



Shark Foundation Annual Report for 2018

August 2019

General

Foundation

Scientific research is expensive, especially when it comes to marine organisms. Costs for boats, crew, fuel, trips, etc., thus often also accrue in addition to effective research materials. Molecular biological research, e.g. the analysis of population dynamics or the examination of extensive migrations via satellite transmitters can swallow huge sums of research money which usually can only be financed through the support of large laboratories and often various financial backers. As a relatively small organization, the Shark Foundation supports or involves itself wherever appropriate in any larger projects which specifically serve shark protection. On the other hand, we also get involved in small, relatively cost-effective projects that can be of interest, such as the analysis of local fish markets and shark landings in poorly examined regions. Smaller projects are, however, rarely supported by large financial backers, and especially by any national research facilities. Yet by financing such projects and networking project managers with each other and with larger laboratories, the Foundation can substantially contribute to shark protection at relatively low costs.

The Shark Foundation has been committed to the international protection of sharks ever since 1997. Without the support of numerous small and large donors it would be impossible for us to continue working for sharks and hence the protection of our oceans.

Once again we would thus like to thank all our donors and benefactors for their ongoing financial support. Our work would not be possible without your generosity!

EEA Conference in Peniche, Portugal

From October 12 to 14, 2018, Alexander Godknecht represented the Shark Foundation in Switzerland at the 22nd International Scientific Conference of the European Elasmobranch Association (EEA) in Peniche (Portugal).

Publications

In 2018 six (**6**) scientific papers were published, based on results of projects supported by the Shark Foundation.

Since 1997 until mid-2018 the Shark Foundation has supported a total of **72** scientific publications, 3 books, various conference reports, posters as well as a diploma thesis.

US Shark Foundation

In 2018 the US Shark Foundation was again registered as a charitable organization seated in Miami, Florida, with Gary Adkison as the registered Director of the US Foundation. The Foundation was self-supporting in 2018 and achieved several important successes for shark protection.

Total administrative costs to date: approx. CHF 58,000

Projects

Shark Exhibit

The exhibit has been in storage since September 2016 and we are looking for new exhibit locations.

A large number of the shark models have been rented to the Dinosaur Museum in Aathal as of

April 2018 where they will remain until January 2019 as part of a special exhibit on "Sharks of the Primordial Oceans."

In 2018 the model of a hammerhead shark was also donated to the Museum of Natural History in St. Gall for its permanent exhibit to honor the memory of Heinrich Thorbecke and as a sign of our gratitude for his longstanding support of our work.

Expenditures/Investments to date: approx. CHF 260,000

Population Genomics of Large Shark Species

Under the direction of Professor Mahmood Shivji's laboratory, this project encompasses the molecular-genetic analyses of various large pelagic sharks, e.g. large hammerheads, makos, white sharks or white-tipped pelagic sharks. These analyses will help in the examination of global genetic connections between populations of especially large pelagic and other shark species on a molecular-biological basis.

Many shark species are being strongly overfished and are threatened globally. Although sharks can swim large distances, it must be assumed that they form local populations (philopatry) so that only a minimum of genetic exchange between the individual populations can occur. The genetic exchange between separated living populations and the resulting refreshment of the gene pool is an especially important factor that determines the survival of strongly declining populations.

During 2018/2019 Professor Shivji's team has been exploring the populations of short-finned makos, a pelagic shark species that is caught in the nets of both hobby fishermen as well as commercial fishing fleets. Significant decimation of their populations is the result of the highly unregulated international fin trade. Makos are on the Red List of the IUCN and are considered as threatened worldwide. In 2018 the team was able to show that the mortality rate in mako fishing was underestimated and was ten times higher than initially thought. This in turn led to the declaration of emergency catch restrictions by the NOAA (US National Oceanic and Atmospheric Administration).

Population dynamic as well as structures, genetic diversity and evolutionary history of the short-finned makos in the entire Atlantic were analyzed using high-resolution genetic analyses (SNP). The resulting information should enable all relevant authorities and international fishing commissions to improve not only the protection of short-finned makos but also the management of their populations.

With the support of the Shark Foundation Professor Shivji was able to publish a scientific paper in 2018, covering his team's scientific work on the large genetic differences among white sharks in the Pacific.

Investments 2018: CHF 12,000

Investments to date: approx. CHF 36,600

Global Analysis of the Migratory Behavior of Large Shark Species

Many shark species are being decimated on a massive scale worldwide, mainly due to increased pressure from the fishing industry for their meat and especially their fins. Large sharks are top predators but they develop and grow very slowly, undergo a long period of time before becoming sexually mature and give birth to only a small number of pups. This makes them especially sensitive to overfishing.

Among the strongly threatened sharks are the hammerheads. Fishing management authorities and organizations are in urgent need of precise data on the migratory routes of their populations, their preferred gathering areas and regions where they are likely to cross paths with the fishing zones of high seas fishing fleets.

Smooth hammerheads (*Sphyrna zygaena*) are globally sensitive (Red List: "vulnerable") and are at risk of becoming extinct. They migrate over large distances although practically very little is known about their migratory routes. This study, financed by the Shark Foundation, should reveal more details on this shark's migratory habits and thus help international fishing authorities establish protection zones with respective timetables to support such protection measures.

Investments 2018: CHF 8,000

Investments to date: approx. CHF 34,400

Shark Nurseries

The project "Shark Nurseries" in Rookery Bay, 10,000 Islands, has been supervised by Pat O'Donnell since the year 2000 in collaboration with the Mote Marine Lab. Sharks frequent this region for use as their primary (pupping) and secondary nursing grounds (juvenile sharks older than one year). The research area encompasses Fakahatchee, Faka Union and Pumpkin Bay. The aim of this research is to determine how any changes in the salinity of the nurseries affect juvenile sharks. The project functions mainly with the help of enthusiastic volunteers which helps to strongly reduce costs. The Foundation continues to invest in the project whenever necessary.

Investments 2018: CHF 0

Investments to date: approx. CHF 61,500

Fiji Shark Protection Zone

Today the Fiji Shark Protection Project is financially self-sustaining. The Foundation is prepared to support the project financially, whenever necessary. At the end of 2013 Mike Neumann requested further support of the Fiji Shark Count project which since 2012 has aimed at establishing an inventory of all sharks in the region. The Fiji Shark Count continues and was co-financed by the Foundation in 2013/2014.

In 2015 Christine Ward-Paige from Dalhousie University, Halifax, evaluated the data collected during the Fiji Shark Count.

Investments 2018: CHF 0

Investments to date: approx. CHF 41,800

Migration of Large Coastal Sharks in Jupiter, FL, and the Bahamas

Great Hammerhead Sharks in Jupiter/Bimini/Bahamas The species of hammerhead sharks is heavily overfished in many regions. In March 2014 the large hammerheads were taken up in both Appendix II of the CITES Convention and the Red List of the IUCN and declared as endangered. They migrate over extensive distances through the territorial waters of various nations. For this reason they are also listed in Annex I of the UN Convention for Highly Migratory Species which calls for close cooperation of all involved countries in the management of these species.

Hammerheads are frequently found in bycatch, but are also actively fished because their fins score high market prices. Regulating bycatch and demanding that hammerheads be thrown back into the ocean makes little sense since the mortality rate of the hammerheads in bycatch is approximately 90%, the highest of all species. For this reason more information on the habitats, seasonal spatial usage and behavior of these hammerhead species must be better known in order to provide them with more effective protection.

In 2018 the project team continued to focus on the migrations of great hammerheads (*Sphyrna mokarran*) in the regions Jupiter (Florida, US), Bimini and generally the Bahamas. Analyses of the movements of great hammerhead sharks confirm a philopatric behavior. They migrate in annual cycles, remain stationary in one region for a season and continue to follow this behavior over many years. In Bimini and the Bahamas they remain from October to April, while in Jupiter/Florida they stay from October to March. Hammerheads who were tagged with satellite transmitters in Bimini or Jupiter wandered up to North Virginia and back, a distance totalling approx. 3,000 km. Such seasonal and thus predictable migrations are dangerous for the already strongly endangered hammerhead populations because they increase the probability of being caught on a targeted basis or they die in bycatch.

Long-term objective of the project is to provide the national US Fishery Authorities with solid scientific data in order to enable granting protection of great hammerheads in the exclusive US fishing zone. For this purpose data must be collected on the seasonal large- and small-scale migrations (received via satellite, acoustic transmitters, classical tags, photo ID), feeding habits (stable isotope analysis) and nurseries/birthing areas (ultrasound and hormone examinations).

Investments 2018: CHF 14,200

Investments to date: approx. CHF 226,400

Whale Sharks

Whale sharks are found on the IUCN Red List and on Appendix II of CITES where they are designated a globally endangered species. In addition to work being done in Mozambique to establish a marine sanctuary for whale sharks, the team of Simon Pierce and Chris Rohner, together with local and international scientists, is studying various ecological, genetic and biochemical aspects of whale shark populations around Mafia Island (Tanzania), the Red Sea, the Persian Gulf, the Philippines, Mexico (Yucatan), the Galapagos and a new whale shark hot spot around Madagascar. The Shark Foundation has been supporting the research of Simon Pierce and the Marine Megafauna Foundation since 2009.

Various projects at various locations include:

- *IUCN Red List of Endangered Species:* In 2017 the official assessment of the global number of whale sharks was updated and extended by data from the Arabian Sea. Current numbers point to an approximate 50% decrease in worldwide whale shark populations since 1980, with no signs of any recovery since then.
- *UN Convention on Migratory Species:* A very significant success for whale shark protection was achieved in 2017. Based on IUCN data compiled by the team of Dr. Simon Pierce and other researchers, whale sharks were placed under the highest protection (Appendix I) of the UN Convention on Migratory Species (CMS). Aim of the CMS is to protect migratory species, not only in specific countries but also throughout their entire territory.
- *Madagascar:* A significant reduction of individuals in all larger whale shark populations was noted in the western Indian Ocean – especially in Mozambique and the Seychelles. The newly discovered whale shark population in Madagascar thus becomes all the more important and fortunately is even much larger than first assumed. Since 2015 more than 240 sharks could be identified there.
- *Mexico:* Genetic studies have shown that Atlantic whale sharks very rarely migrate into the Pacific or Indian Ocean. Based on the current state of scientific knowledge, two whale shark populations could be identified, one in the Atlantic and the other in the Indo-Pacific region.
- *Galapagos:* the Galapagos Island of Darwin is the only place in the world currently known where fully mature, pregnant whale shark females are sighted. Small tissue samples taken from these females should provide information on their population genetics as well as their feeding habits (stable isotopes and fatty acid analysis). The sharks were also tagged with satellite transmitters (not financed by the Foundation) in order to study their migratory routes.

In 2017 the project gained prominence thanks to its introduction in the world renowned BBC Production Blue Planet 2, an important public relations action to help save endangered whale sharks.

In the 2018 expedition to the Galapagos the team succeeded for the first time ever in applying ultrasound to examine the gestation of 21 free swimming and most likely pregnant females. The collected data is still being evaluated. In addition, blood samples were taken from 6 females. Previous attempts to take blood samples from 10 to 12 meter long adult whale sharks for hormonal testing had failed due to their more than 25 cm thick skin. This time the Pierce and Rohner team found an area on the shark with much thinner skin. Tissue samples will provide information on genetic relationships to other locations.

- *Mafia Island:* The whale shark populations around Mafia Island are probably the best studied ones both genetically and biochemically. These studies were continued in 2018, focusing among other things on differences in female and male whale sharks. In 2017 many returning whale sharks were observed, accompanied by some new ones.

For the beginning of whale shark tourism, and based on its respective extensive experience in Tanzania, the team compiled appropriate guidelines which it then presented to the responsible authorities.

- *Mozambique:* The work in Mozambique, including research on the network of whale sharks in the various Indo-Pacific as well as Arabian regions, continues.

- *Biology:* Various analyses on the biology of whale sharks run parallel to protection efforts. Research is thus being conducted to find out where adult females and males stay after they leave the "hot spots." First results indicate that they spend the rest of their lives in open waters on the high seas.

How do whale sharks navigate on the high seas? Movement analyses show that they occasionally submerge to depths of over 1,200 m. Is this how they better orient themselves to the earth's magnetic field?

Further research revealed that parasites accumulate their DNA on the surface of their hosts. This so-called iDNA (DNA won from invertebrates) was discovered for the first time in marine animals in this whale shark study. Modern techniques make it possible to analyze entire genomes from living organisms faster and at lower costs. Genomic DNA can provide considerably more detailed information on populations and their interactions compared to classical short DNA pieces/strings. Applying these new technologies should enable a more detailed analysis of international whale shark populations.

In 2018 four scientific papers were published thanks to the support of the Foundation.

Funding 2017: CHF 9,700

Investments to date: approx. CHF 101,000

2018 successfully completed:
Bull Shark Populations in Fiji

With the constantly increasing overusage/overfishing of the oceans, the conservation of single key species, their populations and their habitats all gain even more importance. As a large top predator with an extensive distribution range, bull sharks belong to those key species because they significantly regulate the ecosystem in which they live. In order to manage and maintain their populations sustainably, obtaining reliable information on their distribution, reproduction, diet and behavior is essential. Bull shark populations in Fiji have already been intensely scrutinized over several years. Nevertheless many questions are still open. In the scope of her doctoral thesis at the University of the South Pacific, Fiji, Kerstin Glaus (University Basel) will address several of these questions:

- Do bull shark populations in Fiji form separate reproduction communities which must also be managed separately?
- Do bull shark populations in Fiji mix with other populations in the Indo-Pacific region or are they strongly isolated?
- How do bull sharks fit into the concept of metapopulations in which individual populations can show very specific behavioral patterns while at the same time can be influenced by the exchange of individuals between the different populations?
 Dynamic metapopulation models start off with a set of populations that are interconnected through genetic exchange, but whose genetic material is outweighed by their individual adaptations.

For this research, genetic population studies will be carried out in the bull shark nurseries around Viti Levu and Vanua Levu. Research will continue to determine the number of bull shark females who use the different nurseries, as well as the survival rate of their offspring. Cohort studies of young male bull sharks in rivers should provide insight into the behavior of the young sharks. Altogether these studies should then make it possible to estimate population sizes and establish effective management plans.

Status 2017/18: During two years of field studies, 236 juvenile bull sharks were caught, measured, tagged and released in the largest rivers of the main island Viti Levu. They include 188 in Rewa, 38 in Navua and 10 in Sigatoka. The collected data is currently being modelled and the respective publication on the prevalence of juvenile bull sharks in Fiji is expected to be submitted to the professional journal "Ecology & Evolution" in August 2018.

The genetic population structure of bull sharks in Fiji will be embedded in a transregional context. This will enable scientists to determine the gene flow between different populations and thus their degree of connectivity and isolation as they focus on populations within the Indo-Pacific oceans. Over 1,000 single nucleotide polymorphisms (SNPs) were identified and

biostatistically analyzed to determine the genetic population structure and connectivity between bull sharks from the Indo-Pacific. Results show that the bull sharks located off Fiji and New Caledonia are genetically different, while a high degree of connectivity exists between the remaining populations. One possible reason for this observation is that the gene flow between the bull sharks off Fiji and New Caledonia and the other populations is limited due to discontinuous habitats and biogeographic barriers within the oceans (e.g. currents, deep sea trenches, temperature differences).

Bull sharks belong to the viviparous shark species. Although the occurrence of juvenile bull sharks in the three river systems has been successfully documented, their exact places of birth are still unknown. In October 2017 20 acoustic receivers were thus stationed in four rivers. Eleven pregnant animals and 3 juvenile bull sharks were tagged with acoustic transmitters. The transmitters used for the young animals have a lifespan of up to 10 years so that the movements and habitat usage of bull sharks off Fiji can probably be documented for the first time over a period up to 10 years.

The project was successfully completed. Results were published in June 2019 in the scientific journal "Ecology and Evolution" under the title "Young bull sharks in Fiji's largest riverine system."

Funding 2018: CHF 15,000

Investments to date: approx. CHF 45,000

New 2018:

White Sharks in the North Atlantic: Analysis of Hormones and Microplastics

As top ocean predators, white sharks are found at the end of the food chains and are thus prone to accumulating environmental poisons such as mercury and microplastics in their bodies. The examinations of white shark populations currently under way in cooperation with Oearch should provide information on their health status. In addition a stress and other hormone examination should indicate the degree of stress experienced by white sharks when they are caught and examined.

The subproject manager, Michael Hyatt, is a veterinarian whose research on "stress through catch methods and examinations" experienced by lemon sharks, bull sharks and hammerheads in Rookery Bay have already been financed by the Foundation and published in 3 scientific journals. The project shall run for 3 years and will be supported annually with \$10,000. In September 2018 the first expedition went to Nova Scotia. In February 2019 an expedition left for southeastern Atlantic regions and another one is planned in August 2019 to Nantucket.

Funding 2018: CHF 10,000

Investments to date: approx. CHF 10,000

Short-Term Projects

Ecological analysis of blue sharks in South Cornwell (England).

Blue sharks (*Prionace glauca*) are large pelagic sharks and top global predators found in temperate and tropical waters. Like other shark species they are a vital regulation factor in their marine ecosystems.

Blue sharks are caught directly for their fins or wind up as bycatch in pelagic fishing fleets. Their current status on the Red List of Endangered Species is "Near Threatened," i.e. shortly before, or with a strong tendency to becoming "Endangered." Any respective current data on this subject is not available at the moment so that they may already have to be deemed as "Endangered".

Blue Sharks are not only threatened directly by the fishing industry but as top predators they are also exposed to another big problem, namely the accumulation of environmental toxins.

Concentrations of arsenic and mercury that exceed by far the European limits have been found in blue sharks. PCB (polychlorinated biphenyls), PAH (polycyclic aromatic hydrocarbons) and DDT (dichlorodiphenyltrichloroethane) can also accumulate in top predators, influencing their health and fertility.

Project objectives are to:

- Analyze the overall water quality along the southwestern coastline of Cornwall.
- Apply photo IDs of dorsal fins and perform population genetic analyses to determine if the region is frequented by various blue shark populations as feeding grounds, or if the local population is homogeneous.

- Determine the health status of one or more populations using chemical and genetic analyses.
- Inform and sensitize the local population and fishermen about blue sharks on the southwestern coast of Cornwall.

The project encountered some snags with regard to the biopsy needles used because blue sharks are very fast swimmers. They were resolved by the Fiji research team and Gary Adkison, President of the US Shark Foundation, thanks to their longstanding experience in collecting samples from bull sharks. This is one of many examples showing how the Shark Foundation was able to solve problems quickly and efficiently thanks to its large network of research teams.

In order to engage a broader public to help with the identification of blue sharks, an online photo databank was created. Photos of blue shark dorsal fins will be collected in this databank and will be analyzed later on.

Project Management: Dr. Andrea Gaion, South Devon College

Funding 2018: CHF 6,700

Investments to date: approx. CHF 13,200

Artisanal fishing in Angola

An alarming reduction of sharks has been noticed in West Africa, due mainly to the ever increasing demand for shark fins in the Asian region. Many shark species are affected by this threatening decrease but so far the ones being most decimated are hammerheads, lemon and bull sharks.

Angola is located in the northern part of the so-called "Benguela Current Large Marine Ecosystem (BCLME)." This is an extremely productive marine region. The confluence of the Benguela and Angola rivers produces turbulence that transports nutrient-rich deep water to the surface.

The demand for shark fins is the reason why local coastal fisheries in Angola have sharply increased, especially within the last 10 years (source FAO, United Nations Food and Agriculture Organization). Precise data on specific shark fishing is not yet available, but shall be collected in this project.

The project is progressing well. An initial interim report including data from different ports in Angola is available.

Project Management: : Dr. Rima Jabado (Environment Agency Abu Dhabi)

Funding: approx. CHF 9,500 for 2 years (2017/18-2019).

Funding 2018: CHF 0, next payment in 2019

Investments to date: approx. CHF 4,700

Public Relations (Shark Foundation and Shark Info)

Media/Public Relations

In 2018 the Foundation supported lectures, gave various interviews, wrote articles for diverse media and provided expert advice and tips on sharks and shark protection.

Web Server

In 2018 the Shark Foundation's German website recorded about 135,000 real visitors who called up 640,000 pages. The visitors stemmed mainly from Germany, Switzerland, Austria and Poland.

The English website recorded 75,500 visitors who called up 200,000 pages. Here the visitors were mainly from the US, Poland, China, the Ukraine and Germany. Most popular with hai.ch and shark.ch was the Shark Databank. Compared to 2017, the trend is clearly retrogressive due to lack of support for mobile browsers and hence a bad ranking from Google.

On hai.ch 47% (2017 44%) of the browsers were mobile versions, on shark.ch it was at least almost 22% (2017 30%). It is thus urgent that the pages are transferred into a CMS System with responsive design. This project is in progress.

Financial Policy of the Shark Foundation

Established on August 29, 1997, the Shark Foundation is an internationally active organization that falls under the supervision of the Federal Department of Home Affairs (FDHA) / Swiss Federal Supervisory Authority in Bern. The Foundation can accept tax-deductible donations and once a year it submits its annual report and financial statement to the supervisory authority for approval.

The Foundation finances all its activities through donations, presentations or the sale of products such as T-shirts or plush toy sharks. The Board of Trustees works on a voluntary basis and its members receive neither attendance fees nor salaries. The Foundation runs a "Shark Shop" on its Internet website (T-shirts, cuddly plush toy sharks, tear-off notebooks, postcards, shark sponsorships). Sales revenues flow directly into the Foundation account, and once a year all interested parties are sent a mailing requesting donations and including a pay-in slip.

In its first meeting of the respective year, the Board of Trustees of the Shark Foundation decides on the usage of any accumulated income and donation money from the previous year. Up until then no reserves are set aside; instead all funds are released to cover ongoing projects, investments and administrative costs.

The annual accounts for both the Foundation and Shark Info are checked by Revisal, an auditing company located in Gossau.
