology, and an examination of ecotourism will be used to identify and answer essential questions in the protection of sharks. Ultimately, this thesis seeks to find the best solutions and legislation for protecting sharks at the international level through institutions and the creation of the first shark commission.

*Keywords:* shark fin trade, apex-predator, trophic levels

## **Introduction**

Sharks have been roaming the oceans of the world for more than 400 million years, as sea creatures were the Earth's first prehistoric animals to exist. The increasing rate of extinction among the world's sea creatures are caused by a plethora of reasons, but media representations of animals are rarely discussed. The vast images and other representations of 'villainous' sea creatures in film are an undeniable aspect involved in the exploitation of animals, and their later possible extinction. The shark is in danger.

Today, the population of sharks is on a dangerous breaking point. Due to the shark fin trade and along with the industry of commercial fishing, most shark species are at the brink of extinction. The widely known "Jaws" image was a climatic moment in the generalization that sharks are predators we should fear and conquer mindlessly. The shark is seen as a mindless killer, but that is not the case. Humans should fear the absence of sharks. Their role in oceanic ecosystems is vital to both these environments and to our immediate world. Annually, humans kill more than 100 million sharks globally (Griffin, Miller, Freitas, and Hirshfield, 2008). Shark is ranked as one of the most expensive seafood. Included in this annual number are the millions of these animals fisherman catch in pursuit of shark fins. Sharks are important apex predators and are essential in maintaining the balance of species in the trophic levels below them, therefore greater legislation to protect them is vital.

All species of sharks are essential in helping to remove weak and sick fish from the sea. Furthermore, along with their competitors, sharks are crucial maintainers of balance to help secure species diversity. As top predators, sharks diversify their prey's habitat, resulting in shifts in the feeding strategy and diets of other marine animals. Therefore, sharks indirectly balance coral

reefs and seagrass habitats. The rapid decline of sharks has led to a deterioration in both seagrass habitats and coral reefs. Also observed was a downfall in commercial fisheries (Griffin, Miller, Freitas, and Hirshfield, 2008). By eradicating sharks from the ecosystems, larger fish would begin to increase in number; thus there would be an increase in the preying of herbivores. With a decrease in herbivores, macroalgae would expand. Then coral would no longer be able to sustain life, altering the ecosystem to an algae-dominated one.

There are many factors about sharks that are still incredibly unknown; because of this, humans find it challenging to track and study the species thoroughly. Many sharks activities and shark migrations are a mystery to biologists and conservationists. These biologists and conservationist seek to know more about what sharks do when they are farther away from the surface. The lack of knowledge about sharks contributes significantly to human fears about them. Gaining more understanding of sharks can change the way humans perceive them, thus improving the way that people react to the shark fin trade. Conservationists need to shift the way that fisherman think, while also highlighting other sources of income that would be beneficial to them, like tourism. By adequately educating fishermen on what the loss of sharks would mean for the ecosystem and appealing to other sources of income, the fisherman would be more inclined not to kill sharks for a living. However, in recent years, the attitude towards sharks has, to an extent, begun to change from the images of vicious and cold-blooded killers to misunderstood, charismatic, and extremely valuable animals.

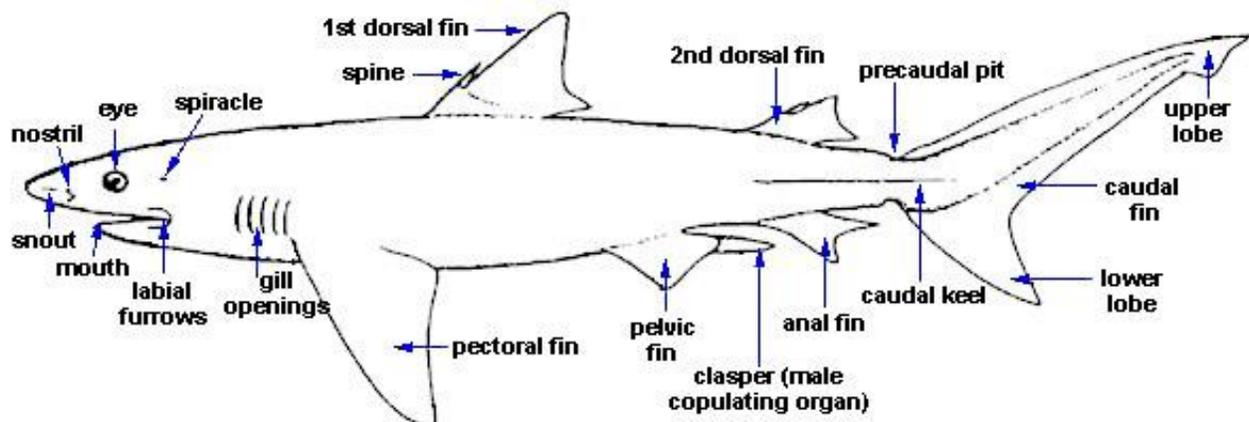
This thesis seeks to explore the shark fin trade and the effects that the business will have on the marine ecosystem in the future. Furthermore, there will be an exploration of what shark conservationists can do to protect the lives of these marine animals better. Extensive background research on shark behavior, shark biology, and an examination of popular culture will be used to

identify and answer essential questions in the protection of sharks. A multitude of case studies on the absence of sharks in the ecosystem will key to this thesis, in addition to an analyzation of various countries involved in the shark fin trade. Ultimately, this thesis seeks to find the best solutions and legislation for protecting sharks at the international level.

## Introduction to Sharks

### Shark Anatomy and Biology

In understanding the shark fin trade, people need to understand basic shark anatomy and biology. Sharks belong under the class of cartilaginous fishes. To be considered in this class, the fish have to be jawed, with two-chambered hearts, and have paired fins. The cartilaginous class is divided into two subclasses which are the Elasmobranchii and Holocephali. In the Elasmobranchii class sharks, rays, and fish with shaped gills are under the category. In the Holocephali class, consists of chimeras which are also known as ghost sharks (Helfman, & Burgess, 2014).



**Figure 1:** Anatomy of a Shark (Florida Museum, 2018).

Shark mouths and nostrils are positioned on the underside of their head exceptions to this statement are frilled sharks and megamouth sharks. In addition, sharks' teeth are attached to their gums rather than their jaws which means that sharks can replace their teeth multiple times (Helfman, & Burgess, 2014). Sharks throughout their lives may go through about 20,000 individual

teeth. Shark's bones are made up of cartilage and may be partially calcified in the vertebral column. In shark cartilage, there is an ingredient that impedes tumor growth which proves that sharks rarely have cancer. With no hard bones present in the shark's body, red blood cells are made in the kidneys and in an organ called the epigonal, and the white blood cells are produced in the spleen and the within the spiral valve of the intestine. About 85% of a single shark's weight is composed of muscle, and in sharks, there are two types of muscle: red and white (Helfman, & Burgess, 2014). Red muscle requires a significant amount of oxygen, and is for slow-contracting movements. Red muscles are also used for cruising and stamina. However, the white muscle is used in a fast-contracting environment and becomes lethargic due to the build of lactic acid (Castro, 2016). The shark's white muscles are used for short explosions of speed of an attack or to escape threats.

Moreover, 90% of a shark's muscle mass is made up of white muscle (Helfman, & Burgess, 2014). Lastly, Sharks have eight fins which are the paired pectoral fin, paired pelvic fin, anal fin, caudal fin, dorsal fin, and second dorsal fin. The fins are made up of cartilage rods and are rigid, not flexible. The paired pectoral fins help lift the shark as it swims, and the paired pelvic fins are essential in stabilizing the shark along with the dorsal fin. Depending on the type of shark, there will be one or two dorsal fins. The most prominent dorsal fin is the fin that is located on the top of the shark right behind the head, and it frequently is seen sticking out of the water. In addition, the dorsal fin prevents the shark's body from tipping over or rolling over (Helfman, & Burgess, 2014).

Due to a shark's anatomy, shark meat becomes contaminated with urea quickly after death unless the meat is kept in the refrigerator which makes shark meat have a low monetary

value and is not worth transporting and selling (Helfman, & Burgess, 2014). Shark fins, however, are an expensive delicacy in Chinese culture and are used in shark fin soup and traditional soups.

### **Where are Sharks Mostly Found?**

Sharks are present in every ocean; however, research shows that 70% of the world's oceans are shark free. Sharks are not territorial creatures like how some other are, which means that their habitat is frequently changing. Unlike other fish, female sharks once they give birth or lay their eggs do not stay to take care of their newborns, and the young sharks are already to take care of themselves. Sharks have been alive for centuries because they are magnificent creatures at adapting to their surrounding environment, which in result means that sharks can change their living habitat in search of a food source. Sharks are cold-blooded, but that does not mean that they only live in cold waters. Sharks live in warm, temperate, cold waters. Depending on the type of shark species, varies on where they live.

Shark migration is a fact when talking about sharks because sharks can travel up to hundreds of miles to find food sources. Most sharks live in the oceans, but some species are known to be found in bodies of freshwater to find food, for example, the bull shark which travels up the Amazon river up to 4,000km (Helfman, & Burgess, 2014). When sharks are found in fresh bodies of water, it can be the result of the destruction of their habitat by human activity and or pollution. Sharks are going to live where the water is deep enough where hiding and hunting can be easier. However, most sharks swim up to the shore and to the water surface to find food, but they do not eat on a daily basis which is why sharks live in deeper waters.

Tropical sharks like the great hammerhead and nurse shark are found in tropical waters near the equator (Helfman, & Burgess, 2014). Polar sharks live near ice caps, and these sharks

have adapted to live in cold waters that are above freezing point. Sharks that can live in polar climates for example are the black dogfish shark and the Greenland sleeper shark. Most notably, large sharks like great white sharks and basking sharks live in temperate waters which lie between tropical and polar regions. Sharks that live in temperate waters often venture out into tropical waters. However, smaller temperate region sharks stay in their region because such drastic changes can harm the shark and are no longer liveable for them (Castro, 2016). In these various regional climates, include different habitats that sharks are found in which are rocky coastlines, sandy plains, coral reefs, open ocean, and freshwater.

Rocky coastlines are rough and may not seem like a hospitable environment for a diverse ocean habitat, but a diverse variety of marine species flourish in these rocky coastlines which is why it is a hotspot for sharks. Small marine animals are on rocky coastlines seeking shelter among the rocks such as seal lions, and coral and algae thrive in this environment. The steady food supply that comes out of this habitat attracts sharks such as dogfish sharks, great white sharks, and hammerhead sharks which are the top most sharks that are shark finned (Helfman, & Burgess, 2014).

The sandy plains, are the shallow regions that make most of the continental shelf, and the sandy and muddy area support a variety of sea life such as small fish and crustaceans (Helfman, & Burgess, 2014). Sharks that thrive in this ecosystem are angel sharks, great hammerhead sharks and saw sharks. These sharks sniff out their prey even if they are buried under the sand. For example, the angel shark hides in the sand to make itself invisible to its prey, and the shark can lay in that position for days.

Coral reefs only occupy a sliver of the earth's ocean, but coral reefs are home to over 25% of the global sea life (Helfman, & Burgess, 2014). Gray reef sharks, Caribbean sharks, and

zebra sharks can be found near coral reefs living off of the diverse marine life. The sharks that live in the coral reef habitats are vital in keeping the environment balanced and healthy. Zebra sharks are known for having a sleek body that can squeeze in the crevices in the coral reefs to hunt, and they usually hunt at night and rest during the day at the bottom of the ocean.

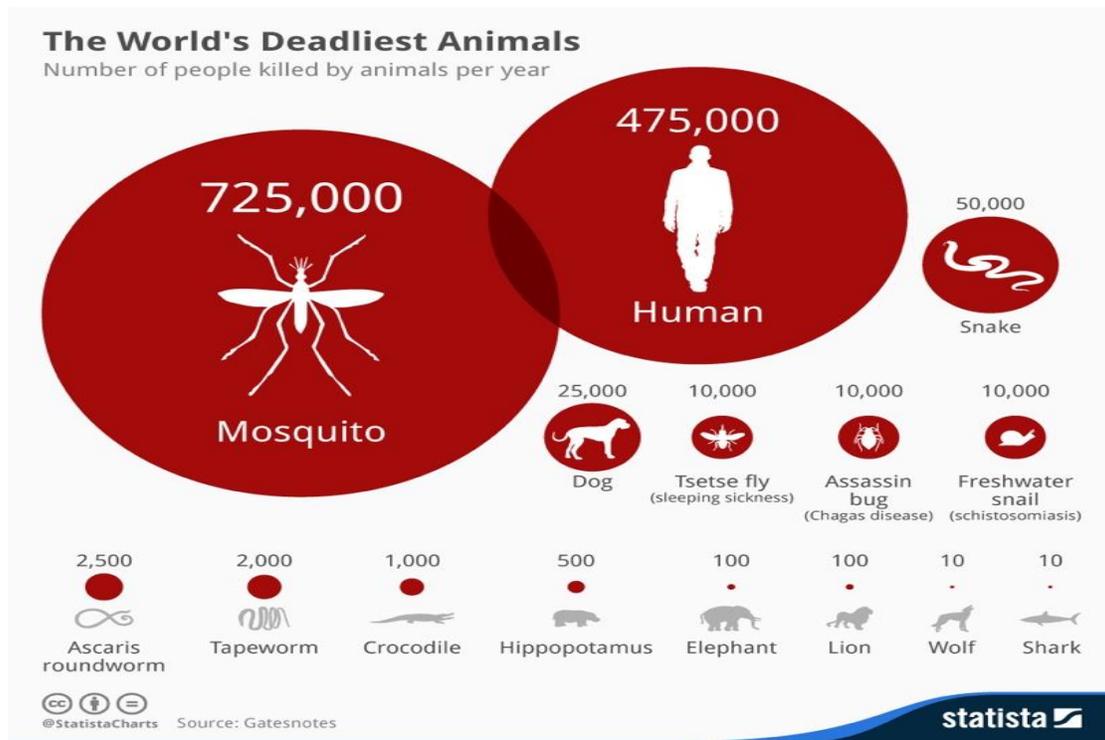
Next is the open ocean, which is over 300 million cubic miles and is known as the “pelagic zone” (Helfman, & Burgess, 2014). In this region, fish are known to travel in schools and are challenging to catch. To live in the pelagic zone sharks have adapted to become fast moving and swift with their movements. Blue sharks, thresher sharks, and shortfin mako sharks are some of the shark species that flourish in the open ocean. The shorten mako shark is extremely fast reaching a speed of 50 miles per hour (Helfman, & Burgess, 2014).

As mentioned earlier, some sharks are found in bodies of freshwater. The most common species living in fresh waters are bull sharks which are located in brackish waters usually living in Australia and Southeast Asia which are the areas where shark finning happens most often.

### **Popular Cultures Effect on the Decline of Sharks**

#### **Why are People Afraid of Sharks?**

People are terrified by sharks because of the bad publicity and movies like Jaws that makes people more aware of shark attacks that happen globally. The ultimate truth is that sharks



**Figure 2:** The World’s Deadliest Animals (McCarthy, 2014)

rarely kill people; dogs and mosquitos kill more people than sharks annually, and even falling coconuts are beating sharks in the number of deaths annually. Humans are afraid of sharks because of lack of knowledge and ignorance about the truth behind what sharks are and what they do under the ocean surface. Scientists believe that sharks only attack humans due to mistaken identity. Surfers on their surfboards to sharks look like a sea lion, sea turtle, and a seal when seen from under the surface which makes sharks curious to try and test their prey. Moreover, sharks often attack humans because of human activities such as aquatic activities, splashing, and fishing. These activities provoke sharks to attack, along with humans wearing flashy and shiny jewelry. Sharks since their first discovery by humans have fallen to the man vs. human and man-hungry stereotype in society; this is also considered the “Jaws” image. In reality, sharks are a species that are highly misunderstood, and a majority of sharks are incredibly harmless to people.

Two-thirds of the annual shark attacks come from only three shark species which are the great white sharks, tiger sharks, and bull sharks (Griffin, Miller, Freitas, and Hirshfield, 2008). However, there are over 350 different species of sharks that are different in size, habitat, and diet.

### **Cinematic Sharks**

In the *Shipwreck Shark*, Hodges writes about Whitetip sharks which are known for besieging shipwrecks and fishing boats, are dealing rapidly due to the shark fin trade. Hodges also explains the power of pop culture and its effect on the white tip sharks. When *Blue Water, White Death* hit the big screen in the 70s, it showed people footage of great white sharks crashing into cages, but the scene that still stands out is Whitetip sharks swarming a whale carcass off of South Africa (Hodges, 2016). The scene is remarkable because it is the first team of divers being caught on camera leaving their shark cages to free-dive among white tip sharks. At one point in time, white tip sharks were most notably the most abundant pelagic sharks in the 60s. If people have seen *Jaws*, then most likely they know what white tip sharks are and what they do, they are found near shipwrecks and swarm the sunken ships. When the U.S.S Indianapolis sank at the end of World War II, the catastrophic event was made famous by Captain Quint's monologue in which he said, "Eleven hundred men went into the water, 316 men came out, and the sharks took the rest." by sharks, Quint meant the white tips (Hodges, 2016, 1). However, the problem with Captain Quint's story is that it does not detail the crew's experience. 1,200 crew members on board the ship, 900 made it into the water alive, most men died by gruesome shark attacks, and only 317 survived (Hodges, 2016). When Cleatus Lebow a survivor of the ship, spoke on the event he stated that most of the crew were hungry and thirsty and that the sharks barely bothered them. Lebow stated "You had to be alert when those sharks were around, and if they got too

close, you'd kick them away. But I don't think I was really afraid of them. We had other problems" (Hodges, 2016, 1).

## **Shark Fin Trade**

### **Introduction to the Shark Fin Trade**

Fishing for sharks is most often described as to some extent a relatively devastating phenomenon, and that is solely because it is driven by the lucrative booming markets of the the expanding Asian upper class throughout the last three decades. Sharks have been feared ever since humans have seen the fish swimming in the ocean, and the shark population is declining at an exponential rate because humans have replaced sharks as the ocean's apex predator (Fairclough, 2013). The most prominent way humans hunt sharks is by shark finning. Shark finning is the process of slicing off the dorsal fins off a shark and disposing the rest of the body back into the ocean while it is still alive (Fairclough, 2013). The shark fin is "only one to five percent of the shark's weight," and the fishermen through the rest of the body off the boat to create more room to hold shark fins (Fairclough, 2013). The sharks when they are thrown back into the ocean are often alive and do not die peacefully and die rather inhumanly. In addition, sharks are unable to swim correctly without their fins and will suffocate and bleed to death. However, the cruelty towards the sharks is not the only reason to stop shark finning, another major factor is shark fisheries. Both shark finning and fisheries have disastrous effects on shark populations across the globe. About 100 million sharks are killed around the world each year, and the most significant cause is the shark fin trade. Sharks have a slow growth rate and low reproductive rate which makes them highly susceptible to extinction, and it is harder for a population to repopulate rather than it is to be diminished.

The species that are most affected by the shark fin trade are multiple Hammerhead shark species, various Mako shark species, Bull sharks, Tiger sharks, numerous Thresher shark species, and Blue sharks. The scalloped hammerhead and the smooth hammerhead shark are both endangered and between 1.3 and 2.7 million of just these two sharks alone are killed annually in the shark fin trade (Fairclough, 2013). In the northwestern Atlantic, the scalloped hammerhead population declined from about 155,500 in 1981 to 26,500 in 2005 (Fairclough, 2013). In shark fisheries, shark populations have decreased between 60-70% (Fairclough, 2013).

The shark fin trade is the action of removing the dorsal fin from fishermen and putting the fins on the consumer market. Shark finning appeals to fisherman because it has a high monetary and cultural value, especially in China. In China, shark fins are used for a delicacy meal called shark fin soup and, if someone eats the soup, it represents them of being wealthy and having a high status in class (Fairclough, 2013). Fishermen choose to cut off the dorsal fins of sharks because the fins can sell up to 500 USD a pound (Fairclough, 2013).

### **Where does Shark Finning mostly occur? (SHARK HOTSPOTS)**

Sharks tend to be found on the continental shelves and in the lower open ocean atmosphere. Latitudinal patterns presented a bimodal distribution of sharks peaking between thirty and forty degrees of latitude in the two hemispheres. Globally, there are several hotspots where sharks accumulate: Southern Japan, Southern Australia, Taiwan, Angola, Southeast Africa, Southeast Brazil, Indonesia, and the United States of America (Lucifora, García, & Worm, 2011). Among these areas, the shark fin trade has affected several specific species. Namely, these species of shark are the Grey Reef, Bull, Great White, Oceanic Whitetip, and Thresher shark. A majority of these are on the brink of extinction, according to the International Union for Conservation of Nature (IUCN). Interestingly, the sharks affected by the shark fin trade showed

a different diversity pattern as compared to those not at risk of the shark fin trade (Lucifora, García, & Worm, 2011). The species of sharks targeted by the shark fin trade were broader in geographic extent and were located more closely to the Equator and in the open ocean.

It is difficult to pinpoint exact locations where the hot spots are for fishers to shark fin. Since most of the shark fin trade is considered illegal, unreported, and unregulated fishing. For example, it is difficult for the IUCN to monitor what happens to the products of the most widely known elasmobranch, the Great White shark (*Carcharodon Carcharias*), once it has been shark finned (Chapman, Abercrombie, Douady, Pikitch, Stanhopen, & Shivji, 2003). The Great White shark is hard to monitor due to the difficulty in identifying the shark parts during processes such as when the fin is dried and off of the carcass. If the fisherman cannot recognize the certain shark that they killed, scientist and conservationist will not know where the removal of the dorsal fin took place (Chapman, Abercrombie, Douady, Pikitch, Stanhopen, & Shivji, 2003).

### **Brazilian Fishermen Case Study; why do Fishermen Shark Fin?**

In Brazil, 67.7% of fishers admitted to selling or have sold shark fins to people mostly from Asian countries (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). However, in southern Bahia, Brazil, Brazilian fishermen stated that 24.6% of their buyers were from all over the country (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). Most times, the fishermen have business deals with intermediaries who travel from long distances to obtain the fins and are also called once a shark is caught. Fishermen partner with these intermediaries because they provide the fishermen with incentives such as having expensive fishing gear on top of being paid after the catch.

The prices of the fins depend on the type of species the shark is, the general condition of the fin whether that would be dry or fresh, and the length of the fin. Processed fins which are dried are worth twice as much as they are new. The estimated price of the small fins (15 cm and

below) are between three dollars and thirty cents and nineteen dollars and seventy cents US dollars (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). The prices for larger fins (15 cm and above) range from fifty-two dollars and fifty cents to two hundred forty-six US dollars (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). Fishermen have developed a system to convert the total weight of the shark into the weight of the fin. For example, if a shark weighed 100-kg, its fin would approximately weigh 1.5 kg in dry fins which would be a total of two hundred and twenty-one dollars and fifty cents.

Fishers catch the sharks mainly by using hand lines and long lines with steel cable straps at the hooks (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). In Brazil, 85% of the fishermen claim that shark finning is increasing, since the fins have more value than the meat itself. However, the Brazilian fishermen still bring in the shark carcass to have the flesh sold on the market. Fishermen are also able to identify the type of shark species that they capture, and most often, the species that the fishers catch is on the IUCN's list of endangered species as well as the Brazilian Threatened Species Red List. The Brazilian Ministry of Environment issued the list, and the species that are included have specific regulations to save them from fishing, transportation, storing, and farming the endangered marine organisms (Barbosa-Filho, Costa-Neto, & Siciliano, 2017). The Brazilian Threatened Species Red List includes 149 endangered species and 153 at serious risk of extinction species, and in that list eighteen of the species are sharks. For example, the Sandbar shark (*Carcharhinus plumbeus*) is at serious risk of extinction in Brazil according to the list. The Sandbar shark's fins are extremely valuable in south Bahia due to the length of the fin and the high quality of the fin (Barbosa-Filho, Costa-Neto, & Siciliano, 2017).

Fishers in Brazil stated that the shark meat that was captured was always commercialized or consumed by their own families for a meal and other resources. It later became clear to the

Brazilian fishermen that the shark fin trade is becoming a threat to the conservation of sharks globally because shark fin buyers do not draw a line between shark fins that are being removed for finning alone. Moreover, the lack of communication between fishermen and buyers is encouraging the ongoing practice of shark finning. Brazilian fishermen who are against shark finning had some ethical issues in relations to nature and human beings as well. In a survey that the fishermen took, it displayed that shark finning not only affects sharks and their populations, but also the people who experience poverty rely upon the fishing communities for food and other resources that sharks can offer them. In Brazil, there will be an improvement of methods that help the elasmobranch species (sharks) in the National Plan for the Conservation of Elasmobranchs. There will be more extensive efforts and funding that will help prevent shark finning in Brazil's exclusive economic zone (EEZ) which will in result help protect the shark populations.

### **Countries Involved in the Shark Fin Trade**

#### **China**

Sharks fall prey to overfishing because of their lifelong history traits like their late age of maturity, slow growth rate, low gestation period, and low fecundity. Also, sharks are vulnerable to become common bycatch in recreational and commercial fisheries through methods such as trawling, gillnet, driftnet, and longlining. As a consequence, shark populations are experiencing an international decline because of human exploitation. The worldly loss of sharks is farther exacerbated because of shark finning. Shark finning is banned in many nations, but the high demand and high prices for shark fins in Asian markets help maintain the global black market. Shark fin bans fail to realize that the primary need of fin exploitation is associated with cultural beliefs in traditional Chinese culture. In Hong Kong, estimates of trade auctions for shark fins show that roughly between twenty-six and seventy-three million of shark fins were traded in the

year of 2000 (Dell’Apa, Chad Smith, & Kaneshiro-Pineiro, 2014). In the year 2010, the trade of shark fins rose between ninety-seven and two hundred and sixty-seven million (Dell’Apa, Chad Smith, & Kaneshiro-Pineiro, 2014). According to the Food and Agricultural Organization (FAO), in 2004 greater than 90% of shark fins are imported from Hong Kong with 58% and China with 36%, most of the shark fins are used as the main ingredient for a traditional soup (Dell’Apa, Chad Smith, & Kaneshiro-Pineiro, 2014).

In 2011, estimates showed that China is defeating Hong Kong as the leading importer of shark fins. This is due to the effect of the Chinese taxing all imports of shark fins from Hong Kong in 2002 (Iloulian, 2017). Before that, shark fin processors would take advantage of the low-cost fees of transporting, processing, and labor to ship to Hong Kong. In 2002 after the tax change, China’s businesses can trade and negotiate for lower prices on fins from the nations which the Chinese are importing the fins, as a result limiting the demand to re-export the shark fins to Hong Kong (Dell’Apa, Chad Smith, & Kaneshiro-Pineiro, 2014).

The shark fin trade has affected the conservation of sharks from across the globe leading many global powers and small countries to implement bans on shark finning in their national waters, such countries like: The United States, European Union, Canada, Australia, Mexico, South Africa, Brazil, Taiwan, etc (Dell’Apa, Chad Smith, & Kaneshiro-Pineiro, 2014). Although the countries have taken these steps, the volume of shark fins that are traded internationally appears not to have been significantly reduced as hoped. The realistic estimate on the number of sharks that are killed to satisfy Asian demands remains unknown because it is a part of IUU fishing. Moreover, shark finning has occurred in marine reserves and marine protected areas such as the Galapagos Islands, and still, there is not an exact total number of sharks finned each year.

The fast growth of China's economy is predicted to expand the demand for shark fin soup. This is because China has a growing middle-class who can now afford to consume the national delicacy which can cost at least one-hundred dollars per bowl (Dell'Apa, Chad Smith, & Kaneshiro-Pineiro, 2014). Shark fins have been a national delicacy in Chinese culture since the Sung dynasty was in power in 960-1279 AD, and throughout the Ming Dynasty 1368-1644 AD when shark fin soup was given to the emperors for dinner. Shark fin soup gained a high reputation because it is difficult to obtain, and the risk involved in catching a shark was a tribute to the emperor. To the Chinese, the consumption of strong and brave animals was believed to give strength to anyone who ate it and therefore was suitable for the imperial family (Iloulian, 2017). The indirect connections between shark fins and culture play an important role in exploiting sharks. Seafood consumption in China is linked to the concept of prosperity and fortune. A chief from Singapore stated, "If you don't serve shark fin soup at important dinners, the host will look very cheap, and that is not giving face to your guests" (Dell'Apa, Chad Smith, & Kaneshiro-Pineiro, 2017, 1). The costs of food and the best efforts to provide high-class hospitality to guests are a sign of wealth and generosity along with giving their guest shark fin soup. The traditional beliefs are seen in contemporary Chinese culture; shark fin soup is now served at weddings, corporate functions, and banquets all over China (Iloulian, 2017). The Chinese have specific taste when it comes to the quality of the fin that depends on the length, thickness, color, and texture of the dorsal fins. They prefer the dorsal fins that come from more significant and more powerful sharks like the Whale shark (*Rhincodon typus*), Hammerhead sharks (*Sphyrnidae*), Mako sharks (*Isurus oxyrinchus*), and Basking sharks (*Cetorhinus maximus*) (Dell'Apa, Chad Smith, & Kaneshiro-Pineiro, 2014). Shark fin soup is essentially tasteless and does not have any flavor; the flavor comes from the other ingredients used in the broth.

In contrast to Chinese culture, sharks have more of a spiritual value to other cultures who reside in the Pacific Ocean. In Vietnam, there is a Whale shark known as the Lord Fish, and the Vietnamese gave sacred burials in Lord Fish's name. In Fiji, the Fijian worship the shark God is known as Dakuwaqa, and in Japan, there was a mythological figure known as the God of Storms.

### **Indonesia**

Over the past twenty years, Indonesia has been the leading nation in shark finning, landing over 100,000 elasmobranchs (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017). Indonesia is centered in a tropical marine biodiverse ecosystem and is identified as a hotspot for fisheries conservation. Indonesia also is home to at least one-hundred and eighteen sharks and rays. However, there is a lack of knowledge in knowing the sustainability of shark landings. Factors that go into the low amount of data collected are the far-reaching archipelagos which account for over 18,000 islands and includes the sixth largest economic exclusive zone in the world. Indonesia also straddles over the equator which is a hotspot for most shark species, has many unreported fishing vessels, includes many remote fishing communities, and has a disconnected government between different branches and stakeholders. Information has begun to emerge recently but lacks information about Indonesia as a whole. However, in Southwestern Indonesia, there is limited data that assess the declining rate of species that are being overfished (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017).

There are roughly 2.7 million fishermen that reside in Indonesia, and many of them live in eastern Indonesia where biodiversity is rich. Many of these fishermen live off of the fish for their livelihood. Poverty is found in this area because there is low access to markets, education, and healthcare. Because of this, shark finning is an ideal lifestyle because fishermen can sell and harvest the product. Shark finning is easy for the Indonesian fishermen because the sharks can be

collected with simple fishing gear, and small boats can carry large amounts of fins if the carcass is thrown back into the ocean. In addition, dry fins are easy to pile when there are not any cooling systems and electricity is present.

Case studies were done in three fishing communities in Indonesia: Pulau Osi, Dobo, and Pepela where shark finning is incredibly prevalent in these coastal communities. In addition, the three coastal communities were chosen for their geographical location because major sea basins surround them.

Pulau Osi is a small island located off of Seram in Maluku province. In 2012, approximately nine-hundred and sixty-three people lived in Pulau Osi and many of the members of the community heavily relied upon the income of shark finning. The introduction of shark finning in Osi was in the early 1990s by a fisherman from Buton and island in Sulawesi (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017). Throughout Maluku, people from Pulau Osi were known for their expertise in hunting sharks, and shark finning and the people would hunt sharks from North Maluku to the islands of Raja located in West Papua (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017). As a result of the number of sharks disappearing in the area, it was later declared in 2013 a shark sanctuary that is now inaccessible to fishermen who are hunting sharks.

The second area studied, Dobo, is the capital of Aru which is an archipelago located in south-eastern Maluku. Dobo is home to about 10,000 people and plays an essential role as a trade center for shark fins for the eastern provinces of Indonesia for more than one-hundred and fifty years. The people of Dobo witness a large number of fishermen who come to the island yearly on their shark fishing boats during the western monsoon season from October through March. The fishermen do not return until the eastern monsoon season starts from April and goes through September. The fishermen from Dobo, fish around the Aru archipelago and east towards Papua,

and south towards Australia (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017). However, most fishermen stay north of the Australian border because fishers have been imprisoned for shark fishing in Australian waters.

The third island studied, Pepela, is located in Indonesia's most southern island, Rote, in the East Nusa Tenggara province and is home to six-hundred people (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017). Pepela has arid land, and therefore fishers had to go out to sea to hunt sharks and reach rich fishing grounds. Fishermen from Pepela would often sail to the Timor Sea, and shark finning was introduced by Bajo fishers who came from southeast Sulawesi. Today, shark fisheries are typically located in the MoU Box which is the rectangular tract of marine waters of the Timor Sea that are lying in Australia's exclusive economic zone. However, Rotenese fishermen still have access to their traditional fishing rights that are found in the Memorandum of Understanding (MoU) between Australia and Indonesia (Jaiteh, Hordyk, Braccini, Warren, & Loneragan, 2017).

### **United States of America**

The United States government during the 1970s and 1980s were active supporters of the exploitation of the Atlantic shark fishery. The objective was to create an underdeveloped resource and to relieve the fishing pressure on favorite fish stocks. As a result, the market for shark fins contributed to 60% of the decline of Atlantic blue sharks (Spiegel, 2000). In response to the severe problem, conservationists and scientist lobbied for federal laws protecting sharks and for management plans for shark fisheries. In 1993, the National Marine Fisheries Service (NMFS) issued the Atlantic Shark Fishery Management Plan for Sharks of the Atlantic Ocean (Atlantic Plan) (Spiegel, 2000). In the plan, it protected over thirty-nine species of sharks and made shark finning illegal in federal waters of the Atlantic Ocean, Caribbean, and in the Gulf of Mexico.

However, there is on significant discrepancy made in the Atlantic Plan which was that the plan only made the wasteful practice of shark finning illegal which is cutting off the dorsal fin and throwing the carcass back into the ocean. The plan still allowed commercial fishing ships to shark fin as long as the number of fins equaled the number of carcasses. The NMFS did not regulate catch quotas, shark finning, and they did not implement laws that stop foreign flag vessels in the United States exclusive economic zone.

The NMFS however, continued to have stricter regulations for the Atlantic shark populations, and by 1997, the NMFS had quotas for large Atlantic sharks and was well on its way to having quotas for small Atlantic sharks. In 1999, the NMFS expanded its list of protecting sharks from thirty-nine to all sharks in the Atlantic. In 2000, the United States government implemented a ban on shark finning across all states. However, Atlantic shark conservation was still a leading problem because laws were not coinciding with federal laws and regulations. A majority of Atlantic coastal states have predominantly lenient and poorly managed regulations. Many Atlantic coastal states also lack anti-finning measures.

In Florida, it is home to the most extensive and active commercial shark fishery on the Atlantic coast. Other shark fishery states include North Carolina, Louisiana, and New Jersey. Most New England states have minor shark fisheries for the exception of Massachusetts who is the leader in the extermination of the spiny dogfish (Spiegel, 2000). Recreational fishing heightens the increasing decline of sharks in the United States.

In the Pacific, shark finning has been the top priority of conservationist and scientist in protecting sharks in federal waters. NMFS recorded the number of sharks that were killed from 1991 through 1998 and the killings rose from 2500% (Spiegel, 2000). In Hawaii, at least 150,000

sharks are becoming prey to shark finning, and the inconsistency between coasts was not enough for the Atlantic Plan to protect (Spiegel, 2000).

Over the years in the United States, it is prevalent that shark finning is now illegal, however, the trading of the shark fins is not. This is controlled at a federal level. Eleven out of fifty states in the United States have already outlawed the trading, selling, and possession of shark fins. These states include California, Delaware, Hawaii, Illinois, Massachusetts, Maryland, New York, Rhode Island, Oregon and Washington. In addition, United States' Pacific territories such as Guam, American Samoa, and the Northern Marian Islands have also outlawed the possession, sale, and trade of shark fins (Mcguire, 2015). In 2015, Texas's senator Greg Abbott signed HB 1579 which banned the commercial shark fin trade in Texas. Moreover, Texas became the first red state in the United States to outlaw the trade of shark fins.

In 2018, a bipartisan bill was introduced in the U.S. House of Representatives that was supported by conservationists, zoos, and aquariums. The bill proposed that all shark products that are being imported in the U.S. must meet certain requirements that the American fishermen have to follow which have to be ethical and sustainable. The Sustainable Shark Fisheries and Trade Act of 2018 was sponsored by seven Representatives and the mission of the bill is to create a formal and clear certification program for countries that import shark products to the United States. Foreign countries have to obtain a certification from the United States Secretary of Commerce that specify, "prohibition on the reprehensible and wasteful practice of shark finning and have shark management policies comparable to those under the Magnuson-Stevens Act" (Financial Services Monitor Worldwide, 1, 2018). The United States believe that it is a better alternative instead of banning all trade of shark fins, because, the Sustainable Shark Fisheries and Trade Act instead of punishing the American fishermen for other countries unethical actions, it would give

an advantage in access to the United States markets and would incentivize other nations to abolish shark finning (Financial Services Monitor Worldwide, 2018). Representative Daniel Webster from Florida stated that it is important to balance the needs of an industry along with conservation, and in the bill, it recognizes the American fishermen's sacrifices they have made to rebuild and sustain the shark populations. In addition, Webster believes that it will encourage other countries that want to export shark products to the U.S. to follow the same ethical standards that U.S. has for conservation and management. Moreover, the Sustainable Shark Fisheries and Trade Act will protect the jobs of many U.S. fishermen and will combat the global threats of shark stocks by promoting a lucrative model of shark management in the United States (Financial Services Monitor Worldwide, 2018).

### **Environmental Consequences**

#### **Trophic Levels; Why are they important?**

Humans have been engaging in war against non-human predators since the dawn of time. In ancient Greece, people who slew lions were considered heroes, in Britain, Gamekeepers were hired to extinct the fox, goshawks, and badger population. In Alaska and Canada, bounties have been placed on seal and sea lions in hopes of maintaining fishery management. Humans have been extremely potent at devastating populations over land and see where it is becoming prevalent to the ordinary citizen. For example, in suburban America, residents who plant a garden is often destroyed by ubiquitous deer. This is because deer in suburban America has no predators. To counter this problem, governments are now restoring animal populations, for example, the re-introduction of the gray wolf in Wyoming. Predators are necessary because they occupy the top level of the trophic ladder and they play a crucial role in regulating the food web in the trophic levels below them. A trophic cascade is the process was eliminating the predators in the top ring

has a catastrophic effect, because it destabilizes the ecosystems and has a domino effect that threatens all the trophic levels below (Terborgh & Estes, 2010). Predators hold a fundamental key to retain high levels of biodiversity in the ecosystem.

The simplest way to explain this is in a three-level cascade (there can be many levels) for example wolf-deer-vegetation. The wolves eat the deer which indirectly helps vegetation, and the deer populations remain low, and as a result, there are high levels of vegetation that experiences only light herbivory (Terborgh & Estes, 2010). A big misconception between trophic level relationships, from the bottom up to top down, there is no exclusive way that the fall of an ecosystem follows. The trophic levels are continually complimenting the flows between them, and they are forever bonded together. From the bottom-up, the scientific fundamentals are driven by photosynthesis and can only sustain itself solely by photosynthesis.

Moreover, if photosynthesis increases in a particular environment, so does the population (Terborgh & Estes, 2010). More productivity means more herbivores and more predators and as a result an increase in the whole food web. However, productivity is not only allocated from the bottom up but from the top down through the trophic cascade. Trophic cascades are always dynamic when an ecosystem is at equilibrium, the herbivores and predators stay constant, and the circle of life continues. Keystone species are vital in trophic cascades; because, keystone species have dramatic effects on the ecosystem's population and biomass. In this instance, sharks are the keystone species in the ocean environment. The keystone species portray the strength of an entire trophic cascade in a single species (Terborgh & Estes, 2010).

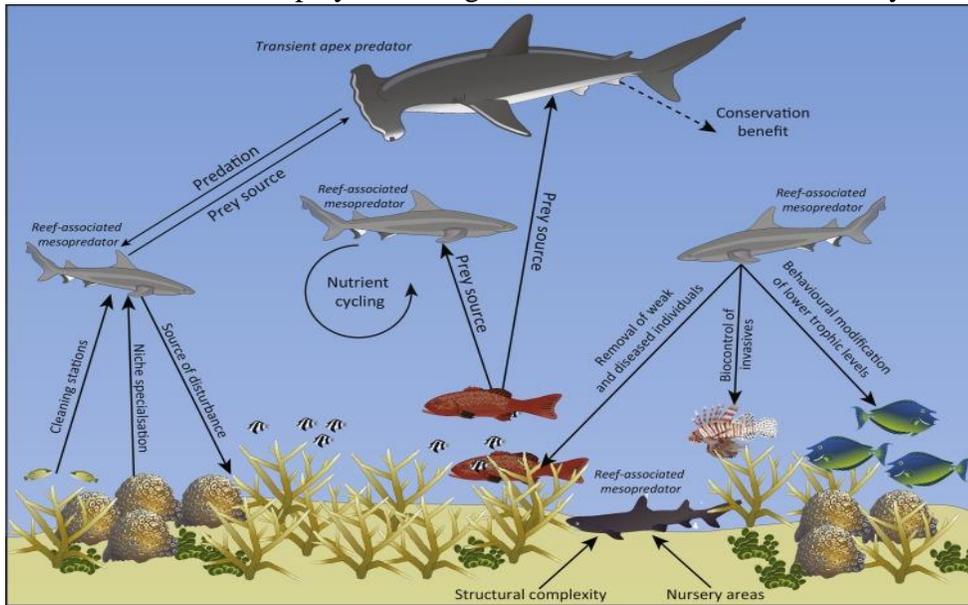
### **Why are Sharks important in Marine Ecosystems?**

Sharks are apex predators and most often occupy the highest trophic level, and sharks hold the power of structuring the food web directly by predation and indirectly by changing prey

behavior. Far-reaching declines of top predators have been seen in marine ecosystems all around the world and trophic downgrading, (a concept that shows the consequences to an ecosystem by removing apex predators from their habitat), has cascading effects on the levels below them which results in an altered ecosystem, mesopredator (middle trophic level predator) release, and an unbalanced food web dynamic (Roff, Doropoulos, Rogers, Bozec, Krueck, Aurellado, Mumby, 2016). The loss of an apex predator in a given ecosystem varies depending on the type of predators and prey, and the amount of biodiversity is in the ecosystem. In environments with high biodiversity like coral reefs, the impacts of predators can be obscure because trophic levels are complex and allows the predators to resist change in the structure of ecosystems by being allowed to adjust interactions between the different trophic levels.

In aquatic environments, sharks are the most diverse and eco-rich apex predators. Over the past years, a large scale on the exploitation of sharks has an after effect on the declining of shark populations. The loss of sharks has caused many trophic cascades in marine ecosystems with temperate waters that have interactions between apex sharks and small-bodied sharks that feed on small crustaceans, to large sharks like, Tiger sharks, that consume marine mammals. Trophic cascades occur when there are pairs of interactions between apex predators and mesopredators and from mesopredators to the primary producers. However, that is not always true because strong interactions occurred in high levels of omnivores activity where the apex shark consumes the primary producer instead of the mesopredator. This type of interactions that consists of high omnivory is what helps stabilize food chains and will help reduce the likeliness of a trophic cascade (Roff, Doropoulos, Rogers, Bozec, Krueck, Aurellado, Mumby, 2016). The loss of apex sharks would mean that there would be an increase in mesopredators and a trophic cascade affecting the prey at lower levels.

The connection between sharks and herbivore fish species (bottom of the chain) is vital because herbivores play an ecological role in coral reefs habitats by enhancing coral resilience



**Figure 3:** Shark Trophic Cascade (Roff, Doropoulos, Rogers, Bozec, Krueck, Aurellado, Mumby, 2016)

mesopredators which allows the fishes that are herbivores to escape the predators so that they can become more plentiful.

Apex sharks are also vital in an ecosystem because they scavenge, they remove invasive species, and participate in nutrient cycling. In coral reef habitats, the movement of mesopredatory sharks takes part in nutrient cycling between the reef and pelagic habitats, on the other hand, large apex sharks during their migration result in a nutrient flux in the marine ecosystems (Roff, Doropoulos, Rogers, Bozec, Krueck, Aurellado, Mumby, 2016). In addition, apex sharks through consuming remove diseased and weakfish from the ecosystems, and by removing the sick fish, it helps keep low densities of the prey population. Also, apex sharks play a vital role in scavenging the open oceans by consuming deceased carcasses which helps benefit stability in the

because the herbivores feed on the macroalgae that are competing for space on the corals. As a result, having high shark abundance leads to a decrease in the abundance of

food chain. Sharks have been known to control invasive species such as lionfish in the Caribbean. However, the ability of the sharks to regulate the abundance of lionfish is limited. Lastly, large apex sharks also help with the removal of large weak and diseased turtles, mammals, and rays.

### **Consequences to Marine Ecosystems of Trophic Cascades After Losing Sharks**

A study was performed along the Atlantic seaboard in 2007 to test the hypothesis that when sharks are removed from an estuary, it can have severe impacts on that ecosystem. The scientist reported and analyzed data on the sharks and the small elasmobranchs that were the shark's prey. In the ecosystem, over the past thirty-five years, eleven sharks experienced a significant decline in population. The Sandbar shark experienced an 87% decline in its species population, Bull, Blacktip, Dusky, Tiger sharks all experienced a 99% drop in their populations as well (Terborgh & Estes, 2010). In addition, the average lifespan of these sharks ranged from seventeen years old to forty-seven years old because of constant exploitation from shark fin trade and overfishing. The elasmobranch prey showed an immense increase in abundance especially a rise in the cownose ray (*Rhinoptera bonasus*) by twenty-fold (Terborgh & Estes, 2010). During the summer, Cownose rays migrate to the shallow waters of Chesapeake Bay, Delaware Bay, and Pamlico Sound; scientist calculated that over forty million Cownose rays alone live in Chesapeake Bay (Terborgh & Estes, 2010). Cownose rays consume shellfish, softshell and hard clams, and scallops and together these are known as bivalves, and in total, Cownose rays ate a total of 840,000 metric tons of bivalves. As a result, the severe loss of the bivalves suggested that because of the booming population of rays is because of the tremendous loss of the great sharks which unbalanced the trophic cascade. Thus, the loss of the sharks at the top of the food chain managed to eliminate a whole population of shellfishery indirectly.

Further implications from the overpopulation of Cownose rays explain that since the bivalves they consumed in open waters are now gone, Cownose rays are turning to seagrass habitats where more bivalves live. Bivalves who live in seagrass habitats are much more protected because of the roots and rhizomes from the seagrass bed that provide them protection from predators such as crabs and whelks (Terborgh & Estes, 2010). Moreover, seagrass habitats not only cater to the security of bivalves but also by providing nurseries for juvenile crustaceans and fish, so the eradication of seagrass beds by Cownose rays suggests that it is a probable extension of the shark-ray trophic cascade.

### **Case Study: Consequences of Illegal Shark Finning in the Galapagos Islands**

The Galapagos Islands are located 1000km west of the mainland of Ecuador in South America, and the archipelago is located in the Eastern Pacific Ocean. For centuries, the Galapagos Islands have been known for their rich biodiversity. Charles Darwin during his expedition on board the H.M.S. Beagle was most famously known for Darwin's work on finches, but according to scientists, Darwin's research was influenced fish's phenotypic variations (Schiller, Alava, Grove, Reck, Pauly, 2015). The Galapagos Islands consists of tropical species, Southern Ocean species, and temperate species and this is because of the deep-near shore waters, rich nutrient upwellings, strong currents. These characteristics provide a stellar habitat to 2,900 fish species, invertebrates, and marine mammals.

Ecuador's government realized that they needed to protect this natural phenomenon; as a result, the government designated the archipelago as a national park in 1959 and 1979 UNESCO declared the Galapagos Islands on their World Heritage Site (Schiller, Alava, Grove, Reck, Pauly, 2015). The foundation of the Galapagos Marine Reserve (GMR) was created in 1998, and it declared a boundary that protected the archipelago. The boundary was 138,000 km<sup>2</sup> around the

Galapagos Islands, which marked it the largest marine protected area in the world (Schiller, Alava, Grove, Reck, Pauly, 2015). Forty shark species have been seen in the waters surrounding the archipelago and 90% of the elasmobranchs (sharks) in the area are on the IUCN Red List as “Threatened” or “Near Threatened” (Schiller, Alava, Grove, Reck, Pauly, 2015). Shark finning is prohibited in the Galapagos Marine Reserve, somehow in the 1950s it became prevalent and had increased every year since.

Fishers would use sea lion flesh as bait to lure the sharks to their longline and the shark finning operations were conducted by Ecuadorian, Japanese, Taiwanese, and Korean fishing fleets. Most of these fleets were licenses tuna fishing vessels but were illegally shark finning in the Galapagos Islands’ waters. Shark finning happens globally even in marine reserves and UNESCO World Heritage Sites, and this is because law enforcement does a poor job in enforcing the laws and regulations that are set in this region (Carr, Stier, Fietz, Montero, Gallagher, Bruno, 2013). Once the sharks are caught, the fins are exported to mainland Ecuador and then to Hong Kong, Singapore, and Taiwan. Even though the Galapagos Islands became a marine reserve in the 80s, the decree did not carry over to national protected area status which made enforcement and managing the exploitation of the area difficult. A concern that the government worried about was that the sharks caught in the border of the Galapagos Marine Reserve. As a result, in 1993, a law was passed that all sharks that were captured by accident must be landed with all the fins still attached to the body. However, there was an escape clause; it was still legal to sell and export the shark fins “incidental catch” (Carr, Stier, Fietz, Montero, Gallagher, Bruno, 1, 2013). As a result, this enables fishers to catch mass quantities of shark fins to export to Ecuador and Hong Kong.

In 1998, the Galapagos Marine Reserve was established as a National Park and had national protection, this made it easier for the government to enforce the laws and regulations. In 2003, the Ecuadorian Ministry of the Environment banned shark finning, trading, and landing inside the border, but despite this, shark finning is still continuing in the archipelago. From 2001-2007, Ecuadorian law enforcement had seized twenty-nine illegal campsites and fishing vessels, and have found catch sizes ranging from two deceased sharks to 1,800 shark fins (Carr, Stier, Fietz, Monte-ro, Gallagher, Bruno, 2013). In 2011, The Ecuadorian Navy seized a longline Ecuadorian fishing vessel called the Fer Mary I, once the navy boarded the thirty-crewed vessel, they found 369 hooks, six-eight meter outboard small fiberglass boat that was used for patrolling the long lines. Also, the Navy found 379 dead shark carcasses 303 Thresher sharks, 42 Silky sharks, 24 Blue sharks, five Smooth Hammerhead sharks, two Tiger sharks, two Galapagos sharks, and one Short-fin Mako shark (Carr, Stier, Fietz, Montero, Gallagher, Bruno, 2013). The caudal fins were removed from the Thresher sharks, and all the cephalofoils (head of the Hammerhead) were removed, the heads of the Thresher sharks were removed as well. The other sharks were not dismembered. The ecological role that the sharks played in the Galapagos Islands waters once they are absent has a long-lasting effect on their prey species. Hammerhead sharks, Tiger sharks, and Galapagos sharks which are the apex shark predators influence the community dynamic directly through the trophic levels. However, more data needs are gathered to truly understand how sharks effect the ecosystem in the Galapagos Islands. To get more data on the effect of shark finning in the Galapagos Marine Reserve, scientists need to conduct tests and create trophodynamic models to describe the role that apex sharks play in the ecosystem.

### **Conservation Efforts: What can Save Sharks?**

#### **Shark Diving**

As anthropogenic causes continue to exploit marine ecosystems (shark fin trade) and are the number one cause to the decline in species population and loss in biodiversity, the value of nature with tourism more than ever have become vital to saving ecosystems and marine populations. This specific type of tourism is called “ecotourism,” and it is “the activities in which tourists observe and appreciate nature that minimize impacts on the natural areas and host communities” (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2, 2015). When it comes to tourism, ecotourism is considered one of the fastest growing sectors in the world. In ecotourism, most of the time, the tours consists of educational features organized by small locally owned businesses. Ordinary humans love to watch species in their natural habitats because it holds a significant aesthetic. Most of the time, the profits made by the trip goes to an animal that the tour is educating people about. In addition, wildlife watching is one of the most profitable and popular eco-tourism businesses on the market.

Charismatic species tend to be the most popular attractions in interacting and viewing the animals up close like whale watching. Since sharks do not have that charismatic charm, shark diving is not on the top lists of many tourists when they visit coastal countries, but it should be. The shark diving tourism is a growing industry that can be prosperous. Shark diving ecotourism is when people get the chance to snorkel or scuba dive with sharks in their natural habitat (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). Shark diving ecotourism is exceptionally diverse because there are many species of sharks, the experience is different in every country (culture), and regulations are different in every country as well. Annually, the shark diving business caters to more than half a million people and operates in eighty-five countries (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). The

burgeoning perception that sharks are worth more alive than they are dead, that is the current argument that shark conservationists are fighting for. Sharks are declining at a rapid rate due to shark finning, and the shark diving industry has monetary benefits that have become a plus for shark conservation. Shark diving has shifted the socio-economic of shark fisheries to a more valuable sector in tourist destinations globally. The activity produces direct revenues for the operators and fishers and generates substantial tax revenues. As a result, local governments are willing to provide assistance, services, and infrastructure for the growing industry (Gallagher, Vianna, Papastamatiou, Macdonald, Gut-tridge, Hammerschlag, 2015).

However, a problem that concerns society is that tourism would alter the natural behavior of sharks in their ecosystem and humans can pose as food for sharks when in the water. These concerns are galvanized by the limited scientific data that regards shark tourism with human interactions. A significant amount of shark diving businesses when out in the open ocean use an attractant (minced fish) to get the attention of the sharks, so that they can be close to the tourists. As a reward, tourists feed the sharks to maintain their interests; this method has sparked speculations within the scientific community because it poses a threat to humans and can have negative consequences for the shark's behavior. In some coastal states and nations such as the United States, have banned the use of the attractant method.

Shark diving ecotourism is a strong argument for conservation efforts to save ocean biodiversity, however, it comes with both positives and negatives that can come from shark diving. Marine Protected Areas are growing in areas where shark diving is prevalent and even in shark diving hotspots where it accounts for the country's GDP. While shark diving tourism occurs year-round, operators and tourists create a defacto Marine Protected Area because they are acting

as monitors, alarms, and deterrents for fishermen who shark fin (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). In addition, fishermen who leave shark harvesting turn to the ecotourism industry, and while that is positive, it is challenging for the fishermen because most often there is a language barrier, fishermen are not well educated enough on the topic, there is not enough capital to start the business, and sometimes does not meet the high expectations from western tourists. With support from a cities local government and by Non-Governmental Organizations, a management system can pay local fishers to operate shark diving tours using their boats. This way, the community is being paid, and the tourists who do go on the shark diving tours can experience the culture of the country first hand.

The biggest underlying fear for any human who steps foot into the ocean is the thought of getting bitten by a shark. Getting bitten by a shark is the biggest concern for shark diving and recreational beachgoers. However, even though millions of tourists go shark diving annually, it is rare if sharks harm people during their dives. From the year 1900-1999, the International Shark Attack File (ISAF) stated that there were seventy-two unprovoked shark bites during leaps between ten years (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). In between 2000-2012, the International Shark Attack File recorded that between 12% and 40% were fatal (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). However, in these statistics, it includes interactions with fishers who spearfished and does not precisely specify whether the attack occurred during a shark diving tour. While sharks can learn and adapt, there is not enough evidence to suggest that shark diving is extremely harmful to humans (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015).

Sharks like every animal can learn across behavioral processes. Experiments that use condition paradigms showed that sharks could learn discriminative tasks as fast as other fish and

mammals. Moreover, sharks can also retain information for months and learn from one another. Scientists found that sharks at noticing and remembering key landscapes as they experience the route more often, this provides that sharks have a secure memory. It is a fact that sharks have cognitive abilities, which is an incentive for the shark diving industry because the businesses can attract unique sharks to a specific location where they will host the divers. It can lead to the use of artificial feeding sites where the sharks are conditioned to go to the same location every day at a given time and will be “conditioned to human interaction by food reinforcement” (Gallagher, Vianna, Papas-taxation, Macdonald, Guttridge, Hammerschlag, 5, 2015). Scientists had worked with the oceans top apex predator, the Great White shark, in Australia had found correlations between when the Great White sharks visited the sight and at a specific time and the day in which the operators were regularly scheduled(Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). Even when dives were not planned for a given day, the Great Whites would still appear at the same location and kept the same moving patterns. The studies that were done in Australia provided evidence that sharks are adaptable and can learn during shark diving tours. Moreover, the evidence shows that the sharks learn by constant reinforcements and by spatial and temporal scales.

### **Tourism vs. Shark Fin Trade in Lombok, Indonesia Documentary**

In this short documentary, *Tourism Vs Shark Fishery Project Hui*, produced by conservationist Madison Stewart and directed by environmental photographer Perrin James (2018), shows the audience what ecotourism can do to low income communities who rely on the shark fin trade. Sharks were nothing but bycatch in Lombok, Indonesia and then fins became capital at the beginning of the twenty-first century. Soon after, Indonesia became the world’s leading shark producer. Many of the fishermen go out for weeks in other nations economic exclusive zone to

shark fin making it extremely illegal. A group of conservationists visited the remote island and went through the city acting as if they were traveling surfers looking for the best surf spots in the world. The low income of the fishermen meant that whatever shark they caught from the catch was their money, and any restrictions meant that the fishermen would not be able to provide for their family. A fisherman who bases his whole life off of shark finning offered to take the group out not knowing they were conservationist battling the shark fin trade. The fishermen took them to a remote coral reef where it is unharmed and is thriving under the ocean waves, and he also brought the group to a secluded beach that had the best waves in Lombok. After the excursion was done, the conservationists offered the fishermen 330 Australian dollars, and the fisherman would instead choose the ecotourism lifestyle than the shark finning lifestyle free of prosecution and home with his family every night (Stewart & James, 2018).

### **What can Ordinary People Do to Save Sharks?**

No matter where you live on the planet, you are connected to the sea. Somehow due to anthropocentric cause, the sea is dying, and shark populations are declining rapidly. Conservation is about making a difference, and one person can make a difference. Here is what ordinary citizens can do to stop the shark fin trade and save sharks. The first is, becoming more educated on the topic and species. The more knowledge that is known about the shark fin trade and the importance that sharks play in the ecosystem will go a long way in the conservation of sharks. Next, do not buy or consume shark products. Shark products can range from shark fin soup to everyday essentials such as vitamins and cosmetics. Before consuming any product, look at the label and read what is in the product. If products containing sharks in them are no longer bought, the demand for those products will be reduced which as a result will reduce shark finning. Third, recycle all plastics and buy reusable bottles. For this, not only are sharks affected because they

are scavengers and will try anything that crosses their path but also to save sea turtles and other keystone species. Also, donate to organizations and conservation efforts. By donating, it will help the organizations funding for conservation efforts and will fund for research. Lastly, write to local legislators, expressing concerns about the shark fin trade to legislators can be beneficial because they can pass laws and regulations to ban it if it is not already banned.

### **Policy Recommendations**

#### **What can institutions do to help save sharks?**

To alleviate the cost of social welfare from exploiting common resources, institutions play a vital role in establishing rules and regulations in a market environment. The rules that are in place set incentives that guide human activity and human economic activity directly impacts the environment through resource extractions. Generally, in the fishing industry, with a lack of a strong institution, it often results in overexploitation of a resource, and a perfect example is the shark fin trade.

Shark fisheries are similar to the tragedy of the commons; however, some factors originate from fishing techniques that differentiate shark finning from other wild-caught fisheries. The first difference is because the price of the fin is worth much more than the rest of the body, the shark fins have an incentive which results in more sharks being caught. Next, without a significant amount of capture fin data, there is a limit in effectiveness on enforcing regulations and laws in addition to monitoring the ocean for illegal shark finning. Moreover, since there is little data on fin captures, it is difficult to calculate the extent of the market, and it will make it difficult to create policies that manage the illegal shark fin trade. Lastly, because sharks play an essential role in the eco-system, it is vital that sharks stay in the ecosystems because their removals have harmful effects on other marine industries in the form of negative externalities (Grimes,

2018). Externalities will always be prevalent in the fishing industries because of the lack of property rights and because of the tragedy of the commons. Without defined property rights, it is difficult to figure out who will pay the cost and how? The effect of trophic cascades on economic organisms is that scientist over-estimated the price of species, for example, the loss of oysters. Trophic cascades are negative shark externalities because sharks are essential to the healthiness of an ecosystem and the loss of abundance in an ecosystem can shift the way of incentives towards generating social welfare for a nation.

However, there still needs to be studies done in the productivity of ecosystems when a shark is absent, to accurately calculate the social cost; but there it is very apparent that there are negative externalities for a few nations that practice shark finning. As mentioned before, ecotourism is the leading cause for sustainability in keeping sharks and marine ecosystems safe. In shark eco-tourism, the most effective way to bring customers, gain revenue, is to keep the oceans and habitats healthy constantly. For example, countries like Palau, Bahamas, and the Maldives are the few that recognize the potential for ecotourism because the marginal cost gained through ecotourism and society is greater than the marginal benefit that is obtained through shark finning (Grimes, 2018). Therefore, Palau, the Bahamas, and the Maldives have all banned shark finning completely, and have also prohibited any shark fishing. Sharks are very popular as they attract divers to come and dive in their ecosystem, shark dives have provided an inflow of money to these remote islands. It is most prevalent in Palau, the revenue of a single Gray Reef shark (*Carcharhinus amblyrhynchos*) in its lifetime is 1.9 million dollars which equals 179,000 a year (Grimes, 2018). Shark eco-tourism helps generate the desire for people to come and dive from all over the world, but the industry also dissipates into the rest of the countries economy by tax revenues, lodging accommodations, and purchasing souvenirs during their vacation stay.

In comparison to the shark fin market, it would take approximately 100,000 dead shark carcasses to equal the amount of revenue from shark ecotourism on the island (Grimes, 2018). In addition, shark fins are not renewable like shark diving and ecotourism and harvesting 100,000 sharks would past the maximum sustainable yield in Palau. When a shark fin is sold into the market, Palau never acquires the revenue from the catch, so in essence, the country does not get paid for shark finning only the fishermen do, which is why it is a negative externality.

### **Case for an International Commission for the Conservation and Management of Sharks**

Sharks and whales are very similar and have similar life history characteristics, but why is only the conservation of whales more critical than sharks? The reason behind this is because, after World War II, there was a high economic need for a whaling industry. As an analyst, there should be a commission that is for the conservation of elasmobranchs just as there is one for whales which is the International Whaling Commission (IWC). The model for the new commission can be based on the International Whaling Commission to establish the International Commission for the Conservation and Management of Sharks. The commission needs two factors: the first is to identify the problem the regime is working with, and the second is how is the regime going to solve the problem. In order to solve the problem there are five steps that are in place: beginning with the rules and regulations that are made by the agency for voting and decision making, if an inter-governmental organization (IGO) is working with a regime, whether epistemic groups are helping the regime, how the regime distributes power within it, and how is leadership distributed (Herndon, Gallucci, De-Master, Burke, 2010). By evaluating what the International Whaling Commission endured, it is likely to predict that the International Commission for the Conservation and Management of Sharks is going to expect some of the same outcomes and

also help the ICCMS prepare for and to predict some of the short fallings the IWC faced. The ICCMS will have to hire individuals who will address the harvest of sharks and also the bycatch of shark. Some countries will be unwilling to eliminate their shark fishing industries and other fishing industries just because they accidentally caught a shark in their bycatch. However other countries will instantly reduce the whole exploitation of sharks in their nation and will turn to ecotourism like Palau and the Maldives for example (Herdon, Gallucci, DeMaster, Burke, 2010).

Another step that the ICCMS can do is establish rules and regulations that simulate effective regimes and the IWC. Creating IGOs in the International Commission for Conservation and Management of Sharks is to develop an independent secretary from the creation of the commission. The Northwest Atlantic Fisheries Organization placed an independent secretary in their conventions and had paid the secretary so that they can function to their full potential (Herdon, Gallucci, DeMaster, Burke, 2010). Next is the establishment of epistemic communities in the ICCMS, the IWC lacked that, and it is believed that epistemic communities can play a vital role in shark re-source management. These types of groups can provide the ICCMS with enforcement, administrative, and data collection abilities free of charge or at a low cost. The IUCN, Nature Conservancy, and other epistemic groups have been helpful in shark conservation, and have played active roles in the European Union in combating shark finning and are funded by people and other organizations who are concerned about shark conservation. Now more than ever is the time to create such a commission because the lives of millions of sharks are at stake. Many shark populations continue to decline at a rapid rate, and the ICCMS can provide a database that has a count on shark populations, has the potential to increase management, and enforcement (Herdon, Gallucci, DeMaster, Burke, 2010). Without an ICCMS, the management of sharks will not

change and will not be sustainable for much longer, and there will not be a global check on illegal shark finning.

### **Conclusion**

Sharks have been roaming the oceans of the world for more than 400 million years, as sea creatures were the Earth's first prehistoric animals to exist. A plethora of reasons cause the increasing rate of extinction among the world's sea creatures, but media representations of animals are rarely discussed. The shark is in danger. Due to the shark fin trade most shark species are at the brink of extinction and are listed on the IUCN' Red List. Sharks are apex predators, but they are declining due to anthropogenic causes. Cinematic movies such as "Jaws" created a general image that sharks are predators that humans should fear and conquer mindlessly. Instead of human fearing sharks, they should fear a marine ecosystem without sharks. Humans kill 11,476 sharks an hour due to the shark fin trade (Griffin, Miller, Freitas, and Hirshfield, 2008).

In this thesis, it explained the vital role that sharks play in the ecosystem and without sharks, there would be trophic cascades. Trophic cascades occur when there are pairs of interactions between apex predators and mesopredators and from mesopredators to the primary producers. The loss of apex sharks would mean that there would be an increase in mesopredators and a trophic cascade effecting the prey at lower levels. In addition, all species of sharks are essential in helping to remove weak and sick fish from the sea. Furthermore, sharks help keep the ecosystems balanced and creates a high abundance of biodiversity.

In addition, sharks are ranked as one of the most expensive seafood products in the world. This is because shark fins are extremely expensive. Most shark fin products are exported to Hong Kong and China where they use the fins in a traditional dish called shark fin soup. Other

countries that are involved in the shark fin trade consists of the United States. Moreover, Indonesia is the number one nation to export shark fins to China. Only thirteen states in the United States have banned all shark products but why not the rest of the U.S.? Policy makers and legislators need to ban together to end the exportation of fins to China across all fifty states. Indonesia needs to begin with banning shark finning first, and a remote island, Lombok, is already on its way to picking the alternative to shark finning which is ecotourism.

To combat the shark fin trade, a specific type of tourism is in place called “ecotourism.” Shark diving tourism is a growing industry that can be prosperous. Annually, the shark diving business caters to more than half a million people and operates in eighty-five countries (Gallagher, Vianna, Papastamatiou, Macdonald, Guttridge, Hammerschlag, 2015). The burgeoning perception that sharks are worth more alive than they are dead that is the current argument that shark conservationists are fighting for. Fishermen would rather have a stable paycheck and be at home with their families then risk their lives everyday committing illegal acts in foreign waters.

Some initiatives can be taken from ordinary people to help save the lives of sharks by becoming more educated on the topic and species and by not buying or consuming shark products. Third, humans should recycle all plastics and buy reusable bottles. In addition, people should donate to organizations and conservation efforts. Lastly, write to local legislators, expressing concerns about the shark fin trade to legislators can be beneficial because laws and regulations can be passed to ban shark finning.

Humans rely off of the ocean for their well-being, and without sharks maintaining balance in the ecosystem, the ocean’s wildlife will continue to diminish because of the shark fin trade. The shark fin trade needs to stop now and in order to accomplish that, it would be beneficial to have an International Commission for Conservation and Management of Sharks. Without

an ICCMS, the management of sharks will not change, and the oceans will not be sustainable for much longer, and there will not be a global check on illegal shark finning. International Commissions have saved species before, let it save sharks now.

## References

- Barbosa-Filho, M. L. V., Costa-Neto, E. M., & Siciliano, S. (2017). Knowledge and Practices of Expert Fishermen of South Bahia, Brazil, Regarding the International Shark Fin Market. *Human Ecology*, 45(1), 67–75. <https://doi.org/10.1007/s10745-016-9873-2>
- Carr, L. A., Stier, A. C., Fietz, K., Montero, I., Gallagher, A. J., & Bruno, J. F. (2013). Illegal shark fishing in the Galápagos Marine Reserve. *Marine Policy*, 39, 317–321. <https://doi.org/10.1016/j.marpol.2012.12.005>
- Castro, J. I. (2014). Historical Knowledge of Sharks: Ancient Science, Earliest American Encounters, and American Science, Fisheries, and Utilization. *Marine Fisheries Review*, 75(4), 1–26. <https://doi.org/10.7755/MFR.75.4.1>
- Castro, J. I. (2016). The Origins and Rise of Shark Biology in the 20th Century. *Marine Fisheries Review*, 78(1/2), 14–33. <https://doi.org/10.7755/MFR.78.1&2.2>
- Chapman, D. D., Abercrombie, D. L., Douady, C. J., Pritchard, E. K., Stanhope, M. J., & Shivji, M. S. (2003). A streamlined, bi-organelle, multiplex PCR approach to species identification: Application to global conservation and trade monitoring of the great white shark, *Carcharodon carcharias*. *Conservation Genetics*, 4(4), 415–425. <https://doi.org/10.1023/A:1024771215616>
- Dell’Apa, A., Chad Smith, M., & Kaneshiro-Pineiro, M. Y. (2014). The Influence of Culture on the International Management of Shark Finning. *Environmental Management*, 54(2), 151–161. <https://doi.org/10.1007/s00267-014-0291-1>
- Fairclough, C. (2013). Shark Finning: Sharks Turned Prey. <http://ocean.si.edu/ocean-life/sharks-rays/shark-finning-sharks-turned-prey>

Financial Services Monitor Worldwide. (2018). Bipartisan Shark Trade Bill Will Improve Global Shark Conservation and Protect Sustainable U.S. Fisheries. *Financial Services Monitor*

*Worldwide; Amman*. <http://search.proquest.com/docview/2014663412/citation/62C31A9B77464DBAPQ/1>

**(Figure 1)** Florida Museum. (2018). Shark Anatomy. <https://www.floridamuseum.ufl.edu/discover-fish/sharks/anatomy/>

Gallagher, A. J., Vianna, G. M. S., Papastamatiou, Y. P., Macdonald, C., Guttridge, T. L., & Hammerschlag, N. (2015). Biological effects, conservation potential, and research priorities of shark diving tourism. *Biological Conservation*, 184, 365–379.

<https://doi.org/10.1016/j.biocon.2015.02.007>

Griffin, E., Miller, K.L., Freitas, B. and Hirshfield, M. (2008). Predators as Prey: Why Healthy Oceans Need Sharks. [https://oceana.org/sites/default/files/reports/](https://oceana.org/sites/default/files/reports/Predators_as_Prey_FINAL_FINAL1.pdf)

[Predators\\_as\\_Prey\\_FINAL\\_FINAL1.pdf](https://oceana.org/sites/default/files/reports/Predators_as_Prey_FINAL_FINAL1.pdf)

Grimes, N. (2018). Institutions in the Shark Fin Market: Externalities and Incentives. *Review of Business*, 38(2), 44–60. [https://search.proquest.com/docview/2085000772?accountid=10353&rfr\\_id=info%3Axri%2Fsid%3Aprimo](https://search.proquest.com/docview/2085000772?accountid=10353&rfr_id=info%3Axri%2Fsid%3Aprimo)

Herndon, A., Gallucci, V. F., DeMaster, D., & Burke, W. (2010). The case for an international commission for the conservation and management of sharks (ICCMS). *Marine Policy*, 34(6), 1239–1248. <https://doi.org/10.1016/j.marpol.2010.05.001>

Hodges, G. (2016). The Shipwreck Shark. *National Geographic*, 230(2), 112–124. <https://login.ezproxy.csum.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=mth&AN=117082004&site=ehost-live>

Helfman, G., & Burgess, G. H. (2014). *Sharks: The Animal Answer Guide*. Baltimore, UNITED STATES: Johns Hopkins University Press. [http://](http://ebookcentral.proquest.com/lib/csum/detail.action?docID=3318816)

[ebookcentral.proquest.com/lib/csum/detail.action?docID=3318816](http://ebookcentral.proquest.com/lib/csum/detail.action?docID=3318816)

Ilouliau, J. (2017). From Shark Finning to Shark Fishing: A Strategy for the U.s. & Eu to Comb- at Shark Finning in China & Hong Kong. *Duke Environmental Law & Policy Forum*, 27(2), 345–364. [https://scholarship.law.duke.edu/cgi/viewcontent.cgi?a](https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1343&context=delpf)

[rticle=1343&context=delpf](https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1343&context=delpf)

Jaiteh, V. F., Hordyk, A. R., Braccini, M., Warren, C., & Loneragan, N. R. (2017). Shark finning in eastern Indonesia: assessing the sustainability of a data-poor fishery. *ICES Journal of Marine Science*, 74(1), 242–253. <https://doi.org/10.1093/icesjms/fsw170>

Lucifora, L. O., García, V. B., & Worm, B. (2011). Global Diversity Hotspots and Conservation Priorities for Sharks. *PLoS ONE*, 6(5), e19356. <https://doi.org/10.1371/journal.pone.0019356>

**(Figure 2).** McCarthy, N (2014). The World's Deadliest Animals [Digital Image] from <https://www.statista.com/chart/2203/the-worlds-deadliest-animals/>.

Mcguire, D. (2015). Without Sharks, There Would be No Shark Week. [http://www.earthisland.org/journal/index.php/articles/entry/witout\\_sharks\\_there\\_would\\_be\\_no\\_shark\\_week/](http://www.earthisland.org/journal/index.php/articles/entry/witout_sharks_there_would_be_no_shark_week/)

Roff, G., Doropoulos, C., Rogers, A., Bozec, Y.-M., Krueck, N. C., Aurellado, E., Mumby, P. J. (2016). The Ecological Role of Sharks on Coral Reefs. *Trends in Ecology & Evolution*, 31(5), 395–407. <https://doi.org/10.1016/j.tree.2016.02.014>

**(Figure 3)** Roff, G., Doropoulos, C., Rogers, A., Bozec, Y.-M., Krueck, N. C., Aurellado, E., Mumby, P.J. (2016). The Ecological Role of Sharks on Coral Reefs. *Trends in Ecology & Evolution*, 31(5), 395–407. <https://doi.org/10.1016/j.tree.2016.02.014>

- Schiller, L., Alava, J. J., Grove, J., Reck, G., & Pauly, D. (2015). The demise of Darwin's fishes: evidence of fishing down and illegal shark finning in the Galápagos Islands. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 25(3), 431–446.  
<https://doi.org/10.1002/aqc.2458>
- Spiegel, J. (2001). Even Jaws Deserves to Keep His Fins: Outlawing Shark Finning throughout Global Waters Note. *Boston College International and Comparative Law Review*, 24, 409–438. <https://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1195&context=iclr>
- Stewart, M., & James, P. (2018). *Tourism Vs Shark Fishery Project Hiu*, Lombok, Indonesia, <https://vimeo.com/294642125>
- Terborgh, J., & Estes, J. A. (2010). *Trophic Cascades: Predators, Prey, and the Changing Dynamics of Nature*. Washington, UNITED STATES: Island Press. <http://ebookcentral.proquest.com/lib/csum/detail.action?docID=3317486>