A SHARK ATTACK: IMPLICATIONS OF FIN TRADE

IN A PACIFIC COSTA RICAN SEASCAPE

By

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Under the Direction of Fausto O. Sarmiento

ABSTRACT

There is a shark attack occurring worldwide. The attack is not one of sharks, but rather an attack on sharks to procure their fins. The shark finning industry is a multi-million dollar operation that persists in the world's oceans. It is largely unmanaged, unmonitored and unsustainable. Costa Rica is one of the tropical countries where supply of shark fins originates. That supply was the inspiration for this study, which examines ecology, human understanding of shark-finning, politics, conservation, and shark biology. The purpose of this study was to gauge ecological conditions in Costa Rica, as well as survey residents and tourists in Costa Rica about their understanding of this critical topic for sustainability.

INDEX WORDS: Sharks, Finning, Shark-fin soup, Fishing, Conservation, Marine Ecology, Political Ecology, Environmental protection

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DEDICATION

To my mother, Jennifer Lynn Combs (Whiteman), who passed away after 2 hard-fought battles with cancer in 2006 at the young age of 47.

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CHAPTER 1

INTRODUCTION

Problem setting

The shark finning industry, fueled by a powerful and profitable market, has made a noticeable and possibly permanent impact in the Tropical Eastern Pacific Seascape (TEPS). Shark finning is the practice of removal and retention of shark fins for the purpose of exporting them to China and Southeast Asia for a traditional dish now connected to a thriving shark fin-soup business. This research will only focus on the supply side (Costa Rica) and not the demand (Southeast Asia). Shark finning is illegal in Costa Rica but it is largely unmanaged and unmonitored. As a result, anywhere between 30 and 100 million sharks are harvested annually for their fins alone (Stewart, 2003).

Objectives and purpose of the study

Shark finning is a multi-million dollar black-market operation that could escalate to an ecological catastrophe, particularly on the Pacific waters of the tropical seascapes, as the TEPS is known as breeding ground for many shark species. Ethics plays a key role in the struggle against shark finning. A review of the suppliers is also outlined for Puntarenas and Quepos in Costa Rica, as two locations exemplifying where shark finning has affected marine ecology. It also gauged interest in San José; the center of government in Costa Rica.

This study seeks to answer questions regarding implications of shark finning in the transformation of coastal communities of Costa Rican Pacific seascapes. The research was conducted in San José, Quepos and Puntarenas within affected social-actors and fishery groups. The study questioned both citizens of Costa Rica and tourists visiting temporarily on the impact of the global trade on marine ecosystems. There were no attempts to talk directly with persons involved in illegal activity.

The goal was to explore people's understanding of the ecology they advertently or inadvertently affect. The general research question is: what are the social, economic, and ecological implications of the shark-fin trade? There are also specific research questions that will be addressed: What is the effect of shark finning on the marine ecology of Costa Rica? Are sharks targeted as a result of bias? How does shark finning affect tourism and the economy of Costa Rica? The research is significant in that it helps to understand perceptions and misconceptions of ecological function and ecosystem health related to appropriation of market trends that force globalization on coastal communities' livelihood; this forces a change of identity of the rural fisher managing local needs into an anonymous worker satisfying global wants.

The issue of shark finning is complex. It is a mixture of social, economic, political and ecological issues. In order to understand the shark finning industry, it is also important to identify the questions of "who", "what", "where", "when", and "why" within the topic.

The question of “who” is four-fold. The four major players in this issue are the suppliers (eastern tropical Pacific harvesters), the demanders (Southeast Asia), politicians, and conservationists. Each of these players have a stake in what will be the outcome of the impact of shark finning.

The question of “what” is the very definition of shark finning. Shark finning is the “unsustainable” practice of cutting off and retaining shark fins while throwing the still living shark overboard back into the sea (Stewart, 2003). Shark finning, like shark hunting, has changed drastically. In the future, the definition of shark finning may be very different. Policies will dictate the direction in which shark finning is heading towards in the future in the TEPS.

The “where” question can be answered very simply; shark finning is happening worldwide, though its concentration is in the TEPS, the tropical Atlantic Ocean, and the tropical Indian Ocean (Clarke et. al., 2007). The key word here is tropical as these tropical locations tend to have the largest shark population density. Also, the majority of shark finning operations occur in places with fewer alternative economic opportunities, such as in countries of the pantropical belt.

“When” is another basic question. Shark hunting has existed for thousands of years. However, on a temporal scale, the practice of shark finning has changed dramatically. The switch from sustenance fishing to post-modern mass industrial fishing made a dynamic “dent” on the ecology of the world’s oceans (Barker and Schluessel, 2005). More sharks can be harvested in a

shorter amount of time; this leads to a maximized profit for the fisheries but an impoverished environment.

Perhaps the most interesting is the question of "why." Why is finning happening to sharks? Is it simply the result of a social tradition or is there a larger issue? A human-induced fear or prejudice against sharks could be the answer. Defenders against shark finning protested, scheduled anti-finning parades, and fought to get political change on the issue (Stewart, 2003). Change takes time so the direction of the shark finning industry depends on negotiations among social actors. That is to be examined further with insights of political ecology.

Methodology and data analysis

Field research was conducted in December 15th, 2011-March 22nd, 2012. Participants were identified at random around the cities of San José, Puntarenas, and Quepos. Anybody over the age of 18 was eligible for the study. The only requirement was that all participants and interviews were conducted in Costa Rica. Anybody visiting Costa Rica was also eligible. Questionnaires were made in both English and Spanish. People from all walks of life participated in this research. In total, 432 observations were made in San José, Puntarenas, and Quepos.

Contacts were made before and during field research. Since the focus of the project was the gauge the understanding of everyday citizens and tourists of Costa Rica, populous public places were desirable. Bus stations, public squares,

restaurants, bars, beaches, national parks, public universities were all places visited to acquire interviews and to deliver the survey instrument.

The research began in a hotel in Sabana Sur. It was an area of cultural interactions and close to everything in San José. What was not accessible could become accessible by the bus station on the next street. It was during field work time when in December 2011 that San José held nightly Christmas concerts; in March 2012 San José hosted an arts festival. Many surveys were achieved with tourists from Europe, Guatemala, the United States, the Dominican Republic, and other countries there.

Puntarenas was the most difficult location in which to conduct field work. Some people did not want to work with the project and others were paid to keep watch on tourists approaching the docks. Research there was conducted mostly on the “Paseo de los Turistas,” the bus station, near the ferry, local restaurants, and the fishing docks.

Quepos was a wealth of information. Field work was conducted at local hotels, the marina, residents of Quepos, Manuel Antonio National Park, and many of the nearby beaches. Though problems with shark finning had recently occurred in Quepos, the citizens and tourist seemed to appreciate the value in conservation. The problem with shark finning is that it usually only involved a few people in a select town; however, that town is branded with a negative image due to international exposure to the issue.

Of all people surveyed, 90.9% believed that shark finning should be illegal in Costa Rica. As shown in Table 1, the general hypothesis that Puntarenas would have the most people (citizens and tourists) that answered “no” to shark finning being illegal was supported. Of the 242 observations in San José on this issue, 234 voted “yes” while only 8 voted “no.” In Puntarenas, 62 voted “yes” and 25 voted “no.” In Quepos, 97 voted “yes” while only 6 voted “no” for whether shark finning should be illegal or not.

	SS	df	MS	F	p
Between:	3.315	2	1.657	5.697	0.004
Within:	124.789	429	0.291		
Total:	128.103	431			

Table 1: Should shark finning be illegal in Costa Rica? San José vs. Puntarenas vs. Quepos

The only general disqualification from this study was if a potential participant was under the age of 18 or the said person had never heard of the shark finning industry before. As most of the questions outlined the shark finning industry, it was imperative for all participants to have at least some knowledge of the topic. The only few who had not heard of the issue were tourists, thus did not partake in the survey.

Tropical Eastern Pacific Seascape

The Tropical Eastern Pacific Seascape (TEPS) eco-region is located “20ºS to 20ºN and 150ºW to the continental shelf of the Americas (Hinke et al.,

2004).” The TEPS is located to the south of Costa Rica and Panama and to the west of coastal Colombia and Ecuador (See Figure 1) (Rosero et. al., 2010). This seascape is home to many endemic species of natural flora and fauna. Nearly 80% of species in the TEPS are endemic; the remaining 20% of species arrived through the Panama Canal and by human introduction (Mora and Robertson, 2005). The Tropical Eastern Pacific Basin is outlined by the conglomeration of 3 tectonic plates; the region extends as far west as the Cocos Ridge, an underwater mountain chain (Rosero et. al., 2010). The Tropical Eastern Pacific ecoregion is distinguishable by its rocky shorelines and coral reef systems (Mora and Robertson, 2005).

Figure 1: Eastern Tropical Pacific Seascape (Photo from http://www.migrammar.org)

The majority of shark fins taken in the TEPS originate in the Galapagos Islands of Ecuador, and Cocos Island in Costa Rica (Stewart, 2003). Both locations have similar histories of human interaction with various degrees of intervention. Both locations have been affected by human arrival, invasive species, and shark-finning, but both are managed as marine protected areas (MPAs) or marine reserves (MRs).

Study area in Costa Rica

Costa Rica is a Central American country located between Panama and Nicaragua. With a total area of 51,100 km^2, it boasts a size just smaller than West Virginia (CIA, 2012). Costa Rica is a country whose economy depends mostly on agriculture, technology and tourism (Greenspan, 2013).

With its motto, “Pura Vida” (or Pure Life), Costa Rica has obtained a reputation for protection of ecosystems, biotas, and biodiversity (Greenspan, 2013). Costa Rica boasts the world’s top location for re-forestation in recent history. It is one of the only countries in which forest land increased rather than decreased due to population growth (Pagiola, 2007). Of all the countries in the world, Costa Rica usually comes to mind when one mentions “ecotourism” or a “green country.”

With all that praise and dedication to conservation, it is hard to imagine something as gruesome as shark finning happening in that location. However, the coast and the rainforest are two very separate worlds in Costa Rica. Costa

Rica has approximately 1500 km of coastline; of which, 85% of that coastline is on the Pacific side (Chacón-Barrantes and Protti, 2011).

San José is the capital of Costa Rica and the center of Costa Rica's government. This bustling city is the starting and ending point for both legs of this study. A majority of the observations came from San José. It was important to understand the opinion of shark finning in San José, as many non-government and government organizations that have the power to promote change reside there. It was not surprising that most of the citizens in San José knew about shark finning or "aleteo." It was, however, surprising to find out just how opinionated people were on the subject.

Puntarenas was the next stop on the journey to find out information about the shark finning industry. Puntarenas is located on the Pacific side of Costa Rica and is the administrative center of a province by the same name. It has a population of nearly 11,000 people (Chacón-Barrantes and Protti, 2011). Puntarenas was the major port in Costa Rica until the 1980s. Today, however, citizens from all over Costa Rica often travel to Puntarenas for weekend getaways and vacations. Now, Puntarenas caters to tourists from cruise ships and Costa Rican nationals who want to get away and relax in the hot sun (Chacón-Barrantes and Protti, 2011). Of all the locations examined, Puntarenas has received the most media attention for its citizens' involvement with shark finning. Puntarenas was exposed in the documentary by Canadian Biologist Rob Stewart, titled *Sharkwater*.

Sharkwater was the inspiration for this project. It depicted the horrors of shark finning. One of the most memorable and sad scenes was when a sea turtle was caught by a longline. The turtle was still alive and the shark-finners hammered away to try to remove the hook from its tough beak. Puntarenas was the mecca for the shark-finning industry and was portrayed in the film as the base port in Costa Rica for movement and exportation of shark fins.

Shark fins were stored on private docks and dried on roofs while awaiting shipment. These docks were key in the search for shark fins, but going to the docks was difficult. Puntarenas is on a "U"-shaped protrusion from the mainland of Costa Rica. On one side is the "Paseo de los Turistas (Walk of the Tourists) (Chacón-Barrantes and Protti, 2011)." This side contains beaches, a boardwalk, basketball courts, and a dock which the locals often use for fishing. A street runs parallel to the boardwalk and contains seafood restaurants, bars, hotels, and general stores. The other side, however, was the most intriguing for this study, where several fishing docks exist. It also has a ferry, which is used to take tourists and locals across the Gulf of Nicoya to Cabo Blanco in the Nicoya peninsula (Chacón-Barrantes and Protti, 2011). Located to the right of the ferry are some of the fishing docks in Puntarenas. This study was conducted in January 2012 and then revisited in March 2012. Each time the docks were guarded by men who claimed they were local fisherman. They issued threats and warnings about the dangers of a foreigner or "*gringo*" walking near the docks.

Quepos was the last city to be examined during the study in March 2012. Quepos was identified as a point of reference through observations made in Puntarenas. Quepos most recently made the news in January 2012 for the apprehension of shark fishermen who came into port with the fins but without the shark carcasses attached. During fieldwork in Quepos, 72 observations were recorded during the course of 5 days.

Quepos is a port city. It is important for tourism and is close to one of Costa Rica's most famous parks, Manuel Antonio National Park (Manuel Antonio). Manuel Antonio boasts over 1,680 acres of land and over 135,906 acres of protected marine reserve (Greenspan, 2013; Rosero et. al., 2010). The coast of Quepos has a sport fishing industry arguably comparable to many locations on the North American Atlantic coast. Pictures at many locations demonstrate large local fishing trophies; species such as sailfish, tuna, and even sharks are proudly displayed.

Importance of ocean diversity

Approximately 70 percent of the world is covered by the oceans. The ocean also provides nearly 1/3rd of the Earth's breathable air; it has a profound effect on the terrestrial environment and the people of the world (Cock et al., 2006). Poorly developed planning, pollution, eutrophication, climate change, introduced species, physical alteration of coastlines, ocean acidification, and over-exploitation of fisheries greatly altered the seascape (Guarderas et al., 2008).

Marine protected areas (MPAs) and marine reserves (MRs) are “important ecosystem-based management tools for the conservation and sustainable use of biodiversity (CBD, 2004). Though the number of MPAs and MRs has increased, they are limited in that their protection is insufficient at large biogeographic scales and that they fail to preserve or conserve connectivity among shark populations or their full range of habitat (Guarderas et al., 2008). International recognition of significant areas in need of protection helps promote local conservation and lasting adequate protection; however, this requires planning and strong support from local people and the nation as a whole (World Bank, 2006).

CHAPTER 2

THE SHARK-FINNING INDUSTRY

The hunting of sharks is not a new topic. Shark products were harvested, valued, and exploited for thousands of years. Shark products were served both as ceremonial objects and weapons of war for many different cultures (Tricas et al., 1997). When Europeans settled Australia in 1788, they ate shark meat and extracted oil from the liver of sharks in order to produce medicine and lighting. Sharks were used as fertilizer for orchards in Tasmania from 1875 to the early 1920s. In addition, shark liver was a product on heavy demand for its vitamin A content in the 1930s; however, this process ended in the 1950s when a synthetic vitamin A became available (Tricas et al., 1997).

Sharks have also been utilized for a variety of other purposes; these are not as wasteful and sharks taken are not over-exploited as they are with finning. Rather, they are harvested when needed and the whole shark is utilized. In Australia, aboriginal people still catch sharks today to prepare *buunhdhaarr*; this is a liver and flesh shark meal that is mixed for food (Tricas et al., 1997). This practice is less catastrophic because the whole shark is used for food. Also, the sharks used are not harvested in mass quantities.

Shark products are widely used for many purposes globally. There are many different uses for sharks if harvested not only for their fins. Sharks are still used today as fertilizer and fishmeal in order to feed domestic animals in some

countries (Tricas et al., 1997). The practicality for using complete shark products even branches into other fields.

Interest in sharks for the purpose of medicine has grown as well; countries such as the United States use shark corneas as a means for eye transplants in humans. Chondroitin, which is derived from shark cartilage, is used as artificial skin for burn victims. An acne treatment is also found in shark bile (Tricas et al., 1997).

Shark hunting and the use of shark products has been around for hundreds if not thousands of years. Historical shark fisheries are “traditional, artisanal, industrial, bather-protection-orientated or recreational (Barker and Schluessel, 2005; Walker, 1998). Of all the purposes of shark hunting, the most invasive, wasteful and inhumane has to be shark-finning.

Shark finning is the practice of removal and retention of fins before discarding the dying carcass back into the ocean. Sharks need fins in order to swim and they need to swim in order to breathe; therefore, when the fins are discarded, the shark drowns, bleeds to death, or is consumed by other sharks as it descends beneath the depths of the ocean (Stewart, 2003). Fins are piled up together with little to no regard of what species they came from (Stewart, 2003). Shark meat, besides the fins, is considered to be low value and discarded after attainment of the fins (Shivji et. al., 2002).

The practice of shark finning is largely unmonitored, unmanaged, and ignored. As such, it is estimated that 100 million sharks are harvested for their

fins on an annual basis (Verlecar et al., 2007). The demand for shark fins comes from a powerful market from the western Pacific. The shark fin trade is a $400 million industry (Sadovy et al., 2003; Clarke et al., 2007).

Sharks have been important in parts of Asian cuisine for thousands of years. Shark-fin soup has been considered a delicacy by the Chinese for over 2,000 years; it became a tradition at banquets and weddings in 1368-1644 during the time of the Ming Dynasty (See Figure 2)(Tricas et al., 1997). Any accomplished chef in affluent Asian cities is expected to prepare an amazing shark-fin soup (Raloff, 2002). Shark fin soup takes hours to prepare. After simmering, the shark fins turn out “gel-like” and tasteless. Shark-fin soup is a sign of status and affluence, much like caviar is to Western cultures (Raloff, 2002). The soup is considered to be an aphrodisiac in many parts of Asia (Tricas et al., 1997).

Shark populations received a break from hunting for several decades in the mid-1900s (Stewart, 2003). For a while, many Chinese people in the revolution era did not want the association with wealth so they distanced themselves from shark fin soup. However, in 1987, the collective attitude of the people relaxed and consumption of shark-fin soup rose tremendously (Stewart, 2003).

Figure 2: Shark Fin Soup: The Final Product (Rapture of the Deep)

Hong Kong is largely considered to be the hub of the shark-finning industry; over 50% of worldwide shark-fin imports arrive in Hong Kong (Clarke et al., 2007). Upon obtainment, fins are stored and dried as they await the journey to their final destination. Shark fins are then graded (see Figure 3) and shipped to Asian food markets (Verlecar et al., 2007).

Just less than 2 percent of the Pacific longline fleet is registered from the United States in international waters. About 98 percent of the Pacific longline fleet comes from Japan, Taiwan, and Korea (Kitchell et al., 2002). International waters pose a different problem because they are nearly impossible to "police;" also, it is unlikely that the numbers of fish harvested are reported honestly (Kitchell et al., 2002).

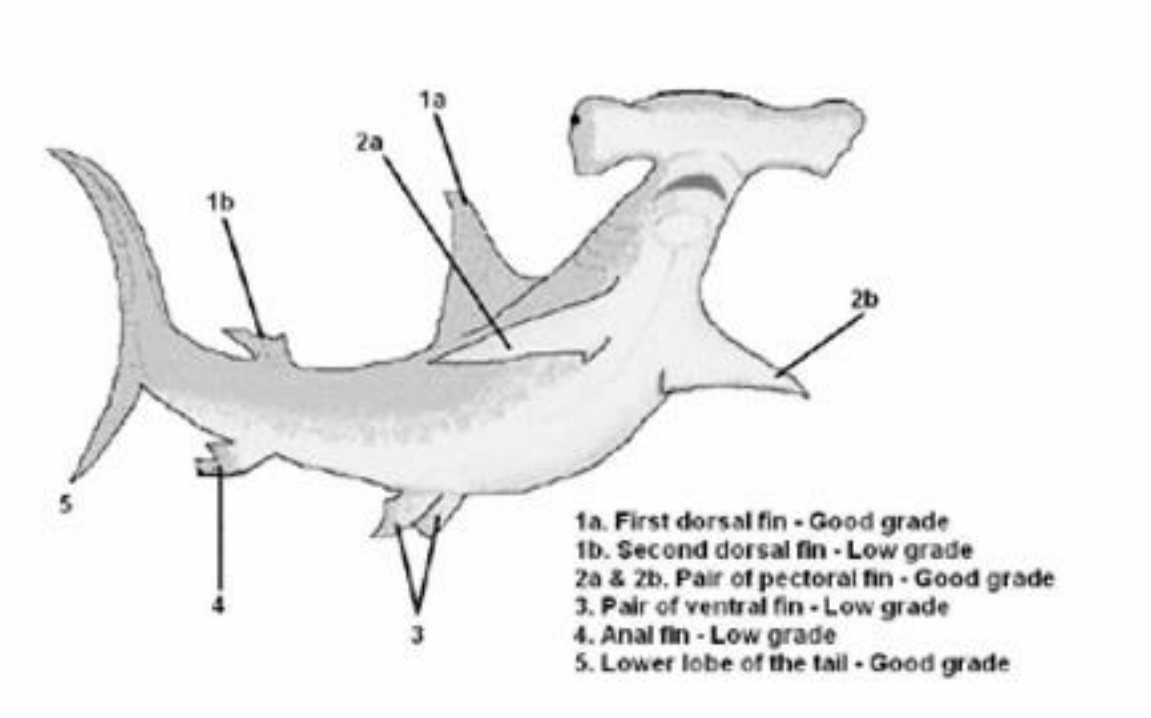

Figure 3: Commercial value of shark fins (Verlecar et al., 2007)

As restrictions exist, the cost of shark fins grows yearly. The demand for shark fins remains high. However, the supply of shark fins is lowered with tighter restrictions. Shark-fin soup in Asia, which normally cost around $150 per bowl, now sees prices skyrocketing 30 to 40 percent higher; that is about $200 for a regular bowl of shark-fin soup and up to $720 or more for high or superior quality of soup (Lemonick, 1997; Chung, 2000). Fins from species such as the whale shark can reach anywhere between $10,000 and $15,000 (Spiegel, 2001). It is estimated that just one pound of shark fin can net around $300 (Sharkwater, 2003).

Shark fins are used in soups for texture. Shark fin is “comprised of protein-packed gelatinous cartilage, and fins with a high “needle” count-the

elastin fibers that make up the fin-are especially desirable (Graham, 1999)." Chefs use the tissues in shark fins in order to flavor and thicken the broth (Spiegel, 2001). Thus, "stringy tendrils from the dorsal, pectoral, and lower tail fins are prized as the namesake ingredient of the soup (Hill, 1999)."

Though this particular study did not focus on the demand for shark fins, it is important to know where shark fins are arriving. The largest importers of shark fins come from China and Southeast Asia. A curb in demand for shark fins or an act of illegalization of importation of shark fins could very well cripple the shark fin industry. However, with many different sovereign nations involved, that will certainly be a challenge to achieve. As long as there is money to be made from shark fins, interest will remain in economic advancement and prosperity.

As sharks are found in all of the oceans in the world, shark-finning occurs anywhere shark populations are dense. In the Atlantic, some shark species were down from 75 to 80 percent of their original populations. As a result, restrictions were placed on shark fishing; a quota of 2,750 metric tons was imposed in 1993 (Baker, 1997). In 1986, over 3000 metric tons of shark products were harvested in the Atlantic. By 1995, just 750 metric tons of shark products were harvested (Baker, 1997). Though this study focused on the Tropical Eastern Pacific Seascape, it is advantageous to look at shark finning on a global scale as well.

The supply of shark fins come largely from the waters of the TEPS. Here, shark finning provides an alternative economic opportunity for fisherman and other people who may not have many options to make as good of money in other

occupations. The opportunists, termed “roving bandits,” help drive a globalized shark fin trade (Berkes et al., 2006). Shark fins can reach figures of up to $116/kg and have become one of the most precious commodities in the world. Sharks are extremely valuable and vulnerable (Verlecar et al., 2007). However, the suppliers who work to obtain the fins directly do not make near the profit as those who negotiate deals and import the fins as middlemen.

Poverty is one explanation for the source becoming involved in shark finning. From the mountains to the seas, a lack of economic opportunity and the increased number of amenity migrants leave people little choice but to take up other activities. Some are forced to change their lifestyle to adapt to these amenity migrants. With more people arriving in Costa Rica, fewer resources are available like land for agriculture, beaches for gathering as a result of tropical farmscape transformation (Sarmiento et. al., 2013). People leave the mountains for economic opportunity and a brighter future; therefore, activities such as the shark-fin trade become an enticing alternative to working long days for less pay on a fishing boat. Some also enter the shark-finning industry by pressure from neighbors or bully tactics to help make quick money by fishing sharks.

The most common way to catch sharks is the use of longlines (Stewart, 2003). Long-line fishing was developed in the 1960s as an alternative way to fish when restrictions were placed on “drag netting,” trawl lining, “purse seining,” and other methods of “destructive” fishing (Barker and Schluessel, 2005; Stewart, 2003). Long-lining involves throwing out lines of up to 50 miles long; these lines have extensions every few meters with hooks (Stewart, 2003). The purpose of

long-lining is to catch as many marine animals as can be acquired in the shortest amount of time. Target species tend to be high-profit animals such as billfish, tuna, and swordfish; however, animals such as sea turtles, sea lions, seabirds, and sharks are hooked as by-catch (Stewart, 2003). With the rise in fin prices and over-fishing for profitable species, fisherman began to target sharks more frequently (Stewart, 2003)."

Many researchers have worked together on a combined effort study the different types of shark fins being imported into Hong Kong (Clarke et al., 2006). Hong Kong is the shark fin importation capital of the world. The practice of genetic identification was used in order to identify shark species taken by examining the DNA in fins (Shivji et al., 2006). In all the shark fins auctioned, 40 percent of those fins belonged to just 14 species of sharks (Clarke et al., 2006). Of all the shark fins recorded in this study, 17 percent of shark fins in the overall market were the blue shark (*Prionace glauca*) (Clarke et al., 2006). Between 2-6 percent of shark fins in the market belonged to the following species: thresher shark (*Alopias spp.*), hammerhead (*Sphyrna spp.*), shortfin mako (*Isurus oxyrinchus*), silky (*Carcharhinus falciformis*), bull (*C. leucas)*, and sandbar (*C. obscurus*) (Clarke et al., 2006).

It is of upmost importance to review what species are taken and how many. In doing so, ecologists and biologists can review the information and use it toward protecting areas where the affected species are the most vulnerable. With the practice of studying the demand (Southeast Asian markets), a protection for supply areas can be assessed as a comparative analysis.

As recent as 2006, approximately 50 locations of retail or wholesale establishments in Hong Kong dealt with shark fin products (Clarke et al., 2006). Shipments from over 85 different countries or territories checked into Hong Kong markets; once the fins arrived they were sorted into market value categories and then sold in retail or auctions right there in Hong Kong. Hong Kong is estimated to deal with over 50% of the global shark-fin trade (Clarke, 2004).

Shark-finning garnered much negative attention in the early 1990s. Shark fins at that time could bring as much as $44 per kilogram (Manire and Gruber, 1990). Immediate restrictions among public outcry were stationed in United States waters; however, in 2012 shark-finning still remains a problem. Shark finning is a reoccurring problem; as such, in order for history to not be allowed to repeat, permanent restrictions and constant observation of the potential illegal operations must be considered.

Shark fins are harvested in a variety of locations. Though this study focused on the port cities and capital of Costa Rica, it is important to also examine just where the shark fins came from to these cities. Some areas in the TEPS in which shark fins originate before arriving in Puntarenas, Quepos and San José are Cocos Island (Costa Rica), are the Galápagos Islands (Ecuador), and Malpelo Island (Colombia). All of the aforementioned areas have made news headlines for shark finning within the last year.

Cocos Island is located nearly 330 miles southwest of Cabo Blanco in the Tropical Eastern Pacific (Rosero et. al., 2010). Cocos Island is lush and green

and is the only rainforest island in the TEPS (Tricas et al., 1997). The island is located a approximately 682 km (423 miles) from the Galápagos archipelago (Rosero et. al., 2010). Historically, Cocos Island was a hideout for pirates; there are legends of buried treasure and it has been interpreted that Cocos Island was the inspiration behind Robert Louis Stevenson's book *Treasure Island* (Tricas et. al., 1997). Cocos Island was declared a national park system in 1978 (Simmons, 1984). Like the Galápagos Islands, Cocos Island faced similar problems with the introduction of feral and invasive species (Rosero et. al., 2010). Today, Cocos Island National Park is only accessible by boat; it is a nearly 30 hour trip from the mainland of Costa Rica. There are no nearby ports or fishing villages near Cocos; in fact its only occupants are personnel from the National Coastguard Service (SNG), MarViva, the Ministry of Environment, Energy and Telecommunications (MINAET), volunteers, and the occasional tourists that come nearby to dive (Rosero et. al., 2010).

The waters surrounding Cocos Island are well known for their high concentration of shark populations. The waters are famous for "LLPs" or "Large Legendary Pelagics (Tricas et al., 1997)." Pelagic is an oceanic word for "open sea." LLPs seen in the surrounding waters are Galapagos sharks (*Carcharhinus galapagensis*), manta rays (*Manta birostris*), scalloped hammerhead sharks (*Sphyrna lewini*), silky sharks (*Carcharhinus falciformis*), whale sharks (*Rhincodon typus*), tunas and jacks (Tricas et al., 1997).

The waters around Cocos Island are also known for an active shark-finning operation. After fins are harvested near the waters of Cocos Island, they

are taken to one of the world's most "notorious" shark finning ports; that port is Puntarenas, also in Costa Rica. Shark fins that were recently harvested are laid out to dry on warehouse roofs in Puntarenas (Stewart, 2003). After drying, the fins are boxed and shipped to their intended destination. Many of the fins are shipped to Hong Kong or Taiwan via Costa Rican airports. Others are passed on ships that meet in international waters (Stewart, 2003).

The Galápagos Islands are just one example of a place directly affected by the shark finning industry. The discovery of the Galápagos archipelago happened in 1535 when Fray Tomás de Berlanga, the Bishop of Panama, and his ship were carried by winds while on a trip from Panama to Peru (Jackson, 1985). Berlanga's crew had trouble locating a water source and suffered immensely through their time on the islands. Two men and ten horses died on the excursion due to dehydration (Jackson, 1985).

Fray Tomás de Berlanga had so much contempt for the Galápagos Islands that he did not even bother to name them and referred to them as "barren" and "worthless (Chambers, 2006)." The Galápagos Islands retained the name "Encantadas" or "Bewitched Islands" even after their discovery because they seemingly disappeared in the fog; the intense and dynamic currents made navigation difficult around the islands (Jackson, 1985). The notoriety of the Galápagos Islands was not recognized until many years later.

The Galápagos Islands are known today as the "birthplace of the theory of evolution" thanks to a visit by Charles Darwin (Quamman, 2006). Darwin visited

the Galápagos Islands on a voyage that also took him to Brazil, Uruguay, Argentina, Chile, New Zealand, Peru, Australia, South Africa, and many other small oceanic islands between the years of 1831 and 1836 (Weiner, 1994). At the time of his journey, Charles Darwin was a young geologist interested in the study of craters. Darwin went on to develop his evolutionary theories and his groundbreaking book, *The Origin of Species*, from his trip to the Galápagos Islands (Bassett, 2009).

The Galápagos Islands consist of nearly 200 islands, islets, and rock formations (Walsh and Mena, 2013). This archipelago is located approximately 600 miles west of its mother country, Ecuador (Constant, 2007). To many people on the outside, the Galápagos Islands seem like a land that has not been touched by humans and that the islands are in complete pristine condition. The water is clear and the animals show a surprising lack of fear when it comes to human contact. Many people feel that the Galápagos Islands are protected and have not had their share of problems. However, most islands in the archipelago have been affected by humans in some manner, both directly and indirectly (Sarmiento, 1987).

Direct human problems, such as the release of feral animals, have had devastating effects on many islands. Indirect human problems, such as black rats boarding ships and making their way to the Galápagos Islands, have also had their fair share of consequences (Perry, 1984). Humans have made their marks on the Galápagos Islands by more than just their footprints (Sarmiento, 1987). The marine reserve has been subject to longline fishing and shark finning

for quite some time. Whether intentional or not, human contact with the Galápagos Islands has been detrimental to many native animals on the islands and in the surrounding ocean waters (Jackson, 1985). Conservation work in the islands did not happen immediately; engaging an ecological "problem" was a process in itself (Perry, 1984).

Destruction of the Galápagos Islands began somewhere between the late 1500s and early 1700s (Jackson, 1985). Pirates used the Galápagos Islands as an escape route to rest, eat, and attempt to get water after raids on Spanish colonial ports (Bassett, 2009). Buccaneer Ambrose Cowley composed the first crude navigation charts of the Galápagos Islands based on when and where to get water, salt, firewood, and tortoises seasonally (Jackson, 1985). Many passing seamen such as pirates enjoyed killing animals for fun as well. The clubbing of birds such as the Nazca booby and reptiles such as the land iguana was common on many islands (Jackson, 1985).

The animals of the Galápagos Islands showed very little fear towards humans so they made themselves easy targets for vindictive humans who enjoyed killing for fun (Jackson, 1985). Buccaneers brought goats to the Galápagos Islands in the 1600s (Perry, 1984). The introduction of foreign species of animals and plants had a devastating effect on native Galápagos species. However, the Galápagos exploitation did not only occur on land. Ocean creatures such as sea cucumbers, sharks and sperm whales suffered because the use of the Galápagos Islands served as a "base" for harvesting purposes (Jackson, 1985).

Conservation work in the Galápagos Islands began in 1934 with the Ecuadorian government (Perry, 1984). The Ecuadorian government started by protecting certain animal species from being hunted or captured. The government of Ecuador also declared the islands of Daphne, Darwin, Española, Genovesa, Marchena, Pinta, Pinzón, Rábida, Santa Fe, Santiago, and Wolf to be "Reserves and National Parks (Perry, 1984)." However, it took much later for the technical officers to arrive in the Galápagos Islands to enforce the rules. Though the first legislation to protect the Galápagos Islands was enacted in 1934, it was not until 1959 that effective legislation would carry the laws out (Jackson, 1985).

In 1959, 1,714,000 acres of land (or over 90% of the Galápagos Islands) were set aside as National Park by the Ecuadorian government (Perry, 1984). The park service of the Galápagos Islands National Park was set up in 1967. In 2007, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) declared the Galápagos an endangered World Heritage site (Bassett, 2009). However, problems with shark finning still exist today.

Malpelo Island is located approximately 500 km (or about 311 miles) off the Pacific Coast of Colombia (Pitman et al., 1995). Until 1986, Malpelo Island was uninhabited and rarely visited. However, after 1986, the Colombian government issued a garrison of 4 to 5 soldiers to stand on the island and watch permanently (Prahl, 1990).

Malpelo Island boasts a healthy seabird population; however, with the exception of potential endemic species of lizards, Malpelo is completely lacking

terrestrial inhabitants (Pitman et al., 1995, Prahl, 1990). Malpelo Island is a vertical rock face; its terrain is devoid of vegetation or soil (Pitman et al., 1995). However, the waters around Malpelo Island, along with Cocos Island and the Galapagos Islands, offer a rich system of biodiversity.

Among the biodiversity in waters surrounding Malpelo is a rich shark population. However, just in January, 2012, a group of shark "fishermen" carrying a large amount of shark fins in a ship from Costa Rica were caught and arrested in the waters surrounding Malpelo Island. Costa Rica and Colombia now have an allied effort in the war against shark finning (Rosero, 2010).

Shark-finning is largely unsustainable. Many large sharks do not reach sexual maturity until about the age of 7 years old (Verlecar et al., 2007). The larger sharks only give birth to a couple of pups at a time; those pups are lucky to survive to adulthood. At that rate, many shark populations cannot sustain numbers need to continue the species. Sharks are being killed at a much quicker rate than they can reproduce. For example, a sandbar shark takes up to 15 years to reach sexual maturity (Baker, 1997). A missing species deeply affects the ecological niche (Barker and Schluessel, 2005).

From an ecological perspective, sharks fill an important niche as predators and scavengers (Verlecar et al., 2007). They help keep the ocean clean and functional. A disappearance of sharks could also directly affect the ocean's place as a carbon sink (Tricas et al., 1997). The ocean acts as a carbon sink (Hardt and Safina, 2010). Sharks help balance the system by keeping the food chain in

balance. The ocean soaks up nearly 30 million tons of carbon dioxide on a daily basis (Hardt and Safina, 2010). Plankton plants help to facilitate photosynthesis; without an apex predator like the shark to keep predators of plankton plants in balance, the carbon cycle cannot function properly (Tricas et al., 1997).

CHAPTER 3

SHARK BIAS

Many cultures respect and revere sharks in a positive light. Among those are the indigenous people of Polynesia and Melanesia. They have a strong spiritual relationship with sharks. Sharks are believed to be the "reincarnated souls of their deceased family members" and the indigenous Polynesians and Melanesians refuse to kill them (Tricas et al., 1997). Sharks adorned the totems of many indigenous populations along the Pacific coasts of North America (Ferrari and Ferrari, 2002). However, not everybody has a high reverence for sharks.

A human-induced fear of sharks is engrained in society. From media portrayal to oral tradition, warnings about shark attacks impact people. Whether it is psychological fear of sharks (selachophobia or galeophobia) or natural fear of blood (hemophobia), the thought of what could be in the open water (thalascophobia) scares people. Identifying a possible prejudice against sharks is a key in understanding human-shark relations. Many view sharks with animosity and fear (Spiegel, 2001).

Sharks rarely achieve positive coverage in the media. Bias against sharks has existed for a very long time. Many phrases such as "shark feeding frenzy," "shark-infested waters," "bloodthirsty shark," and others denote sharks as merciless killers. This bias comes from a lack of understanding about sharks and

the way sharks are portrayed in the media. In actuality, sharks are selective hunters that fill an ecological niche in marine ecology.

Shark attacks are a reality. Though shark attacks are rare, they receive much media attention when they do occur (Baldridge, 1974). Beaches and other tourist locales can suffer image problems months after a shark attack (Gilbert, 1968). The ocean is vast; the probability of shark attacks grow more each year with globalization and a greater number of humans coming into close contact with sharks (Tricas et al., 1997). However, attacks by sharks do not occur as frequently as many assume, despite being portrayed even with cataclysmic flair, such as in Sharktopus, Dinoshark, or lately Sharknado.

There are many misunderstandings and misconceptions about sharks. A particularly laughable video was produced by the United States Air Force in 1964 titled “Shark Defense (United States Air Force, 1964).” It was used by the USAF as a training method in which to utilize as a deterrent or defense against sharks when in the ocean. In this video, servicemen are suggested to repel sharks by slapping the water with a cupped hand to create noise, rub a finger over the life preserver or raft in order to create a scary sound, use black dye in order to camouflage the victim and scare the shark, shout underwater, light and fire a flare underwater while it is burning, direct a stream of bubbles from a life preserver in a shark’s direction, and to tear paper into small pieces and scatter them around a life raft (United States Air Force, 1964). The USAF shark defense training video also states the following; “*You may have heard that porpoise will always attack sharks. This is not true! The porpoise may attack the shark but*

may not necessarily do so. Precautions should be taken even when porpoise are nearby (United States Air Force, 1964)." Though the video falls short of contemporary scientific knowledge of sharks, shark research amplified in the late 1960s.

In 1968, it was thought that of over 250 species of sharks in existence, only about 35 of those are "potentially dangerous" to humans. It was also recognized that three times as many people die annually from bee stings or lightning than as a result of shark attacks (Gilbert, 1968). It was noted that during World War II, "probably far more servicemen drowned from panic at the sight of a shark fin than from shark attack (Gilbert, 1968)." The need for protection of sharks was clear, defined, and outlined as early as the late 1960s. However, for many people, a particular box office hit in 1975 changed and altered the human view of sharks for many years to come.

The movie Jaws, one of the highest grossing box office hits of all times (and the top box office hit of all time in 1975), was just one way in which sharks were portrayed as beastly and malevolent. It is worth noting that the artist of the movie poster for "Jaws" changed the teeth of the great white shark to those of a mako shark; the teeth of a mako shark appeared more "dramatic looking" and made the monster portrayed in the movie fiercer (Tricas et al., 1997). Shark scientist Eugenie Clark was quoted as saying, "'Jaws' was a fun and wonderful movie, but it created this horrible reaction in people to go out and kill sharks (Arehart-Treichel, 1976)."

The reality of shark attacks

As an estimate, for every human that has been bitten by a shark, 1,000,000 sharks were killed by humans in 1990. Yet the portrayal of sharks as "evil" or "vulgar" in the media is a common occurrence every time an attack happens. In truth, death as a result of shark attack is very low worldwide (See Table 1) (Tricas et al., 1997). Many other statistics about sharks are interesting as well (See Table 2).

Though the total number of shark attacks worldwide are difficult to record on an annual basis (as some attacks go unreported), the Florida Museum of Natural History (FMNH) in Gainesville, Florida, keeps a collection and records all reported shark attacks and the type of species of sharks that attacked (Burgess, 2012). According to the University of Florida's International Shark Attack File, United States shark attacks declined in 2011. However, fatalities around the world amounted to an all-time high (Burgess, 2011)

The political ecology of shark-fin trade

A prejudice against sharks can possibly help explain why shark finning is happening. Indiscriminate shark fishing occurs all around the world. It is anticipated that around 20 species of sharks possibly could become extinct by the year 2017 due to current fishing techniques (Verlecar et al., 2007). It is important for people to understand what sort of risks come with the possibility of losing one species, two species, or even an entire class of sharks. Education

and understanding shark behavior and ecology is one of the cogent ways in which people can realize the global importance of sharks.

Area	Average number fatal attacks/year
World	**6**
Australia	**1**
New Zealand	**0**
Brazil	**<1**
South Africa	**<0.5**
Hong Kong	**1**
Japan	**<0.5**
Florida, USA	**0**
California, USA	**<0.2**
Hawai'i, USA	**<0.5**
Other Areas	**<3**

Table 1: Shark Attack Statistics (Tricas et. al., 1997) This table shows the average of fatal shark attacks that occur every year in places with a high number of human-shark interactions.

Year	Number of Shark Attack Fatalities	Number of Dog Attack Fatalities	Number of Hunting Fatalities	Attacks on the Homeless Fatalities	US Bicycle Fatalities	Annual Tornado Fatalities	Number of WORLDWIDE Shark Attack Fatalities
2001	3	23	79	N/A	732	40	4
2002	0	15	89	N/A	665	55	3
2003	1	25	53	N/A	629	54	4
2004	2	22	42		727	36	7
2005	1	28	41		786	39	4
2006	0	31	27		772	67	4
2007	0	31	19	61	701	81	1
2008	1	23	N/A		718	126	4
2009	0	32	N/A		630	21	6
2010	2	33	N/A	N/A	N/A	45	6
2011	0	31	N/A	N/A	N/A	550	12
Total	10	294	350	61	6,360	1,114	55

Table 2: U.S. Fatalities between 2001-2011: (Multiple sources UFMNH, NRA, etc.) : This table shows a comparison of fatalities per year. Its purpose is to illustrate that in between 2001-2011, shark attacks fatalities were lower than many other fatality totals.

CHAPTER 4

SHARK BIOLOGY

Predatorial function

Sharks have been top predators in the world for a very long time. They are estimated to have existed on the planet for over 400 million years (Carrier et al., 2004). The largest shark to have ever lived, the megalodon (*Carcharodon megalodon*) was a close relative of the great white shark (*Carcharodon carcharias*); its teeth from random excavations date back between 3 to 25 million years (Tricas et. al., 1997). Shark excavations have yielded other important finds. The oldest living fossils recorded are over 400 million years old; dinosaurs arrived nearly 200 million years later than the oldest known radiocarbon-dated shark ancestors (Carwardine and Watterson, 2002). Though subtle changes and adaptations occurred, sharks remained virtually unchanged throughout their life history, the “perfect predator (Stewart, 2003).”

Sometimes finding evidence of prehistoric sharks is a result of luck rather than scientific prowess. Sharks have a cartilaginous skeleton that dissolves rapidly after their death; therefore, fossilization was not a viable option due to the lack of time permitted for organic matter to be replaced by minerals (Ferrari and Ferrari, 2002). The clues to unravel the past stemmed from teeth, scales, small portions of vertebrae, and spines.

Sharks are a byproduct of evolutionary and adaptive trial and error of Chordata that followed the path of a soft endoskeleton of cartilage instead of sturdy bone material (Spiegel, 2001). Sharks can be found in all the world's oceans (Manire and Gruber, 1990). Sharks range dramatically in size; the smallest are the one-foot dwarf sharks and the largest are the over fifty-feet whale sharks (*Rhincodon typus*) (Spiegel, 2001).

Despite attacks on humans being rare, sharks are predators with an exceptional arsenal of weapons. Their jaws are the most feared. The jaws of a shark can shred between 25 to 30 pounds in only one bite (Arehart-Treichel, 1976). Furthermore, shark teeth are replaceable. A constant supply of new teeth is formed and emerges from the gums to replenish them once teeth are dull or lost. The teeth are arranged on both jaws and in ordered rows (Tricas et. al., 1997).

When a shark's mouth is closed, the jaw is normally set below the skull. As the mouth opens, the upper jaw remains close to the skull. However, the upper jaw can then detach from the skull to open the mouth wider in order to take in more food in one bite (Tricas et. al., 1997).

Notwithstanding, sharks are predators and hunt a wide variety of target prey, humans are not their natural food source (Hueter and Neff, 2013). Common prey species consists of fish, seals, seabirds, mollusks, other sharks, plankton, etc. Of course, prey selection varies by target species and by prey availability in a given area. Hunters come in many forms displaying tactics as

ambush predators, benthic foragers, reef interior hunters, and group strategies from solitary explorers to intricate social arrangements for communal feeding (Tricas et. al., 1997).

Anatomical forms

Sharks are either born by egg-layers (oviparous), or live born (viviparous) (Tricas et. al., 1997). Nevertheless, most sharks are viviparous. Sharks do not guard their offspring (pups); once born the pups are left to fend for themselves. Some take to cannibalism and eat smaller siblings while others hatch and eat unhatched eggs of their siblings (Ferrari and Ferrari, 2002). Others leave right away and fend for themselves in the vast ocean upon birth.

Many of the problems with shark finning are the result of a slow maturation and a long reproductive cycle (Manire and Gruber, 1990). Sharks produce few young (Clarke et al., 2002); even fewer have a chance to make it to adulthood when all the various dangers of the ocean are considered. Compared to bony fishes, sharks have a very low reproductive potential (Manire and Gruber, 1990).

The skeleton of sharks is made up of cartilage. Cartilage is an elastic tissue with a higher concentration of water than bone (Tricas et al., 1997). Therefore, sharks have a light frame and a high degree of body flexibility. Sharks are also extremely quick and agile when necessary. When skeletal parts are physically stressed, those parts are “stiffened by secondary calcification” rather than bone (Tricas et. al., 1997).

Lateral lines are some of the most interesting systems in the body of a shark. Lateral lines are sensory hair cells that run throughout the body of the shark from head to tail. Their primary function is to detect water movements by potential prey and predators alike (Tricas et. al., 1997). A sick fish is going to be easier prey; a sick fish will flail and swim more erratic so a shark will know that this is easier prey.

Sharks often communicate by using body language. Much like pets, sharks cannot communicate how they feel by word of mouth. They do however differentiate aggressive vs. non-aggressive behavior. When a shark is aggressive, their body curves, becomes tighter, and they move more erratically. When a shark is relaxed, their body remains straight and they swim at a calm, slow pace (Tricas et. al., 1997). If a shark is turned upside down, tonic immobility can occur. Tonic immobility is a “coma-like stasis” in which a shark becomes immobile; it is an extremely stressful period for the shark yet the cause of the phenomena is still unknown (Brooks et. al., 2011).

Sharks use their fins to change direction, for balance, and to swim faster. The fins are necessary for movement. As the shark swims, they filter oxygen-rich water through their gills in order to breathe (Tricas et. al., 1997). Without their fins, a shark becomes a mere sinker in the water as they cannot move to breathe (Spiegel, 2001). When the fins are removed, the living shark slowly sinks to the cold, dark depths of the ocean to die.

Biogeography of sharks

Sharks thrive in all of the world's oceans. From the tropical waters of Costa Rica to the polar waters of Greenland, sharks thrive in the ecosystem for which they are equipped. Shark species are all different; some are migratory and travel from coastline to coastline while others stay in a close radius to their birthplace the entirety of their lives.

With regards to movement, sharks are generally categorized in 3 ways (Tricas et. al., 1997). These are local sharks (non-migratory species), coastal pelagic sharks, and open oceanic pelagic sharks. Local sharks, such as the bull shark (*Carcharhinus leuchas*) or nurse shark (*Ginglymostoma cirratum*), are found near shore and around reefs; while they may travel at times, their range generally occupies under a few hundred miles. The coastal pelagic sharks, such as the tiger shark (*Galeocerdo cuvier*) or dusky shark (*Carcharhinus obscurus*), are capable of migrations in excess of 1,000 miles or more (Tricas et. al., 1997). A blue shark (*Prionace glauca*) is an example of an open oceanic pelagic shark. These sharks can travel thousands of miles over the open ocean. For example, the longest recorded linear movement was a blue shark (*Prionace glauca*) that traveled from the northeast United States and was recaptured 300 miles south of the Equator, a grand total of 3,740 miles. In total, there are 30 species of open oceanic pelagic sharks (Dulvy et. al., 2008).

The ecosystem in which a shark inhabits depends entirely on temperature requirements, food source, and anatomy of a particular species. Along with

preferred locality, that being coastal, reef or open ocean, sharks exist in the epipelagic, mesopelagic and bathypelagic “realms” of the world’s oceans (Tricas et al., 1997). The epipelagic realm is most commonly associated with coral reefs and beaches. Species such as the bull shark (*Carcharhinus leuchas*), whale shark (*Rhincodon typus*), blue shark (*Prionace glauca*), etc. are found in this realm. As one lowers to the mesopelagic region, the waters become darker. Sharks found in the mesopelagic are the megamouth (*Megachasma pelagios*), spiny dogfish (*Squalus acanthias*), crocodile shark (*Pseudocarcharias kamoharai*), etc. Vegetation is sparser and complex adaptations of deep-sea sharks exist. The world’s smallest sharks are located in the mesopelagic and bathypelagic realms; these sharks possess well-developed “luminescent photospores” that are used in order to communicate in the darkest of conditions (Tricas et al., 1997). The bathypelagic realm is the darkest and home to species such as the cookiecutter (*Isistius brasiliensis*) and pygmy (*Euprotomicrus bispinatus*) sharks.

Sharks are a model for adaptation. Though only few species live in polar regions, sharks that have adapted thrive in the harshest of conditions. Sharks such as the Greenland shark (Somniosus microcephalus) live in frigid waters 31º to 39ºF (-0.6º to +0.4ºC) (Tricas et. al., 1997). While migratory sharks chase favorable conditions, polar sharks are found in the same locale year-round. As opposed to tropical sharks, the polar sharks are sluggish yet methodical in movement; they rely quick explosive reactions in the darkest of conditions to hunt, reproduce, and avoid other predators (Tricas et. al,1997).

The Tropical Eastern Pacific Seascape is home to some of the largest schools of sharks on the planet. Schools of hundreds of scalloped hammerheads (*Sphyrna lewini*) can be found in the waters near Cocos Island, Malpelo, and the Galápagos Islands. Though many theories are present, nobody truly knows why the large schools exist in the TEPS (Hearn, 2009). There are, however, many ideas surrounding the spectacle. One is that they may serve a reproductive or social function; schools tend to be organized of females (with the largest females near the center) with males circling the schools on the outside fringes (Hearn, 2009).

Many sharks travel long distances to feeding and breeding grounds. Sharks do not recognize political boundaries. As such, they often go in between protected and non-protected boundaries with varied amounts of danger. If the shark finning industry is hitting a particularly delicate area, overall population may be drastically affected.

Most sharks are considered to be the apex predator in their respective food webs. As such, sharks exert much control over these food webs (Manire and Gruber, 1990). It is important to also note that as sharks are found in all the world's oceans and at depths from a few inches to thousands of feet, the decline of sharks on a global scale could be catastrophic (Manire and Gruber, 1990). It is imperative to study how the removal of a specific species could impact their ecological seascape at lower latitudes and also at temperate zones and polar regions.

Underwater, sharks have no equal with the exception of mammals of the dolphin family (Delphindae). They exhibit a strength, speed, and hunting prowess that is unmatchable by competing species. However, with all of these talents, sharks are no match for human weapons and technology. As such, shark attacks on people have become much less of a concern; the slaughter has become one sided with the sharks on the losing end of the war. With an estimated 100 million sharks killed every year for their fins alone, many people feel strongly that the practice of shark finning is unacceptable (Verlecar et al., 2007).

CHAPTER 5

RESULTS

In all, 432 total observations were made in this study. Of these 432 observations, 242 (56 percent) were made in San José, 87 were made in Puntarenas (20.1 percent), and 103 (23.8 percent) were made in Quepos. Participants were selected at random locations and their responses were made confidential at all times.

One aspect of this study was to find out whether the people in Costa Rica felt that shark finning was happening due to bias or not. It was important to engage in this particular aspect of study in order to assess why finning is happening specifically to sharks and the level of public interest in saving sharks. For example, if people perceive the shark as a monster, why would they want to help them in the first place? If there were no sharks at the beach, the water would be safe for swimming, boating and practicing any other recreational activities.

The purpose of this section on the questionnaire was to engage thoughts and education about shark conservation and shark ecology (See Appendix 5). If this practice were to happen to marine mammals such as sea lions, orcas and dolphins, there would be public outcry. As such, it was necessary to see how people felt about this particular issue.

Also, questions were laid out in order to detect bias for the protection of sharks. A question was asked whether participants were involved in a shark

conservation program of any kind. Also, just in case a friend or family member was involved, another question was asked in the interviewee knew anybody specifically involved with the shark finning industry. All of the aforementioned questions were asked in order to dispel bias from people taking the surveys; their purpose was also to venture into whether bias against sharks was the reason in which the shark finning industry has thrived for so long.

The next step in the study was to determine how families fared economically as a result of shark finning. Was shark finning beneficial to a large group of people or just a few citizens "lucky" enough to be involved? Also, were shark products commonly found in Costa Rica available for purchase by tourists and the like? Shark finning could be happening for reasons of bias against sharks; people may not care to protect what they do not see as cute and cuddly.

There could be plenty of reasons not to want to protect sharks. However, a strong case is also presented about the economics of the shark-fin trade. How profitable is the shark-fin trade for those involved in supplying the demand? That is something that needs to be examined further in future research. However, as reference to gauge the magnitude of the trade, one participant stated that only $1/6^{th}$ of the total price of the value of shark fins sold at market is divided between the entire crew doing the actual labor.

The last step was to find out just how people felt about shark finning in Costa Rica, a practice called "aleteo" in Central America. A very straightforward question was asked in order to close the study; should shark finning be illegal in

Costa Rica? Shark hunting for sustenance has been around for hundreds of years; however, in Costa Rica shark finning is neither traditional nor historical. The people of Costa Rica do not serve shark-fin soup on menus in any of the restaurants visited in San José, Puntarenas, or Quepos. So why does shark finning in Costa Rica continue to persist? From information gathered between over 432 participants, that question can be examined.

One of the first questions asked to help prevent bias in the study was to ask participants if they have ever been involved in a shark conservation program of any kind. Of all 432 observations, only 85 (or 19.7 percent) had ever belonged to a shark conservation program currently or in the past. Of those 85 people who had been involved, 62.4 percent (or 53) came from interviews conducted in San José. 29.4 percent (or 25) came from Quepos and 8.2 percent (or 7) came from Puntarenas (See Figure 3).

When asked if there was a bias against sharks, 63.7 percent (275) of participants in all locations answered “yes” and 36.3 percent (157) of participants answered “no.” Many answered that it is not bias but merely economic opportunity and profit for what drives the shark finning industry on. A simple lack of control over the industry helps the industry to profit rather than a general dislike of sharks or a misunderstanding about their place in ecology. Fear of repercussion may keep citizens from trying to protect sharks further.

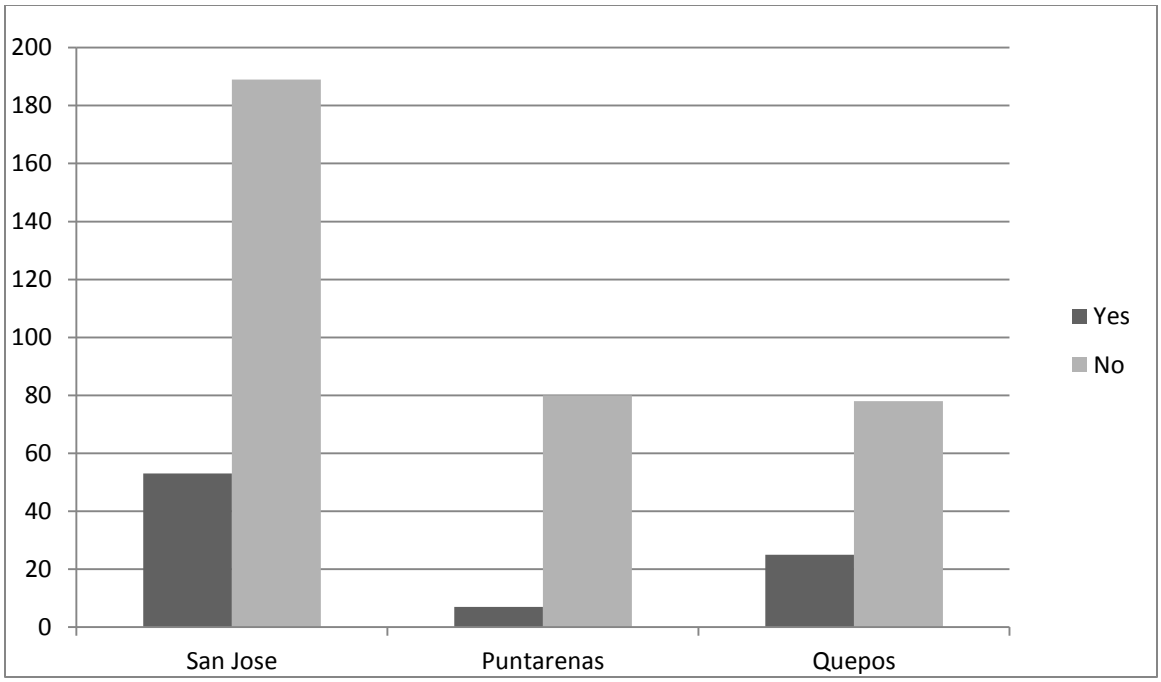

Figure 4: Have you ever been involved in a shark conservation program?

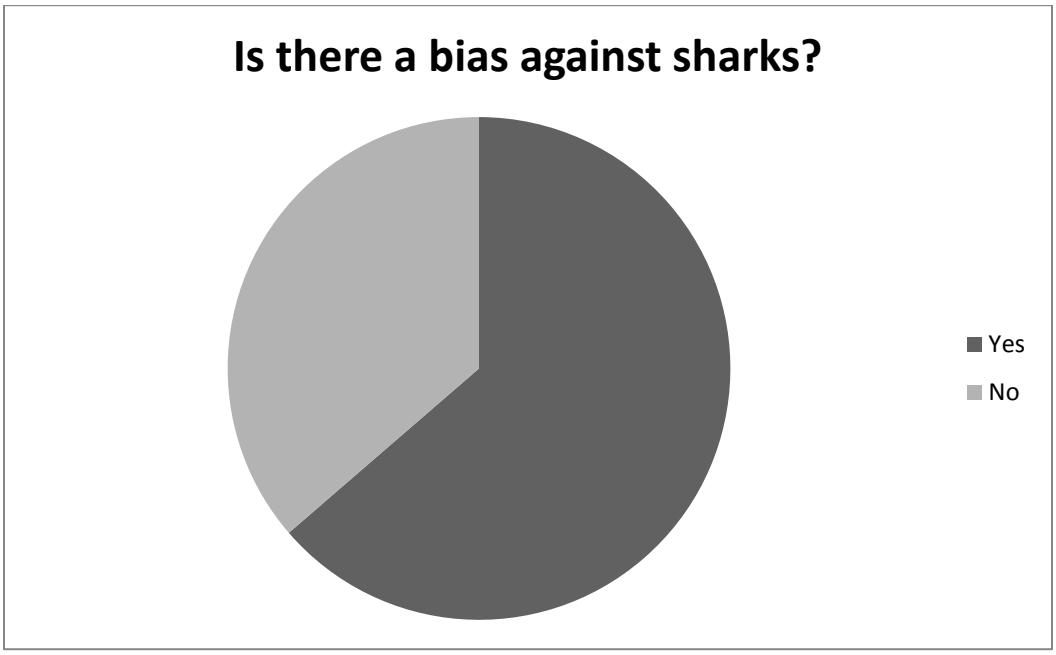

Figure 5: Is there a bias against sharks?

Others felt that shark were targeted because they are dangerous and overlooked for the very same reasons. Many talked about how this would normally not happen with a 'charismatic species.' Even though the hunting of animals such as whales persists, they receive much more media attention because people, in general, just like whales more than they like sharks.

There was overwhelming support for a ban on shark finning within these observations. 90.9% of those interviewed stated that shark finning should be illegal. That is 393 people out of 432 questioned. It is clear that the economic benefits to few do not branch out to the general population. Costa Rica, as in the country itself, does not reap benefits that certain bribes cover and that certain people directly involved in the industry. The hypothesis of this study was supported completely in that the people of Costa Rica understand that shark finning is wasteful and that it serves no purpose to the everyday citizen of Costa Rica. The average everyday Costa Rican is not necessarily burdened by the shark finning industry, but they do not benefit or see community improvements based on money made from the shark finning industry.

The reason for the disparity in observations was that much more time was spent investigating NGOs, wilderness parks, and universities in or near San José. Also, with shark finning being an illegal activity, personal safety had to be taken into account, specifically in Puntarenas. Also, time spent in Quepos was only allotted for less than 5 days; still, many observations were made and Quepos was a gold mine of information about the shark finning industry.

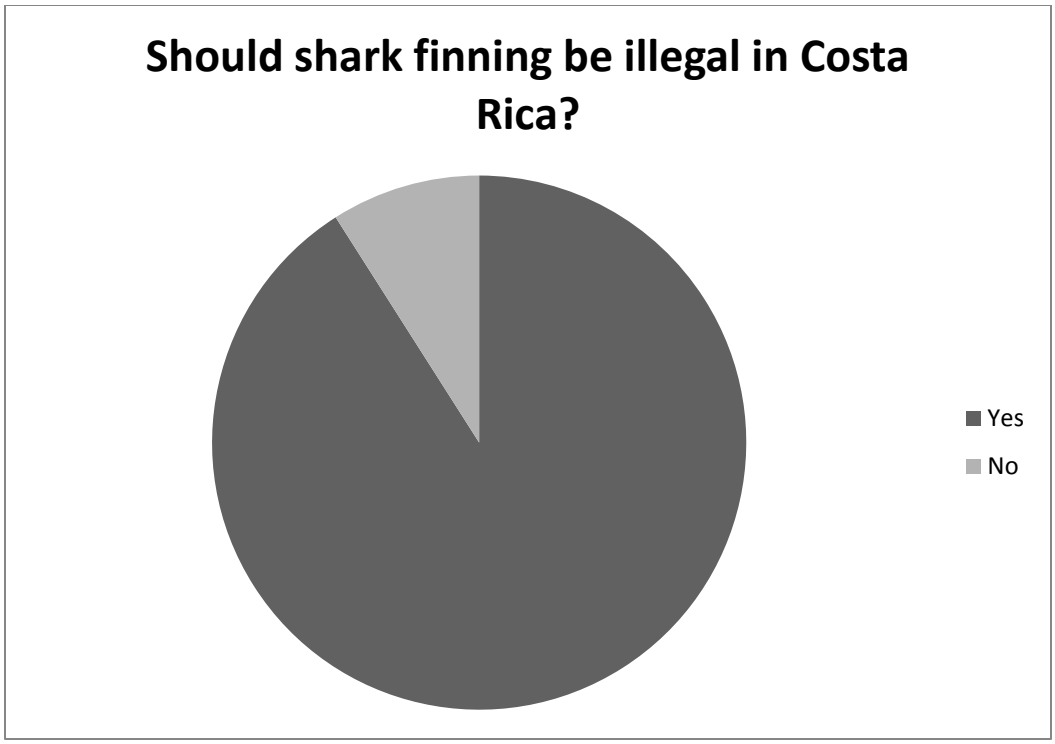

Figure 6: Should shark finning be illegal in Costa Rica?

There are certain problems associated with studying an illegal activity. For one, chances of people lying can be high as they may not refuse to take the interview but they may answer questions falsely such as the targeting knowing of somebody in the business. However, other questions were asked in an attempt to weed out "bad" observations without skewing the data.

In order to check for bias or to weed out "bad" observations, many questions were asked. One of the first was "Have you ever heard of shark finning (or the removal and retention of shark fins)?" This question prevented prospective survey takes from proceeding; should they have no knowledge of shark finning they would not have been able to honestly answer questions about

the shark finning industry. An answer of “no” disqualified people from participation in this study.

Another question asked in the survey instrument involved whether the participant had ever been involved in a shark conservation program or not. Asking this question helps to explain why those involved in the shark finning industry may answer questions in a certain way. On contrary, the question “Are you aware of somebody directly related to the shark finning industry?” was asked. This was asked to explain why a participant may or may not want to protect the shark finning industry (for economic purposes should a family member or friend be involved). Both of the aforementioned questions were strategically placed in order to seek bias in one direction or the other.

Shark finning exists on the Caribbean side and Pacific coast of Costa Rica. More research will be needed on the Atlantic side to determine environmental impact. There are also other coastal Pacific towns which could potentially house shark fins and hide them. That is also something to be looked at in the future. Watching out for the shark finning industry has been a never-ending task since the early 1990s. It will continue to be a problem as long as people can find loopholes and ways to manipulate the system.

Shark finning is difficult to police. Not only does shark finning exist in places such as Puntarenas, a drug trade is at large as well. Couple that with other various crime syndicates and it became nearly impossible to keep up with every illegal activity imaginable.

Costa Rica is under much more international pressure from places like the United States to keep the Colombian drug trade and Mexican cartel from passing drugs through their country than to protect sharks. Not only do bribes exist but it is dangerous to attempt to quell something as prosperous as shark finning. Protecting the marine ecology is something that the current president, Laura Chinchilla, has promised to the people of Costa Rica. However, it is much more difficult to say it will happen than to actually act and to do something about it when seemingly there are more pressing matters at hand.

CHAPTER 6

DISCUSSION OF FUTURE CONSERVATION

The practice of shark finning can be thought of as a double-edged sword. On one hand, harvesting sharks provides jobs and economic opportunity for people who may otherwise not have a chance to advance their income. On the other hand, however, is the detrimental effect of shark finning on marine ecology.

By outlawing shark finning, people may lose the one resource that helps them to feed their families. Many fishermen may feel pressured into shark finning as it may be their only option to make a better living. Whatever their reasons may be, a compromise is imperative to balance ecology and people's livelihood.

The problem with a business being largely unmonitored, unmanaged, and ignored is that it can also be unsustainable. Tighter restrictions and imposed quotas may be one way to curve over-catch. One proposal is a tradeoff of closed fisheries and ship traffic; however this also leads to ignorance of data for that given area (Kitchell et al., 2002).

There are compromises that may be able to bridge the gap between conservationists and fishermen. Incentive-based conservation may be a way to help curve disagreements. The allotment of fishing gear to ship crews who condone or stop shark finning has also been proposed (Kitchell et al., 2002).

Alternatives to shark finning may also be a possibility. The practice of shark "farming" may provide an alternative lifestyle for people. The species of sharks farmed can be controlled so rare species will not fall prey to the indiscriminate shark-fin trade. Nevertheless, two of the main drivers of the shark trade may be beyond control. These are world population increase and personal wealth of shark fin importers (Clarke et al. 2007). However, the topic of shark finning in mainstream teaching and education may help counter both drivers.

One of the best options in dealing with shark finning may be public awareness and education. By educating people about the ecological impacts of the shark-fin trade, people can understand what may happen if shark populations are eradicated. Educating the consumer and supplier populations on the impacts of mass fishing could help lead to a reduction in unsustainable fishing practices (Clarke et al., 2007). The Marine Conservation Biology Institute is initiating a program to send textbooks on "ocean conservation and resource sustainability" to international schools in Southeast Asia (Clarke et al., 2007).

Future research is needed in order to ensure that ecological and social balances are complied. One necessary project is to understand the social aspect of shark finning. It is also important to understand why people turn to shark finning as a means of living. Ecological studies are needed to understand the community ecology in areas affected by shark finning; is there oceanic habitat fragmentation? It would be helpful for government agencies to utilize remote sensing to find establishments housing the shark fin trade.

As the demand for shark fins increased, so did awareness. Many places, including the US, Brazil, the European Union, South Africa, and Costa Rica placed national bans on shark finning (Fowler et al., 2005). Places such as Canada, Australia, Ecuador, Oman, and the Maldives have also banned the practice of shark finning without using the whole carcass (Stewart, 2003). Enforcing a shark finning ban is another story.

People continue to fight for their "right" to shark fin (Stewart, 2003). In August 2002, the US Coast Guard caught the King Diamond II, a Honolulu-based vessel, with over 32 tons of shark fins just southeast of Acapulco, Mexico (Stewart, 2003). The practice of shark finning itself raises many ethical questions (Tricas et al., 1997). Many conservation groups are fighting to save sharks. However, a single fin of a whale shark (*Rhincodon typus*) can fetch up to $15,000 (Stewart, 2003). The potential money to be made in shark finning may outweigh the ecological value for many people.

Many shark species are considered threatened or endangered. Of these, 57% of hammerhead sharks (family Sphyrnidae) are seen as threatened, and 80% of mackerel sharks (Order Lamnidae; great white (*Carcharodon carcharias*), basking (*Cetorhinus maximus*), shortfin mako (*Isurus oxyrinchus*), etc.) are seen as threatened (McClenachan et al., 2011). A fundamentally different approach may be required when viewing terrestrial extinction potential versus oceanic extinction potential. Species on land are often restricted to a specific area or island. A habitat for a great white shark (*Carcharodon carcharias*), for instance, stretches over a much larger area. It is important to view different shark species

on a case by case basis in order to correctly assess their habitat needs (McClenachan et al., 2011).

The CITES, or Convention on International Trade in Endangered Species of Wild Fauna and Flora, was established as a means to "ensure that the international trade in specimens of wild animals and plants does not threaten their survival (IUCN-Marine Biome, 2012)." Currently, 175 countries (or "parties") are involved in CITES. CITES currently protects over 34,000 species (McClenachan et al., 2011). However, marine species are only represented by <10% of those protected species (McClenachan et al., 2011). Sharks are incredibly under-protected for their level of threat. Luckily for sharks, many different NGOs have joined the fight to protect sharks.

It is incredibly difficult to enforce a ban on shark finning. In being a very profitable market, many foreign and domestic representatives in Costa Rica will continue to fight in order to protect their assets. Dishonesty runs rampant even behind inspections. Costa Rica is an extremely law-first nation; in so, it takes an extended process to change a law or enforce a law for that matter.

As they are a black-market resource, shark fins are difficult to detect. They are easy to hide because of their size and can be hidden beneath traditional fish catches or hidden within the ship itself (Spiegel, 2001). Random boat inspections could potentially help ease this possibility (Spiegel, 2001). However, it is not guaranteed that inspections would be honest or that the shark fins could not be hidden in small compartments throughout the ship.

Legally, dealing with shark finning is a difficult matter. Every country in the Tropical Eastern Pacific coastal region has different laws. It is evident that there are problems of corruption and bribery on a large scale. Also, shark finning participants are now bringing shark fins from locations such as Malpelo Island and the Galapagos Islands into Costa Rica. Fins can also be taken to or stored in surrounding countries such as Guatemala, Nicaragua or Panama in remote costal locations. Some vessels are international ship liners that never touch landfall in Costa Rican ports. Shark fin transfers from small fishermen boats to cargo ship liners at sea are also arranged (Stewart, 2003).

As the seascapes are interconnected, the government of Ecuador sought to forge a link with neighboring countries in the TEPS. As such, Ecuador joined with Costa Rica, Panama and Colombia to create the "Marine Conservation Corridor"; on April 2004 in San José, Costa Rica, the San José Declaration was signed and the 4 participating nations agreed to work together to conserve and utilize the Marine Conservation Corridor to the best of their ability (NOAA, 2005). Their goals were to conserve marine resources, improve shipping, promote responsible tourism, and efficient fisheries management. With this agreement, the aforementioned countries set up a regional plan of management that involved joint work between the governments, NGOs, and international bodies (Arango, 2012).

An MPA is an oceanic area in which "some or all activities are limited or prohibited to protect natural and cultural resources (Lubchenco et. al., 2003)." There are 5 MPAs located in the Eastern Tropical Pacific (Rosero et. al., 2010).

Among those are Cocos Island in Costa Rica, Coiba National Park in Panama, Malpelo Fauna and Flora Sanctuary in Colombia, Gorgona Natural National Park in Colombia, and the Galápagos Islands in Ecuador. Of these 5 MPAs, many share common problems. Among these problems are uncontrolled population growth, excessive artisanal fleet size, lack of bio-security and regulations, lack of awareness of MPA regulations in neighboring communities, park warden salaries neither competitive nor attractive for employment, and lack of MPA personnel and no job profiles upon which to base appointments (Rosero et. al., 2010).

There are many different types to MPAs. Among those are (1) Limited-take MPAs, (2) no-take MPAs, and (3) mixed-use MPAs (Guarderas et. al., 2008). Limited-take MPAs allow some marine resources to be harvested. No-take MPAs do not allow any marine resources to be harvested. Mixed-use MPAs allow some marine resources to be harvested while others cannot be harvested in a given area. MPAs have been established to protect threatened species, biodiversity and natural habitats. In Costa Rica alone, there are a total of 20 MPAs that cover over 4148 km^2 of seascape (Guarderas et. al., 2008). Simply tagging an area as a MPA, however, does not mean that the area is off-limits to poachers and illegal fishermen.

No-take MRs are the highest protected of areas. They "prohibit extractive and destructive activities with the goal of protecting habitats, species, and their interactions (Lubchenco et al., 2003)." MRs help in sheer abundance of species. They provide breeding grounds, feeding grounds, etc. Like MPAs, MRs rarely have adequate management and law enforcement and can become a "feeding

grounds" for illegal fishing. For instance, the Galápagos Islands are one of the most well-known marine reserves in the Eastern Tropical Pacific. The Galápagos has stiff laws regarding poaching, overfishing, and shark-finning. Yet despite this legal framework and official denomination, shark finning continues to occur in the Galápagos Islands.

The numbers of MPAs and MRs have increased exponentially in the last 20 years. However, pollution, population growth, beach resorts, climate change, illegal fishing and many other problems all threaten their existence (Guarderas et. al., 2008). When utilized properly, MPAs and MRs are incredible platforms for the sustainable use of biodiversity. However, they need proper management for optimal utilization.

Many organizations are working towards ensuring ecological stability in Pacific Costa Rica. These organizations can be categorized as Big International Non-Government Organizations (BINGOs) and Non-Government Organizations (NGOs). While both share the same goal, BINGOs often have multiple projects or goals in multiple countries while NGOs focus on local community-based issues.

Some of the BINGOs working to fight against shark finning are Humane Society International, Oceanic Defense, Predators in Peril, the Sea Shepherd Conservation Society, The Shark Alliance (The Shark Trust, The European Elasmobranch Association, The Ocean Conservancy, etc.), Shark Angels, Shark-Free Marina Initiative, Shark Savers, The Shark Trust, WildAid, etc. Some of the

NGOs working exclusively in Costa Rica are PRETOMA (Programa Restauración de Tortugas Marinas), MarViva and ARCAE (Asociación Red Costarricense para el Ambiente y la Educación). They all share a common concern; sharks are an important part of marine ecology and need to be protected.

Various BINGOs such as the Sea Shepherd Conservation Society, led by Captain Paul Watson, have joined in the fight to eliminate shark finning (Stewart, 2003). The governments of both Costa Rica and Ecuador accepted a Sea Shepherd plea to let them protect the waters near Cocos Island and the Galapagos Islands. However, once near Cocos, the government of Costa Rica rescinded the offer and threatened to arrest the Sea Shepherd Crew (Stewart, 2003). The Costa Rican government was bribed by the powerful suppliers of the shark fin trade.

PRETOMA is just one NGO working on marine issues in Costa Rica. PRETOMA stands for Programa Restauración de Tortugas Marinas. They are "a marine conservation and research organization working to protect ocean resources and promote sustainable fisheries policies in Costa Rica and Central America (PRETOMA)." Though they deal mostly with endangered sea turtles, they also turned their attention towards the shark finning industry as well.

PRETOMA works directly on field research projects in Costa Rica, research and outreach on fishing vessels, public awareness and education, and litigation and public advocacy (PRETOMA). They conducted a very public campaign against shark finning which garnered over 80,000 signatures to ban

the practice (PRETOMA). They also constantly "gather and publish data on sharks and sea turtles including in satellite tagging studies as well as studies on capture of these species in the national longline and shrimp fishing fleets (PRETOMA)."

The ARCAE is another NGO working in Costa Rica. ARCAE stands for Asociación Red Costarricense para el Ambiente y la Educación. Their mission is "to improve the quality of life for Costa Rica's rural, costal residents through environmental conservation, sustainable economic development opportunities, and by bridging the gap that exists between urban and rural educational systems (costaricanconservationnetwork.wordpress.com)." They have many projects with the purpose of fighting shark finning in Costa Rica. In 2012, they conducted a visual marine flora and fauna survey; the data from this survey served to help establish a larger network of marine protected areas and other "responsible fishing zones (costaricanconservationnetwork.wordpress.com)." They also hold educational workshops on the effects of shark finning.

The United Nations Food and Agriculture Organization (FAO) "developed an International Plan of Action for the Conservation and Management of Sharks that calls for all member nations participating in shark fisheries to develop and implement their own national plans of action ensuring the conservation and management of shark stocks (FAO, 1998)." The United States also countered with their own plan titled the "National Plan of Action for the Conservation and Management of Sharks (NMFS, 2001)." However, shark finning does not solely exist in tropical Pacific waters. India, the Mediterranean Sea, Australia, and

many other locations also face problems from foreign intrusion on shark populations. The best solution for sharks would be to ban shark finning globally (Spiegel, 2001). However, with so many hands in the game that is globalization and with so much at stake, a common solution is difficult to agree upon. There are many theoretically logical solutions that could help demoralize participants in the shark fin industry.

Even though education campaigns can change the opinion of many people, their costs still need to be factored in the solution (Spiegel, 2001). Protecting sharks may be seen as a worthwhile and noble endeavor; however, is campaigning alone worth funding and will it be cost effective in the eyes of governments and political machines around the world? (Spiegel, 2001) It is also nearly impossible to patrol the open sea at all times and protect every corner of the world's oceans (Spiegel, 2001). However, tighter regulations and bans could have a lasting effect if tighter rules and restrictions were enforced.

Though this study focused on the supply, the demand can also be examined for a solution. Countries that currently import shark fins could be convinced that shark finning is destroying ocean ecology. Though shark-fin soup is a cultural delicacy, it is possible that education can direct change whether it is now or in the future. The generation in schools today can be the deciding factor in the direction of the shark finning industry; they can refuse shark products and thus make those products obsolete in their culture. In China, for example, young couples getting married will refuse to offer shark-fin soup in those receptions, as a fashionable statement of modernity.

Targeting students to educate in international baccalaureate schools, for example, could lead to education reforms in public schools. It is important to view ecology on a global scale as many countries share the same resources. It is unjust for one country to rob another of their resources (as the shark fin industry in Asia is doing to Costa Rica). In short, the shark finning industry is stealing potential tourist attractions and the opportunity for a stable ecological system from Costa Rica and the entire TEPS. Wiping out an entire ecological system does not provide a benefit to anybody long-term.

Education is the best way to tackle in order to prevent over-exploitation of vulnerable shark populations. In knowing just what species are being exported, tighter restrictions and a larger scale of attention can be leveled accordingly to areas of higher shark loss. The world's over-exploited shark populations then have a possibility of recovery (Shivji et al., 2002).

CHAPTER 7

CONCLUSIONS

The people of Costa Rica are well aware of shark finning due to widespread media attention. Most of the people surveyed had never participated in a shark conservation program. However, information about the effects of shark-finning is not uncommon on a daily basis in San José, Puntarenas, and Quepos. Radio programs, television programs, billboards, the news, and even commercials on stations such as the Discovery Channel educate people about the effects of shark finning on ecology.

While bias against sharks remains debatable, this study suggests that shark finning does not help families economically in Costa Rica. The people involved in shark finning do so for their own economic gains. Tighter regulations on shark fin products would not hurt families in Costa Rica financially or economically. Shark products are commonly seen around Costa Rica. Anything from shark-tooth necklaces to shark-eye paper weights can be seen at any novelty shop or market around Costa Rica.

Evidence from this study also shows that the people of Costa Rica view sharks as an important part of marine ecology. The oceans are large and bountiful; however, the people know that the loss of sharks due to the practice of shark finning is too great to be sustainable for the long-term health of marine environments.

Of upmost importance was one of the last questions. The question was as follows; Do you believe that shark finning should be illegal in Costa Rica? With an impressive 90.9% of those surveyed answering “yes,” it is safe to say that shark finning should be illegal in Costa Rica.

Understanding the role of sharks in ecology is imperative to emphasize much needed research and education on the topic. Predators are often misunderstood, but they provide a balance on Earth. Proper management and conservation of sharks can help balance the ecology of the Earth’s oceans in four important facets:

First, identifying a human-induced fear of sharks is important. Sharks are widely considered to be “dangerous” animals; that tag has a large impact on shark conservation. People want to conserve what they see as beautiful or majestic. From an ecological perspective, however, sharks are of great importance in marine community ecology. It is important not to overlook important species that are not classified as ”charismatic;” those not perceived as charismatic could be the most imperative in their respective food web.

Second, understanding the shark fin trade is one key to management. It is important to understand the economic and social aspects of the shark fin trade. By understanding the aforementioned aspects, a plan can be produced in order to benefit both people and sharks.

Third, understanding the ecological impacts of the shark finning industry is of utmost importance. Sharks fill an important role as scavengers and predators. They also help determine the effectiveness of the ocean as a carbon sink.

Last, it is important to identify effective means of shark conservation. There are many hurdles and problems in shark conservation. Ethical and logical conservation planning is important in assuring the future of shark populations.

By tying together all of the previously mentioned themes, the conflict regarding the practice of shark finning can be managed. Understanding the ecological side is imperative for understanding the social side, and vice versa. Management of the problem is key for ensuring the future of marine ecology and the fisheries of the world's oceans. Though the issue is complex, understanding across political, ecological, economical, and conservation barriers must be reached in order to assure successful community ecology in the Tropical Eastern Pacific seascape.

This study was dangerous; shark finning is illegal and there is a network consisting of many international groups and mob "organizations" with their hand in this venture. Studies like this one should never be conducted without proper planning, solid contacts, and informing the participant's embassy about whereabouts beforehand. All of the aforementioned precautions were taken during this study. Many people who are involved in this illegal activity are dangerous and would do whatever it takes to protect their assets.

There is still much to learn about shark biology, ecology and management. It is important to remember that sharks have a vital role in the ocean and are not simply vicious killers. They are selective predators and have co-existed with humans for thousands of years. To ensure the health of marine ecosystems, it is imperative to protect pelagic fauna, including sharks. The implications of the global shark attack at present do not come from shark attacks on humans; rather, they are the attacks from humans on sharks that pose the greatest threat and are more disturbing for the future of marine and oceanic ecosystems.

Figure 7: Fishermen in Quepos, Costa Rica (Photo by Brandon Combs)

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APPENDIX 1

ACRONYMS

ARCAE- Asociación Red Costarricense para el Ambiente y la Educación

BINGOs- Big International Non-Governmental Organizations

CBOs- Community-based Organizations

CITES- Convention on International Trade in Endangered Species of Wild Fauna and Flora

ENSO- El Niño-Southern Oscillation

FAO- United Nations Food and Agriculture Organization

FMNH- Florida Museum of Natural History

HSI- Humane Society International

ISAF- International Shark Attack Files

IUCN- International Union for the Conservation of Nature

LLP- Large Legendary Pelagics

MPAs- Marine Protected Areas

MRs- Marine Reserves

NGOs- Non-Governmental Organizations

NMFS- National Marine Fisheries Service

PRETOMA- Programa Restauración de Tortugas Marinas

SCBD- Secretariat of the Convention on Biological Diversity

SSCS- Sea Shepherd Conservation Society

UNESCO- United Nations Educational, Scientific, and Cultural Organization

USAF- United States Air Force

APPENDIX 2

NGOS WORKING WITH SHARK-FINNING IN COSTA RICA

ARCAE- Asociación Red Costarricense para el Ambiente y la Educación: "To improve the quality of life for Costa Rica's rural, coastal residents through environmental conservation, sustainable economic development opportunities, and by improving rural educational systems."

Shark Coalition (Latin America) Members (Listed Below): "To promote responsible and effective shark management and conservation at a national, regional and global level."

AIDA (Asociación Interamericana para la Defensa del Ambiente) Mexico

Carlos Ormond, Panama/USA

Deborah Chiriboga High, Ecuador

Deep Blue Resort, Honduras

Defenders of Wildlife, Mexico

FUNZEL (Fundación Zoológica de El Salvador), El Salvador

HSI (Humane Society International), USA/Costa Rica:

Jorge Eduardo, Brasil*

Malpelo Foundation, Colombia

MarViva, Panama

PRETOMA (Programa Restauración de Tortugas Marinas), Costa Rica**

TEYELIZ , Mexico

WildAid, Ecuador/USA

Conservation Science Institute (CSI)

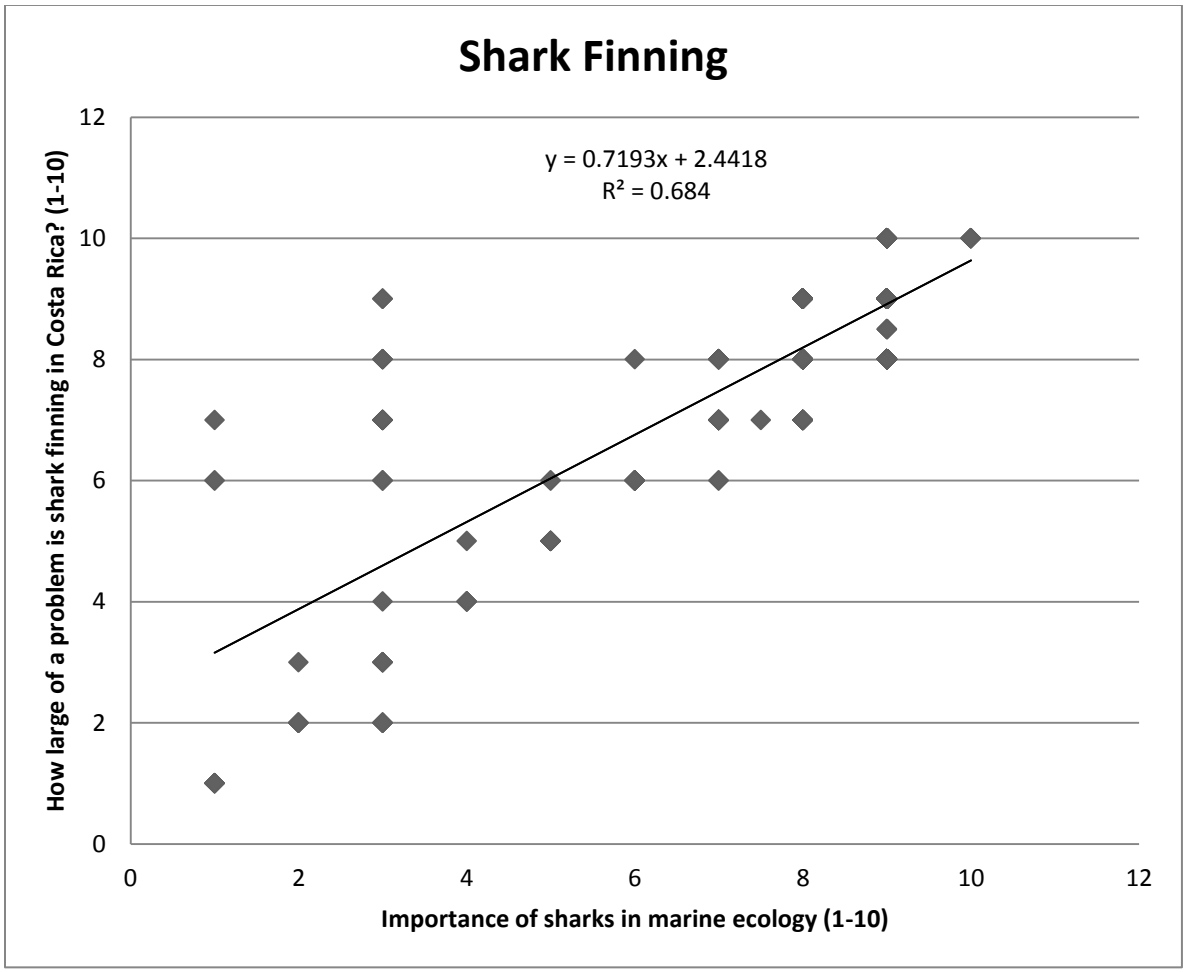
IEMANYA OCEANICA

Institute for Tropical Ecology and Conservation (ITEC)

Utila Whale Shark Research

APPENDIX 3

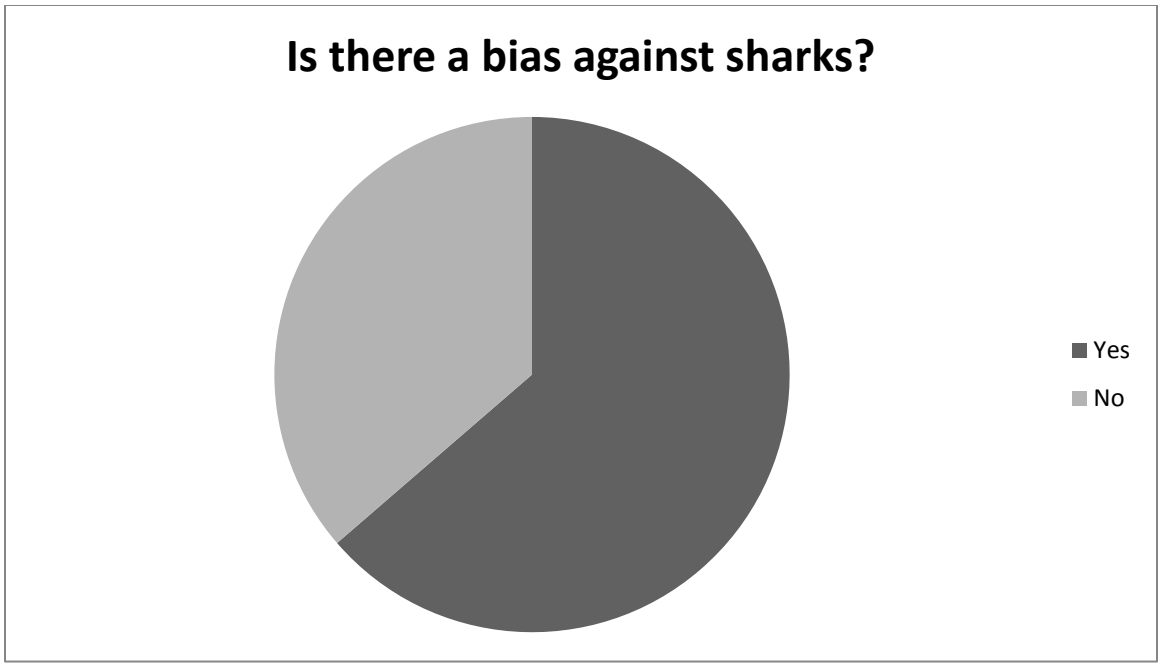
RESULTS MATRIX



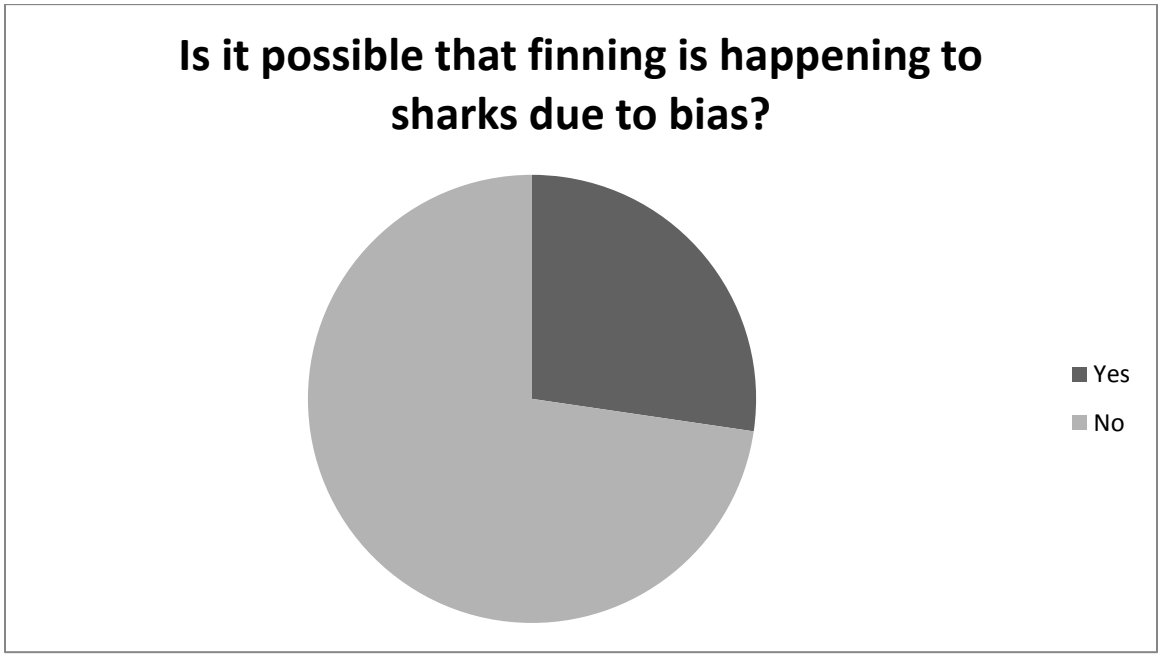
Hypothesis: There is a correlation between people's view on the importance of sharks in marine ecology and their view on how large of a problem shark finning is in Costa Rica.

Formula result: 0.950927

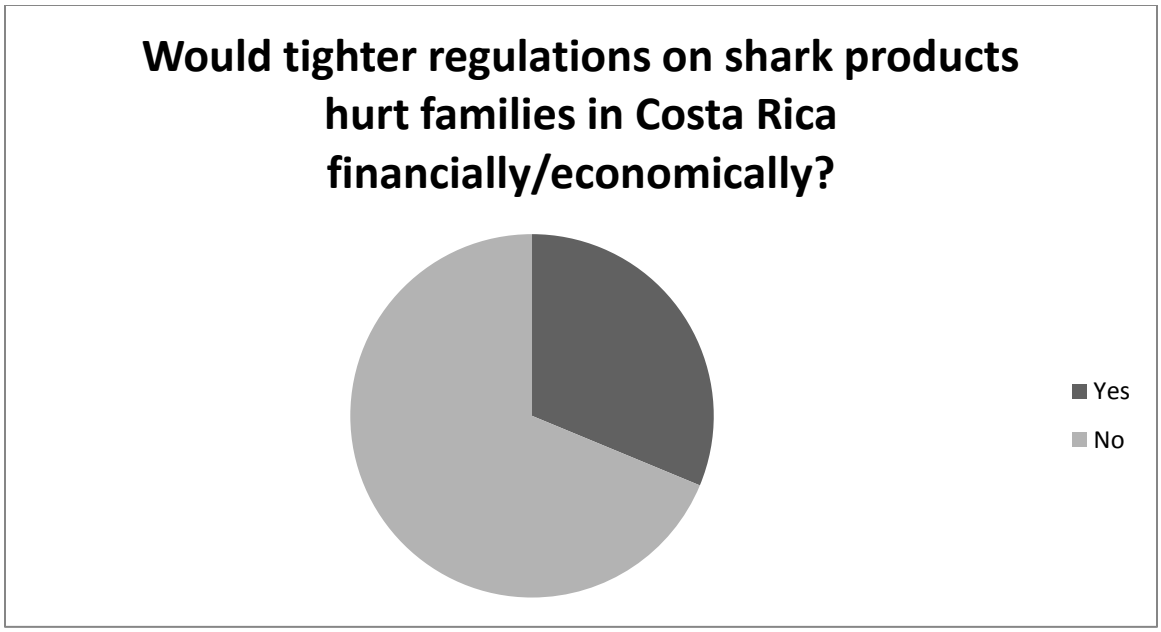
Results: The hypothesized correlation was supported in this data.



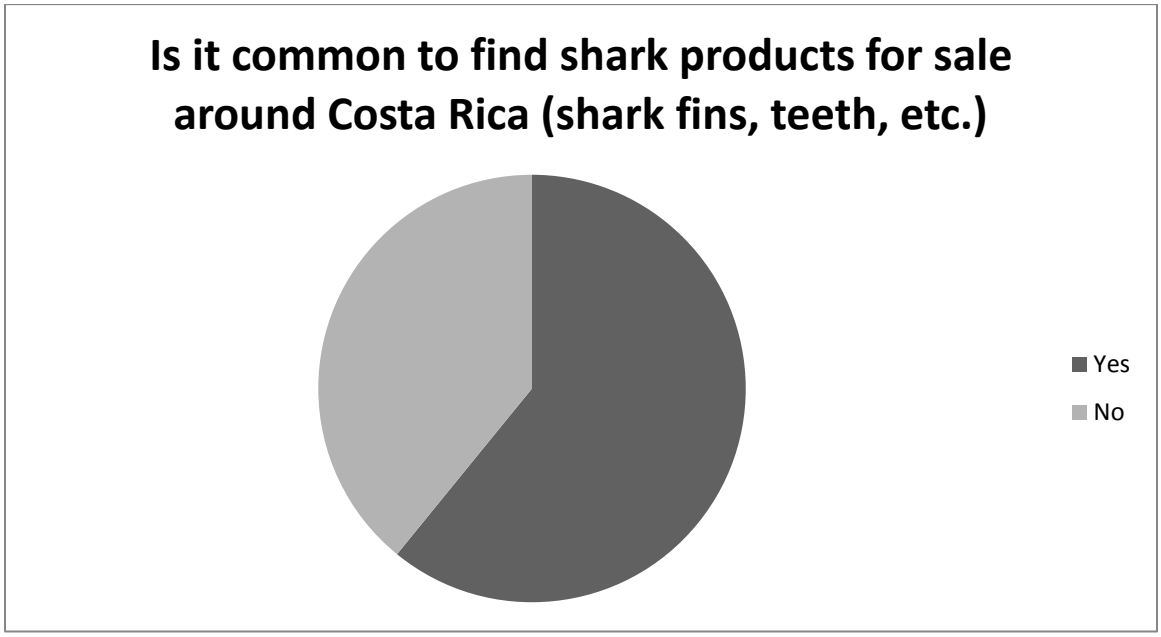
Yes (63.7%) 275 No: (36.3%) 157



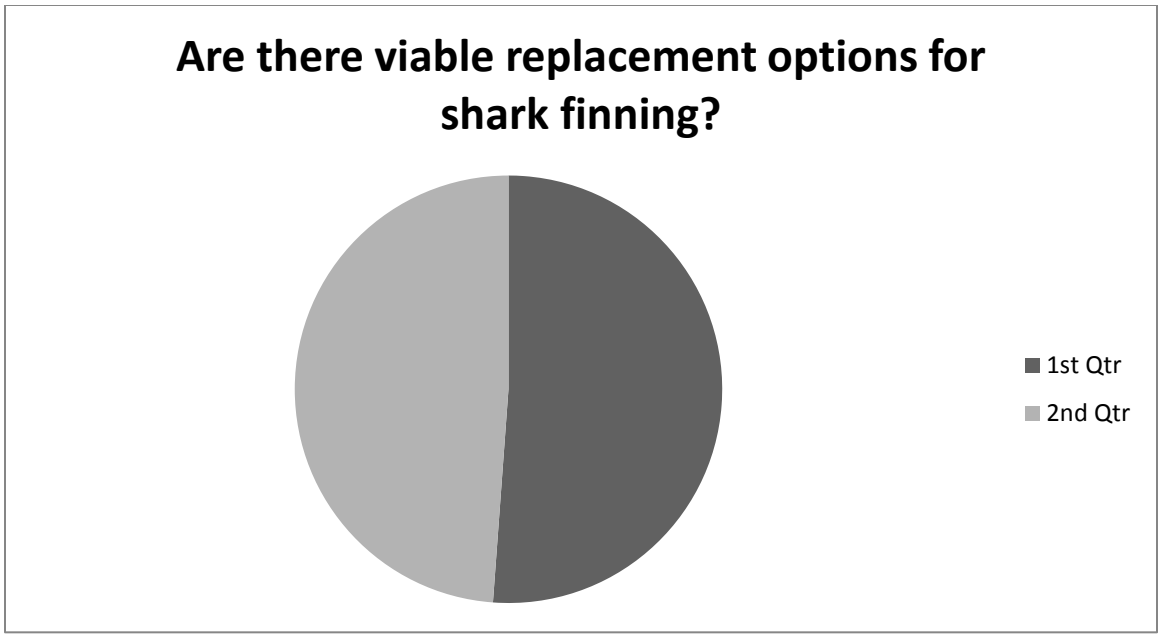
Yes: 118 (27.3%) No: 314 (72.7%)



Yes: 135 (31.25%), No: 297 (68.75%)



Yes: 263 (60.9%) No: 169 (39.1%)



Yes: 221 (51.2%) No: 211 (48.8%)

Yes/No

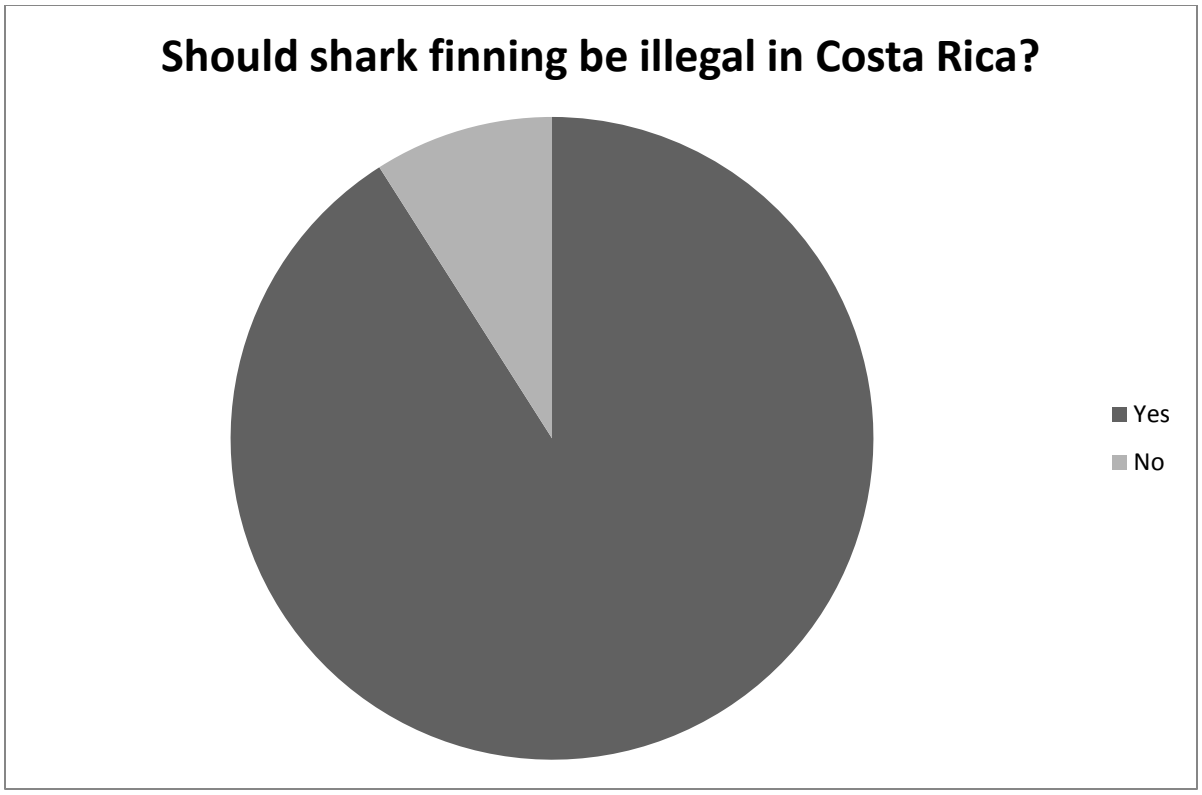
- Are you aware of somebody directly involved in the shark finning industry? **Yes**: 27 (6.25%), **No**: 405 (93.75%)
- Have you ever heard of shark finning? **Yes**: 100%
- Is shark finning abundant in Costa Rica? **Yes**: 93%
- **Interesting**: The loss of sharks annually due to the shark finning industry does not affect the day to day lives of people. **Yes**: 388 (89.8%)

True or False

- -The loss of sharks due to the practice of shark finning does not affect the day to day lives of people. False: 100%
- -Sharks reproduce at fast enough rates to sustain their populations alongside the shark finning industry. Therefore, the overall impact of shark finning is minimal. False: 100%

Scale of 1-10

- -On a scale of 1-10 (1: No problem, 10: Very problematic), how large of a problem is shark finning in Costa Rica? Total: 8.4
- -On a scale of 1-10 (1: Disagree completely, 10: Agree completely), how important are sharks to marine ecology? Total: 9



Yes: 393 (90.9%) No: 39 (9.1%)

APPENDIX 4

ADDITIONAL RESULTS BY CITY

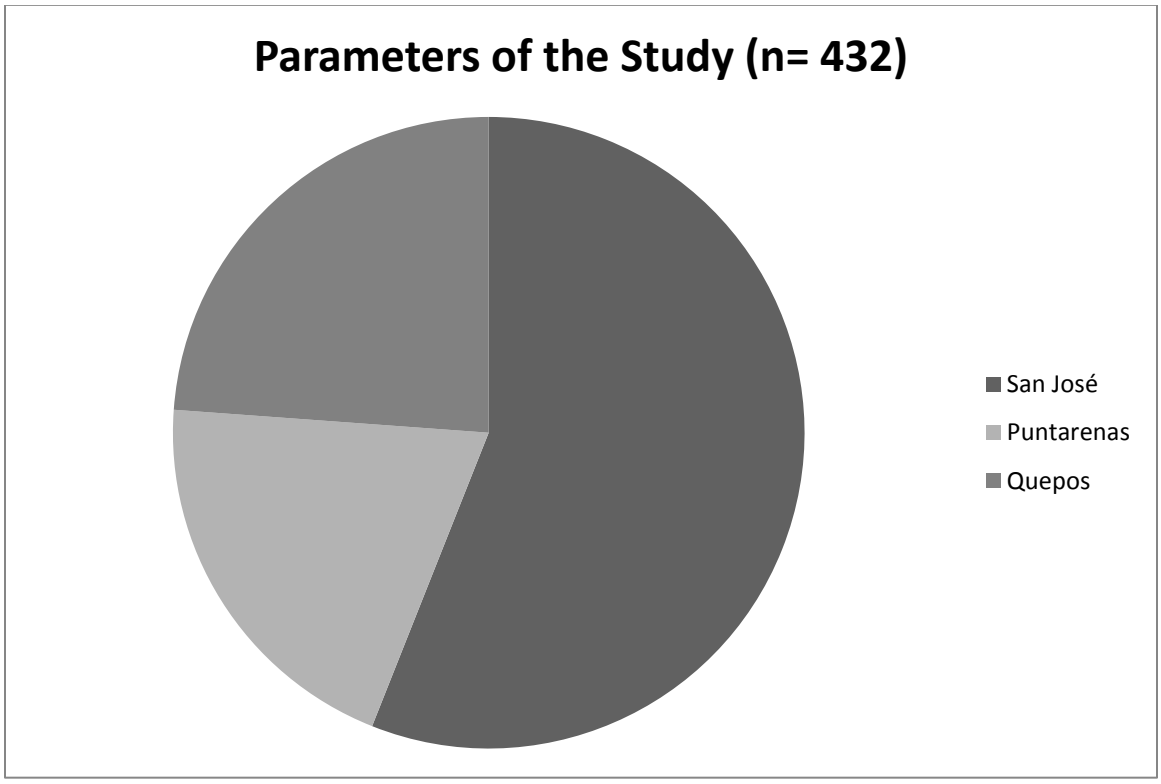
Parameters of the Study

Number of Observations: n= 432

San José: 242 (56%)

Puntarenas: 87 (20.1%)

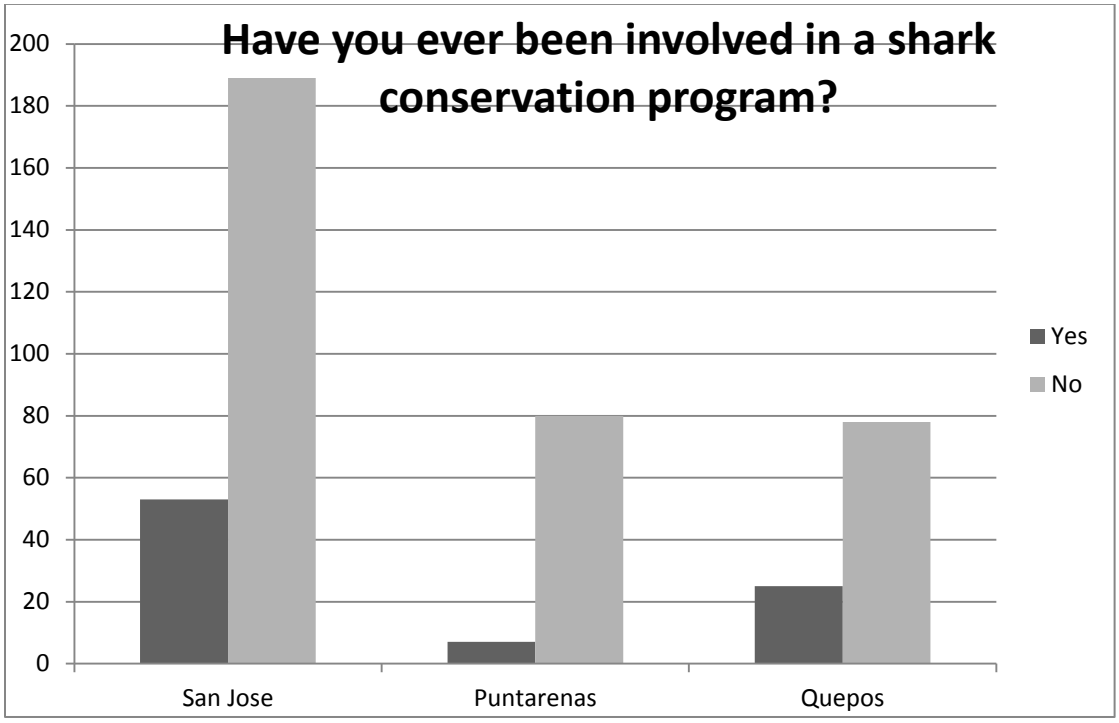
Quepos: 103 (23.8%)



Should shark finning be illegal in Costa Rica: San Jose vs. Puntarenas vs. Quepos

	SS	df	MS	F	p
Between:	3.315	2	1.657	5.697	0.004
Within:	124.789	429	0.291		
Total:	128.103	431			

Hypothesis: Puntarenas has the most correspondents answering “no”



San José: Yes- 53 (62.4%), No- 189
Puntarenas: Yes- 7 (8.2%), No- 80
Quepos: Yes- 25 (29.4%), No- 78

APPENDIX 5

SURVEY INSTRUMENT

A Shark Attack Questionnaire

Purpose: Why is the fin industry targeting sharks; also, how does shark finning affect marine ecology?

Age:

Gender:

City:

Income Level:

Profession/Occupation:

Education: Pre-High School Some High School High School Graduate Some College College Graduate Post-Graduate Degree

Years in Puntarenas/San José/Quepos:

1. Are you/have you ever been involved in a shark conservation program?

Yes No

If yes, then how?

2. Have you ever heard of shark finning (or the removal and retention of shark fins)?

Yes No

3. Is shark finning abundant in Costa Rica?

Yes No

4. How large of a problem is shark finning in Costa Rica?

(1) No problem 1-2-3-4-5-6-7-8-9-10 (10) Very problematic

5. Are you aware of somebody directly related to the shark finning industry?

Yes No

6. Would tighter regulations on shark products hurt families in Costa Rica financially/economically?

Yes No

7. Is it common to find shark products for sale around Costa Rica (shark fins, teeth, etc)?

Yes No

8. Sharks are an important part of marine ecology.

(1) Disagree 1-2-3-4-5-6-7-8-9-10 (10) Agree Completely

9. The loss of sharks annually due to the shark finning industry does not affect the day to day lives of people.

Yes No

10. True or False. The loss of sharks due to the practice of shark finning does not affect the overall ecology of the world's oceans; the oceans are large and bountiful.

11. True or False. Sharks reproduce at fast enough rates to sustain their populations alongside the shark finning industry. Therefore, the overall impact of shark-finning is minimal.

12. Are there viable replacement options for shark finning?

Yes No

If so, what?

13. Do you believe that shark finning should be illegal in Costa Rica?

Yes No

14. Is there a bias against sharks (Sharks are a predator that many people fear)?

Yes No

15. Is it possible that finning is happening to sharks due to bias?

Yes No

APPENDIX 6

SHARK SPECIES IN TEXT

Shark Species In Text		
Common Name	**Scientific Name**	**Family**
Thresher (common) shark	*Alopias vulpinus*	Alopiidae
Blue shark	*Prionace glauca*	Carcharhinidae
Bull shark	*Carcharhinus leucas*	Carcharhinidae
Dusky shark	*Carcharhinus obscurus*	Carcharhinidae
Galápagos shark	*Carcharhinus galapagensis*	Carcharhinidae
Sandbar shark	*Carcharhinus plumbeus*	Carcharhinidae
Silky shark	*Carcharhinus falciformis*	Carcharhinidae
Tiger shark	*Galeocerdo cuvier*	Carcharhinidae
Basking shark	*Cetorhinus maximus*	Cetorhinidae
Nurse shark	*Ginglymostoma cirratum*	Ginglymostomatidae
Great White shark	*Carcharodon carcharias*	Lamnidae
Shortfin Mako	*Isurus oxyrinchus*	Lamnidae
Megamouth shark	*Megachasma pelagios*	Megachasmidae
Crocodile shark	*Pseudocarcharias kamoharai*	Pseudocarchariidae
Whale shark	*Rhincodon typus*	Rhincodontidae
Scalloped Hammerhead	*Sphyrna lewini*	Sphyrnidae
Cookiecutter shark	*Isistius brasiliensis*	Squalidae
Greenland shark	*Somniosus microcephalus*	Squalidae
Pygmy shark	*Euprotomicrus bispinatus*	Squalidae
Spiny Dogfish	*Squalus acanthias*	Squalidae

APPENDIX 7

GLOSSARY

Bathypelagic: darkest oceanic zone; depths exceed 3000 feet and beyond

Endemic: native/natural species in a given area existing there and nowhere else in the world

Epipelagic: part of the oceanic zone into which light can penetrate for photosynthesis (0-600 feet)

Galeophobia: abnormal/extreme/irrational fear of sharks

Hemophobia: extreme/irrational fear of blood

Mesopelagic: of or relating to oceanic depths from about 600 feet to 3000 feet

Neritic: ocean waters between the low tide mark and a depth of about a hundred fathoms (200 m); generally well-oxygenized waters and low water pressure, with stable salinity levels and temperature

Oviviparous: mode of reproduction in which embryos develop within eggs before being laid and hatching outside the mother's body

Pelagic: of, relating to, or living in the open ocean or seas rather than inland waters

Seascape: large, multiple-use marine areas in which private organizations, government authorities, and other stakeholders work together to conserve abundance and diversity of marine life; based on 9 elements: enabling legal framework, adequate institution and capacity, ecosystem-based management, private sector engagement, social and political support, maintenance and restoration of critical habitats and ecosystems, threatened species recovery, human well-being benefits, and sustainable financing and market mechanisms

Selachophobia: extreme/irrational fear of sharks

Thalascophobia: extreme/irrational fear of what could be in the open water; intense and persistent fear of the sea

Viviparous: giving birth to live offspring that develop within the mother's body; live bearing