

Late Spring 2019

SHARK RESEARCH INSTITUTE

Newsletter

Shark Research Institute Global Headquarters

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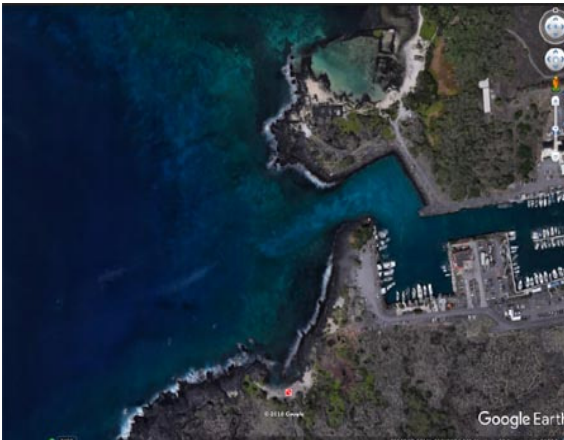
Shark Research Institute Tiger Shark Expedition. Kailua Kona, Hawaii.

by Charlie Fasano



Another day in Hawaii begins with breathtaking views of the sun cresting over Mauna Loa and Hualālai mountains. Inside Honokōhau harbor, the busiest harbor on the Big Island of Hawaii, numerous commercial and recreational vessels begin their preparations for their day's activities on the ocean. The sea is calm and the air still as Wyland and I load our gear onto our vessel. From my many years of personal experience diving this bay, I knew it would be another pristine day just outside the harbor.

Nested along the southern boundary of Kaloko-Honokōhau National Historical Park, an anomaly of nature exists. The harbor proper, where the vessels are sheltered, was built by the US Army Corps of Engineers in 1970. The lava rock was blasted with dynamite and carved with large hydraulic chisels to form a protective harbor that houses more than 230 vessel slips. Of the approximate 190 km of shoreline along the west side of the Big Island, this is the most active bay.



As vessels leave the harbor mouth, a single green buoy, an aid to navigation, assists their path. Underwater, the amount of biodiversity along this path is greater than in most hikes through dense rain-forests. If you could remove the water from the bay, you would see an expansive underwater coral reef playground. The wealth of nature along this path dazzles many marine naturalists and scientists.

Diving and observing every day for a whole year is needed to view all the various fish and invertebrates living in this area, especially inside the coral structure. The path through the coral, heading towards the green buoy, ends when the coral ledge meets a large sand shelf at 20m. The coral ledge gives way to a sandy bottom that hides a wealth of marine life including hundreds of Hawaiian garden eels (*Gorgasia hawaiiensis*) that sway in the current. The bay also offers the most wonderful anomaly, in my opinion, the spinner dolphins (*Stenella longirostris*) (Hawaiian Name: *Nai'a*) that frequent the bay for resting and sleeping. Although this is the busiest bay along 190 km of coastline, large pods of dolphins still elect to use it as a daytime resting site.

IN THIS ISSUE:

Joe Romeiro Honored	3	Spring Art Contest	8
News from Germany	3	Tiger Shark Expeditions	9
Status of NJ Shark Fin Bill	4	Afuera Expeditions	10
Science Expo	5	Djibouti Expedition	11
Beneath the Sea	6	Journal Articles	12
Upcoming Events	7	Shark Shop	15
Bookshelf	7	Our Supporters	16

Ancient Hawaiians had a cultural connection to the oceans. Their survival was dependent on the sustainability of the reefs. They understood, and knew, that if there were no fish in the oceans, they would not survive. They also saw how individual fish roles for the betterment of the reefs were similar to individual humans' roles for the betterment of society. These assimilations were written down as *olelo no'eau*, proverbs, that were told through generations.

Continued on page 2

Hawaiians knew that as you dropped off the reef into the deeper waters, the big sharks roamed. But besides the danger that this posed, they also respected the sharks as *aumākua*, the spiritual embodiment of ancestors. These sharks were revered and respected. When an *aumākua* was present, it was the sign of forthcoming good or ill will, depending on how the *aumākua* was treated.

We leave the pier in downtown Kailua Kona for a short 20-minute boat ride along the Kona coastline looking for dolphins and enjoying the view. Wyland and I enter the water from our vessel, then make a short swim along the lava ledge into the sandy path, passing over healthy corals and the many fish that inhabit the reef. Vessels overhead skim across the surface at normal speed, leaving a wake that dances with the light rays penetrating the water's surface.

We rest along the ledge to spot the tiger sharks. The first passes are best for photographs since the sharks are more curious in the early morning. We are cataloging individual tiger sharks to determine their annual use of the area. We position ourselves in the sand, hiding behind boulder-sized coral heads. Within minutes, a small tiger shark (~2.75 m) comes along to investigate. There is a quick inspection, but the beautiful animal shows little interest in the carcass and quickly swims off. As I wonder why the shark didn't eat the carcass, a larger tiger shark (~4.5 m) appears directly in front of me, obviously, she has scared off the smaller shark.

It is amazing how this large animal suddenly appears. I liken its appearance to the Cheshire Cat of *Alice in Wonderland* fame. I was staring at a single small coral head when the shark just materialized in front of it. Imagine: A 4.5 m shark is able to simply appear in front of me from just three meters away! This supports the concept of the tiger shark being a professional hunter. The animal knows how to stay out of your visual range and only appears when it allows you to see it. I was looking in shark's direction before realizing that I was looking at it, and only then did I see it because it allowed me



to. This happens about three times within a couple of meters of me. The amazing ability of this large animal to suddenly appear is chilling. This animal is a professional of underwater camouflage. After the shark eats the fish carcass, it swims off leaving a sandy cloud in its wake. Seeing this display reminds me of how important a role these animals play in the environment. They keep the reef clean and healthy by consuming injured and dead animals.

The naming of the shark as "tiger" goes beyond its striped body pattern. It moves as stealthily as a feline with confidence and a nonchalant attitude. It moves through the water with the grace of a big cat and then disappears.

Our boat returns us to the hotel pier by 3 pm and we are free to enjoy the rest of the day. We'll stop at a Kona coffee cafe and browse galleries along the walkway bayfront. We may also relax at the local open-air jazz bar or at Kona Brewery where the famous Kona beer is crafted. Both places are a five-minute walk from the hotel. If we feel really adventurous, then we'll dive with Manta rays or experience the famous Blackwater night dive.

Like everyone joining the SRI expedition, we have gained an appreciation for Hawaii's tiger sharks and enjoy the feel of old Hawaii.

Joe Romeiro Honored! March 9, 2019



Congratulations to Joe Romeiro who was honored as The Diver of the Year on March 9th at the 65th Annual Boston Sea Rovers Clinic! The award, considered the "Stanley Cup of Diving," was presented by SRI Honorary President Dr. Sylvia Earle; National Geographic photographer, Brian Skerry; Dr. Robert Ballard, who located the wreck of the *Titanic*; and Roger Munn from the BBC Natural History Unit.

Joe, a member of SRI's Advisory Board is also one of the founders of the Atlantic Shark Institute in Wakefield, Rhode Island, a Fellow of the Explorer's Club and a member of the Ocean Artists Society. In addition to being an award-winning underwater cinematographer, Joe is a producer, director, editor, photographer, artist, and shark researcher. He has been a television presenter on the BBC, National Geographic, Discovery Communications, OWN, MSNBC, NBC, CBS, FOX, and Lionsgate Pictures. He is also a regular on Discovery Channel's *Shark Week* and National Geographic's *SharkFest*.

March 10 and 16, 2019



March 10, 2019: SRI CEO Jupp Kerckerinck gave presentations on sharks at the Montessori School in Munich, Germany.

March 16, 2019: Elstners Reisen, "Die Retter der Haie" (*The Saviours of the Sharks*), a 90-minute documentary about sharks, was aired on SWR, a German TV station. The film featured Jupp's work with sharks in the Bahamas, and is part of the "Elstner Reisen" series.



NJ Shark Fin Trade Bill**March 18, 2019**

The A-Team shown left-to right: Brian Hackett, HSUS; Drs. Dino Rulli and Dean Fessler of the Shark Research Institute; Tim Dillingham, American Littoral Society; Doug Hackett and Molly O'Neil from Jenkinson's Aquarium, all of whom testified in support of NJ A4845 on Monday, March 18, 2019 before the New Jersey Assembly Appropriations Committee. The Committee passed A4845* by a vote of 8-1. The bill was posted on the voting list for a full Assembly vote on March 25, the last step needed before heading to the governor for signature. A4845 bans the sale, trade, possession, or distribution of shark fins. With passage of this bill, NJ will join 12 other states in taking a stand to protect sharks.

To our disappointment, Assembly Speaker Coughlin pulled the bill from the schedule on March 25 at the last minute, thereby preventing a vote. We are still trying to find out exactly why he took this action, especially after this bill overwhelmingly passed both the State Senate and Assembly Appropriations Committee. We have all been working on this bill for a number of years and will have to wait longer. The bill is scheduled to be presented to the Assembly again in late May.

Please call Speaker Craig Coughlin's office; respectfully request an explanation as to why the bill was pulled from the voting docket and ask that it be voted upon at the next session. His office number is (732) 855-7441. With 73-100 million sharks killed each year, your few minutes to do this will be well spent.

*https://www.njleg.state.nj.us/2018/Bills/A5000/4845_11.HTM

Science Expo March 22, 2019



The Hopewell Valley Science Expo is always one of our favorite local shows. Some of the projects were educational or featured innovative robotics. Many of the projects consisted of recycling or repurposing materials like this temperature-regulated fan. Two of our favorite projects: a foundry producing metal castings from aluminium cans and a greenhouse constructed of plastic water bottles. Dozens of kids signed our *Ban the Shark Fin Trade* notes to legislators.



To encourage more efforts against the alien invasion of Lionfish SRI contributed prizes to REEF's 7th Annual Lionfish Derby held March 29-31, 2019.

Beneath The Sea March 29, 30 & 31, 2019



Heather Cifuentes, Dave Grant, Dean Fessler, Charlie Fasano, and Galit Tsadik in her happy shark hat

Beneath The Sea is the largest consumer dive and travel show in the USA. This annual event held at Meadowlands Convention Center in Secaucus, NJ, features workshops and seminars, imaging competitions, Ocean Pals for children, a film festival, and provides scholarships.



Alex Rose of Ocean Geographic Society and Dave Grant

It was a great opportunity to catch up with members and friends, and meet some amazing individuals.



Some highlights of the show included the Diving Pioneer 2019 Award to Cathy Church; Diver of the Year honors to Kathy Weidig (Science), SRI members Margo Peyton (Education) and Jonathan Bird (Art). (The Women Divers Hall of Fame received the Legend of the Sea Award. Dora Sandoval (at left) was inducted into the Women Divers Hall of Fame along with Twila Bratcher-Critchlow, Tanya Burnett, Ellen Cuylaerts, Honor Frost, Sabine Kerkau, Sara Olsen, Julie Ouimet and Susan L. Williams.

The Film Festival was emceed by SRI member Nancy McGee and featured films by members Jonathan Bird, Annie Crawley, Richie Kohler, Amos Nachoum, and Explorer Club Fellows Michel Lebreque and Julie Ouimet. Presenters included SRI members Stan Waterman, Joe Romeiro, Cristina Zenato, Anita Ares and John Ares. Seminars showcased members Maureen and Steve Langevin and their recent documentary shot in Papua New Guinea, Lynn Funkhauser's spectacular images, and advance clips from the soon-to-be released movie on the work of Amos Nachoum. Winners of the David Doubilet (Photography) and Stan Waterman (Videography) International Imaging Competitions were outstanding.



Iquarium had one of the most innovative new products at BTS. Eddie Hanson of York, Maine, founder of Iquarium, spent four years designing aquariums for children with autism. The tanks come with marine life, require only minimum care, and an iPad can provide a changing background.

info@iquarium.us.



Upcoming Events

April 20, 2019: Fossil Shark Tooth Hunt. Colts Neck, NJ from 1 to 3 pm. \$10 per person, \$20 per family. Children and SRI members free. Registration is required (we bring equipment for everyone). Call (609) 921-3522 to register.

April 22, 2019: Earth Day. Please take 30 minutes to pick up trash in your neighborhood or nearest beach.

May 10, 2019: Fintastic Friday: Giving Sharks, Skates and Rays a Voice. This annual holiday created by Whale Times is now celebrated worldwide to raise awareness and encourage advocacy for sharks, skates, and rays. http://whaletimes.org/?page_id=122

May 23-June 3, 2019: CITES CoP18. Colombo, Sri Lanka. Our scientists will be attending and fighting for protection for additional species of sharks and other endangered wildlife. www.cites.org

May 25, 2019: Fossil Shark Tooth Hunt. Colts Neck, NJ from 1 to 3 pm. \$10 per person, \$20 per family. Children and SRI members free. Registration required. Call (609) 921-3522 to register.



May 28-31, 2019: Fifth International Whale Shark Conference. Exmouth, Western Australia. The focus of IWSC5 will be bringing together the world's leading whale shark scientists, conservationists, natural resource managers, and tourism managers to develop collaborations, explore all aspects of whale shark biology and ecology, and decide how this can translate to direct, on-ground conservation efforts. It is timed to showcase Ningaloo's whale shark management program and will follow the Ningaloo Whaleshark Festival, an

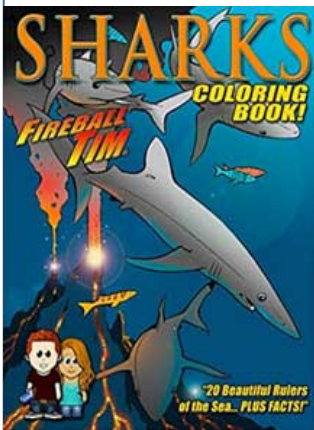
annual community event that celebrates these magnificent animals.

<https://www.facebook.com/iwscq/>

June 3-8, 2019: World Oceans Week at the Explorers Club. World Oceans Day is celebrated each year on June 8th to address the challenges faced by the international community in connection with the oceans. Throughout the week, from morning 'til night, there will be presentations at the Explorers Club on Deep Ocean, Marine Wildlife, Youth Programs, Coral Reefs, Marine Protected Areas, Plastics, The Blue Economy, and many more. The schedule will be posted at: www.explorers.org/events/

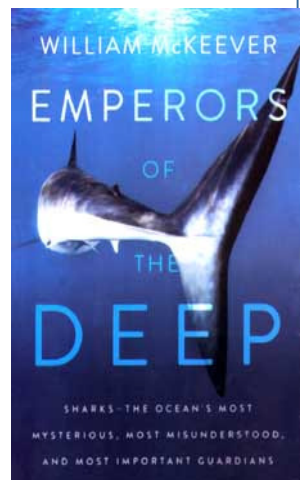


Bookshelf



The Fireball Tim SHARKS Coloring Book \$6.99 from Amazon.com. There are a half-dozen shark coloring books available on Amazon.com, but this is the one we recommend. The 20 sharks featured in this book are accurately drawn by former Disney artists. There are fascinating facts accompanying each shark and a maze for added fun.

Emperors of the Deep by William McKeever, \$12.99 Kindle, \$25.99 Hardcover, \$39.99 Audio CD from Amazon.com. The author is a documentary filmmaker and founder of Safeguard the Seas, an NGO dedicated to ocean conservation. He is the producer and director of the forthcoming feature-length documentary "Man Bites

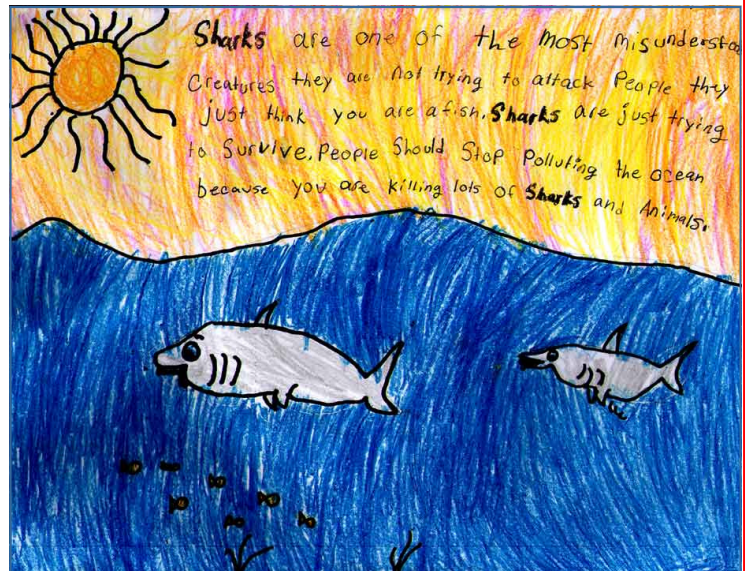


Kids' Corner

Shark Research Institute Spring Art Contest

Sharks have been named for many other animals. There are bull sharks, catsharks, cow and dogfish sharks, tiger and zebra sharks, crocodile sharks and goblin sharks. Some sharks are named for their colors: blue, copper, lemon, blacktip, whitetip and silver tip. The names of other sharks are sometimes descriptive. For example, the snaggletooth and raggedtooth sharks have crooked teeth, the whale shark is BIG and the basking shark often basks on the ocean surface. *How about drawing one of these sharks?*

Or you could draw a picture telling why sharks need protection. Sharks are essential for a healthy ocean, but the numbers of some kinds of sharks have declined by more than 90% in the past 50 years and are on a fast track to extinction. Most sharks are killed for their fins, for shark fin soup. Finning—the practice in which a shark is caught, its fins sliced off (often while it is still alive) and the mutilated animal is tossed back into the sea—is illegal in our country. BUT the law still allows shark fins to be sold in the USA, regardless of where or how the fins are obtained or if the fins are from endangered species. If sharks are to be saved from extinction the trade in their fins must end. *How about a drawing about why sharks are important or a drawing to call attention to their plight with a catchy phrase like “Keep shark fins on sharks” or “FINish the Shark Fin Trade”?*



Color your drawing with markers, crayons or colored pencils. Then mail your drawing with your name and address to:

**Shark Research Institute
PO Box 40
Princeton, NJ 08542**

Entries must be received by April 30, 2019.

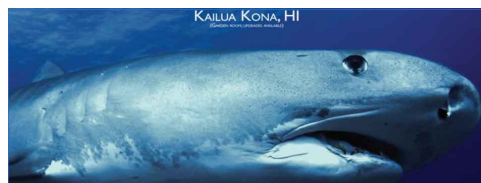
All entries will receive a Ban the Sharkfin Trade sticker. The winner of the contest will be awarded a lifetime adoption. Your drawing might even be printed on postcards like the one above: Chelsea Cahall's from Hopewell Elementary School, winner of our 2018 Spring Art Contest.

TIGER SHARK IDENTIFICATION EXPEDITION

Join a Shark Research Institute expedition in Hawaii to assist with research on tiger sharks

Six Expeditions during September and October, 2019

The expeditions will be led by Charlie Fasano, SRI Regional Director-Hawaii. Citizen scientists participate in cataloging individual tiger sharks. The objective is to determine tiger sharks' annual use of the area. The project will also increase the biological information available to guide conservation efforts for this species, on both a regional (Hawaii) and global scale, with important data such as life history, species distribution, abundance and diversity, population productivity and extinction risk. This information will then be used to inform international conservation forums, such as CITES, as well as local fishery risk assessments and management plans. An education and awareness campaign on the status of Hawaiian Tiger sharks will be conducted in conjunction with the survey to increase awareness of the habitat use of the species.



Location

Kailua Kona, Hawaii

Cost

Eight day expeditions: \$3,750 (double occupancy), \$4,250 (single occupancy)

Five day expeditions: \$2,500 (double occupancy), \$2,900 (single occupancy)

Payments made through PayPal will incur an additional \$50 per person processing fee. All payments are non-refundable. Dive insurance and travel insurance are required. Nitrox is available, recommended, and mandated for five day expeditions. A \$500 deposit is required to hold your space. Balance due 60 days prior to the commencement of the expedition.



Included

Transfers between airport and resort, resort accommodations at King Kamehameha Kona Beach Hotel Courtyard Marriott, Mai Tai reception, daily boat dives to catalog resident tiger sharks of Big Island, non-alcoholic drinks, fruit, and snacks on board the boat, celebrity lecturer, imaging workshop.

Not included

Airfare To Kailua Kona, Hawaii, alcohol and meals, dive gear (can be rented), concierge activity services and gratuities. Manta ray and tethered Blackwater night dives are available at an additional cost.

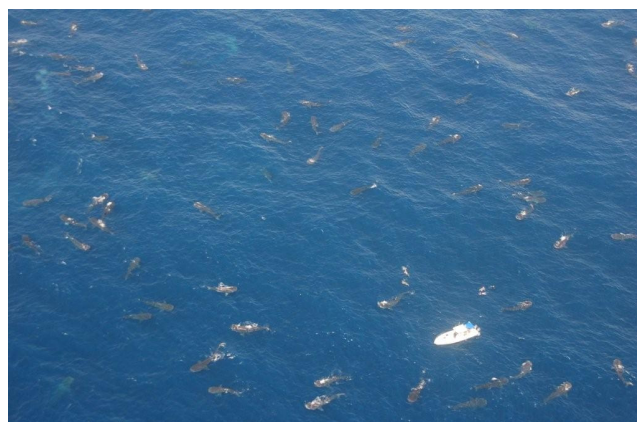
For more details or to reserve your space, contact the expedition leader at Charlie@sharks.org

The AFUERA

The Great Massing of Whale Sharks in the Caribbean

July 24 to July 28, 2019 and July 30 to August 3, 2019

The largest gathering of whale sharks in the world occurs each June through August in the Caribbean off Mexico's Yucatan Peninsula. Known as the Afuera, more than 600 whale sharks have been observed during a single aerial survey. The sharks mass in a patch of ocean about the size of several football fields where the water is 20 to 60 feet deep to feed on dense patches of fish eggs, a rare place where you can observe and photograph whale sharks in blue water.



The expedition dates coincide with the peak of the Afuera. Each expedition is five days in length, including three days snorkeling with the sharks (weather and sea permitting) and a travel day on either end.

The expeditions are led by Dr. Jennifer Schmidt, Director of Science and Research at the Shark Research Institute, who has worked with whale sharks for nearly 20 years. By Mexico's regulations, all expeditions and whale shark ecotourism trips are snorkel only because scuba bubbles disturb the sharks when they are feeding. But excellent diving and many other activities are available before and after the expedition.

The cost includes four nights double occupancy hotel in Cancun, three days of whale shark interactions, lectures on whale sharks by Dr. Schmidt, snorkeling at Isla Mujeres, and lunch on whale shark days. It does not include airfare to Cancun, airport transfers, or dinners.

The share per person is \$1,400 if paid by check in USD (\$1,450 if paid online via Paypal) based on double occupancy. A single supplement is \$200. A \$500 deposit is required to hold your space. All payments are non-refundable. Dive and travel insurance are required. Maximum of nine participants per expedition.

These expeditions fill very fast, so reserve your space now!

For more information or to reserve a spot, contact jennifer@sharks.org

Optional side trips are available and can be arranged in Cancun. After the expedition you could dive Manchones Reef, visit the Cave of the Sleeping Sharks of Isla Mujeres, dive one of Mexico's crystal clear cenotes, or visit some of the world-famous Mayan ruins of the Yucatan such as Tulum or Chichen Itza.

DJIBOUTI WHALE SHARK EXPEDITION

Join a Shark Research Institute expedition to assist with research on this fascinating population of the world's largest shark

December 6th — December 14, 2019

Join this expedition led by SRI Director of Science & Research, Dr. Jennifer Schmidt to study the whale sharks that aggregate in the Gulf of Tadjoura, Djibouti, Africa. Djibouti hosts an aggregation of the youngest whale sharks found anywhere, most sharks are between three and five metres with two metre animals occasionally seen. Participants will act as research assistants, documenting whale sharks by photo identification, collecting and analyzing plankton samples and hopefully observing night feeding behavior. Research goals are to understand where these animals come from, why young sharks congregate in the area, and where they go when they leave.

Our home for this liveaboard expedition is the *M/V Deli*, a Turkish gulet that accommodates 12 people in shared rooms with private baths. The chef prepares a daily menu of local and continental cuisine. Whale shark interactions are snorkel only, but excellent diving is available from the boat at sites such as Ras Korali, Turtle Point, Moucha Island and La Faille, a convergence of tectonic plates. Whale shark interactions and diving are available each day, and participants may choose any combination of activities.

Cost: \$2,200* includes shared accommodation on the boat, double occupancy hotel for the nights of December 6th and December 14th, all meals on the ship, hotel and port transfers, and a tax-deductible donation to the Shark Research Institute. Not included are airfare, Djibouti visa, soda and beer, and meals off the ship. Post-trip excursions are available to explore the geologic formations and vast salt lakes of the East African rift valley.



The site is remote, and accommodations basic, but the experience is unmatched. Share this unique wildlife expedition to a stark and beautiful corner of the world.

For more details or to reserve your space, contact the expedition leader at Jennifer@sharks.org

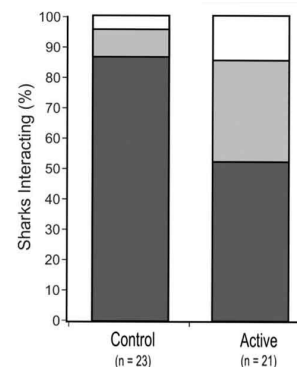
*Payments made through PayPal will incur an additional \$50 per person processing fee.

Buyer Beware

Egeberg CA, Kempster RM, Hart NS, Ryan L, Chapuis L, Kerr CC, Schmidt C, Gennari E, Yopak KE, Collin SP. (2019) **Not all electric shark deterrents are made equal: Effects of a commercial electric anklet deterrent on white shark behaviour.** 2019 Mar 11;14(3):e0212851.

[doi: 10.1371/journal.pone.0212851](https://doi.org/10.1371/journal.pone.0212851). eCollection 201

Personal shark deterrents offer the potential of a non-lethal solution to protect individuals from negative interactions with sharks, but the claims of effectiveness of most deterrents are based on theory rather than robust testing of the devices themselves. Therefore, there is a clear need for thorough testing of commercially available shark deterrents to provide the public with information on their effectiveness. Using a modified stereo-camera system, we quantified behavioural interactions between *Carcharodon carcharias* (white sharks) and a baited target in the presence of a commercially available electric anklet shark deterrent, the Electronic Shark Defense System (ESDS). The stereo-camera system enabled accurate assessment of the behavioural responses of *C. carcharias* when approaching an ESDS. We found that the ESDS had limited meaningful effect on the behaviour of *C. carcharias*, with no significant reduction in the proportion of sharks interacting with the bait in the presence of the active device. At close proximity (< 15.5 cm), the active ESDS did show a significant reduction in the number of sharks biting the bait, but this was countered by an increase in other, less aggressive, interactions. The ESDS discharged at a frequency of 7.8 Hz every 5.1 s for 2.5 s, followed by an inactive interval of 2.6s. As a result, many sharks may have encountered the device in its inactive state, resulting in a reduced behavioural response. Consequently, decreasing the inactive interval between pulses may improve the overall effectiveness of the device, but this would not improve the effective deterrent range of the device, which is primarily a factor of the voltage gradient rather than the stimulus frequency. In conclusion, given the very short effective range of the ESDS and its unreliable deterrent effect, combined with the fact that shark-bite incidents are very rare, it is unlikely that the current device would significantly reduce the risk of a negative interaction with *C. carcharias*.



Proportion of interactions (Type 0, 1 and 2) by *C. carcharias* during control and active trials. N refers to individual sharks.

Focus on Predator-Prey Relationships

Hammerschlag, N (2019) **Quantifying shark predation effects on prey: dietary data limitations and study approaches.** *Endangered Species Research*. Vol. 38: 147–151, 2019 <https://doi.org/10.3354/esr00950>

Understanding the ecological impacts of sharks on prey populations has become a research priority given widespread shark population declines due to overfishing, combined with significant conservation efforts. Accordingly, many studies have conducted analyses of shark stomach contents and/or used biomarkers, such as stable isotope signatures, to assess dietary patterns in order to infer ecological roles. Here, I summarize how relying on stomach contents and/or stable isotope signatures to assess the potential for sharks to initiate trophic cascades can be misleading and may significantly underestimate the strength of shark top-down predation effects on prey. However, a study approach that measures attributes of the sharks (e.g. hunting mode), potential prey (e.g. escape speed) and the environment (e.g. habitat rugosity) can provide greater insights for quantifying the magnitude of top-down predation effects of sharks and the potential for their population declines or recoveries to trigger trophic cascades. To aid future investigations, I provide a set of predictions, based on ecological theory, which would specifically lead to increases in the magnitude of shark predation effects on prey populations. I also present key study approaches currently being employed by researchers to test such predictions.

White Shark More Closely Related to Mako Shark than to Meg

Ehret DJ, Hubbell G, and McFadden, BJ. (2009) **Exceptional Preservation of the White Shark *Carcharodon* (Lamniformes, Lamnidae) from the Early Pliocene of Peru.** *Journal of Vertebrate Paleontology*. 29(1):1-13

An exceptionally well-preserved white shark fossil (*Carcharodon* sp.) is described here from the early Pliocene (ca. 4 Ma) Pisco Formation of southwestern Peru. This specimen preserves 222 teeth and 45 vertebrae as well as fragmentary jaws. The teeth show characters of *Carcharodon*, including weak serrations and a symmetrical first anterior tooth that is the largest in the tooth row. This dentition also shows a character of *Isurus* with a distally inclined but mesially slanted intermediate tooth. Although the Pisco specimen demonstrates characters of both *Isurus* also known from the Pisco Formation, and modern *Carcharodon carcharias*, it is assigned to the genus *Carcharodon* and referred to herein as *Carcharodon* sp. While *Carcharodon* from the Pisco Formation shows numerous diagnostic characteristics shared with *C. carcharias*, it differs from the extant species in having a distal inclination in the intermediate tooth. The precaudal vertebral centra of the Pisco *Carcharodon* preserve distinctive dark and light incremental bands that, based on calibration with oxygen isotopes, indicated annular growth couplets. The fossil shark was at least 20 (± 1) years old at the time of its death. Based on measurements of teeth and vertebral centra, this specimen is estimated to have had a minimum total body length of 4.80-5.07 m, similar to estimates for modern older individuals of *C. carcharias*. Relative to the extant *Carcharodon carcharias*, the Pisco *Carcharodon* grew at a slower rate. The fossil record of lamnoid sharks preserved in the Pisco Formation demonstrates that the modern white shark is more closely related to *Isurus* (*I. hastalis*) than it is to the species *Carcharodon megalodon*, and the latter is therefore best allocated to the genus *Carcharocles*.

Lineage of White Sharks

Ehret, D J, Macfadden B J, Jones D S, DeVries TJ, Foster DA and Salas-Gismond R. (2012) **Origin of the White Shark *Carcharodon* (Lamniformes: Lamnidae) based on recalibration of the upper Neogene Pisco Formation of Peru.** *Paleontology*, Vol. 55, Part 6, pp1139-1153

The taxonomic origin of the white shark, *Carcharodon*, is a highly debated subject. New fossil evidence presented in this study suggests that the genus is derived from the broad-toothed 'mako', *Carcharodon* (*Cosmopolitodus*) *hastalis*, and includes the new species *C. hubbelli* sp. nov. — a taxon that demonstrates a transition between *C. hastalis* and *Carcharodon carcharias*. Specimens from the Pisco Formation clearly demonstrate an evolutionary mosaic of characters of both recent *C. carcharias* and fossil *C. hastalis*. Characters diagnostic to *C. carcharias* include the presence of tooth serrations and a symmetrical first upper anterior tooth that is the largest in the tooth row, while those indicative of *C. hastalis* include a mesially slanted third anterior (intermediate) tooth. We also provide a recalibration of critical fossil horizons within the Pisco Formation, Peru using zircon U-Pb dating and strontium-ratio isotopic analysis. The recalibration of the absolute dates suggests that *Carcharodon hubbelli* sp. nov. is Late Miocene (6-8 Ma) in age. This research revises and elucidates lamnid shark evolution based on the calibration of the Neogene Pisco Formation.



Carcharodon hubbelli

Acoustic Telemetry May Reveal Illegal Fishing

Tickler DM, Carlisle AB, Chapple TK, Curnick DJ, Dale JJ, Schallert RJk and Block BA. (2019) **Potential detection of illegal fishing by passive acoustic telemetry** *Animal Biotelemetry*. 7:1 <https://doi.org/10.1186/s40317-019-0163-9>

Acoustic tagging is typically used to gather data on the spatial ecology of diverse marine taxa, informing questions about spatio-temporal attributes such as residency and home range, but detection data may also reveal unanticipated insights.

Many species demonstrate predictable site fidelity, and so a sudden cessation of detections for multiple individuals may be evidence of an atypical event. During 2013 and 2014, we acoustically tagged 47 grey reef sharks (*Carcharhinus amblyrhynchos*) and 48 silvertip sharks (*Carcharhinus albimarginatus*) near reefs in the British Indian Ocean Territory (BIOT) Marine Protected Area (MPA). From March 2013 to November 2014 inclusive, tags were 'lost', i.e. permanently ceased to be detected within the monitoring area, at an average rate of 2.6 ± 1.0 tags per month. Between 1 and 10 December 2014, detection data suggest the near-simultaneous loss of 15 of the remaining 43 active tagged sharks, a monthly loss rate over five times higher than during the previous 21 months. Between 4 and 14 December of 2014, the BIOT patrol vessel encountered 17 vessels engaged in suspected illegal fishing in the northern BIOT MPA; such sightings averaged one per month during the previous 8 months. Two of these vessels were arrested with a total of 359 sharks on board, of which grey reef and silvertip sharks constituted 47% by number.

The unusual and coincident peaks in tag loss and vessel sightings, and the catch composition of the arrested vessels, suggest illegal fishing as a plausible explanation for the unusual pattern in our detection data. A Cox proportional hazards model found that the presence of fishing vessels increased the risk of tag loss by a factor of 6.0 (95% CI 2.6–14.0, $p < 0.001$). Based on the number of vessels sighted and the average number of sharks on vessels arrested in BIOT during 2014, we conservatively estimate that over 2000 sharks may have been removed during the suspected fishing event. Based on average catch compositions, over 1000 would have been grey reef and silvertip sharks. Assuming a closed population mark-recapture model, over one-third of the locally resident reef sharks may have been removed from the monitoring area. The data suggest that even sporadic fishing events may have a marked impact on local reef shark populations, but also demonstrate the potential of electronic tagging a tool for detecting illegal or otherwise unreported fishing activity.

Caught in the Act

Ehret, D J, Macfadden and Salas-Gismond R. (2009) **Caught in the Act: Trophic Interactions between a 4-million-year-old white shark (*Carcharodon*) and Mysticete Whale from Peru.** *Palaos*. Vol 24, pp 329-333. DOI: [10.2110/palo.2008.p08-077r](https://doi.org/10.2110/palo.2008.p08-077r)

Trophic interactions between sharks and other marine vertebrates are represented by both indirect and direct evidence from the fossil record. Indirect evidence includes such traces as shark tooth marks and gouges on the bones of prey, such as fish, reptiles, whales, dolphins and seals. Direct evidence is represented by the presence of shark teeth in definite association with prey species. In this paper we report direct evidence for trophic interaction between a white shark (*Carcharodon* sp.) and a mysticete whale from the lower Pliocene (~4-5 Ma) Pisco Formation of Peru: a partial mandible of an unidentified mysticete whale with a partial tooth of a white shark embedded within the cortical bone. Modern white sharks are known predators of many marine mammal species, and both active hunting and scavenging have been well documented. In this instance, we interpret this specimen to represent a scavenging event. This fossil is unusual because it represents a seldom-reported event that preserves direct evidence of trophic interactions.

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With spring well on the way there is plenty of shark fishing and surf fishing from swimming and surfing beaches. These activities attract marine predators, possibly putting people at needless risk.

Recognizing that some municipalities still permit such activities, SRI member Jerry Taggart designed a series of **Warning Flags** to alert marine resource users when these hazards are present. For more information about how your local officials about how to order the flags, email: tagchum@gmail.com

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