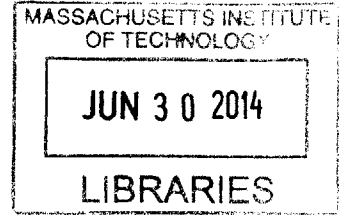


Preying on the Predator: The Shark Fin Controversy

by

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ABSTRACT

The consumption of shark fin soup dates back to the Ming Dynasty in China, when it was served to emperors. Today, the cultural delicacy represents wealth, status, and power. Over the past 30 years, with the rising middle class in China, the demand for shark fins has surged. To address the increasing demand, a group of fishermen came to realize there was little value in carting massive shark bodies to shore when all they needed were the highly valued fins. So they sliced off the fins, and threw the still living, rudderless sharks to die in the open ocean. So began the gruesome practice known as “shark finning.”

Shark populations have been unable to withstand the demand for their fins, and dozens of species are now threatened or endangered. From enhancing legislation to control the shark fin market to building sustainable fisheries to promoting synthetic shark fin soup – efforts to address the issue of shark depletion are seemingly endless. And yet despite these efforts, both the market for shark fins and global catch rates have continued unabated. If the demand for fins and the practice of shark finning continue at the current rate, human interference may forever change the nature of our oceans.

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The captain cut the motor. The waves had been increasing for an hour. 'It's too rough out here,' he said, anticipating the disappointment that washed over our faces. We had risen before the sun's rays peaked over the horizon, we'd pulled on our damp wetsuits and climbed with sleepy smiles into the boat. We set out with purpose, headed towards a manta ray cleaning station – a car wash of sorts where sergeant majors and butterflyfishes picked off parasites and cleaned mantas' wounds. Despite the captain's best efforts, however, we were still within sight of Mozambique's coastline.

But before we could react, he was shouting at us. A whale shark, the largest known fish in the sea, had passed just beneath the boat. My hands shook as adrenaline coursed through my veins. I pulled my flippers over my feet and fastened my snorkel mask. We dove backwards simultaneously off the boat, limiting our disturbance of the animal to one collective splash.

The average whale shark is about 30 feet long and weighs 20,000 pounds – it's a school bus of a fish. Despite its enormous size, whale sharks are filter-feeding, docile creatures and pose little danger to humans.

Once in the water, I flanked the group slightly, hoping to secure the ideal viewing position for my first live shark encounter. But when I peered through my snorkel mask, I saw nothing but microscopic fish. I popped my head up and tried to follow where the group was looking. Still nothing. How was it possible to overlook an animal that is

the size of a bus? My anxiety was mounting. Suddenly, a dark shadow emerged just beneath the surface of the water, no more than 10 feet in front of me. I held my breath and lowered my face. And there, in the middle of the Indian Ocean, I found myself staring into the open mouth of a feeding whale shark.

My underwater scream was conveniently muffled as I swam towards the rest of the group as fast as my flippers would allow, out of the path of the gentle giant. I wasn't at risk of being eaten by the filter-feeding shark. But if it had turned to avoid me and mistakenly rammed me with its enormous tail, it might have been my early end.

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When one hears the word "shark," it's unlikely a docile whale shark is the species that first comes to mind. It's more common to imagine members of the toothier variety, such as a great white or a hammerhead. But shark species range considerably. Nocturnal nurse sharks nestle along the sea floor, ambushing crustaceans. Lemon sharks are social butterflies and prefer grazing on fish near the warm surface of the water. Spiny dogfish are the runts of the shark litter, maxing out at just over three feet.

Sharks tend to invoke a sense of fear in humans – the indestructible predators of the sea. Yet they face their own dangerous predator. Sharks kill 12 humans each year, while humans kill 11,417 sharks every *hour*. A shark's fin is a gold mine in certain cultures: the pectoral fin of a whale

shark is worth more than my Subaru Outback.

Not long ago, a group of shark fishermen came to realize there was little value in carting massive shark bodies to shore when all they needed were the fins. So they sliced off the fins, and threw the still living, rudderless sharks to die in the open ocean. So began the gruesome practice known as “shark finning.” Due to its massive size, luminescent markings, and unique texture, a whale shark fin is the Rolls-Royce of the fin market.

Shark fishing and especially finning has resulted in the addition of dozens of species to the list of threatened and endangered species. Over the past ten years alone, numerous shark conservation groups have emerged around the world. Media campaigns, celebrity advocates, and new government regulations have attempted to curb the demand for shark fins. Yet despite these efforts, the fin market continues unabated.

It doesn't help that sharks continue to face a public relations nightmare that all began with a fictional Hollywood thriller.

Shifting our primordial fears

Ever since *Jaws* was released in 1975 – a film that depicts a giant, man-eating great white shark attacking a quiet, seaside town – it's easy to understand why people have tended to fear this toothy predator. But even Peter Benchley, the author of the novel and screenwriter for the movie, spent the latter part of his career

advocating for shark conservation efforts. Following the sensationalist portrayal of sharks in his film, he sought to confront the public's negative perception of sharks that he had perpetuated with his writing. He wanted people to better understand marine ecosystems and the important role sharks play. This became increasingly important in light of the threat of overfishing.

For Peter Pyle, a wildlife biologist and white shark expert, *Jaws* and the public's negative perception of sharks had a profound impact on his research. In 1981, just six years after the film's release, Pyle began working on the Farallon Islands. Located less than 30 miles off the coast of San Francisco, the Farallones are notoriously difficult to reach, owing to rough weather, rougher seas, and roughed up stomachs.

Pyle initially traveled to the Farallones to study the vast species of migratory seabirds that inhabit the islands. He soon realized, however, that the timing of his visits overlapped with one of the largest gatherings of great white sharks in the world. He watched explosions of blood splatter the ocean canvas as sharks fed on seals and sea lions inhabiting the island waters. Pyle understood there was a unique opportunity to learn about this critical predator. The perspective of sharks then, especially white sharks, remained one of fear, he said.

From the early 1980s, Pyle and his colleagues worked to show people that sharks are not monsters but instead are keystone predators that are critical to the marine world.

“People were still in that mindset that these were senseless killers, so we spent a lot of time trying to convince people that they weren’t after us.” A big part of their focus was on tagging and tracking the sharks to better understand their patterns, and then educating the public. Pyle and his team were curious about the predation behavior of the sharks, and kept records of where and when sharks attacked their prey, which included California Sea Lions, Northern Fur Seals, Elephant Seals, and pelicans. The team even rigged a surfboard with an underwater camera to record how sharks stalk and strike at these animals. In 1992, Pyle’s work helped to inspire a campaign to protect white sharks in California.

Today, attitudes towards sharks are finally beginning to shift, said New England Aquarium biologist John Mandelman. In the ten years Mandelman has been working for the Aquarium, he has witnessed an evolution in the public’s perception of sharks. “When I first got here, if you asked the average person ‘what’s the deal with sharks?’ you would hear about fear – they were scared of them,” he said. “People are generally in favor of shark conservation now.”

The truth is, sharks face a much greater threat than the bad rap introduced by an iconic film. The real danger comes in the form of a revered, ancient, Chinese delicacy....a bowl of soup.

Shark Fin Soup

Over the years, the demand for shark fins has been driven by a desire to consume soup fit for a king...or, more accurately, soup fit for an emperor. Shark fin soup, an ancient Chinese cultural tradition, is a dish served at formal banquets, weddings, and government functions. The soup is often used to represent wealth, status, and power, as well as to signify the importance of a given occasion.

The first reference to shark meat consumption in the literature dates as far back as the fourth century, and occurred in Asia as well as areas of Africa, Latin America, and the Pacific Islands. Evidence reporting consumption of shark fins as a specific delicacy dates back to the Sung Dynasty in 960-1279.

During the Ming Dynasty, shark fin soup was served within the palace to emperors as well as to candidates in Beijing who were taking the imperial government examinations – a process designed to test the education and merit of a candidate. Products from animals like sharks, considered to represent strength, were believed to transfer that strength and power to those who consumed them.

By the Qing Dynasty (1644-1911), the Chinese had listed shark fin as second among the “eight culinary treasures” from the sea and consumption of the soup began to spread outside of the palace to wealthy Chinese citizens. While the shark fins themselves are virtually tasteless (the soup’s taste is comprised of other ingredients), the fins provide a unique, gelatinous texture to the dish. It is a dish that is

difficult to prepare, which further adds to its allure.

Shark fins have fallen in and out of favor over the years. After World War II, the Communist government discouraged the consumption of shark fin soup, as officials felt it represented elitism. But the practice of serving shark fin soup at formal banquets experienced a revival in the mid 1980s. Since then, economic prosperity and the growing middle class in China has led to an increase in demand for the soup. It is expected that, in the absence of successful government regulations and campaigns designed to address the demand, the fin market will continue to grow.

In China, shark fin is known as 'yu chi' or 'fish wing.' A survey that was carried out between 2005 and 2006 found that 80 percent of respondents did not know the soup was actually made of shark fin, a fact that frightened conservationists hoping to raise awareness about the perils of shark finning.

While the use of shark fins in Chinese cooking serves as a symbol of wealth, power, and status, many believe the fins have medicinal benefits as well.ⁱ Cartilage from shark fins continues to be used today in pharmaceutical products that claim to treat illnesses ranging from heart disease to cholesterol to impotence, and even to cancer. Trials testing shark cartilage on treating cancerous tumors began in the 1980s. While the effect of cartilage showed some promise in treating cancer in animals, it had no effect in humans. Despite the lack of evidence,

the myth that 'sharks don't get cancer' (a fact that has been disproven by scientists) has helped to fuel the market for fins through the promotion of "anti cancer" drugs.

Shark finning, shark fishing, and by-catch

The demand for shark fin soup and fin-based medicinal products has led to a booming market for the fins. And this, in turn, encouraged a fishing practice that offers a faster, more economical way to collect fins. It is unknown when shark finning first began, or how extensive the practice is today, but it is clear it has contributed to the rapidly depleting global shark populations.

Shark finning is the process of cutting off a shark's fins and throwing the still-living animal back into the water. Without its fins, the shark cannot swim and therefore drowns, bleeds to death, is eaten by another predator, or dies from starvation. This practice is separate from shark fishing – which involves killing the shark and bringing its entire carcass back to shore. A third method of killing sharks is known as "by-catch," and occurs when fishermen are targeting other species, such as tuna, and mistakenly hook a shark on one of their long fishing lines. Often by the time the fishermen reach the hook, the shark has already died. Shark advocates often blur the lines between these three methods of shark removal, but it is important to understand the distinction.

While shark fishing and by-catch do contribute to global shark removal,

shark finning enables fishermen to kill massive numbers of sharks on a single trip. There are no good statistics on shark finning – no one knows who first started the practice of finning, and it is unclear how extensive the practice is today. Fishermen have no incentive to report its practice. But by all accounts, it's by far the leading method to get fins get into the market – other methods of removing sharks from the ecosystem pale in comparison.

The incentives are clear. Shark meat has little value, while the fins are one of the highest priced items on the seafood market. Shark meat needs to be refrigerated on the boat, which requires additional space, while the fins can be dried and stored. A fishing boat can hold 150 sharks, while a shark finning boat can hold around 10,000 fins.

In some cases, finning is the direct aim of a fishing vessel, and fishermen seek to bring back as many shark fins as they can carry. In other cases, finning can take place on ships fishing for tuna and other species that have limited space on the vessel and therefore cannot land the entire carcass.

The practice of finning was becoming such a problem that national and international agencies began coming up with strategies to ban the practice. For many countries around the world, the practice of shark finning is now illegal. But who can truly regulate what happens in the open ocean?

Are there more fish in the sea?

It was a Friday afternoon at the California Academy of Sciences, just a few hours before closing. John McCosker, Chair of Aquatic Biology, slowly led me from the research entrance to his office, pausing to greet each of his staff along the way. Before our meeting, the research receptionist described the tall, thin McCosker, who is nearing 70, as “just the nicest possible man.” He paused to offer me a cup of tea before settling into his chair.

McCosker grew up surfing and scuba diving in Southern California. He was the first trained marine biologist to swim with great white sharks, and is considered to be a world-renowned shark expert. McCosker spends his days educating the public on the importance of preserving the health of the oceans, and has a particular interest in preventing the worldwide depletion of the shark populations. McCosker's fear is if we don't do something to protect these animals, our oceans will be filled with nothing but jellyfish. “When I was a kid, I was always told, ‘Don't worry, there's always another fish in the sea,’” he said. “I don't know if they tell kids that anymore.”

Sharks are the apex predators of the marine ecosystem – the top dogs of the sea – and play an important ecological role. By keeping prey species populations in check, they balance their marine environments. Like humans, sharks have no predators of their own and exist at the top of their food chain. While the effects of apex predators on ecosystems have been studied on land,

such as in wolf populations, marine predators have not been extensively studied, in part because of the difficulties involved in researching the massive frontier that is the open ocean. Scientists don't know, for example, what the true population of sharks is. A method to measure the ocean's contents just doesn't exist.

If fishermen knew how many sharks were out there, and how long it takes for them to reproduce, they would be more cautious with their allowable catch limits, said McCosker. Instead, he believes that fisheries are trying to get away with fishing just a little bit more, enough to keep the fishery alive. But these numbers doesn't align with what the shark populations can withstand, he said. "I feel for these folks, but at the same time I feel for the health of the oceans more."

One of the primary reasons why the removal of sharks can be so devastating is related to their slow growth rate and reproductive capacity. Sharks take a long time to reach sexual maturity (whale sharks don't reach sexual maturity until around age 30), have a long gestation period (for spiny dogfish, this can be up to 24 months), and produce few pups (hammerhead sharks usually have between 12 to 15 pups in a litter). This varies considerably from other fish species that tend to be fast growing and reproduce at a young age. An adult female fish can produce thousands or even millions of eggs each reproductive cycle. Sharks are, in these respects, more similar to marine mammals such as whales than they are to fish.

For some, the environmental impact of removing sharks from the ocean through fishing, finning, or by-catch may seem intuitive. If you remove all the sharks, the populations of the mid-level carnivores, such as snappers, explode. The snappers then eat all the plant-eating fish – parrotfish, for example. And when the parrotfish are gone, algae and sea grass explode and the coral reefs deteriorate. This phenomenon is known as a trophic cascade.

The truth is, scientists don't know for certain what happens when you remove sharks from the ecosystem. The removal of a top-level marine predator is unprecedented. It would be like killing off all the lions in the Serengeti. Maybe the cheetahs or the leopards would assume their role, maybe not. Based on available evidence, it's possible to venture a guess as to what the outcome of shark removal will be. "There's a whole bunch of theory that would suggest how important they are, but in terms of actually documenting what happens to the ecosystem after you remove sharks, that's a little bit trickier," said Simon Thorrold, senior scientist at the Woods Hole Oceanographic Institute.

The studies that have been conducted are often controversial. In part, this is because these studies occur out in nature, rather than in controlled laboratories. In natural environments, other factors might interfere with the results, such as weather patterns, climate change, or variations in the research settings. For example, there may be differences in the environments where sharks are plentiful as compared to where they

have been overfished that can invalidate the findings. There's no way to control for these factors in a natural experiment. Some scientists rely on models to predict what happens in an ecosystem, but these too have their problems.

In 2010, Francesco Ferretti and his colleagues from Dalhousie University brought together all of the existing studies and models that looked at the ecological effects of shark removal. They found that even a little bit of fishing pressure is enough to cause major decreases in shark populations, especially for larger shark species. The models the authors reviewed also show that a trophic cascade is possible – the interaction that occurs when a predator influences its prey population and behavior, which then affects the survival of the next feeding level lower down.

Despite the data limitations, researchers have been asking themselves: does the lack of reliable data really matter? The focus seems to have shifted from what do we know to what do we *need* to know? How well do scientists and policy makers need to understand these ecosystems in order to better regulate or potentially stop shark fishing (and finning) entirely? McCosker argues that if you have limited evidence on what happens when you remove sharks, but know there is potential it could cause enormous harm to the oceans, then simply stop removing the sharks. The risk alone says that it's not worth it. But fishermen and shark fin distributors whose livelihoods depend on the market may not agree.

Steve Palumbi is the Director of Stanford's Hopkins Marine Station. He feels that it's a mistake to say that sharks are definitely required to maintain the health of the oceans. We can't say that with the little data we have available, he said. But we can say they play an important ecological role and here are some examples of that. "Can the ocean do without big sharks?" said Palumbi. "Why would we have to answer that question before we stopped killing them all?"

Some policy makers feel they don't have the time to wait for additional data and instead are working with what is available. Shark populations have declined significantly. What will it take to bring them back? It may be impossible to regulate the open ocean, but at the very least, they can regulate what's happening on land. Many believe that shark fin bans are the only option. If you can't beat the market, shut down the market.

Playing by the Rules

There are eight states in the U.S. that have banned the possession and sale of shark fins. California is the most recent. After a two-year phase-in period, lawmakers said that as of July 1, 2013, no one could legally possess shark fins in the state. The bill was discussed in several other states with major fisheries, including Massachusetts, Florida, and Texas, but ultimately the fin ban was not passed.

While the market for shark fins remains open in 42 of the 50 states, the practice of shark finning has been banned nationally. The U.S. enacted a

law to ban finning called the Shark Finning Prohibition Act, which was put into place in 2002. This act allowed fishing vessels to land shark fins as long as the weight of the fins was less than five percent of the total weight of sharks on board the vessel. The European Union adopted a similar law in 2003, called the Removal of Shark Fins regulation.

There were several loopholes in the U.S. law, however, and shark fishermen quickly exploited them. For example, multiple fins could be collected for each shark carcass that was kept, so finning practices could technically continue as long as the five percent ratio was upheld. In addition, the regulations only applied to fishing vessels. They said nothing about non-fishing vessels. So finners could continue to hunt for sharks and sell their catch, as long as they transferred all of the marketable fins to a non-working ship before bringing them to shore.

It wasn't until 2010 that the U.S. regulation was amended to more directly ban finning practices. The new law clearly states that all fins landed in the U.S. must be attached to the sharks. Only after landing can the fins be removed and marketed. To enforce these regulations at a federal level, the National Oceanic and Atmospheric Association (NOAA) Fisheries Office of Law Enforcement (OLE) is responsible for investigating any report of shark finning practices. In 2011, there were three violations of the national finning ban, which were mentioned in a report to Congress in 2012. One case report detailed a

violation by fishermen on a commercial shrimp boat:

Officers with the Louisiana Department of Wildlife and Fisheries (LDWF), while conducting a Federal fisheries patrol pursuant to the NOAA OLE Joint Enforcement Agreement (JEA) Program, boarded a commercial shrimp fishing vessel actively fishing in Federal waters. During the course of the boarding, a crewman was found to be in possession of shark fins with no corresponding shark carcasses. Further investigation located 146 shark fins and revealed that the vessel did not possess the required HMS permit. The shark fins were seized as evidence and the case is currently under review by the NOAA Office of the General Counsel Enforcement Section.

Despite the fact that officials are now enforcing shark finning regulations around the world, it is unclear what impact these regulations have had on the shark fin market globally.

To enforce the state-level bans on the shark fin market, individual states employ their own regulation strategies. In California, for example, the Department of Fish and Wildlife conducts fish business inspections, also known as FBIs. These inspections are part of normal business practice and are intended to track the sale of different fish, including shark fins. "The way we make sure these fishery stocks don't collapse is we require accounting records for every step of

the process, from when the fish are caught to when they're sold to distributors back on the dock to when they're sold to a restaurant to when they're ultimately sold to a consumer," said Lieutenant Pat Foy of the California Department of Fish and Wildlife.

During the FBI, officials rely on accounting records to aid in their investigation. The records indicate what type of fish restaurant owners have in stock, whether it aligns with the reported data, and if that matches with the records from the business who distributed the fish to them in the first place." For the first six months the shark fin ban was in place, there were approximately four citations issued to those caught in possession of illegal fins in California – two restaurants, a wholesaler, and an herbal shop.

The rise and fall of a shark fin tycoon

It was mid-January in San Francisco and the weather was unseasonably pleasant – 74 degrees and not a cloud in the sky. Unfortunately, it was the beginning of the worst drought California had experienced in years. In a matter of days, the governor would declare a state of emergency.

Michael Kwong was leaning against his car finishing up a cigarette outside of Philz – a hipster hotspot and his favorite coffee shop in the Mission District of San Francisco. It was a Saturday at 9:00 a.m. and the line at Philz was nearly out the door.

I had called Kwong about a week earlier to ask if he'd be willing to meet with me during my trip to the Bay Area. "How did you get this number?" he asked. Truthfully, through a fairly intensive Google search, I told him. I had tracked down his business listing after seeing his name in several articles covering the recent ban of the shark fin market in California. He agreed to meet a few days after I arrived in the city.

The tall, 42-year-old Kwong turned to me. "So what's your angle here?" he asked. More than anything, I wanted to get a perspective from someone who is in the industry. How was he affected by the ban? What were his opinions on it? I needed the other side of the story. I explained that I was hoping to disentangle the effects of finning from fishing and by-catch, and to better understand the true burden of shark removal. He seemed pleased with my answer and said it was good that I understood there was in fact a difference between finning and fishing. We ordered our coffee and sat down at one of the community tables, struggling to hear one another over the other customers.

As the owner and operator of a shark fin processing company – Hop Woo, Inc. (also referred to as Kwong Yip, Inc.) – Kwong's industry had been hit hard by the fin ban. He explained that his business was currently "on sabbatical until further notice." Kwong's grandfather was the first to start processing shark fins back in 1906, initially as a side business. But as the demand for shark fins grew so did the business, until it became a full-time enterprise. Kwong's father took

over the company from his grandfather. Then in the 1980s, Kwong began his own training in the family trade. Because his father's English wasn't very good, Kwong played a key role in the business from an early age.

Back then, he said, "a lot of American fishermen had no clue what to do with [shark fins]. As time went on, and they became more of a desired commodity, fishermen started to learn and we started finding more fisheries that were apt to take processed shark fins."

Kwong explained that he was frustrated with the recent shark fin ban and felt that conservationists and shark advocacy groups were misrepresenting his industry. "The stories and the way the environmentalists are painting the picture of this industry - it's nasty," he said. "It's just wrong. They have their blinders on, saying look at the numbers."

The numbers he was referring to are the estimated numbers of sharks killed each year, which is now reported to be 100 million. This figure has been controversial, not only because it represents a wide range of estimates - from 63 million to 273 million sharks - but because it relies on traditional data measurements to estimate the numbers of animals being caught, such as fishermen records or data from officials observing the fishermen. The reports can be unreliable, as not all fishermen accurately document their catch - in some countries, reporting is voluntary. In other cases, fishermen downplay their catch so as to avoid

interference from authorities. Despite the controversy around the figures, however, environmentalists agree that shark fishing is depleting shark populations on a global scale.

After several minutes of straining to hear one another over the drone in the café, Kwong and I decided to move locations. We walked over to the garden terrace near the apartment I was renting for the week. As soon as we sat down, away from the chaos of the café, Kwong seemed to be more relaxed. As we talked, he asked me what I knew about the fishing industry. I told him about my friend who is a tuna fisherman in Gloucester and who has been affected by the changing regulations in Massachusetts - his catch limits have decreased to the point where he can no longer sustain his business. Ah, then you understand, he said. With that, he leaned back in his chair and unfolded.

Kwong explained that his frustration with the conservationists and policy makers did not relate to shark finning - a practice he didn't agree with. "Even to this day, does finning go on? I don't doubt it," he said. But because of the federal regulations in place, "it doesn't land in the U.S." Instead, his anger was over the decision to ban the entire shark fin market in California. Such a ban meant that the possession or trade of shark fins, even those caught legally and in regulated waters, was forbidden.

So for example, if a fisherman caught several sharks on one of his trips and landed the sharks with the fins still attached, as per U.S. regulation, he could sell the meat but he would need

to throw away the fins. "In the state of California, we can't do anything with [the fins]," he said. "It's a waste. This new ban forces us to waste." Without a new policy to overturn the state ruling, Kwong's business would undoubtedly go under. "In the state of California, I'm done," he said.

Kwong's primary business had been wholesaling to restaurants. Around 98 to 99 percent of the clientele were Asian – it was a very a niche community. The soup has little relevance outside of the Asian community, said Kwong. "If you put a bowl of shark's fin in front of some guy in Wisconsin, he'd be like what the hell? It's a different culture, different people." Given the size of the Asian American community in San Francisco, there was considerable local demand for his product.

The California shark fin ban was introduced during a state assembly meeting back in 2011. Following speeches from representatives both for and against the ban, the state assemblymen allowed several minutes for an open microphone. Kwong was frustrated that the speakers advocating for the market to remain open were coming at the argument from the point of view that the ban was a form of discrimination: they said it was unfair to Asian American populations. But Kwong didn't agree. He felt the ban was unfair for industry – it was shutting down his business. Not only that, he was frustrated with the quality of the speakers' English, with their public speaking abilities, and that "for lack of a better word, they were putting people to sleep." So he walked up to the stage. All you're

going to do is push our businesses outside of the state, he recalled saying. "I'm not a representative, but no other industry person was voicing."

The ban may be in place now, but there continues to be an underground market for shark fins, said Kwong. "In the state of California, can you get a bowl of fins? Yes. It's about 50 percent more expensive than two years ago. Unfortunately, it's mislabeled a lot of times, and they might even ask you to sit over there in a corner and keep it quiet."

One possibility that Kwong had considered was moving to another state where the ban was not in effect, such as Nevada. But he didn't want to do this, he said. California was his home; it had always been his home. He was at a loss as to why the state felt the need to call for this ban. His business had been in good legal standing. He shouldn't be penalized for a practice he condemned. "We've had a wonderful relationship with the Food and Drug Administration, NOAA, National Marine Fisheries, California Fish and Game, Department of Health," he said. "We've had no problems; we've had no citations."

"That's the only way, and the right way, to do business. That's why we're here so long. I mean, you try to do any kind of shifty, nasty stuff – it's just dumb. You won't last very long."

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About ten days after my meeting with Kwong, the California Department of Fish and Wildlife identified a restaurant outside of San Francisco –

Hong Kong East Ocean Seafood in Emeryville – that was selling shark fin soup. Following an investigation, the wildlife officers caught the restaurant in possession of illegal shark fins and issued a citation. As with previous investigations, they sought to determine where the shark fins were coming from.

The wildlife investigators arrived at a warehouse in San Francisco, following up on a lead from the restaurant. It didn't take long for them to find the fins – in part because of the sheer quantity in the owner's possession. The officers collected 2,138 pounds of shark fins boxed up inside two trucks parked behind the warehouse – a quantity that likely represented thousands of sharks.

Violation of the California state fin law is considered to be a misdemeanor offense, punishable by up to six months in jail and a fine of \$1,000. Of the estimated four citations that have been issued in the state, in all cases it was for small amounts of shark fin – less than 10 pounds. To Foy's knowledge, no jail time has been issued to date.

It was by far the biggest shark fin bust since the ban went into effect. And the man at the heart of the enterprise? Michael Kwong.

"It's the judge's job to match the punishment with the crime," said Foy. "I would expect that a person who was convicted of possession of less than 10 pounds of shark fin for sale would have less of a sentence than someone who is in possession of 2,138 pounds of shark fin."

It was not possible to tell whether these fins came from sharks that were fished for legally or if they had been finned. One potential way to find out is to look at the species of shark fins. "There was considerable variation in the species," said Foy. He recalled there were black fin and whitetip shark fins mentioned – two species currently on the endangered list. There were also some very large fins that had not yet been identified.

Since the citation, Kwong has refused to speak to reporters. I talked to him briefly at the end of March, but he said he was unwilling to give a statement before his hearing.

The regulations in place are meant to limit the supply of fins available in the market. Clearly there are loopholes, which Kwong tried (and failed) to exploit, but the hope is that over time, with pressure on both the supply and demand side of the shark fin market, the market will dry up. For some, the question is whether such a drastic step is needed, given the fact that shark fin soup is so engrained in Chinese culture. What if there were a way to simply reduce the size of the market and drive up the cost of the fins? Such a market, in theory, would contain only species of sharks that are not endangered, whose populations are flourishing. Is it possible? And could it be regulated?

Sustainable shark fishery

Two large orange buoys floated on the surface of the water off the coast of

Chatham, Massachusetts, as the shark divers, which included researcher Greg Skomal, fastened the locks on the aluminum cage underneath the surface. In front of the cage floated an enormous whale carcass – placed there by the researchers to lure in the sharks. Sure enough, after a few minutes, an 18-foot white shark swam out of the depths toward them, lunging at the carcass. The second diver – a videographer – focused on the shot as the shark tore off a piece of whale meat.

As suddenly as it appeared, the white shark turned from the whale and swam toward one of the buoys that were holding the cage to the surface of the water. For a moment, it got stuck between the cage and the buoys, unable to swim away. If the shark detached the buoys, the cage would fall to the ocean floor, likely carrying the divers down with it. In its struggle to free itself, the shark thrashed and inadvertently unlocked the cage – exposing Skomal and the videographer. Skomal quickly worked to shut the lock while the videographer continued to film. Eventually the shark freed itself and swam away, leaving Skomal and the videographer shaken but in possession of some incredible footage.

Although it may have looked like a stunt to satisfy the hungry fans of Discovery's shark week, in fact, Skomal was in Chatham to research the white sharks and learn about their migratory behavior. He wanted to understand what brought them back to the Cape in such large numbers.ⁱⁱ The footage that aired on the Discovery Channel during 2011's

Shark Week was titled "Jaws Comes Home" and included a dramatic rendition of the event that was likely to satisfy many fear-craving shark fanatics.

Skomal is a biologist who has been working with the Massachusetts' Division of Marine Fisheries researching shark species for more than 20 years. He has spent the better part of his life tagging and tracking sharks to understand their movements, ecology, and population sizes. He uses the data to manage and conserve shark populations.

A market ban on shark fins doesn't make sense to Skomal, who finds himself arguing as much with conservationists as he does with fishermen. The demand for shark fins is unlikely to disappear anytime soon, he said. "But if you can feed that beast with sustainable shark fisheries, on a global basis, the supply may go down but the price will go up – that's a better route to take than trying to shut down a market that's driven by a cultural theme that has been around for hundreds if not thousands of years," he said.

A sustainable shark fishery refers to a fishery targeting sharks whose populations are thriving and can be fished for without affecting their numbers. The fishing limits would depend on how many sharks can be replaced through reproduction. Threatened or vulnerable shark species would have very low catch limits. Endangered sharks would be off limits.

Another important focus of sustainable fisheries would be limiting

unnecessary by-catch for fishermen targeting other fish through use of different baits, hooks, or in some cases banning fishing when sharks are known to be present in large numbers. A sustainable fishery would also promote the full use of the shark, not simply the fins.

Simon Thorrold of the Woods Hole Oceanographic Institute agrees with the concept of sustainable fisheries. Thorrold has worked with Skomal on several shark tagging and tracking expeditions, including one that was led by a non-profit group called Oearch in July 2013 off the coast of Cape Cod, Massachusetts. "At this point, there's no reason why sharks should be treated any differently than any other species of marine fish," he said.

Building this type of shark fishery is not the only method to address the problem of finning, however. Skomal and Thorrold agree that it's also important to address the demand side of the equation. For Thorrold, it's not a question of using one method or the other. We still have to get people off of the idea of consuming shark fin soup, he said, because there aren't enough sharks in the sea to feed that current demand. Applying both methods together – curbing demand and running sustainable fisheries – is a potential solution to the threat of shark removal.

Not everyone agrees with the concept of sustainable fisheries, however. One issue is that the fin market is currently too large and it will be impossible to shrink it to a sustainable level. Another issue is that the plentiful

species they are targeting, such as spiny dogfish, are not highly coveted as compared to the endangered species, some advocates say. "I think the industry sees a potential market where there isn't one," said David McGuire of Sea Stewards, a shark advocacy group.

Some argue that there's no reason to keep the shark fishing industry open at all, given the important role sharks play in ocean ecosystems. The services that sharks provide are more valuable to the fishermen than the shark fin itself, said McCosker. "There's no justification for it. Let them go and fish for something else."

Another risk to the sustainable fishery concept is the potential risk of exploitation. "Anytime you have these legal fisheries, it creates a vehicle for this massive illegal trade," said Chris Fischer, director of Oearch. For example, the sale of Atlantic billfish has been illegal for years, said Fischer. But the sale of Pacific billfish was legal. So fishermen began selling "Pacific billfish" into the U.S., but in fact they were simply killing Atlantic billfish and relabeling them as Pacific billfish. A small legal channel was being leveraged for a big illegal trade. Because it's difficult to differentiate between the fins, it's a similar situation here. "The bad guys will leverage the legal system at a scale that's 5,000 times bigger than the legal system," said Fischer.

Genetic Testing

As Fischer said, it can be impossible to tell the fins apart. A shark fin is a fin is

a fin. So in a sustainable fishery, how would you regulate? It's often difficult, if not impossible, to tell what species it originates from merely by looking at it. How could officials know that the fin on the market came from a regulated species of shark that is still plentiful, as opposed to an endangered species of shark, or one that was finned? Would a sustainable shark fishery simply open the door to massive exploitation, as Fischer predicted? Some feel that the sharks themselves could help to address these issues: the answer, perhaps, lies in their DNA.

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Stanford's Hopkins Marine Station, located in Pacific Grove, California, is situated on Monterey Bay, directly next to the world-famous Aquarium. After a terrifying drive from San Francisco along the windy, cliff-hugging Route 17, I arrived in Pacific Grove to meet with the Director of the Hopkins Marine Station, Steve Palumbi. Sporting a gray ponytail, the 57-year-old Palumbi was speaking with a young researcher as I approached. "I'll be ready in just a few minutes," he said. "Feel free to wander about. The only thing is, there's a whole colony of harbor seals in that region and they're pretty skittish, so try to stay away." Harbor seals in the backyard. Naturally.

I walked outside. Sun glistened off the water while cormorants dried their wings on rocks jutting out into the bay. A pair of divers clad in wetsuits emerged unexpectedly from the water. Several researchers sipped coffee on picnic tables overlooking the

water, perched in front of their laptops. World-famous shark experts played basketball in the driveway.

Palumbi is perhaps best known for his work using molecular genetic techniques to identify species of whales, dolphins, and even sharks whose products are available in commercial markets. He has had his share of controversy around genetic testing of marine animals. Back in the early 1990s, Palumbi and his colleague decided to investigate reports about the whaling industry in Japan. There were rumors that the existence of legal whale hunting for research purposes was serving as a cover for illegal hunting of endangered species.

They traveled to Japan to investigate. Because they weren't able to transport the meat they purchased out of the country, they set up a lab within their hotel room and conducted DNA analyses on what they collected. They determined that not only was the whale meat from endangered species of whales – such as Humpback and Fin whales – but that there were also dolphins and porpoises that were being marketed as Minke whale meat. It became both a conservation issue as well as a public health one, as the dolphin and porpoise meat contained high levels of mercury and therefore were particularly dangerous for pregnant women.

In the early 2000s, Palumbi turned his attention, if somewhat unofficially, to genetic testing of shark fins. This process has a potential role in shark fishing and finning regulation. In a shark fishery regulated through the

use of DNA testing, for example, one could test a sample of the fins within each shipment to determine whether they came from the regulated species – one that’s abundant – as opposed to an endangered species. The procedures would be similar to those used in the U.S. to regulate meat safety. If a couple of pieces of meat are above a particular bacterial count, the whole shipment must be discarded. Similarly, if even one shark fin is from an endangered species, as indicated by the DNA test, the entire shipment of shark fins would be discarded and the fishermen would face the ensuing punishment.

As with any new regulatory system, there would undoubtedly be flaws. “The problem with [testing a sample] is how do you unkill a shark?” said McCosker. While it’s true the sharks that didn’t meet the guidelines would have already been sacrificed, the idea is that the fines or penalties imposed would be severe enough to prevent the fishermen from repeating the same mistake. In other words, it would be a scare tactic.

DNA testing of shark fins developed into a new method of genetic testing called genetic stock identification (GSI). GSI allows researchers to determine not only the species of shark but also the geographic origin. In 2009, researchers from Stony Brook University collected samples from 62 dried Hammerhead shark fins from the Hong Kong market. After examining each fin’s mitochondrial DNA sequence, they determined that 57 of the 62 fins could be traced to the Atlantic or Indo-Pacific regions. This information also has the potential to

help regulate the industry – if there are regions where shark species are declining, perhaps those regions would be off limits for shark fishing. The ability to name the species as well as the location where it came from would give more power to the regulators.

So why did you decide to start testing shark fins? I asked Palumbi. He leaned back in his chair. Back in 2002, he was teaching a molecular ecology class and searching for a class project – something to demonstrate the power of genetic testing. He considered what might be interesting – what would fall into the category of “I can’t tell what it is but the DNA might,” he said. He decided on shark fins. So each year, he gave the students \$20 and sent them to Chinatown in San Francisco to buy the highest quality fins they could find. Over time, \$20 afforded smaller and smaller fins. It was clear the market was shifting.

In 2011, the hearings in California to ban the shark fin market were occurring in Sacramento. Palumbi’s ecology class was sitting on data that could be relevant to the hearings, but the sample sizes were so small they couldn’t make a substantial case. The evidence they had collected suggested that the shark fin market in California was voracious, said Palumbi. In this state alone, it was sucking in sharks from all over the world. “It’s the black hole of shark fins,” he said. “That’s what we would have concluded, but we couldn’t prove it.” Not only that, there wasn’t much interest on the part of lawmakers as to which shark species were being targeted. “It didn’t occur to anyone to ask that question,”

Palumbi said. Instead, the discussion revolved around human economic concerns – the cultural relevance, what it will do to the vendors, and whether there are alternatives.

Although Palumbi believes that a sustainable shark fishery is “intellectually conceivable,” he too is concerned about the potential exploitation of such a market. As he learned with the whale meat work, if there is even a small window for legal product, particularly if that product is highly valuable, there is great risk of illegal products entering the market.

The price tag for a DNA test regulation system would be manageable, assuming the testing would occur on a sample of fins rather than every fin that entered the market. “If you have savings of economies of scale – you could go from fin to sequence for \$5,” he said. That means a fin has to be worth substantially more than \$5 to be worth it.

Unfortunately, these genetic testing techniques still do not tell scientists what they want to know more than anything – the true population of the sharks. As of now, there are only estimates on population sizes based on what can be seen and monitored in the water. It’s nearly impossible to know what effect you’re having on the population through shark removal when you don’t know what the actual population is.

What we do know is that sharks are animals with some of the lowest reproductive rates in the ocean, as well as some of the longest maturation times. Because of that, they’re going to

have a really low sustainable hunting rate, said Palumbi. For people who are used to working with sustainable fish, it’s just not the same. Sharks produce just a few pups in a litter, compared to fish that can lay millions of eggs. Even in a regulated market, how could the populations ever catch up?

Synthetic shark fin soup

For conservationists concerned about how to quell the overwhelming demand for shark fin soup, one viable option is to create a synthetic shark fin that maintains the same properties as actual shark fin and can create a gelatinous texture within the soup. A few chefs are already pursuing this idea.

In Hong Kong, mock shark fin gained popularity in the 1950s and 1960s for Chinese who were unable to afford the real thing. It is now being used by chefs who are seeking ways to reproduce the delicacy without feeding into the shark fin market.

Corey Lee is a James Beard Award-winning chef and owner of Benu – a high-end restaurant located in downtown San Francisco. Lee has developed a recipe for shark fin soup that uses synthetic shark fin.ⁱⁱⁱ “Shark fin is an obvious ingredient to think about because it has such a strong presence in Chinese cooking and is very symbolic – more in terms of what it represents than what it offers on the palette,” said Lee.

To develop the product, Lee worked with a company called CP Kelco – one of the largest manufacturer’s of

hydrocolloids, a substance derived from ingredients such as seaweed that forms a gel when it's in the presence of water. Hydrocolloids are also used in food products such as jelly or Jell-O to create a gelatinous texture. Lee's initial tests using hydrocolloids involved side-to-side comparisons to real shark's fin using both sight and taste until he created a texture for the shark's fin substitute he was satisfied with.

Lee decided to use faux shark's fin back in 2008 – years before the state of California elected to ban the shark fin market. He said it was never intended to be a political statement, but instead reflected his personal perspective on the issue. "The reason people want to serve shark fin is not for the taste, although the texture is really unique," he said. "It's because it's rare and expensive – and it's for those reasons that it's served at banquets and for special occasions."

When Lee first began serving synthetic shark fin soup, he received a number of threatening emails from people who assumed the soup used real shark's fin. After he and his staff made it clear the shark's fin was actually of the synthetic variety, the restaurant was contacted by various marine conservation groups who were interested in promoting its use in some way. Lee wasn't interested in that either. He simply wanted to serve a dish with unique meaning.

For some, despite the historical relevance, the allure of shark fin soup remains elusive, particularly when it comes to the taste itself. "Personally I would say shark fin soup is not

delectable," said McCosker. "It's close to terrible. It's sort of like washed sock water."

But for many, it's less about the taste than what it signifies. It's about the luxury of the fish, the historical significance, and for those who believe in it, the nutritional value of it. "If you can somehow deliver that feeling in a different way without real shark fin, I don't think there's a need for it," said Lee.

Soup to Nuts: What's the Answer?

From enhancing legislation to sustainable fisheries to synthetic shark fin soup – efforts to address the issue of shark depletion are seemingly endless. And yet despite these efforts, both the market for shark fins and global catch rates have continued unabated.

Some conservationists and advocacy groups blame the lack of progress on global collaboration. "Northern California, Australia, New Zealand – you have a couple of kingpins reigning over their kingdoms and they don't want anyone to come in because they might not be the king or queen anymore," said Chris Fischer of Ocearch. "They're not really into collaboration, they're not really into ocean or shark first. They're into being the man, or being the woman. So we have to disrupt this...the ocean needs our help now."

Regardless of the various controversies around shark conservation, today scientists are left with unanswered questions about the

cost of shark removal to the world's oceans. Fishermen whose livelihoods depend on the shark fin industry have had to contend with rapidly changing laws and regulations around their catch quotas. And a cultural delicacy that was once revered is now considered to be distasteful.

The laws alone aren't cutting it. Michael Kwong didn't get away with hoarding shark fins, but there are undoubtedly others who are managing to slip through the cracks in the system - exploiting the loopholes or turning to illegal channels. In recent years, reporters and conservationists working to expose the industry were shot at by pirate shark finners in South America. In the meantime, shark populations are collapsing - some populations have declined by an estimated 90 percent over the last 30

years. If a sustainable shark fishery will lead to exploitation, genetic testing is limited to only a sample of fins, and synthetic shark fin soup hasn't gained favor, then what do we do?

If the demand for fins and the practice of shark finning continue at the current rate, human interference will forever change the nature of our oceans. In precisely what way, we can't be sure. Conservationists and shark advocates are now turning to the next generation to gain momentum in turning the tide. By educating today's youth on the impact of shark fin consumption, they hope to stem the future demand for shark fins and relieve the pressure on one of the ocean's key predators. Dishonoring shark fin soup may be our only answer.

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