Institutions in the Shark Fin Market: Externalities and Incentives

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Abstract

This study analyzes the role institutions have in shaping incentives within the shark fin market. It combines literature findings from multifarious fields of fisheries economics, shark biology, and institutional economics to provide an argument that institutions, both formal and informal, were fundamental in establishing the market, guiding how it operates currently, and are needed to find ways to correct for negative externalities engendered by sharks' functions in ecosystems. The strength of the formal institutions of the primary nations involved was measured through the economic freedom index, and classified in terms of inadequate, ineffective, and effective based on how efficient those nations were at conserving shark populations. Developing nations generally provided inadequate institutions that lead to shark finning and overexploitation of their populations. Ineffective institutions are carried out by developed nations with strong enforcement capabilities and high economic freedom, but unproductive management or incentives are in place. Separate methods to properly align incentives in developing and developed nations are suggested. This study recommends using incentive-based strategies, such as a by-catch reward system, in developed nations due to their ability to centrally enforce such policies. For developing nations, locally structured property rights need to be distributed to allow fishermen a stake in the conservation of sharks. These applications can provide both economic and environmental sustainability for shark populations.

INTRODUCTION

The natural environment and the global economy are much more inextricably linked than first appearance would imply. Numerous business activities revolve around the acquisition of natural products often obtained from wild sources. In some cases the extent of capture exceeds the rate of growth for the natural environment to replace. This discrepancy is most relevant in natural resources that are common goods. Common goods are resources that are non-excludable and rival, in that once extracted the resources are no longer available to other

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users (Basurto, 2005). Common goods are often subject to what is known as the *tragedy of the commons* where the resources are overexploited. The rival and non-excludable nature of common goods leads to the formation of incentives that guide users to allocate for themselves as much of the resources as possible before a competitor extracts those very same resources. Commercially caught fisheries exhibit all the characteristics of common goods.

To mitigate the loss of social welfare from the exploitation of common resources, institutions are imperative to establishing the rules of the game for the market. Those rules structure the incentives that guide human economic activity (Baumol, 1990). Human economic activity impacts the environment through direct resource extraction or indirectly by consequence. Institutions are also fundamental to defining property rights (Jentoft, 2003). In the fishing industry, the difficulty in establishing property rights through a lack of strong institution often leads to overexploitation (Gordon, 1954). This would be a clear example of destructive entrepreneurship as the seemingly inexhaustible renewable fishing resource is systematically degraded through profit-maximizing behavior (Baumol, 1990; Gordon, 1954). Within the global fishing industry, no market better highlights this scenario than the market for shark fins.

Shark fisheries have the characteristic signs of a pool of resources subject to the tragedy of the commons. However, there are additional factors originating from the biology of sharks and the nature of the capture techniques that distinguish this market from other wild-caught fisheries. First, the difference in the value of a shark fin compared to the rest of the shark leads to an incentive to fin the sharks. This leads to significantly more sharks being captured than would otherwise be possible. Second, sharks have life histories characterized by slow growth, low fecundity, and late maturity distinct from their fishery counterparts of pelagic teleosts like tuna (Au, Smith, and Show, 2008). These biological constraints make it exceedingly difficult for shark populations to recover from fishing pressures. Third, paucity of shark capture data, both for shark fins and total shark meat, limits the effectiveness of monitoring and enforcement measures. Without capture data as well as market data such as price, it is arduous to predict the extent of the market and make future management policies. Finally, sharks have a unique role in structuring the ecosystem and their removal may cause costly effects on production in other aquatic industries in the form of negative externalities.

This study will examine the roles of institutions both formal and informal in the growth and function of the shark fin market. To understand and develop a clear picture of the market and the institutions currently structuring the shark fin market, an analysis on the driving forces will be conducted with a brief review on seminal work conducted. The role of institutions in data collection will also be addressed and how opaque regulation and enforcement have led to a depravity in data, from which the cycle of institutions is disrupted. Economic freedom of the nations auspiciously involved in the market will be used as a metric for determining the effectiveness of institutions. To understand the destructive nature of the shark fin market from the formation of negative externalities, the biology of sharks and their importance in the ecosystem will be discussed. Additional externalities from shark propelled ecotourism is also addressed and to what extent they degrade social welfare. Whether there are ways incentives can be aligned through the construction of institutions that are able to place effective property

rights or regulations to design an appropriate set of rules will be illuminated. Examples will be drawn from other fields of study as there is yet to be a definitive argument for the case of shark finning leading to externalities and strategies to mitigate such consequences. All of these issues will be addressed through a combination of theoretical ideas and comparison to case studies done in other marine commodity fields.

THE MARKET FOR SHARK FINS: DRIVERS, SUPPLIERS, AND DENIERS

Shark fins are acquired in two ways, either the whole body utilization of captured shark where the fins are removed once landed, or by the act of finning defined as removing the fins of a shark and discarding the body at sea (Cortes and Neer, 2006). The issue with finning is that it allows for the profligate waste of entire sharks. Finning is done as the value of the shark fins can be order of magnitude higher than the rest of the shark. Therefore, as profit-maximizing individuals, the fisherman will want to allocate only the fins on their space-limited boat (Hareide, et al., 2007). This leads to a disproportionate capture return on sharks and the overexploitation of the resource. Also, sharks are usually finned as a product of by-catch in tuna and swordfish long line industries (Hareide, et al., 2007). The market for shark fins is opaque, yet analysis does indicate there are typical market operations occurring. For example, there are defined preferences in shark fin products for different species due to the varying quality between species (Fong and Anderson, 2001). These preferences are directed at large predatory sharks with characteristically sizeable fins, such as Sphyrnidae hammerheads, or species with high densities of ceratotrichia (Clarke, 2004).

The seminal paper analyzing the shark fin market was done by Clarke, et al. (2006b) to estimate the global value of shark fins in the world and to determine the biological mass of sharks depleted. Clarke, et al. (2006b) employed Bayesian statistical models to convert sparse data from Hong Kong shark fin imports into a sum of shark fins traded into Hong Kong. Based on Hong Kong's assumed market share, a global approximation of harvested sharks was derived. Biologically derived conversion factors converted the number of fins traded to the global biomass of sharks finned. Clarke, et al. (2006b) found that 26–73 million sharks were killed in the world in 2000 for their fins. This equated to $400–$550 million worth of exchange, almost four times higher than data reported to the United Nations FAO estimate for shark fins. Leah Biery conducted another study attempting to quantify the shark fin market in 2012. Using combined samples from the Sea Around Us projects, journal entries, trade data from nations and the FAO, and anecdotal reports, she compiled a Best Catch Estimate for nearly every nation in the world. From these estimates, she calculated the amount of shark fin harvested within each nation. Biery found that 19–38 million sharks a year from 2000–2009 were caught and finned. Like Clarke, et al. (2006 b), Biery found that total value of trade was higher than the reported FAO by a significant margin.

Global supply of shark fins encompasses all oceans and numerous nations. Countries with institutions that place incentives on shark finning or lack strong regulatory behavior comprise the majority of global production (Biery and Pauly, 2012). The following two sections describe how different institutions affect the

supply and demand, respectively. Cultural perceptions act as an informal institution that spurs demand in the market. The formal institutions that affect the aspects of supply, such as data reporting, will be detailed afterward.

Informal Institutions Shaping Demand

Consumption is driven by the Hong Kong and Chinese markets (Clarke, et al., 2006a). An informal institution dictates and creates the incentives for the Cantonese cuisine affinity for shark fins. Shark fins are a popular luxury good. Their primary use is for consumption as an ingredient to shark fin soup. The fins only serve to provide texture and absorb taste through the alignment of the shark ceratotrichia, or cartilaginous fin rays (Clarke and Milner-Gulland, 2007). Shark fin soup has been a staple to Chinese cultural dishes as a symbol of affluence and believed to provide some medicinal properties. Though legitimacy of the medicinal elements have been brought into question, there is little doubt that shark fins offer a sign of social status. Shark fins are traditionally a focal dish of Chinese weddings and celebratory banquets where lavishness is encouraged. Originally served during the Song Dynasty (960–1279 A.D.) and fully established as the primary component of imperial banquets in the Ming Dynasty (1368–1644 A.D.), shark fins were engrained to the Chinese populace as a means to impress the emperor (Clarke and Milner-Gulland, 2007). This sentiment began to permeate and mutate to a symbol of general wealth still recognized today throughout the populace.

Due to their informal cultural institutions that lead to incentives for consuming shark fins, China and Hong Kong are the largest consumers in the world. The cultural significance ascribed to shark fins as a measure of wealth, creates an incentive for individuals to demonstrate their affluence, fuels the demand for shark fins. In 2000 Hong Kong had a 44–59% approximate share of the global imports (Clarke, 2004). The percentage share of consumption by Hong Kong has gone down in the last few years primarily due to the emergence of China, both in terms of wealth and entry into the World Trade Organization. Together however, China and Hong Kong continue to dominate the market. As described above, shark fin consumption has been ingrained into Chinese cultural sentiments for millennia, but has only recently become the massive multi-million dollar trade market of today. What catalyzed this increase in consumption were the near exponential growth of Hong Kong since the 1960s and the growth of China since the beginning of 1990s.

How this growth translates into increased shark fin consumption is through the income effect. As China and Hong Kong have grown, their disposable income for all their citizens has increased. By the income effect, an increase in disposable income leads to an increase in the demand for previously unobtainable luxury goods (Dubois and Duquesne, 1993). With the steady rise in growth for Hong Kong, there has been a subsequent increase in shark fin importation (Figure 1). Importation data is more readily available and there is no quantified metric for the consumption of shark fin within those nations. Since Hong Kong is essentially isolated and cannot catch any significant numbers of sharks itself, it is required to import most of the shark fins it wishes to consume (Clarke and Milner-Gulland, 2007). Import values from China are more recondite as there is little reliable data for the shark fins. Lack of reliable data is not just in Chinese

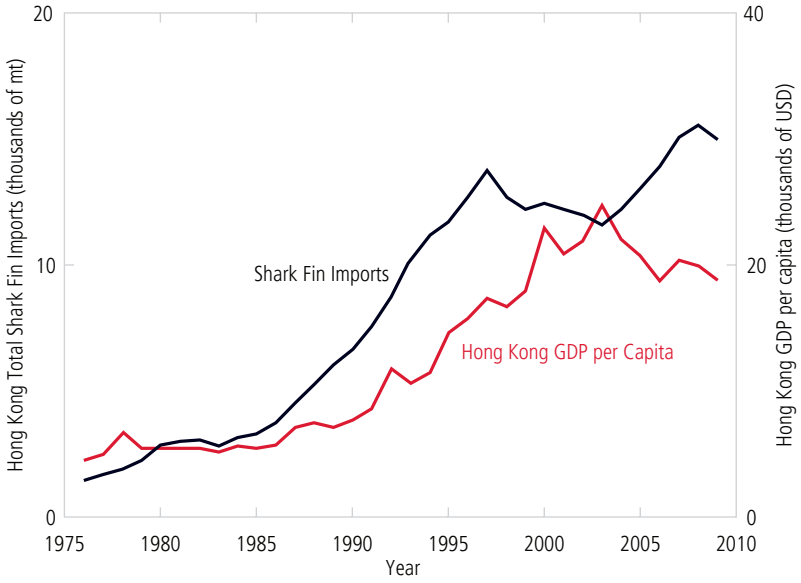

FIGURE 1. Hong Kong Imports of Shark Fin and GDP per Capita from 1976–2009. GDP per capita is used as a proxy for disposable income. Data was retrieved from the World Bank for the GDP per capita and the imports from the FishStatJ (FAO 2013).

and Hong Kong markets where prices, catch, and true consumption data are missing, but also in the global supply of shark fins.

Knowledge as Feedback for Institutions

The supply of shark fins is also dictated by institutions. Unlike the demand for shark fins where informal institutions are the primary driver, formal institutions, or lack thereof, influence supply. States are major influencers of formal institutions (Peterson, 2002). The institutions a government creates can be either specific, such as policies and particular management plans, or broad, as in state's ability to enforce policies for promoting economic freedom. Two distinct areas that formal institutions affect in the shark fin market are management and the reporting of catch data. Though not a direct economic outcome, the collection of data is imperative for a feedback loop in the cycle of institutions forming the rules of the game leading to incentives that guide economic outcomes (Boettke, 1993). Generally in a free market economy, prices and consumption quantities, or the measureable allocation of resources, act as the requisite information for updating how institutions ought to operate (Boettke, 1993). In the shark fin market there are two characteristics that are preventing this feedback cycle from functioning.

The first is partially due to the inherent difficulty in recording data for shark fins. Some of the difficulty arises from the complex issue of compiling catch reports at sea, which plagues all fisheries. The ability for fishermen to accurately differentiate species, and the prevarication of shark fin catch by fishermen due to the generally illegal nature of shark finning adds to the issue (Hareide, et al., 2007). When the fins are separated from the bodies, it is difficult to provide estimates for the quantity of sharks landed (Biery and Pauly, 2012). This problem is exacerbated by international trade coding policies. This equivocation of the data often leads to underreporting of shark catch implying healthy shark populations (Clarke, et al., 2007). This is an institutional flaw as it is nations that prescribe trading policies. Effects from changes in trade coding policies on the shark fin import data is most apparent in China and their reported values to the UN Fisheries and Agricultural Organization (FAO).

The best readily available data resource for fishery trade data is the FishStatJ tool provided by the FAO. FishStatJ provides total capture, trade, production, and aquaculture production of every marine product in every nation that reports to the FAO in terms of weight and value. Though commendable, FishStatJ contains inaccuracies arising mostly from a lack of set guidelines for trade reporting. FishStatJ must be exculpated from these errors though, as it is the nations who are erring in the reporting of their trade, as demonstrated next.

Before 2000, China's import commodity coding system had a specific category for shark fins. Implemented in 2000, China made an amendment to its coding policy and placed all imported frozen shark fins into the same category as shark meat (Clarke, et al., 2006b). Changing the coding caused a disturbance in China's import of shark fins (Figure 2). China did not simply stop importing or consuming shark fins, the market would be become evanescent, but shark fin consumption remains prevalent in China (Clarke and Milner–Gulland, 2007). This example demonstrates the role government practices can play in allowing feedback to occur and it is not isolated to China alone. Other developed and developing nations misreport their catch, as the use of observers is sparsely employed. Additionally, artisanal fisheries in less-developed nations have an even greater difficulty in the report of their catches (Smale, 2008). Together these misleading data aggregate into an opaque market. Estimations through trade data analysis and Best Catch Estimates highlight that the reported information is erroneous (Clarke, et al., 2006b; Biery, 2012). Misrepresentative data can be used to fuel incentives. If data is underreported it implies that sharks have a healthy population and the resource can sustain increased fishing pressures, leading to higher quota allowance (Clarke, et al., 2007).

The second characteristic that inhibits information dissemination is the responses to market interactions within Hong Kong and China. Through direct anecdotal evidence, there is indeed a functioning market within the Cantonese area (Fong and Anderson, 2001). Preferences and prices are dictating consumer demand, but both China and Hong Kong have taken little managerial effort to quantify the internal trade market. Without these fundamental data points it is challenging to get a picture of the market and the effects on shark populations.

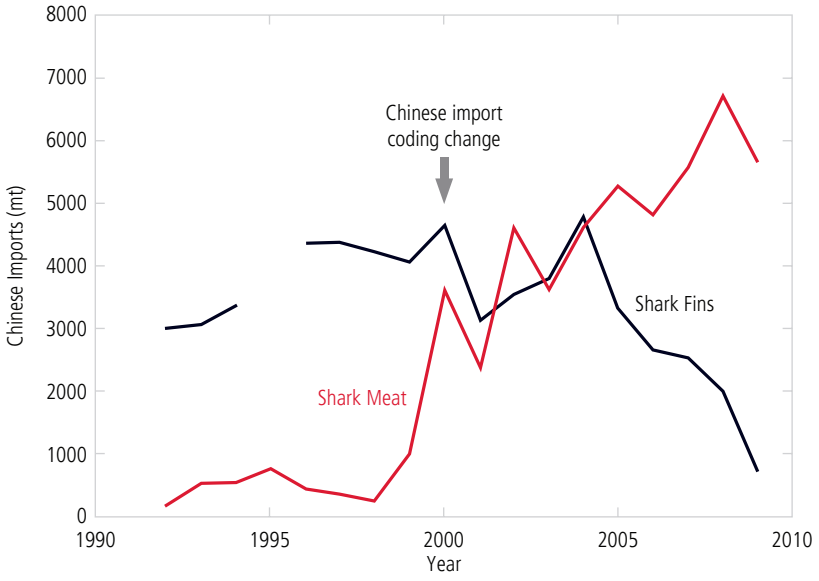

FIGURE 2. Chinese Frozen Shark Meat and Frozen Shark Fin Imports from 1991–2009. The arrow points out the implementation of the Chinese coding policy change that moved shark fin imports into shark meat import category. In 1995 there was no data reported by China for shark fins to the FAO. Data compiled from FishStatJ (FAO 2013).

Data translates to knowledge that is required for effective policies and cycled through the institutions (Barker and Schluessel, 2005). With estimations as high 73 million sharks a year caught for their fins, there have been pernicious reductions in shark populations (Clarke, et al., 2006b; Dulvy, et al., 2014). To begin to properly analyze this market, species specific data needs to be acquired. This can be done through proactive strengthening of formal institutions to create incentives to properly record capture data and reaching an international agreement on how sharks fins ought to be recorded within trade statistics. With more data available, both economists and biologists can begin to assess the true impact of the shark fin market and be able to inform players of possible effective management strategies.

Strength of Institutions in the Supply of Shark Fins

Institutional strength affects data collection. It is through the strength of the institutions that engender the economic outcomes. As it is problematic and convoluted to measure the direct strength of an institution, the Economic Freedom Index can be a proxy to measure the direct strength of an institution. The Economic Freedom Index can be a measure of institutional quality where higher ranks imply more free institutions (Nystrom, 2008). Within the index, four categories that all relate to institutional structure measure the ability for individuals within the nation to operate autonomously (Heritage Foundation, 2013). For shark fins, the influence of two of the measures is particularly important. The rule of law and regulatory efficiency measures are effectively or ineffectively structuring the market. The leading nations that supply shark fins and the high seas score very low in economic freedom. Table 1 below depicts this outcome. Together, the top ten nations and the high seas account for approximately 60% of all the supply.

With the notable exceptions of New Zealand, Taiwan, and Spain, all the nations have some of the highest possible rankings, from which weak institutions can be inferred. Instead of segregating actors in the shark fin market with either strong or weak institutions, they ought to be separated into categories of inadequate, ineffective, and effective institutions. The presence of highly free nations with strong institutions, yet are significant actors in the market, opens up the argument that the institutions are designing ineffective incentives to mitigate shark finning. Also Taiwan and New Zealand have legislation in progress of being passed and implemented that require shark to be landed with fins attached (Biery, 2012). However, based on their performance and contribution during the 2000s, they will for the purpose of this

TABLE 1. Economic Freedom Rank of the Top Shark Fin Suppliers

Country	Production Rank	% of Global Production	Economic Freedom Rank
India	1	9.51	119
Trinidad and Tobago	2	5.44	72
Taiwan	3	4.84	20*
Pakistan	4	4.8	121
Indonesia	5	4.2	108
Sri Lanka	6	3.24	81
Iran	7	2.58	168
Spain	8	2.5	46*
New Zealand	9	2.35	4*
Brazil	10	2.17	100
High seas	N/A	19.68	N/A

*Represents a nation with ineffective institutions. There is no economic freedom measure for the high seas as it is not under any sovereignty. Rankings for economic freedom were obtained from the Heritage Foundation. Measures of percentage of global shark fin production obtained from Biery (2012).

study be classified as ineffective based on the policies in place during the beginning of this millennium.

On a spectrum, inadequate institutions are the closest to ascribing fishing industries as common goods (Peterson, 2002). The race-to-fish mentality precipitated by access to common goods leads to the tragedy of the commons and the overexploitation of fishing resources including sharks (Hilborn, et al., 2005). The ultimate example of an inadequate institution is the high seas. In the high seas there are no property rights, no enforcement, and no management strategies. Once there, a fisherman can only extract rents by capturing fish before a competitor does so. This incentive, structured by the lack of any formal institution in the high seas, allows shark finning to be prevalent and to the overexploitation of all fish stocks (Jensoft, 2003; Biery, 2012). Nations want to avoid building a model close to that experienced in the high seas. Institutions that prove to be inadequate are the closest to such a model.

Inadequate institutions describes nations with little to no policies regulating the shark fin trade and the act of finning, ineffective or no enforcement of policies implanted, weak or ill-defined property rights in their waters, and they contribute to equivocation of data reporting. There are also informal institutions at play to counter any efforts taken by governments. As management can be expensive and artisanal subsistence fishing is more common in developing nations, residents are more concerned with feeding themselves and employment than the conservation of an animal population (Barker and Schluessel, 2005). There is little environment awareness. If there are management plans in place, they are not being enforced. Not enough activity is at work to properly structure effective incentives. Nations with low economic freedom scores will most likely have inadequate institutions. From Table 1, India, Trinidad and Tobago, Indonesia, Sri Lanka, Iran, Pakistan, and Brazil all exhibit the signs of nations with inadequate institutions and are reflected in their low economic freedom rankings. Developing nations will fit into this category as enforcement of regulations is subject to bribery or simple lack of effort. Also, property rights are not distributed to individuals. In the ocean, even if the government "owns" the water, it is still treated as a common pool by its citizens. Recommendations to correct inadequate institutions will be discussed in a later section.

Ineffective institutions are those that have the strength to instigate change or protection, yet enforce policies that encourage finning. Ineffective institutions arise from the lack of funding for management or political contention from within the nation (Barker and Schluessel, 2005). New Zealand, Taiwan, and Spain, as well as numerous other developed nations, employ regulation dictating a 5% fin-to-body ratio (Biery, 2012). This legislation outlaws direct finning, but allows fins to be removed as long as there is a corresponding body weight ratio. This was enacted primarily in the EU and Canada as a means for the shark fisheries to be able to store the carcasses more efficiently on boats thus promoting yield (Biery and Pauly, 2012). However this universally applied ratio creates a loophole for fisherman to keep finning (Cortes and Neer, 2006). Shark fins do not account for 5% of the total body weight, especially in species that are finned including the Sphyrnidae and Carcharhinidae (Cortes and Neer, 2006; Biery, 2012). When various carcass dressing practices are accounted for, the number of fins begins to grossly out match the bodies. In this type of ineffective legisla-

tion there is still an incentive and ability to fin. Another example of ineffective laws is the employment of subsidies. Shark-fishing industries are often subsided despite reporting profit losses (Barker and Schluessel, 2005). This creates incentive to not reduce catch or find ways to become economically efficient. Coupled with measures that allow for finning, subsidies detract welfare by siphoning government funds that could be used in more productive endeavors and increase anti-finning pressures.

Effective institutions are far from perfect, but they offer the best potential strategies. Characteristics of effective institutions in the shark fin market include a fins-attached policy, shark sanctuaries, pellucid and effective management strategies, and stronger property rights in their local waters. With the passage of the Shark Conservation Act in 2010, the United States (10th in economic freedom) has moved to the forefront of possessing effective institutions. Though not a shark sanctuary, the United States prohibits the act of finning entirely. Possession of fins, whether to sell or transport, in the United States is subject to heavy fines and all sharks must be landed with fins attached. From the Magnuson-Stevens Act there is also clear and enforced regulation on shark fishing as a whole, including the use of catch quotas (NMFS, 2012) The Bahamas (35th in economic freedom) has also displayed the use of its effective institutions by implementing and enforcing a shark sanctuary (Gallagher and Hammerschlag, 2011). Even if economic freedom is low, nations can still structure effective policy. Egypt (125th) and the Maldives (149th) both were able to decree their water to be shark sanctuaries, and they have been reasonably effective in enforcing it. They were able to accomplish this by enforcing their nations' sovereignty in its own waters from poaching international fishing vessels (Sathiendrakumar and Tisdell, 1987). Both of these nations had incentives to implement shark sanctuaries as sharks provided their economies with ecotourism revenue. All nations should recognize that sharks require protection. The need for protection originates from the sharks' unique biological characteristics.

BIOLOGICAL REPERCUSSIONS

The reason there is such concern over the magnitude of shark mortality from finning, examined from a biological perspective, is that sharks are extremely susceptible to overfishing. It is vital to study sharks' life history stages to obtain a much greater understanding of how shark fisheries would respond to fishing pressures. Economic surplus production modeling, often used in other pelagic stock assessments, requires consistent and reliable catch and catch-per-unit effort (CPUE) data time-series (McAllister, et al., 2008). The paucity of shark fin data degrades this model as an effective management tool. Until data collection becomes more efficient, the thorough demographic models that require biological inputs to measure elasmobranch susceptibility to overexploitation estimate the potential vulnerability of shark populations. Sharks have the characteristic life history stages of K-selective species based on their slow growth rates, late maturity, low fecundity, and great longevity (Hoenig and Gruber, 1990).

When these life history characteristics are parameterized, the intrinsic rebound potential may be calculated. Intrinsic rebound potential is a measure of a population's ability to grow after a disturbance, such as increased fishing pressures. The lower the intrinsic rebound potential, the harder it is for the shark

population to recover. Sharks have much lower intrinsic rebound potentials than that of pelagic teleosts fishes like tuna, which is why there ought to be even more concern for shark populations, even when some tuna populations remain sustainable with higher levels of fishing pressure (Au, Smith, and Show, 2008). Many commonly finned sharks have the lowest rebound potentials, such as the scalloped hammerhead *(Sphyrna lewini*) (Smith, Au, and Show, 2008). Coincidentally many of the sharks that fall on the International Union for Conservation of Nature (IUCN) endangered and threatened list are those that are finned with low intrinsic rebound potential (Dulvy, et al., 2014). Also, sharks are highly migratory and transverse through numerous economic exclusion zones, further exacerbating management efforts as it requires the collaboration between nations.

With their life history characteristics, it is strenuous for sharks to repopulate under the extreme stress caused by such a profligate and unsustainable action like shark finning. However, effects of the removal of sharks are not confined to only their populations. Their absence is disruptive to the structure of entire ecosystems. Sharks are known apex predators, the animals at the top of the food chain, especially the targeted large coastal and pelagic sharks that are preferred for their fins. In a top-down controlled trophic web, perturbations in the apex predator population lead to disruptions of the trophic cascades (Ferretti, et al., 2010). Trophic cascade is the trickling effect of predation on subsequent lower trophic levels. Without the top predators to control the population of the mesopredators (or mid-level predators), the mesopredators proliferate and consume greater amounts of the base of the food chain. The primary consumers are generally essential to maintaining ecosystem structure and are often commercially important species.

The most prominent study on sharks' roles in trophic cascades and potential consequences was done by Myers, et al. (2007) off the eastern coast of the United States. From survey collections of over 35 years, Myers, et al. (2007) found the populations of 14 "great" shark species to be declining rapidly. Simultaneously, the prey populations of these sharks all saw exponential increases. One of the common prey items of these sharks was the cownose ray (*Rhinoptera bonasus)*, which feed on scallops and clams in the Chesapeake Bay. With the increase in cownose rays, Myers, et al. (2007) suggested the oyster populations in Chesapeake Bay were greatly reduced by predation from the rays leading to exceptional losses for the oyster and scallop farmers. Also, as oysters play an integral role in water filtration, there were uncalculated indirect economic effects from the loss of ecosystem services. This cascade down to foundation species with the removal of sharks can lead deleterious effects on non–shark-fishing industries.

EXTERNALITIES OF SHARK FINS

The indirect consequences of the removal of sharks on other industries can be classified as a negative externality. Externalities have always been present in fishing industries due to lack of clearly defined property rights and the tragedy of the commons (Smith, 1969). However, identification of the consequences on economic activity outside of the fishing industry has been a relatively recent addition to the literature. This case is even more apparent with the loss of shark

species due to finning. Although literature has begun to identify the repercussions of the removal of apex shark predators and the ensuing restructuring of the trophic levels through trophic cascades, there has been little speculation as to the addition of social cost. Part of this is due to intrinsic difficulties in measuring externalities. Without clearly structured property rights, it is incredibly challenging to identify who ought to pay the brunt of the cost. Also, how much should they pay? The full-scale effects of trophic cascades on base-level economic organisms is yet to fully be measured. More information and understanding of trophic cascading needs to be developed by biologists before economic impact studies can take place. One of the criticisms of Myers, et al. (2007) is that they overestimated the dollar sum value of the loss of oysters, as well not having a sufficient data sample to make such broad sweeping claims (Burgess, et al., 2005). The focus on trophic cascades as a negative shark externality has merit from its ubiquity throughout oceans of the world. As sharks are essential in ecosystem dynamics, identifying some way to connect the loss of ecosystem services and productivity would be an ideal way to shift incentives toward an outcome that generates more social welfare for the community as a whole.

Even though the removal of sharks and the consequences on the productivity of the ecosystem needs further study in order to properly quantify a social cost, there is a clear negative externality for certain nations associated with shark finning. Ecotourism has become a driver for sustainability of pristine environments and species integral to maintaining the biodiversity (Gossling, 1999). In ecotourism, the best way to attract visitors, and therefore revenue, is to keep alluring and captivating animals and habitats healthy. Island nations such as Palau, the Bahamas, and the Maldives recognize this potential more so than other nations. The marginal cost on society is much greater than the marginal benefit gained through finning simply due to the ecotourism value associated with sharks. Therefore these nations have banned the act of finning completely, and some have banned any shark-fishing activity altogether (Biery, 2012). As sharks are a key attraction for divers to travel to these remote nations, they provide in influx of monies into the island economies. This is most noticeable in the island nation of Palau.

In Palau, the revenue a gray reef shark (*Carcharhinus amblyrhynchos*) generates over its lifetime is $1.9 million dollars or $179,000 a year (Vianna, et al., 2011). The tourism sharks generate as people desire to see these animals is not confined to just the diving industry, but leaks and dissipates into the rest of the economy in the form of hotel accommodations, tax revenues, and purchasing other commodities during their stay. At average market value for fins and meat, it would take approximately 100,000 harvested sharks to equate to the same revenue for shark ecotourism in Palau (Vianna, et al., 2011). However the harvest of sharks is non-renewable when compared to ecotourism and the harvest of 100,000 sharks would be far beyond the maximum sustainable yield for Palau. When a shark is finned and removed through harvest, the island nation of Palau ceases to acquire the additional revenue stream. That is a loss of welfare for Palau as a whole and adds to the social cost of shark finning resulting in a negative externality. This phenomenon of added value in sharks from ecotourism is not solely in Palau. The reef sharks of the Maldives generate $33,500 a year, in Bimini this number is enhanced to $250,000 a year (Anderson and Ahmed, 1993; Hall 1994). These values are not even beginning to accommodate for the added

value of healthy ecosystems and the services provided by them. With those services accounted for, the value of individual sharks will only continue to increase.

INCENTIVE STRATEGIES

It is clear that some nations have found a compelling incentive to reduce their involvement in shark finning. The current rules of the game from the institutions in place in other countries are not sufficient in designing those same incentives. The changes necessary depend on whether a country is developed or developing. There is no one strategy that will correct all the ailments for the different institutions. The most difficult, but perhaps the most influential, task in shaping a new, sustainable direction for the shark fin market is altering the cultural significance attributed in the demand of the market.

The remarkable difference in price between fin and meat entices fisherman to fin (Hareide, et al., 2007). By addressing the informal institutions that place value into the fins, a new cultural outlook will restructure incentives that lower the value of the fins. Manipulating informal institutions is challenging, but education offers the best alternative as it is less intrusive then say a forceful mandate by the government. Recently, efforts by organizations like Shark Truth have been successful in lowering demand for shark fins by asking Chinese newlyweds to refrain from using shark fin soup during their reception (Shark Truth, 2013). Efforts like this need to continue to eventually remove the inordinate value placed on shark fins.

The ineffective institutions of developed nations need to remove policies currently in place that are inefficient before restructuring incentives to preserve shark populations. First, due to inefficacy, the 5% fin-to-weight-ratio policy needs to be removed and replaced with a fins-attached policy (Cortes and Neer, 2006; Biery, 2012). Secondly, subsidies that promote the overexploitation of sharks have to be taken away (Barker and Schluessel, 2005). With these policies removed, additional legislation can be used effectively. The simple and most straightforward way to reduce shark finning is to flat out ban it, just as the United States did in 2010 with the Shark Conservation Act (Cortes and Neer, 2006; NMFS, 2013). Provided a nation has the effective institutions in place or the ability to transition ineffective policies to such a stance, this is the most effective tool for shark conservation. To limit the overexploitation of sharks as a whole and reduce the chances of finning to occur, property and incentive-based strategies can be utilized (Barker and Schluessel, 2005). The ability of developed nation's institutions to structure incentives is much more refined than those of developing nations. It is for this reason that more comprehensive incentive strategies ought to be employed. Streamlined pricing data will assist the construction of these incentive strategies, as it serves as the knowledge feedback for institutions to assemble appropriate incentives (Jensoft, 2003). From the depravity of shark fin pricing data, incentive-based price instruments may not be sufficient until data is reliable (Sanchirico, 2003). Alternative methods can be used to reduce deleterious behavior, or property rights can be defined more clearly.

The first method that has had success in other fishing industries is the use of individual transferable quotas (ITQs) (Barker and Schluessel, 2005). ITQs define and distribute a set amount of quota from the fishery to be obtained by the individual fishermen and allow for the transfer of rents to more productive

individuals (Hilborn, Orensanz, and Parma, 2005). Through ITQs the race to fish behavior is limited and the tragedy of the commons is eliminated (Hilborn, Orensanz, and Parma, 2005). When fishermen have a stake in the stock, they have an incentive to conserve it for the future. To distribute the rights to the ocean, the government can only prescribe legitimate claims. Auction systems have helped assign equitable distribution of fishing rights in the past (Peterson, 2002).

The second method is especially pertinent to sharks. By-catch rewards or penalties can shape incentives to minimize by-catch. Tuna fisheries in industrial nations often fin sharks as by-catch. In the Bering Sea, the pollock industry employs this system (Pascoe, et al., 2010). Fines and penalties reduce the profit of profligate vessels who catch a prodigious amount of by-catch. The penalties are then redistributed to vessels that are effective at limiting their by-catch. With distinct incentives to reduce by-catch, there is less of an opportunity to fin sharks.

To address the negative externality intrinsic to shark finning regarding the degradation of ecosystems, nations must find some way to correct and adjust the cost to the socially efficient equilibrium. In developed nations, where shark ecotourism is unlikely to bring a significant revenue stream (with the exception of Australia, South Africa, and the Florida Keys), another solution to mitigate the negative externality is to tax the guilty industry. Though a direct tax could limit wasteful fishing behavior, there are questions as to where the government revenue should be spent (Pascoe, et al., 2010). Compensatory mitigation is a method that could simultaneously reduce the incentive to fin from by-catch and fund ecosystem restoration (Wilcox and Donlan, 2007). Ecologically important organisms, like sharks, that are caught as by-catch degrade the environment, leading to costs in other industries. Placing a required compensation amount for every shark caught as by-catch transfers revenue from destructive practices to potentially constructive ones. For example, the compensation payments from by-catch could be used to fund scientific research that designs fishing gear to lower by-catch. This ensures future reduction in by-catch and more sustainable fishing practices. In order for any of the proposed methods to work, management enforcement must be effective.

For developing nations with inadequate institutions, those methods suggested above will be more difficult to implement. Enforcement strength is not on par with that of developed nations. With seven of the top ten producers of shark fin in the world as developing nations, finding a way to alleviate the motivation for finning is imperative. Developing nations in the Coral Triangle and Caribbean have incredible amounts of shark species diversity (Dulvy, et al., 2014). Like in the developed nations, allowing local fisherman a stake in the resource will promote conservation. Foreign vessels rent out rights to fish in some developing nations (Barker and Schluessel, 2005). The government does extract a diminutive amount of rent from these taxes, but the foreign vessels have no reason to conserve the stock as they can simply move to the next site. Foreign fishing vessels treat the resource as a common good and devour rents voraciously. By transferring property rights back to individual communities, conservation through reduction of finning will be achieved, especially where fishing remains part of the subsistence for maritime communities.

The importance of property rights in their ability to constrain involvement of encroaching foreigners is exemplified by the Seri Indians of Mexico. In the

1970s the Seri Indians were granted maritime rights to their traditional tribal territory. The area produces a tremendous amount of bivalves that are sold on the international market. To balance the interest of the community, the tribal council structured laws that required the involvement of local Seris in the fishery, in conjunction to acquiring rights from the government (Basurto, 2005). This structure was effective to cull overfishing as the presence of Seri fisherman and divers with a vested interest in the resource checked the efforts of the outside fisherman (Basurto, 2005). Though this model was for benthic bivalves, encouraging foreign companies to employ locals to act as de facto observers will help ensure the adherence to conservation goals without the ability for strong enforcement measures to take place by a centralized agency.

CONCLUSION

Institutions and incentives matter. How the shark fin market operates is dictated and driven by both. The rising levels of income spurred an engrained cultural practice in China and Hong Kong of purchasing shark fins as a symbol of affluence. Prices spiraled upward from the increase in demand and led fishermen, who were limited on space in their boats, to rationally choose the profit-maximizing outcome to fin sharks. Finning sharks allows for an aberrant and deleterious amount of sharks to be harvested. With their biological characteristics, their populations cannot sustain under the pressure exhibited. When removed from their habitat, sharks are not able to contribute extra value through their facility to attract ecotourism, and without sharks ecosystem services degrade, adding social cost. Revenue loss from these activities is a negative externality in the shark fin market.

To adjust the market to reach the socially optimal equilibrium, institutions need to play a proactive role. Rules in international trading create data paucity that prevents the transmission of knowledge to facilitate signals to the marketplace. From these signals, knowledge derived from the data is used to design effective management practices. There are three echelons of institutions in the supply side of the shark fin market: inadequate, ineffective, and effective. Developing nations generally possessed inadequate institutions for aligning incentives to fit the social equilibrium, and limited, weak enforcement capabilities. Developed nations that had policies in place, but allowed the continuation of finning, were deemed ineffective at attaining the socially optimum level of output. Suggestions to correct these deficiencies have to be separated for the developed nations. Policies and strategies that work for developed nations will not translate well to developing ones due their differences in promoting management, funding conservation efforts, and enforcing policies. For developed nations with ineffective institutions, the first step is to remove unproductive policies, such as subsidies and the 5% fin-carcass ratio, and supplant them with stronger policies. For them to further promote conservation and economic prosperity, incentive-based strategies may be implemented, including compensatory mitigation, by-catch reward/punishment systems, and the use of individual transferable quota. How developing nations respond to the growing concerns of shark finning will be key to determining the course the market will take. As their waters are rich in productivity, they must protect their resources from overexploitation. The best way to do this is to establish property rights that allow local communities to enforce

conservation policy, rather than a large, centralized entity that could become bloated and expensive to manage. Institutions are always changing as people's perceptions change, governments take different courses of action, and new information arises to suggest the possibility of a more desirable outcome. Scientists, economist, and policy makers need to communicate with each other to fuel the process by which institutions can create incentives. This process will be crucial to guiding the course for the future of shark populations.

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