

From the Jaws of Extinction

The Role of the Guy Harvey Research Institute In the Global Fight to Conserve the World's Shark Populations

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The summer of 1975 proved to be the beginning of a critical time for sharks, great whites in particular. In June of that year, Hollywood released a horror movie that eventually became an international phenomenon, a movie so enormously popular and commercially successful that it forever changed the landscape of summertime box-office fare. Equally powerful was the response of the audience to the film's central character, a reaction that was so strong - so visceral - that it has taken the general public almost thirty years to start reconciling the true nature of the character with its movie persona.

The movie, of course, was *JAWS*, the cinematic version of Peter Benchley's best-selling book about a fictional great white shark that terrorized a fictional small beach town during the height of a fictional summer tourist season. Unfortunately for sharks, the general public couldn't separate fiction from fact. The movie set off an unprecedented tidal wave of hysteria and paranoia and as a result the public's perception of sharks plummeted as fast and as deep as the *Titanic*.

Fortunately, the public image of sharks as a whole has improved dramatically over the past decade or so. Scientific, conservation and educational organizations have worked diligently to give sharks a public image makeover that recasts the shark not as foe, but as an integral player in the health and sustainability of the world's marine ecosystems. Even Benchley, whose book and movie screenplay helped perpetuate and spread the myth of sharks as mindless, man-eating killing machines, has spent the past several years attempting to erase the negative stereotypes attributed to sharks by voicing his support and appreciation of them as ecologically critical ocean predators. In addition to speaking out publicly in favor of greater protection for sharks, Benchley went as far as writing a new book about sharks in 2002. The book, titled *Shark Trouble*, was dedicated to educating the public about the true nature of these great animals as well as what humans should expect when we venture into the world's oceans. However, even with all the recent progress, sharks are still involved in an uphill battle for survival. "Although we have a much better understanding and appreciation of sharks today than we did thirty years ago, or even just ten years ago, we are still killing them off at an alarming rate," said Dr. Guy Harvey, the world-renowned marine life artist and scientist, who is also the namesake and main benefactor of the Guy Harvey Research Institute (GHRI), a scientific research organization based in Ft. Lauderdale, Florida, at the Oceanographic Center of Nova Southeastern University.



Above: Fins drying in the sun. Once dried They will be shipped off to the Asian food market

The International Fin Trade and Its Impact on Global Shark Populations

The irony of the shark myth, according to Dr. Harvey, is that some species of sharks are being hunted to the point of extinction by humans, not the other way around. "Many species are at critically low levels and if we do not act immediately on their behalf, then entire marine ecosystems could collapse," Harvey explains. Although some shark species are now receiving protection - recent national legislation and international treaties have resulted in unprecedented protection for the many shark species that are considered to be either vastly depleted or especially sensitive to exploitation - conservationists estimate that tens of millions of sharks are harvested worldwide *every year*.



This unimaginable slaughter of global shark populations stems largely from the seemingly insatiable demand for shark fins, which are coveted in many cultures for their supposed healthful properties. Some Asian cultures in particular have a strong belief that consumption of shark fins promotes better health, including



Above: Officials confiscate illegally sold shark fins.

improved digestion, enhanced sexual function and increased energy. Although they have not been proven scientifically, these claims - which are steeped in ancient cultural beliefs and traditions - continue to fuel the trade of shark fins on a global scale.

Although the use of shark fins and other products as a medicinal and dietary supplement has been in practice for centuries, the global demand for shark fin reached a frenzied state in the 1980s when shark fin soup soared in popularity and affordability in Pacific Rim locations such as San Francisco, Hong Kong and Singapore. Once a dish reserved largely for the rich and elite, shark fin soup has since become a must-have delicacy at trendy Asian restaurants as well as a common ceremonial dish at weddings and other formal events in some Asian cultures. In fact, the demand for shark fin remains so strong that the trade of fins in the Chinese dried seafood market grew at a rate of 6% per year from 1991 to 2000.

Harvey agrees that the claims attributed to shark products are uncertain. "There are no firm scientific conclusions regarding the nutritional or healthful benefits of

consuming shark products," said Harvey. He adds, "Actually, in some instances the fins may be harmful due to the high levels of mercury found in many shark species around the globe. Regardless, it's the enormous number of sharks killed primarily for their fins that is of huge ecological concern."

Further compounding the effects of the fin trade on shark populations is the sharks notoriously slow reproductive cycle. Many species valued in the fin trade breed only once every two years and usually give birth to only a few pups each breeding cycle. "Shark populations are very likely experiencing a net loss each year as a result of shark harvesting outpacing shark reproduction," said Harvey. "Sharks simply cannot reproduce fast enough to meet the demands of the global fin trade."

Scientists and conservationists agree that shark populations cannot sustain this level of exploitation indefinitely. "We are already seeing huge declines in certain shark populations in many regions around the world," said Harvey. "Recent studies of hammerhead populations in the northwest Atlantic, for example, have shown a catch rate decline estimated as high as 89% since the mid-1980s and the great white populations in the same region of the Atlantic may have declined by as much as 79%." Harvey adds that several species are already in such decline that it may be difficult for them to recover, with the end result being the potential ecological extinction of some species of sharks from the world's oceans. "Although there are many factors at play in the decline of shark population around the globe, much of the decline can be attributed to the overharvesting of these species in an effort to accommodate the global demand for shark products."

Existing Protective Measures - Are They Working?

To save these endangered species, several international governments have enacted local and international legislation and agreements, such as limiting or outright banning the catch and trade of certain shark species. For example, South Africa, Namibia, Malta, the U.S. and Australia - whose are important habitats of the threatened white shark - have passed national legislation prohibiting the capture and trade of this species.

Governments are also establishing protective zones, known as marine reserves, which provide a safe harbor for sharks and other marine life by prohibiting or limiting fishing of any kind within a defined area. One of the more well-known marine reserves, Glovers Reef Marine Reserve in Belize, contains an interior no-take "conservation zone", which is surrounded by a larger "general use zone" that allows for fishing of legal-to-harvest species, although the use of fish-traps, longlines and gillnets are prohibited.

Additionally, conservation groups, committees and multi-national organizations such as CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and the IUCN (International Union for the Conservation of Nature) Red List of Threatened Species, have placed several shark species on international endangered or threatened lists in an effort to draw attention to critically low population numbers in certain regions around the globe.

These initiatives, although established with good conservation intentions and affording some level of protection to specific shark species, appear inadequate to stem the damage being done to the world's shark populations by the

global shark trade.

One of the primary shortcomings of the current initiatives is that they are hampered by a lack of reliable information. While it is widely accepted that the fin trade is seriously impacting global shark populations, more specific information is needed to quantify the effects. In order to protect sharks from being overexploited, it is necessary to know, among other things, which species are being fished and traded, to what extent they are being fished and traded and from which regions the sharks are being taken. To date, this information has been largely insufficient.

The Role of the GHRI in the Fight to Save Declining Shark Populations



Above: Mahmood Shivji doing some field studies on a juvenile lemon shark.

Current research being conducted by scientists at the GHRI working with the Pew Institute of Ocean Science (PIGS) is providing the critical missing data by developing DNA tests for multiple shark species that can be used to analyze shark products found in markets as well as in suspect catches at sea and at dockside. The DNA tests allow scientists, conservationists and, more importantly, law enforcement officials to better monitor populations and enforce protective measures by providing the specific data needed to assess what sharks are most at risk. "The forensic tests developed by the scientists at the Guy Harvey Research Institute are having a huge impact on the monitoring and measurement of shark populations," said Harvey. "One of the applications of the DNA test is that it allows us to identify specific species of sharks that are found in the international fin trade from just body parts, which then enables us to map where the sharks are being harvested. We can determine patterns that are developing within the fin trade, such as if a particular species within a particular region is being overharvested, or if a particular species that is protected within a particular region

is being illegally fished." Harvey adds, "This DNA test is so unique and delivers data so vital to measuring the effects of the fin trade that it may very well be one of the most important new tools in the urgent effort to conserve the world's declining shark populations."

Identifying species-specific shark products present in the global fin trade is critical to the survival of the overharvested species. Before the DNA tests were developed, the identification of specific species was difficult due to the manner in which the fins are harvested and sold at the markets. Since the real commercial value of a shark is its fin and not the meat, the majority of sharks are believed to be harvested via "finning", which is the process of catching a shark, cutting off its fins and discarding the carcass - sometimes while the shark is still alive. The fishermen then deliver the detached fins to the markets for wholesale or retail.

The practice of finning sharks, in addition to being wasteful since most of the animal is being discarded, circumvents the enforcement of regulations banning the trade of protected shark species since it is often very difficult to distinguish the fins - or other body parts - of one species from another just by visual inspection. The trade of fins rather than whole sharks has facilitated the illegal harvesting of many banned or threatened species, including white, hammerhead, dusky and night sharks, leading to further decline in the already dangerously low populations of these sharks in some regions.

In order to assist law enforcement in the management of the fin trade and conservation of protected shark species, the scientists at GHRI developed a DNA test that can rapidly distinguish different species of sharks. The researchers first identified short segments of DNA that are specific to a particular species of shark, such as a great white or shortfin mako. Then, they created a set of primers, or small strands of synthetic DNA, diagnostic for each species - that is each primer for a particular species matched the actual DNA from only that species. Thus, when a sample from an unknown shark is mixed with a set of primers, the DNA from the sample will bond to a species-specific primer, providing a type of DNA fingerprint that identifies the type of shark from which the sample (for example, a fin) was taken.

Helping Conservation of Hammerhead Sharks

The GHRI recently developed a version of the DNA test to specifically identify hammerheads so that scientists could attempt to measure the extent that these shark species are present within the worldwide fin trade. Despite the presence of management measures in some regions, the three known species of large-bodied hammerheads appear to be in serious decline. For instance, according to recent studies by scientists at Dalhousie University in Canada,

catch rate declines for hammerheads in the northwest Atlantic were approaching 90% from the levels caught in 1986. This finding is cause for concern since some management practices were in place in that region over the years of decline. Researchers fear that if declines are occurring in areas despite some level of management, it is likely that equal or steeper declines will be found in regions with little to no management or protective measures.

Like many large sharks, it is suspected that much of the decline in catch rates of hammerheads is the result of overfishing to provision the international fin trade. However, before the DNA tests, assessing the extent of the hammerheads contribution to the trade proved difficult due to the limitations inherent in trying to identify particular shark species from just fins or other body parts.

Once a need to identify hammerhead body parts was established and a hammerhead-specific DNA test was developed, GHRI researchers, in collaboration with Dr. S. Clarke of the National Research Institute for Far Seas Fisheries, Japan, began to test shark products found in Hong Kong, which is considered to be the world's largest fin trade center. The results of the study, which are to appear in an upcoming issue of the scientific journal *Conservation Genetics*, represent a large step towards the goal of understanding the fin trade and will facilitate the development of more effective conservation and management efforts:

1. GHRI's forensic research confirmed that hammerhead fins (mainly from the three large-bodied species - great hammerhead, scalloped hammerhead and smooth hammerhead) are in fact present in the fin trade and are highly valued in the Hong Kong fin market in particular. The DNA research also demonstrated for the first time the relationship between Chinese trade names for the fins and species names. This connection between market names and corresponding species names was unknown until the results of this study confirmed the relationship. This trade name-species concordance information will be invaluable in monitoring the fin trade in Chinese markets. The information will also prove useful for determining the contribution that each hammerhead species is making to the fin market as well as for estimating the number of each hammerhead species being killed to supply the fin trade.
2. The study's conclusions - based on pricing of Chinese trade categories - also demonstrated that hammerhead fins are among the most highly valued fins in the market, supporting the notion that the decline in catch rates in regions such as the northwest Atlantic is in fact due in some part to the demand for their fins in the international fin trade.
3. The DNA forensic techniques developed for the hammerhead study will be useful for identifying meat from different hammerhead species. Additionally, the techniques enable researchers to distinguish whole animals, which can be difficult to correctly identify when they are small (young).
4. The research conducted while testing the diagnostic accuracy of the forensic DNA primers revealed the unexpected presence of a new, undocumented shark species resembling, but different from, scalloped hammerheads in US Atlantic waters.

As these results show, the DNA research developed and conducted by the GHRI is providing invaluable information for the development, implementation and enforcement of management and conservation initiatives designed to curb the overfishing of certain shark species. Harvey also notes that the discovery of an entirely new hammerhead species by DNA technology further highlights the importance of the groundbreaking research the GHRI is conducting marine conservation.

In addition to the hammerheads, the GHRI has developed DNA tests for 26 more species of sharks, including the white shark, shortfin mako, dusky and silky shark. The ability of the tests to quickly determine species-specific fins in the fin trade, is vital in creating conservation and management initiatives. "Different species respond in different ways to the effects of overfishing," Harvey explains. "A management plan designed for one species may not be suitable or viable for others, so it is imperative to know exactly which species are being overfished."

Despite progress made in the widespread efforts to conserve the world's shark populations, much work remains to be done. Ongoing research by the GHRI and PIOS team is developing DNA tests for additional shark species so that all species involved in the fin trade can be accounted for and managed, and afforded some type of protection if warranted based on their population status. The results of various emerging studies using powerful DNA testing and other new technologies makes clear that shark populations need to be monitored more closely on a species-specific and regional basis, and local and international laws must be strictly enforced if the decline in shark populations is to be halted and the functional integrity of marine ecosystems maintained.

The Next Step

Scientists from the GHRI will be traveling to Mexico's Guadalupe Islands in the near future to document and tag the region's white shark population. Harvey is also hoping to capture some of the white sharks - on camera. "I shot video for an episode of my show *Portraits From the Deep* on a previous expedition to Guadalupe and came away with some incredible footage of white sharks." Harvey said. "The white sharks were so impressive and made for such interesting subjects that we decided a follow up trip was in order. Many of the world's white shark populations are threatened and we are hoping to use the show to create awareness of their plight as well as to tell the story of the great scientific research being done by the staff of the GHRI to support shark conservation."