SHARK NEWS

Newsletter
of the IUCN SSC Shark
Specialist Group
#2/2021

IUCN SSC
Shark Specialist Group

Photo by Michael Scholl | Save Our Seas Foundation

Our Vision

A world where sharks, rays, and chimaeras are valued and managed sustainably.

Our Mission

To secure the conservation, management and, where necessary, the recovery of the world's sharks, rays, and chimaeras by mobilizing technical and scientific expertise to provide the knowledge that enables action.

Photo by Mike Sealey

Covers: Stratoni is a small seaside village on the Halkidiki peninsula in Greece. What makes it unique is the presence of two seahorse species that live in the small bay, and this is perhaps the only known colony of seahorses in Greece. The Rough Ray *(Raja radula)* is another species that shares the same area. You can find them at 15-20 meters depth, on a sandy bottom where they feed on small crustaceans. When they swim, their underside looks like a smiling face, a face that definitely makes your mood whenever you photograph it!

Photos by Nicholas Samaras | underwater-photography.gr | instagram.com/nicholas_samaras/

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Editorial

A note from the Chair Rima Jabado

Dear readers,

It is a pleasure to welcome you to the second issue of Shark News, the official IUCN Species Survival Commission Shark Specialist Group (SSG) newsletter! I would like to open with heartfelt thanks again to all the members who contributed to our first issue with stories of all the great things happening in the shark conservation space. The newsletter was received with enthusiasm and we had fantastic feedback. I am so happy to have a platform where the SSG network can stay connected and informed. This second issue is even more packed with incredible stories. As you know, the challenge of shark conservation requires merging different scientific fields so we can achieve our ultimate goal of healthy shark populations. The contents of this issue reflect just that! It is loaded with information on projects being carried out across the world. It is clear that SSG members have been busy, and these stories bring optimism and hope that together we can and are making a difference. The stories are inspiring, hopeful, and engaging -- from using art as a tool for social change and education on sharks and rays, interviewing the public in Hong Kong about the shark fin trade and consumption patterns, establishing a network of researchers across the European range of Angel Sharks and developing regional action plans, collaborating across borders to save a Critically Endangered Sand Tiger Shark population in South America, using fisher knowledge to understand the status of sawfishes in Sri Lanka, organizing a regional symposium to bring together scientists and find synergies across research and management actions, exploring shark fisheries in Albania and Kenya, and studying Silky Sharks in the Atlantic Ocean. These stories are exemplary in showcasing how different individuals are pushing beyond the constraints of daily realities, taking risks despite the complexities of their situations, and proving that there are so many ways to contribute to shark conservation. Indeed, the fate of sharks is inextricably linked to all these projects, their findings, how we use them to inform policy, and our interactions with each other. But don't miss out on other news such as the first record of a juvenile Megamouth Shark from China, what shark species are listed on the Convention on Conservation of Migratory Species of Wild Animals (CMS) and what that means, an update on the beautiful 'River Jewels' – the South American Freshwater Stingrays, the hunt for the East Atlantic Pygmy Devil Ray off West Africa, information on how shark liver oil is being used, the upcoming release of the much-awaited new edition of Sharks of the World, and a new book on shark biology and conservation. You will also find an invitation to take part in a training course on the human dimensions of shark conservation, information on upcoming IUCN Red List of Threatened Species assessments and how you can get involved, and the establishment of a new Working Group on Marine Historical Ecology. I truly believe that together we can make a difference and I am excited to continue receiving these contributions and learning about everyone's work. Thank you to all the photographers that have shared their imagery – they allow us to tell the story of the diversity and beauty of sharks to an audience that can make a difference for the future of their conservation. Special thanks once again to Michael Scholl, Chair of the Communication Working Group, for coordinating all the contributions and the design of the newsletter. And finally, thank you to all the members for their dedication and contributions which continue to make Shark News a reality and the public face of shark science.

Q&A

Research, regulation, enforcement – a strategy for saving sharks

By Chelsea Stein

Photo by Stan Shea | BLOOM | bloomassociation.org

Photo by Hollie Booth | WCS

Observing shark landings in Tanjung Luar, Indonesia with local Wildlife Conservation Society staff

Lee Crockett, Executive Director of the Shark Conservation Fund, covers the group's priorities and vision for change.

Photo provided by Lee Crockett

"We are very focused on policy and legal change... we do fund research, but it has to be useful for near-term management because we are close to a tipping point on sharks, and we need to be taking action now."

That's Lee Crockett, Executive Director of the Shark Conservation Fund (SCF). He's been with SCF since 2017, just after the group came together formally in 2016. SCF is a funder's collaborative composed of philanthropists that care deeply about sharks and rays – like the Paul M. Angell Family Foundation, Paul G. Allen Family Foundation, The Moore Charitable Foundation, Oceans 5, re:wild and the Volgenau Foundation.

By pooling funds to support the development of new shark conservation policies and their enforcement, SCF aims to have a more significant immediate impact that will turn the tide for species around the world. Since SCF's launch in 2016, the group has awarded $23 million in grants to support 68 organizations and have helped leverage an additional global investment of nearly $7 million in shark conservation.

In this Q&A with Lee, we explore the SCF's funding priorities, outcomes to date, and vision for change.

Q: What are SCF's funding priorities? What are the types of grants you offer?

A: Our strategy is primarily focused on two main priorities:

1. We want to get most of the Hong Kong shark fin trade listed on the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) Appendix II. The biggest problem facing sharks globally is overfishing, whether in the high seas or coastal waters. Particularly in developing countries where fins are exported, and sharks are poorly managed. So, how do you get a developing country to care about their sharks? If a species is listed on CITES Appendix II, countries need to demonstrate that the trade in products from those species are not detrimental to the species in the wild; they need to develop a non-detriment finding (NDF) to trade the species legally. This creates an incentive for developing countries to manage shark species better when they weren't doing this at all before. But listing a species is the first step; implementation is vital for on-the-water change. We also support non-profits to go into countries and help manage sharks through things like data collection, analysis, and lending expertise on developing management plans.
2. We want to prevent extinctions. We're focused on endemic shark species, and we use geographic information system (GIS) data to plot these species' hotspots on the map, which helps focus our work. In these areas, through our grantmaking, we are hoping to establish legal protections. Endemic sharks are species like catsharks or shysharks (family Scyliorhinidae), the ones that a lot of people don't even know about, so putting legal protections in place is a first step to helping these species.

We offer larger grants up to $500,000 per year for three years, in addition to our small grant program, which typically involves $25,000 grants for projects that are one-year in duration. The beauty of the small grant program is it gives us the ability to fund really small groups in developing countries. At the same time, having large grants to fund big international NGOs is great because there are benefits to the larger capacity of the organization, and their in-country staff usually conducts the project working closely with the local government.

Q: What are some of the projects and partners SCF has worked with?

A: Below is a sample of the projects that SCF has supported financially since its inception and the results of those investments:

- **Pew Charitable Trusts and Wildlife Conservation Society** CITES listing efforts led to 18 shark species being listed on Appendix II, including ten species of wedgefish (family Rhinidae), six giant guitarfish (family Glaucostegidae), and Short and Long Fin Mako *(Isurus* spp.) in August 2019. A total of 46 species of sharks and rays are listed on CITES, approximately 25% of the Hong Kong fin trade – and our goal is to hit 50%.
- **BLOOM INC Hong Kong's** three-day training workshop for Hong Kong Customs officials in January 2020. The training gave officials the tools to make the largest seizures of illegal shark fins ever: 26 metric tons valued at over $1.1 million in May 2020. The fins originated in Ecuador, and due to the negative attention from the seizure, on June 1, 2020, the Ecuadorian government announced that the "marketing or export" of Oceanic Whitetip shark *(Carcharhinus longimanus)* and four hammerhead species *(Sphyrna* spp.*)* was prohibited, bringing the country's total number of protected shark species up to nine.
- **Shark League for the Atlantic and Mediterranean's** work with the European Union's (EU) CITES Scientific Review Group, which developed the EU's Mako NDF, to help them understand the science of and threats to Makos. The Review Group recommended a negative NDF for Makos – meaning that no EU Member States can land or trade Makos. This has led Spain and Portugal, the two largest shark fishing nations in the EU, to establish zero quotas for Mako in 2021.
- **IUCN SSC Shark Specialist Group** conducting the third IUCN Red List of Threatened Species global assessment for all shark and ray species (approximately 1,250 species). They've developed the first Red List indices for sharks that allow tracking of relative abundance trends. Results for oceanic sharks published in the journal *Nature* demonstrated a decline of over 71% spanning the last 50 years primarily due to overfishing and that 75% of these species are threatened with extinction.
- **Humane Society International – Australia's** successful lawsuit put an end to the use of lethal drum lines in the Great Barrier Reef National Park. They also secured an end to deliberate culling in this area, reducing the target list from 19 to three, with the remaining target species released if found alive. Because of this, Tiger Shark mortality is down approximately 50%.
- **Wildlife Conservation Society's** subgrant to the Misool Foundation supports a community in Indonesia as it developed new fisheries. In 2014, Indonesia introduced sweeping new laws protecting manta rays *(Mobula alfredi* and *M. birostris)*, making it illegal to use any part of the animal in response to the species being listed on CITES. This caused a major challenge to the long-standing tradition of Manta hunting by local fishers. Through the grant, the community was given a fishing boat, and local fishers were trained to use the vessel to catch different types of bony fish. A "sustainable fisheries collective" was established, through which villagers were given access to borrow money and receive a share of profits. Targeted manta hunting has declined 90-96% since 2013.

Q: Where has SCF been able to have the most impact?

A: We're delighted and excited about the IUCN SSG Red List assessment and the new Red List indices. That's huge for our work

to get people to realize the scope and urgency of the problem. It was one of the first grants we made, and the results have been helpful for management and, because of IUCN's reputation, almost unimpeachable.

The listing of commercially valuable shark species on CITES, beginning in 2013, and the requirements to demonstrate non-detriment to trade has led to national plans of action that we just weren't seeing before. This has been the driver for the work and change. We see management plans go in place through CITES implementation work, catch limits, gear restrictions – we're just starting to see things come into focus and their impacts.

I've been involved in advocacy for a long time, and you're always looking for a lever or a driver to get the government or some management agency to do the right thing. I learned a long time ago that just because it's the right thing to do or because science says it's the right thing to do, doesn't mean managers will do it. So, you need to figure out a way to overcome these opposing forces and get entities to do the right thing, and I think CITES is a particularly effective tool for that.

Q: What's next on the horizon for SCF?

A: The next step we'll be looking at is the enforcement side of things because even if species are listed on CITES and new management measures are put in place, illegal trade will undercut those new measures. There are positive and negative incentives to get countries to manage their sharks better. We provide positive support by funding capacity building. But, getting a shipment of fins seized, fines assessed, and the attention that derives from that is an example of a negative incentive.

We'd also like to use the 30 by 30 initiative to protect 30% of all wild land and water by 2030, to enhance shark conservation. For example, when marine protected area (MPA) funders go into a country, and they're looking at what areas to protect, we hope to emphasize the critical regions for sharks – looking at migration patterns, pupping grounds, nursery areas – and applying that information to the decisions of where to site these MPAs and the development and implementation of management plans. We're just starting this work now; Oceans 5 is beginning a project in Namibia where spatial data about sharks will be applied to the siting and decision-making process. We hope this becomes a pilot program to show other funders how this process would work.

Longer-term, I'm interested in working with development banks that are putting hundreds of millions of dollars into promoting sustainable terrestrial communities worldwide. Once we have the legal framework in place to protect sharks, I want to get development banks to come in and support alternate livelihoods and other ways for communities to succeed without killing sharks. Long-term sustainability has to address the human aspect of conservation.

Bottom line, SCF's focus is on changing policy, changing laws and locking in policy gains right now. We just see the urgency of the declining status of sharks and the health of populations around the world as overriding everything else. This urgency causes the SCF board and me to re-double our efforts because we need to put protections in place now and make sure that the research we fund has a direct connection to immediate management to begin to turn the tide for sharks.

Shark Conservation Fund

The Hunt for a Pygmy Devil

Written by Simon Hilbourne[1], Guy Stevens[1], Aristide Takoukam[1] and Giuseppe Notarbartolo di Sciara[1, 2]

[1] Manta Trust
[2] IUCN SSC Shark Specialist Group | Mediterranean Regional Group | Member

A lifeless ray laying on the tiled floor of a fish market in Senegal attracts little attention from passers-by. It is a sad sight, but one that is unfortunately common throughout many tropical countries worldwide. Mantas and Devil Rays (collectively referred to as mobulids) are caught by targeted and bycatch fisheries in their tens of thousands annually. For most visitors to this market, it was just a typical day. However, it was special for the Manta Trust team because this little ray may represent the beginning of a species resurrection - the East Atlantic Pygmy Devil Ray *(Mobula rochebrunei).* And if not a resurrection, some answers to an important conservation question.

First described in 1879 by L. Vaillant, this species was named *Cephaloptera rochebrunei*. The genus *Cephaloptera,* which translates from Greek to 'head-wings' and refers to the species' cephalic lobes, is now obsolete (Fig. 1). There was little in the way of mentions of, or research on, this species following its description until some eighty years later when more detailed data were collected. From this point forward, the often-changing taxonomic status of the East Atlantic Pygmy Devil Ray, and the entire mobulid family, for that matter, begins.

In 1960, a French marine biologist named Jean Cadenat studied several dozen specimens of this species on the West African coast, several of which he preserved from Senegal, but many have since been lost (Fig. 2). The only remaining preserved specimen of *M. rochebrunei* is the stuffed holotype in the National Museum of Nature History in Paris. In 2017, Manta Trust researchers attempted to analyse tissue samples from this poorly preserved specimen as part of a global genetics study. However, the quality of the tissue was too degraded for analysis and was therefore left out of the study.

Around the same time, a different team of genetic researchers conducted a similar global mobula genetic study. It was this paper that led to the amalgamation of the *Manta* genus into *Mobula*. After genetic analysis of the same single holotype specimen of *M. rochebrunei* from Senegal, these authors concluded that this species was no longer valid. Instead, the researchers suggested it to be synonymous with *M. hypostoma,* the West Atlantic Pygmy Devil Ray. The Manta Trust team feels

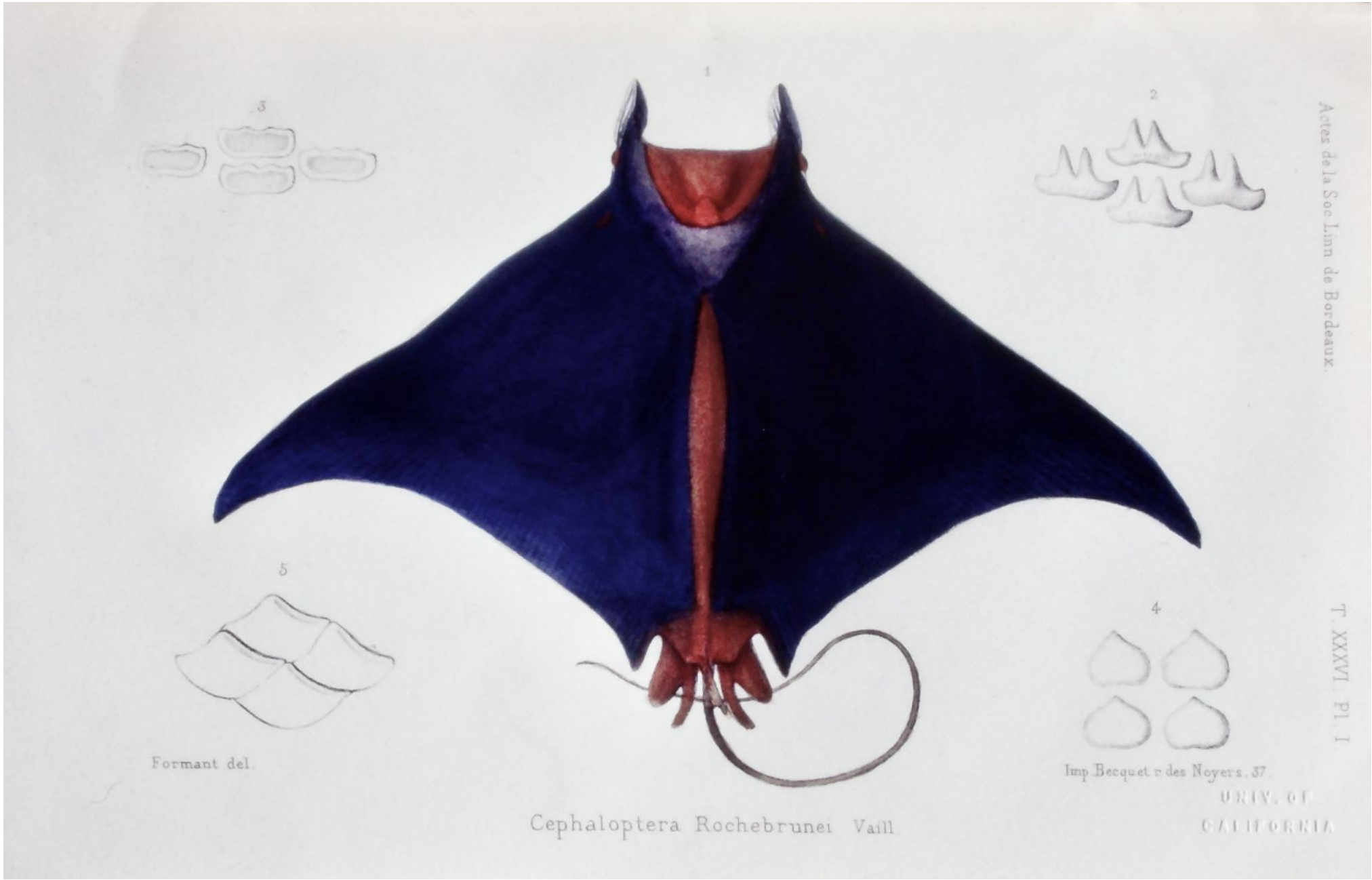

Figure 1
The 1879 original illustration of *Mobula rochebrunei*, then *Cephaloptera rochebrunei*.
© L. Vaillant.

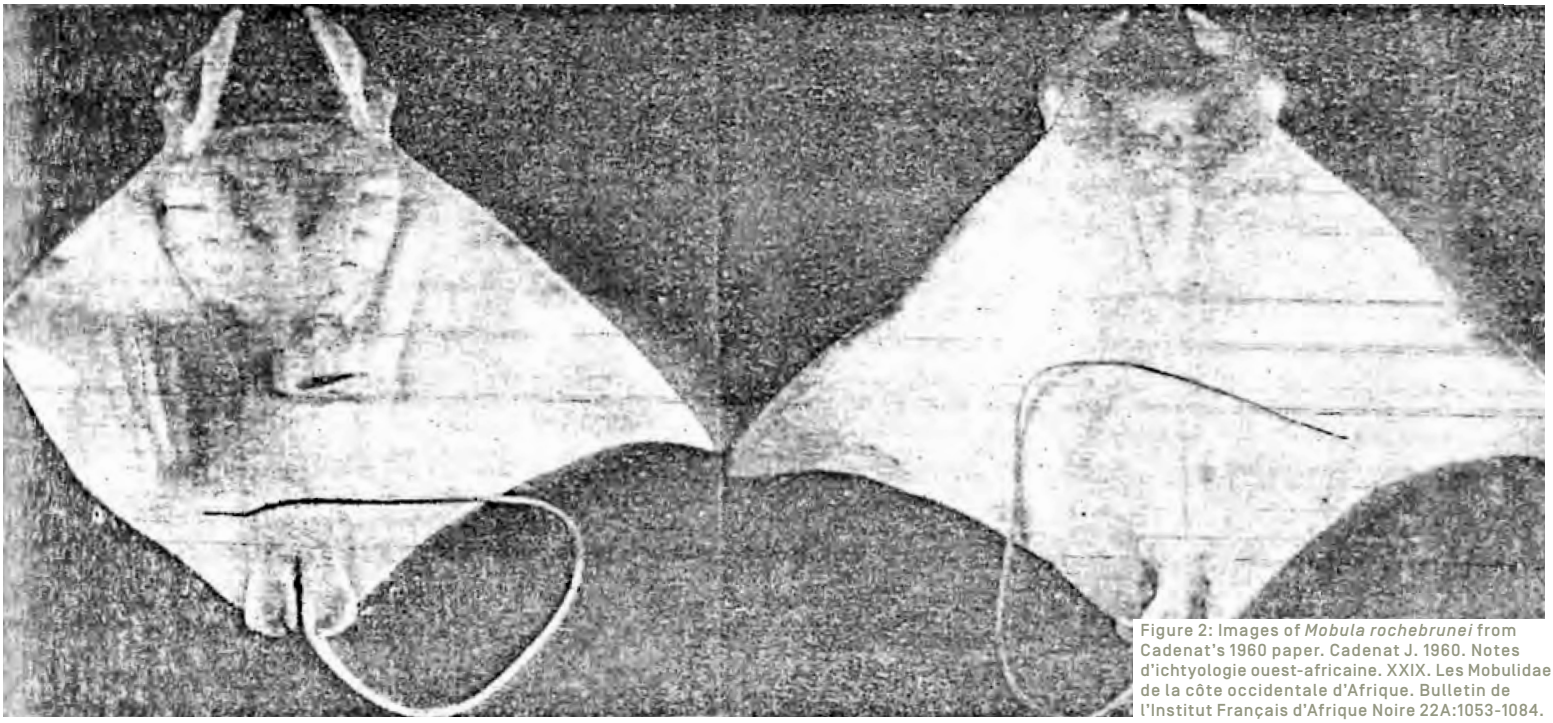

Figure 2: Images of *Mobula rochebrunei* from Cadenat's 1960 paper. Cadenat J. 1960. Notes d'ichtyologie ouest-africaine. XXIX. Les Mobulidae de la côte occidentale d'Afrique. Bulletin de l'Institut Français d'Afrique Noire 22A:1053-1084.

more data are required before the species should be considered a junior synonym of another species. The consequences of this quasi-extinction on the conservation of the population are dire. Therefore, our hunt continues to find more specimens of this species to undertake further genetic analysis.

Six years ago, the Save Our Seas Foundation funded a Manta Trust project to go out and search for specimens of the West Atlantic Pygmy Devil Ray. As is sometimes the case with fieldwork, things did not exactly go to plan. The team hoped to travel to Guinea, Senegal, and other West African countries to survey fish markets in the hope of finding specimens. With Isabel Ender already in Senegal and Daniel Fernando on route from Doha, things quickly took a turn for the worse when an outbreak of the Ebola virus made it unsafe for the team to visit the countries they hoped. So, instead, Daniel and Isabel changed their plans and carried out surveys in Morocco and Western Sahara further to the north. Unfortunately, they did not find what they were looking for.

After the disappointment of the field trip, we re-directed our remaining funding to support a local fisheries researcher based in Guinea, Framoudou Doumbouya, to collect elasmobranch fisheries landing data for the following year. However, alas, still no confirmed *M. rochebrunei* could be found. As a result, no specimens or tissue samples of this species have been collected since Cadenat's study in the 1960s. Over recent years, however, a few compelling images of mobula rays from Cameroon, Gabon, and Guinea have appeared on the Manta Trust's radar, reigniting our hopes of finding this species. In October 2020, we created a 'WANTED' poster for *M. rochebrunei*. With the help of the African Marine Mammal Conservation Organization (AMMCO) and the volunteer fishers of the SIREN citizen science program established by Aristide Takoukam, we disseminated the posters in English, French, and Portuguese to researchers working in fish markets across the region (Fig. 4).

Remarkably, just a month later, we were sent images by the president and founder of AMMCO, Aristide Takoukam, of what we have been searching for. The little ray Aristide's contacts had collected had been landed in a fish market in Cameroon. We believe this is a new specimen of the elusive Pygmy Devil Ray (Fig. 3) from initial observations and images. The Manta Trust arranged for a fridge to be purchased and used to store the specimen. Unfortunately, now COVID-19 instead of Ebola is hampering our efforts to get this sample back to the UK to run genetic tests.

Even if this Pygmy Devil Ray does indeed turn out to be a junior synonym of *M. hypostoma*, this West African population is likely to be extremely susceptible to extinction given the state of fishing in the region and the localised and nearshore habitat requirements of this species. Therefore, the sooner we can undertake further research on this species, the quicker we can aid effective conservation management efforts.

If you have any further information about this species, and you would like to help, please contact the Manta Trust at info@mantatrust.org

Article originally published on the Manta Trust's Cyclone platform' with a link here mantatrust.org/the-cyclone

© AMMCO

Figure 3. Could this be a specimen of the elusive *Mobula rochebrunei?*

Figure 4: WANTED poster for Mobula rochebrunei, posted in fish markets around West Africa.

•WANTED•

East Atlantic Pygmy Devil Ray

Mobula rochebrunei

This species has not been officially recorded since 1960. Due to overfishing across the region, it is likely near extinction. But there is some hope. We have seen photographs that look like this species, or its close relative found on the other side of the Atlantic - *Mobula hypostoma*. To confirm this, we need more information and YOU can help us!

What to do if you find a specimen:

1) Take lots of photos of the animal's features (including close ups of the head, tail, sexual organs, etc; both ventrally and dorsally).
2) Take lots of measurements (e.g. disc width, body length, etc.).
3) Collect tissue samples - 3 samples of 1 gram each: 2 frozen, 1 stored in ethanol (not methanol).
4) Ideally collect the whole specimen and preserve it frozen.
5) Contact the Manta Trust (**info@mantatrust.org**)

For detailed information about what to collect visit:
www.mantatrust.org/resources

For full species description visit:
www.mantatrust.org/mobula-rochebrunei

Manta TRUST

Contact info@mantatrust.org for more information or to report a potential sighting!

Photo by Renato H. A. Freitas

Photo by Luciano Fischer

In Memory of Professor Carolus Maria Vooren

Dr Maria Cristina Oddone

IUCN SSC Shark Specialist Group |
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Professor Vooren and Maria Cristina Oddone during his last visit to Laboratório de Morfologia II-Pesquisa em Chondrichthyes, at FURG, on May 3, 2019

Professor Vooren and Maria Cristina Oddone during a research cruise onboard the R/V 'Atlântico Sul' (FURG), observing specimens of *Gurgesiella atlantica*, on August 10, 2001

With great sadness, we share that last March 12, we lost one of our most committed researchers in fighting for chondrichthyan species conservation in South America. Professor Dr Carolus Maria Vooren was born in Rotterdam (The Netherlands) on November 14, 1941, and he passed away at the age of 79, on March 12, 2021, at his home in Rio Grande (Southern Brazil). Apart from being an outstanding professor and researcher in the field of elasmobranch fishes, he also became a pioneer in the studies of seabirds in Brazil. In the last two decades, he developed many activities that emphasized his strong determination to preserve Southern Brazilian elasmobranch species. It can be said that he devoted his last years to conservation and to how to put it in practice in an active and determined way so that the most threatened species could find a way to survive. He saw these species as evolutionary pieces, some of them from the Jurassic, which urged them to be respected, admired and preserved for future generations. Among his most beloved species were the demersal and coastal ones, like the Angel Sharks (genus *Squatina)*, the Brazilian Guitarfish *Pseudobatos horkelli* and the Striped Smooth-hound *Mustelus fasciatus*. Professor Vooren participated very actively in many IUCN Red List of Threatened Species chondrichthyan species assessments, mainly for the Southern South America diversity hotspot region. He also was one of the leading specialists for the Brazilian Red List Assessments and was one of the Chondrichthyes taxon coordinators for some time. Professor Vooren was also one of the founding members of the Brazilian Elasmobranch Society (SBEEL).

Many of the present leading elasmobranch researchers in Brazil were once his undergraduate or graduate students, having definitely left his shark and ray conservation concerns in their hands now. He always approached oral or poster presenters with more questions than answers and often pointed to a different way of thinking or understanding morphology, biological process, fisheries, and many other topics. He published five books, 30 book chapters, and over 50 scientific papers with many of his students during his career. Professor Vooren retired in 2010 but kept his research activities until his health condition allowed, in the last months of 2020. In 2019, SBEEL, in partnership with the Brazilian National Plan of Action for Threatened Sharks and Rays Group and Technical Advisory Group (GAT), established that we would celebrate the Sharks and Rays National Day on his birthday date (November 14), as a tribute to his efforts towards elasmobranch conservation in the country. We will all miss him very much. Thank you for teaching us so much!

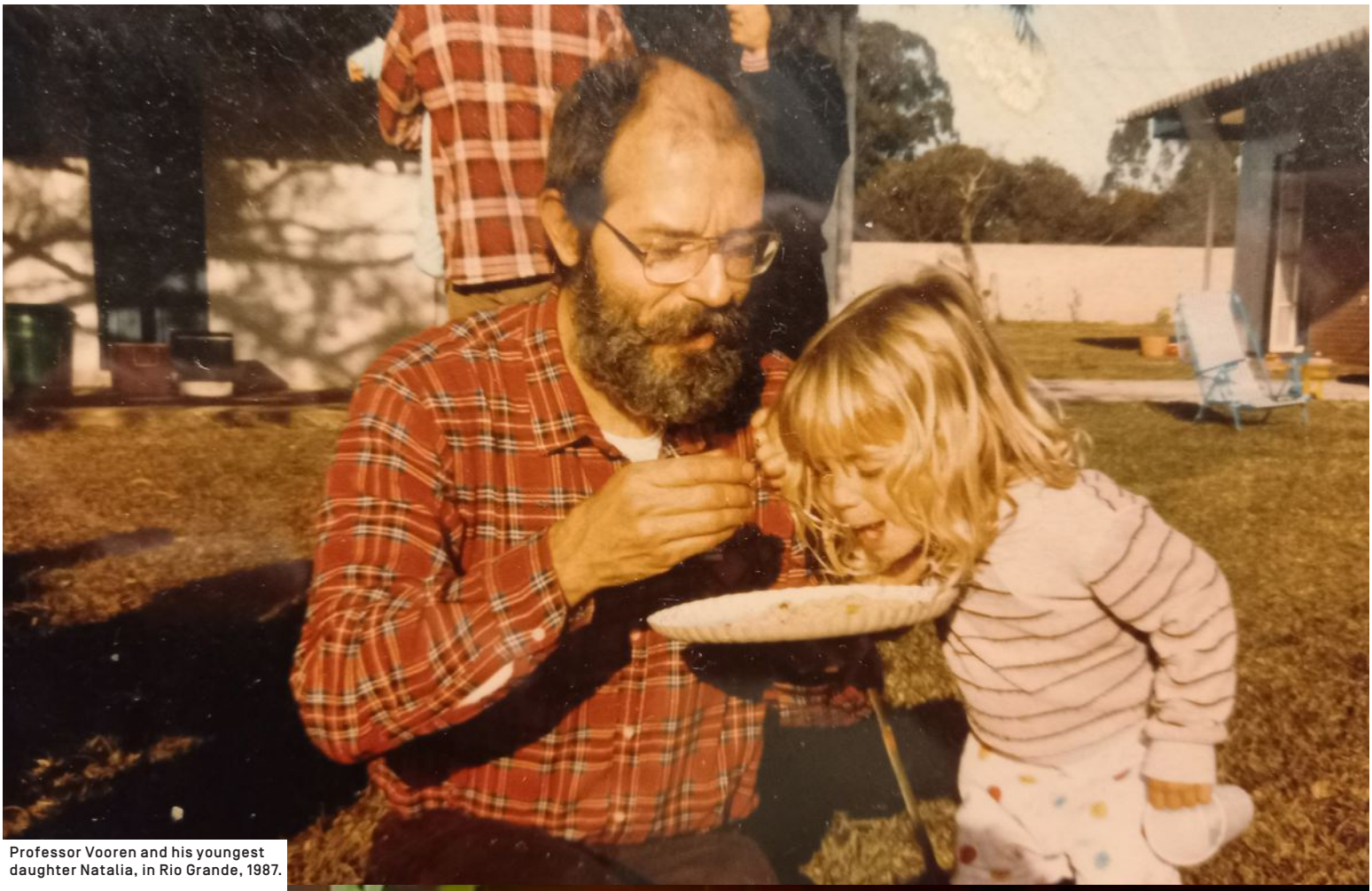


Photo provided by Natalia Vooren

Professor Vooren and his youngest daughter Natalia, in Rio Grande, 1987.

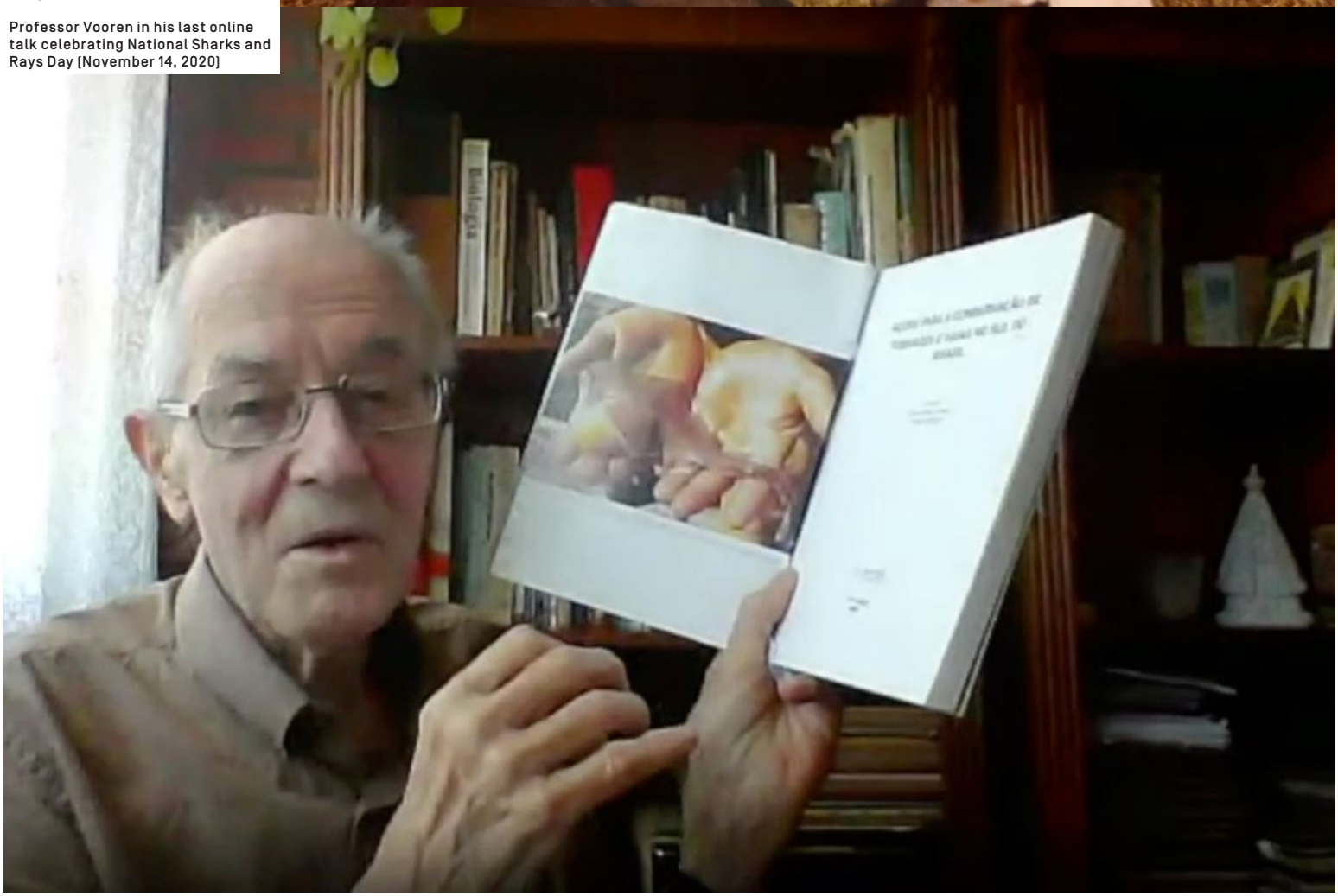


Photo by Patricia Charvet

Professor Vooren in his last online talk celebrating National Sharks and Rays Day (November 14, 2020)

The Convention on Migratory Species and Sharks*

*The term 'shark' refers to all species of sharks, rays, and chimaeras.

Text by Jennifer Pytka and Andrea Pauly

What is CMS?

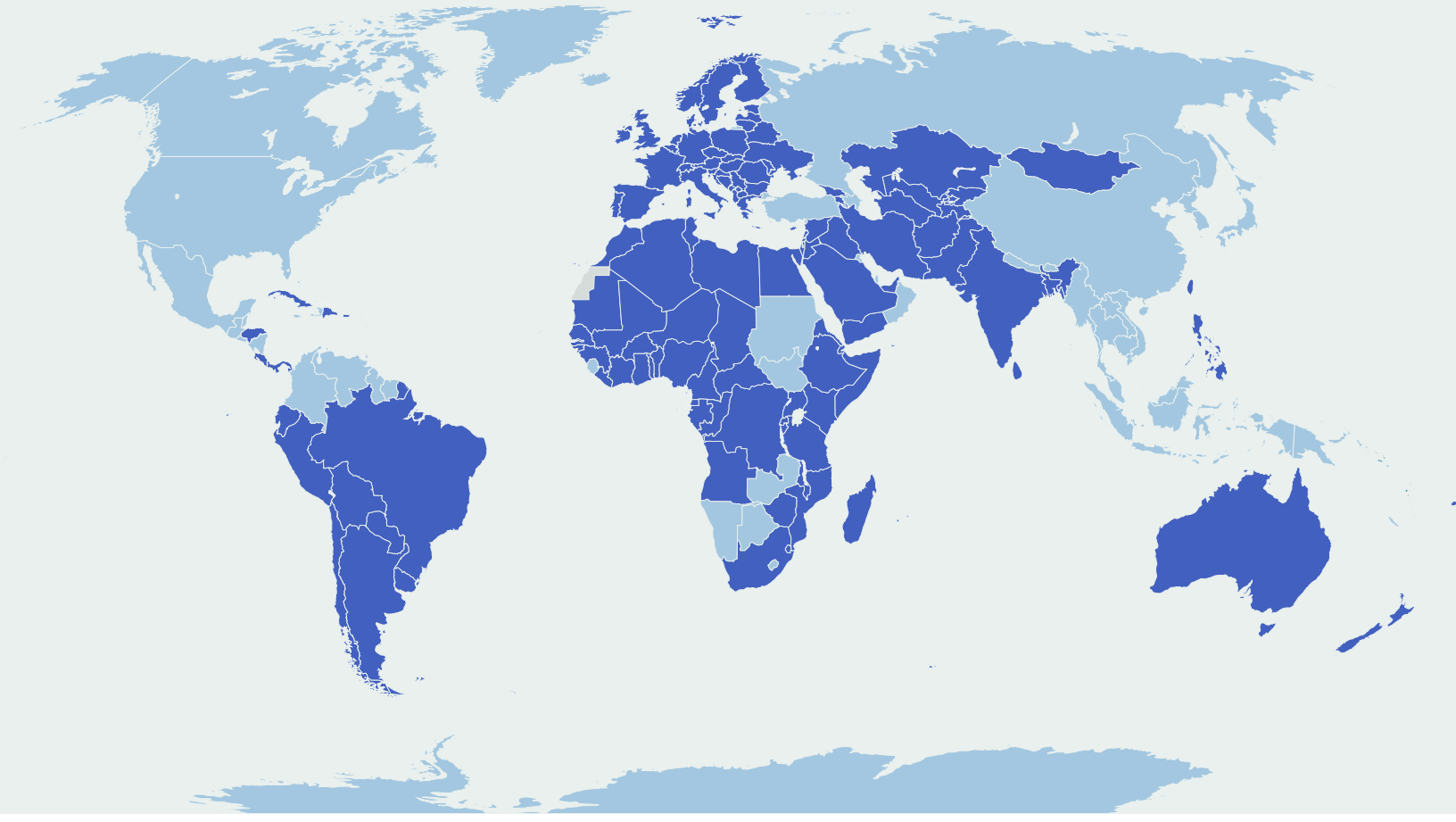
The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, is an intergovernmental treaty under the United Nations Environment Programme (UNEP). It serves as a global platform for the conservation and sustainable use of migratory animals and their habitats. The Convention was signed in 1979 and, as of April 2021, includes 132 Parties.

What is considered a migratory species?

A **migratory species** is defined as: 'the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a **significant proportion** of whose members **cyclically** and **predictably** cross one or more national jurisdictional boundaries.'

Cyclically relates to a cycle of any nature, such as astronomical (circadian, annual etc.), life or climatic, and of any frequency.

Predictably implies that a phenomenon can be anticipated to recur in a given set of circumstances, though not necessarily regularly in time.



Map showing Parties ● and non-Parties ● to the Convention on the Conservation of Migratory Species of Wild Animals (CMS) (as of April 2021). Source: www.cms.int

Migratory species are listed in two different Appendices (I and II) depending on their conservation status. However, it is important to note that a migratory species can also be listed in both Appendices.

What does a CMS-listing mean?

CMS Appendices can be amended at any Conference of the Parties, held every three years. Once Parties agree to listings, these enter into force 90 days later. It is important to note that Parties can also submit a reservation regarding a listing on either Appendix, which exempts the Party from the obligations under the Convention for the species concerned.

When submitting proposals for listings, information on whether the entire or only part of the population undertakes migrations needs to be provided with details of why this should be considered **a significant proportion of the population.**

An **Appendix I** listing is for migratory species that are considered **endangered**. In the context of CMS, endangered refers to a species or regional population that has been assessed as Extinct in the Wild, Critically Endangered, or Endangered using the IUCN Red List of Threatened Species categories and criteria. If a species has been assessed in a lower IUCN Red List threat category (e.g., Near Threatened), a special consideration can be made for an Appendix I listing if its status is deteriorating and the listing would be beneficial for its conservation.

A **Range State** is any State that exercises jurisdiction over any part of the range of a migratory species, or a State, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species.

For all species listed on Appendix I, Range States **shall endeavour to** conserve or restore habitats important to a migratory species' positive conservation status, take actions to prevent or reduce obstacles to migration, as well as measures to prevent factors that are endangering species. These Range States **shall prohibit the taking** of all Appendix I-listed species. However, exceptions to the prohibition can be made for (1) scientific purposes, (2) enhancing the propagation of the species, (3) traditional subsistence use, and (4) extraordinary circumstances.

Taking refers to taking, hunting, fishing, capturing, harassing, deliberate killing, or attempting to engage in any of the stated conducts.

An **Appendix II** listing is for migratory species which have an **unfavourable conservation status** and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement. A species that has been assessed as Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, or Near Threatened on the IUCN Red List is eligible for consideration.
If one of the following criteria for a favourable conservation status are not met, a species is considered to have an unfavourable conservation status. These include:

(1) population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems;
(2) the range of the migratory species is neither currently being reduced, nor is likely to be reduced, on a long-term basis;
(3) there is, and will be in the foreseeable future sufficient habitat to maintain the population of the migratory species on a long-term basis; and
(4) the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management.

What other provisions exist for CMS-listed species?

There are a number of other provisions that Parties and Range States can agree on to take necessary steps to conserve migratory species and their habitats. Parties are **encouraged** to conclude **Agreements** that would be beneficial for a listing's conservation status. For sharks, the Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MOU) was established in 2010. Parties have also adopted a number of **Resolutions** and **Decisions** that are relevant to sharks including (but not limited to):

Resolution 12.22 and Decisions 13.62 to 13.63 on Bycatch
Parties have agreed to a comprehensive set of measures to avoid incidental capture and minimize mortality of CMS-listed sharks.

Resolution 13.3 and Decisions 13.71 to 13.73 on Chondrichthyan Species
Parties are requested to implement a comprehensive list of measures to minimize threats to migratory shark species, improve knowledge, monitoring, data sharing, legislation and international cooperation.

Concerted Actions
Parties have adopted Conservation Actions which are priority conservation measures, projects, or agreements undertaken to improve the conservation status of selected species or groups under Appendix I and II.

Further reading:

CMS, Convention on the Conservation of Migratory Species of Wild Animals, cms.int/en

CMS, Convention Text, 23 June 1979, available at cms.int/en/convention-text

CMS, Bycatch, 5 December 2017, UNEP/CMS/Resolution 12.22, available at cms.int/en/document/bycatch-0

CMS, Chondrichthyan Species (Sharks, Rays, Skates and Chimaeras), 7 April 2020, UNEP/CMS/Resolution 13.3, cms.int/en/document/chondrichthyan-species-sharks-rays-skates-and-chimaeras-2

CMS, Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), 22 May 2020, cms.int/en/species/appendix-i-ii-cms

CMS, Concerted Action for the Angelshark (Squatina squatina), 29 May 2020, UNEP/CMS/Concerted Action 12.5 (Rev.COP13), available at https://www.cms.int/en/document/concerted-action-angelshark-squatina-squatina-1

CMS, Concerted Action for the Mobulid Rays (Mobulidae), 29 May 2020, UNEP/CMS/Concerted Action 12.6 (Rev.COP13), available at cms.int/en/document/concerted-action-mobulid-rays-mobulidae-2

CMS, Concerted Action for the Whale Shark (Rhyncodon typus), 29 May 2020, UNEP/CMS/Concerted Action 12.7 (Rev.COP13), available at cms.int/en/document/concerted-action-whale-shark-rhincodon-typus-2

CMS, Concerted Action for the Common Guitarfish (Rhinobatos rhinobatos), the Largetooth Sawfish (Pristis pristis) and the Smalltooth Sawfish (Pristis pectinata), 29 May 2020, UNEP/CMS/Concerted Action 13.8, available at cms.int/en/document/concerted-action-common-guitarfish-rhinobatos-rhinobatos-largetooth-sawfish-pristis-pristis

CMS, Concerted Action for the Common Guitarfish (Rhinobatos rhinobatos) and the Bottlenose Wedgefish (Rhynchobatus australiae), 29 May 2020, UNEP/CMS/Concerted Action 13.9, available at cms.int/en/document/concerted-action-common-guitarfish-rhinobatos-rhinobatos-and-bottlenose-wedgefish

CMS, Bycatch, UNEP/CMS/Decisions 13.62 to 13.63, available at cms.int/en/page/decisions-1361-1363-bycatch

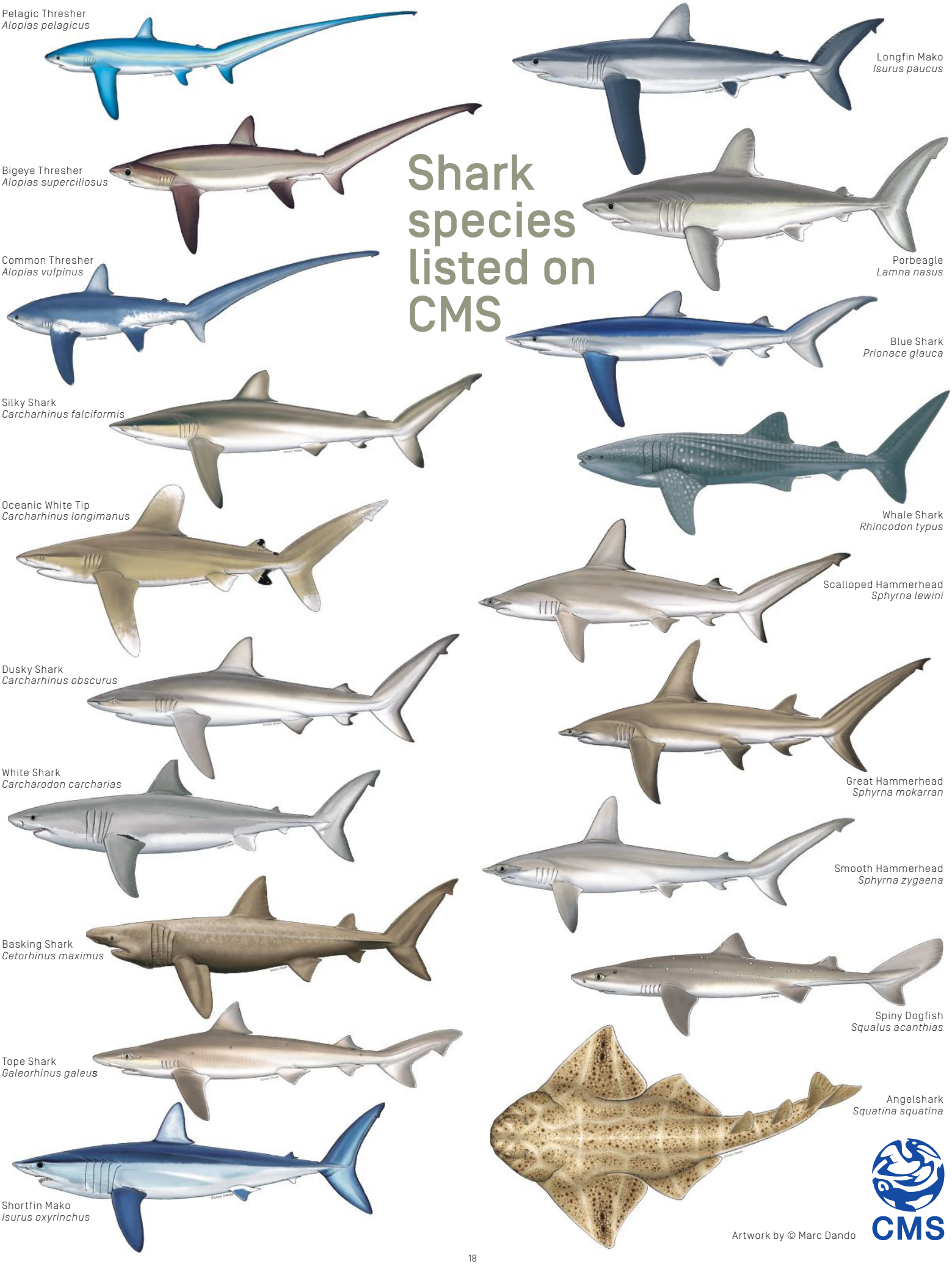
CMS, Chondrichthyan Species (Sharks, Rays, Skates and Chimaeras), UNEP/CMS/Decisions 137.71 to 13.73, available at cms.int/en/page/decisions-1371-1373-chondrichthyan-species-sharks-rays-skates-and-chimaeras

Which species are covered by the Convention?

There are currently 37 shark species listed on CMS. The following table provides information on each of these species along with the Appendix they are listed on and the year they were listed. An [1] indicates that Concerted Actions have been adopted for the species; indicates that only the Mediterranean population of this species has been listed on Appendix I; [2] indicates that only the Northern Hemisphere population has been listed; [3] indicates that the taxonomy of these species has changed since they were listed and changes have been made to their scientific names. For example, the genus *Manta* is no longer considered valid and has changed to *Mobula; Mobula japanica* is a synonym of *Mobula mobular; Mobula eregoodootenke* is now known as *Mobula eregoodoo*; and *Mobula rochebrunei* is believed to be an invalid species. Species reservations are denoted by a two-letter country code: AU=Australia; DK=Denmark, applies only to Faroe Islands; NO=Norway; SA=South Africa; UK= UK territories of Bermuda, Montserrat and the Turks and Caicos.

Order and Family	Species Scientific Name	Common Name	App I	App II	Year Listed
SHARKS					
Order Orectolobiformes					
Rhincodontidae	*Rhincodon typus**	Whale Shark	x	x	2017[App1]
					1999[App2]
Order Lamniformes					
Lamnidae	*Carcharodon carcharias*	White Shark	x	x	2002
	Isurus oxyrinchus	Shortfin Mako		x	2008
	Isurus paucus	Longfin Mako		x	2008
	Lamna nasus	Porbeagle		x	2008
Cetorhinidae	*Cetorhinus maximus*[AU,DK,NO]	Basking Shark	x	x	2005
Alopiidae	*Alopias pelagicus*[AU]	Pelagic Thresher		x	2014
	Alopias superciliosus[AU]	Bigeye Thresher		x	2014
	Alopias vulpinus[AU]	Common Thresher		x	2014
Order Carcharhiniformes					
Triakidae	*Galeorhinus galeus*[AU]	Tope Shark		x	2020
Carcharhinidae	*Carcharhinus falciformis*	Silky Shark		x	2014
	Carcharhinus longimanus[UK]	Oceanic White Tip	x		2020
	Carcharhinus obscurus[AU]	Dusky Shark		x	2017
	Prionace glauca[AU,SA]	Blue Shark		x	2017
Sphyrnidae	*Sphyrna lewini*[AU]	Scalloped Hammerhead		x	2014
	Sphyrna mokarran[AU]	Great Hammerhead		x	2014
	Sphyrna zygaena[AU]	Smooth Hammerhead		x	2020
Order Squaliformes					
Squalidae	*Squalus acanthias*	Spiny Dogfish		x[2]	2008
Order Squantiformes					
Squatinidae	*Squatina squatina**	Angelshark	x	x	2017
RAYS					
Order Rhinopristiformes					
Rhinidae	*Rhynchobatus australiae**[AU]	Bottlenose Wedgefish		x	2017
Rhinobatidae	*Rhinobatos rhinobatos*	Common Guitarfish	x[1]	x	2017
Pristidae	*Anoxypristis cuspidata*	Narrow Sawfish	x	x	2014
	Pristis clavata	Dwarf Sawfish	x	x	2014
	*Pristis pectinata**	Smalltooth Sawfish	x	x	2014
	*Pristis pristis**	Largetooth Sawfish	x	x	2014
	Pristis zijsron	Green Sawfish	x	x	2014
Order Myliobatiformes					
Mobulidae*	*Mobula alfredi*[3]	Reef Manta Ray	x	x	2014
	Mobula birostris[3]	Giant Manta Ray	x	x	2011
	Mobula eregoodoo[3]	Pygmy Devilray	x	x	2014
	Mobula hypostoma	Atlantic Devilray	x	x	2011
	Mobula japanica[3]	Spinetail Devilray	x	x	2014
	Mobula kuhlii	Shortfin Devilray	x	x	2011
	Mobula mobular	Giant Devilray	x	x	2014
	Mobula munkiana	Munk's Devilray	x	x	2011
	Mobula rochebrunei[3]	Lesser Guinean Devilray	x	x	2014
	Mobula tarapacana	Sicklefin Devilray	x	x	2011
	Mobula thurstoni	Bentfin Devilray	x	x	2011

Shark species listed on CMS



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CMS

Ray species listed on CMS

Reef Manta Ray
Mobula alfredi

Giant Manta Ray
Mobula birostris

Pygmy Devilray
Mobula eregoodoo

Atlantic Devilray
Mobula hypostoma

Giant Devilray
Mobula mobular

Spinetail Devilray
Mobula japanica

Shortfin Devilray
Mobula kuhlii

Munk's Devilray
Mobula munkiana

Lesser Guinean
Devilray
Mobula rochebrunei

Sicklefin Devilray
Mobula tarapacana

Bentfin Devilray
Mobula thurstoni

Narrow Sawfish
Anoxypristis cuspidata

Dwarf Sawfish
Pristis clavata

Smalltooth Sawfish
Pristis pectinata

Largetooth Sawfish
Pristis pristis

Green Sawfish
Pristis zijsron

Common Guitarfish
Rhinobatos rhinobatos

Bottlenose Wedgefish
Rhynchobatus australiae

Artwork by © Marc Dando

CMS

The Quagga Catshark

Written by Michelle Scott

Dorsal view of *Halaelurus quagga*.

Lateral view of *Halaelurus quagga*. Photo by K.V. Akhilesh. Specimen collected from the southwest coast of India (2011).

5cm

Shark Spotlight

Taxonomy

The Order Carcharhiniformes includes 295 species from 51 genera and nine families: Carcharhinidae (requiem sharks), Hemigaleidae (weasel sharks), Leptochariidae (barbeled houndshark), Proscylliidae (finback catsharks), Pseudotriakidae (false catsharks), Pentanchidae and Scyliorhinidae (catsharks), Sphyrnidae (hammerhead sharks) and Triakidae (houndsharks). This order contains some of the most well-recognised shark species including the Tiger Shark *(Galeocerdo cuvier)* and the Bull Shark *(Carcharhinus leucas)*, as well as the Hammerhead sharks (family Sphyrnidae).

Until recently, the Scyliorhinidae was considered the largest family with at least 160 species from 18 genera (as of November 2019). However, the Scyliorhinidae sensu lato has been shown to be paraphyletic and the subfamily Pentanchinae is now considered a valid family, sister to the family Scyliorhinidae sensu stricto. Following this classification, the Scyliorhinidae contains 50 species from seven genera and the Pentanchidae 110 species from 11 genera. Nevertheless, the taxonomy of catsharks is still problematic and in urgent need of revision.

With the expansion of deepwater fisheries and research efforts in deeper waters, new species are being discovered and described very quickly. The largest catshark genus *Apristurus* (Demon catsharks) contains at least 39 species, while the smallest *Cephalurus* and *Pentanchus* contain a single species each, the Lollipop Catshark *(C. cephalus)* and the Onefin Catshark *(P. profundicolus)*. The catsharks are found worldwide, albeit mostly with restricted ranges, usually on or near the seabed from the intertidal zone to depths of over 2,000 m.

Morphology

The Quagga Catshark *(Halaelurus quagga)* is one of seven species in the genus *Halaelurus* (family *Pentanchidae*). It was discovered in 1899 but has remained poorly understood. The Quagga Catshark was named due to its banded markings which resembled that of the Quagga, a sub-species of the plain Zebra that was endemic to South Africa until it was hunted to extinction in the late 19th century. The Quagga Catshark has a light brown dorsal surface with a dark brown banded pattern of more than 20 narrow vertical bands that form saddles under the dorsal fins. Its ventral surface is whitish with additional whitish markings on the pectoral, pelvic and anal fin posterior margins. Reaching a maximum total length of 37 cm, this is a small shark. At birth it is reported to have a total length of approximately 8 cm. The snout of the Quagga Catshark is knob-like but not prominently upturned.

Distribution and habitat

Reports of the Quagga Catshark are rare and fragmented. It is believed to be endemic to the northwest Indian Ocean and occurring off southwestern India and Somalia. The first record was of a male taken from the Arabian Sea coast of India (off Malabar) at a depth of 186.5 m in 1899. The second record from Indian waters was over 100 years later. Four individuals were reported, two males and two females (one gravid), caught from depths ranging between 90 m and 220–280 m. Further records were published from off Somalia based on specimens collected in the 1960s.

Conservation measures and IUCN Red list status-

The Quagga Catshark has been assessed as Data Deficient on the IUCN Red List of Threatened Species. Feeding primarily on a diet of shrimps, this shark may be taken as bycatch by commercial deep-sea shrimp and demersal trawlers. It has no known economic value and with its small size, it is likely to be discarded at sea if caught. The development and increase of deep-sea shrimp bottom trawls in southern India is suspected of having resulted in population declines though further data are required to confirm this. Information on deep-water fisheries in Somalia is limited and the absence of monitoring and enforcement has resulted in high levels of illegal and unregulated fishing activity within its Exclusive Economic Zone. Dedicated surveys are necessary to develop population and abundance estimates with a specific need to assess bycatch rates in the Indian deep-sea shrimp trawl fishery.

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ANGEL SHARKS

A growing network to safeguard the future of these Critically Endangered sharks

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Resting adult Angelshark (*S. squatina*) in its typical habitat

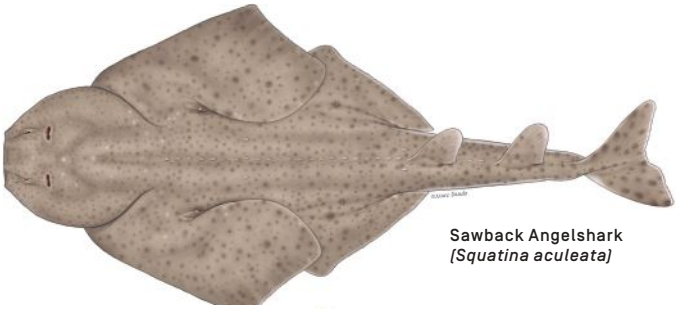
Authors: Eva Meyers[1], Charlotte Pike, Dave Jacoby, Lucy Mead, Jake Davies, Sarah Al Mabruk[2], Ioannis Giovos[2], Patrik Krstinic, Simone Niedermüller, Joanna Barker, Michael Sealey, Belen Caro, David Jimenez Alvarado

[1] IUCN SSC Shark Specialist Group | Northern Europe Regional Group | Member
[2] IUCN SSC Shark Specialist Group | Mediterranean Regional Group | Member

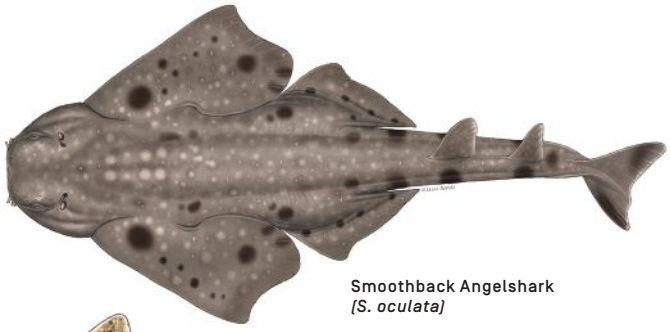
Angel Sharks

Angel sharks (family Squatinidae) are among the most threatened fish worldwide, facing significant threats across the globe. Three species of Angel Sharks: the Sawback Angelshark (*Squatina aculeata*), the Smoothback Angelshark *(S. oculata)* and the Angelshark (*S. squatina*), historically inhabited the Northeast Atlantic, the Mediterranean Sea, and the Black Sea. However, following dramatic declines associated with intensification of fisheries, habitat loss, and the species' slow reproductive rates, the three species have been assessed as Critically Endangered by the International Union for the Conservation of Nature (IUCN) Red List of Threatened species.

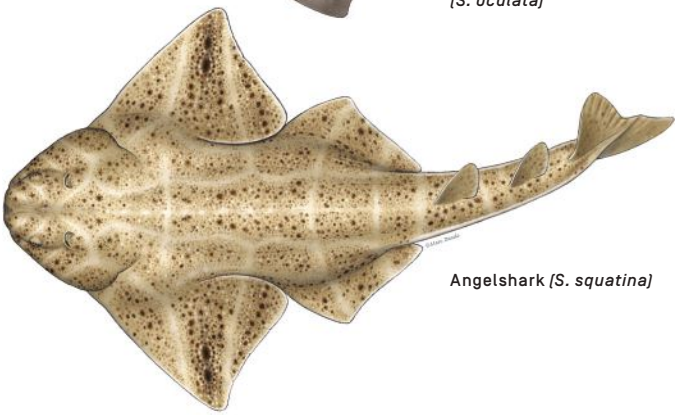
Invisible, hidden and overlooked. For decades, these flat-bodied ambush predators have remained under the radar of science and conservation.



Sawback Angelshark *(Squatina aculeata)*

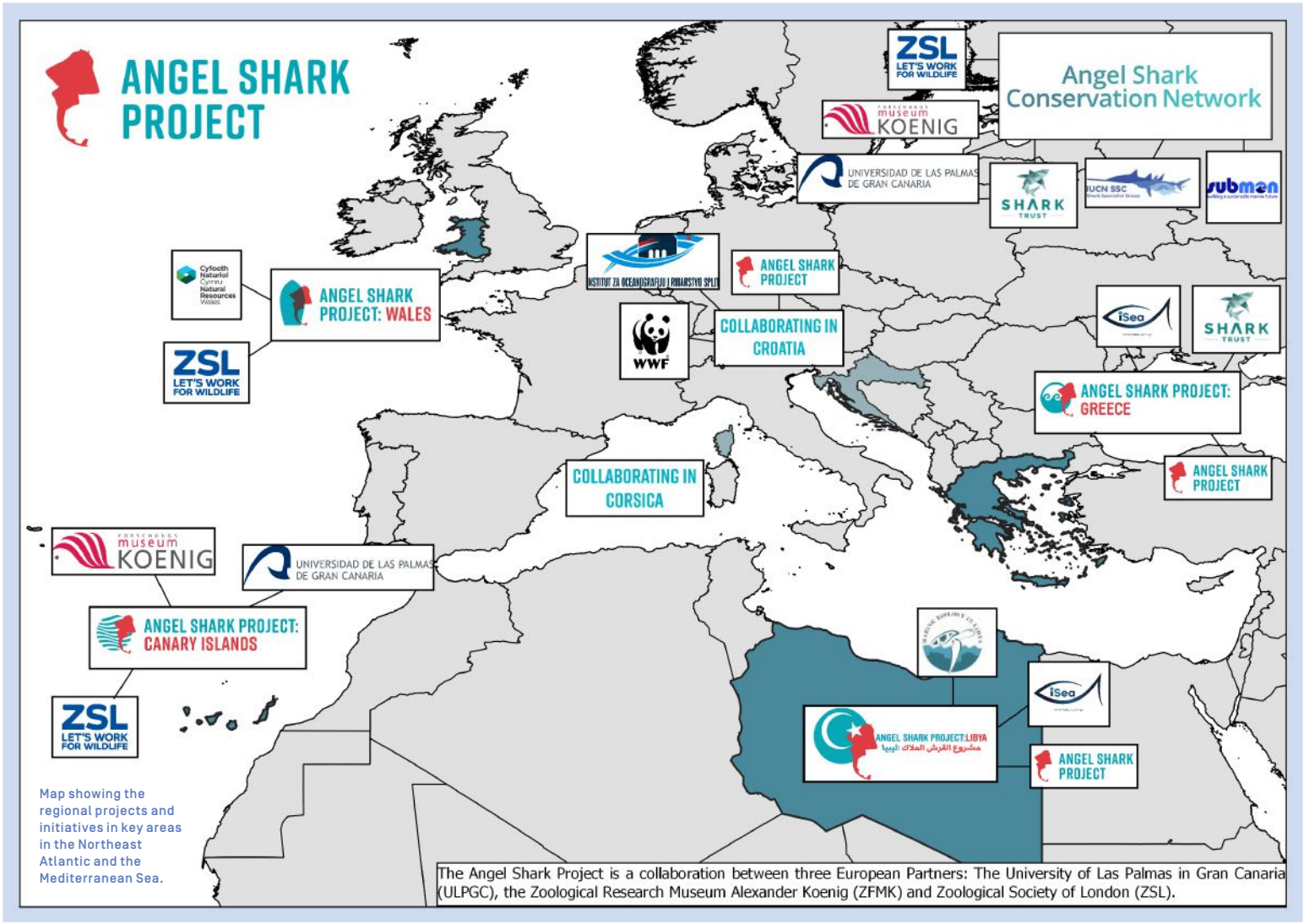


Smoothback Angelshark *(S. oculata)*



Angelshark *(S. squatina)*

Artwork © Marc Dando



Map showing the regional projects and initiatives in key areas in the Northeast Atlantic and the Mediterranean Sea.

Angel Shark Project (ASP)

The Angel Shark Project (ASP) – a joint project created by the Universidad de Las Palmas de Gran Canaria (ULPGC), Zoological Society of London (ZSL), and Zoologisches Forschungsmuseum Alexander Koenig (ZFMK) – was set up in 2014 to safeguard the future of Critically Endangered Angel Sharks throughout their natural range.

The Canary Islands was identified as a unique stronghold for the Angelshark *(S. squatina)*. Unlike any other place in its range, the Canary Islands is the only place known where divers and fishers can regularly encounter Angelsharks *(S. squatina)*. Thus, the Canary Islands were the starting point of the project and a unique opportunity for us to gain vital biological and ecological data about this cryptic shark. The data and knowledge we have gathered to date have supported the development of conservation plans and legislative changes and has served as a model replicated in other regions where Angel Sharks are present.

Since establishing the ASP in the Canary Islands, we have worked in close collaboration with local partners across the globe and developed regional projects in critical areas in the Northeast Atlantic and the Mediterranean Sea.

Angel Shark Project: Canary Islands (ASP: CI)

Taking advantage of this global 'hotspot' of the Angelshark *(S. squatina)*, our project initially focused on gathering baseline data through a citizen science programme mainly engaging the SCUBA diving community and involving fishers. Coupled with targeted underwater visual surveys, we have started to learn more about the population structure, habitat use, and distribution of this shark in the coastal waters of the Canary Islands.

Critical areas

The results of our first published study demonstrated that Angelsharks exhibit highly structured and reproductively active populations distributed along with shallow coastal areas in the entire Canary Island archipelago. Angelsharks were encountered throughout the year but not consistently over different months, suggesting a breeding season and a mating season. This study demonstrated that Angelsharks display spatial (vertical and horizontal) and temporal segregation by size and sex. Angelsharks were encountered from < 1 m to a maximum depth of 45 m (biased to the limit of recreational diving). Newborns and juveniles exclusively occurred in shallow water (0-20 m). Most sharks were associated with sandy bottoms, particularly adjacent to reefs, and we also discovered that their behaviour might be driven by environmental factors such as seawater temperature.

After learning more about the distribution of Angelsharks in the Canary Islands and the seasonal distribution patterns, we decided to implement a low-cost tagging study in key hotspots to learn more about these sharks' movement and site fidelity. We developed a bespoke underwater capture and tagging method to complete tagging without removing the shark from

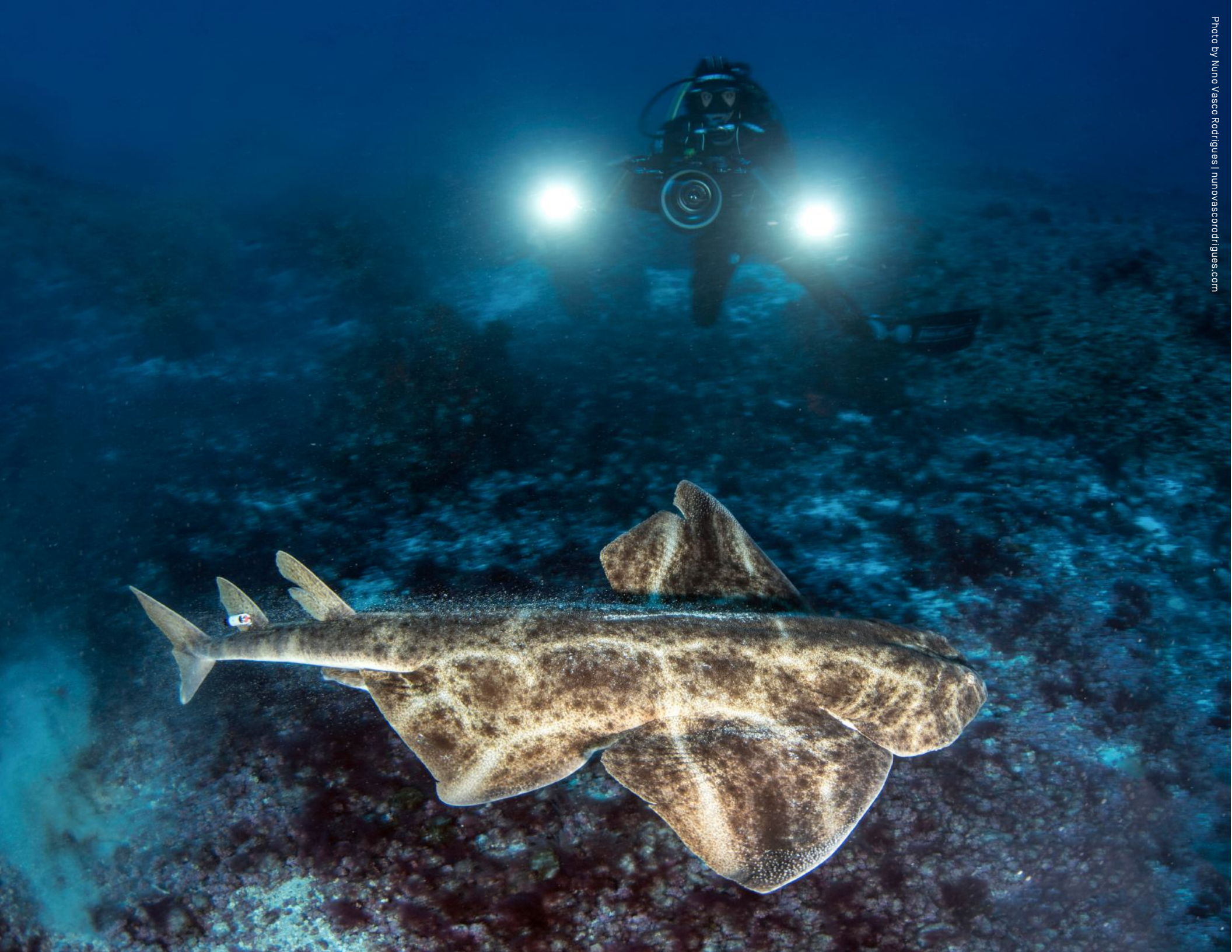


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Photo by Alexander Lehnen

the water. Although designed for Angelsharks, it could be adapted for other Angel Shark species and potentially other benthic sharks and rays. A coloured visual ID tag (T-Bar Anchor tag) uses a different colour for each island, with a unique code placed between the two dorsal fins of the shark, making it easy for divers to identify the individuals to report them to us through our online sightings map. We have received reports from sharks returning to the same sites over several years and actively engaged the SCUBA diving community in conservation with this low-cost methodology.

Angel Shark Nursery Areas

By combining citizen science data, satellite imagery, and focused tagging surveys, the first evaluation of juvenile Angelshark habitat in the Canary Islands was completed, leading to the identification of confirmed and several potential nursery areas, one of which is considered to be the largest nursery area for the species discovered to date. The results were used to develop eight key recommendations on how local and national governments can better protect juvenile Angelsharks in the Canary Islands. Data was also used to create a Guidance Document to better protect important habitats of this Critically Endangered species.

A more extensive research programme has been developed in Las Teresitas beach in Tenerife, which was the first confirmed Angelshark nursery area in the Canary Islands. It is thought to be the largest known. It is a perfect natural laboratory thanks to the density of sharks and the excellent conditions of this beach to carry out our work.

Acoustic Study in the Largest Marine Reserve of Spain

Since 2018, an array of acoustic receivers has been installed around the La Graciosa Marine Reserve (LGMR), a protected area north of Lanzarote. This network provides the first electronic tracking data for this species, delivering round-the-clock information on the movement and habitat use of tagged adult Angelsharks found within the reserve. In addition, to reduce the impact of this work on this Critically Endangered species, the project has designed and developed a novel, low-cost and ethically approved in situ tag attachment methodology, allowing animals to be tagged underwater through SCUBA diving, therefore reducing the stress and impact of fishing and handling, usually associated with tagging procedures.

To date, 84 sharks have been tagged with acoustic transmitters, and receivers have been deployed in 13 locations across LGMR. Even at this early stage of the project, more than 100,000 detections have been picked up so far, suggesting peak occurrences of this species between January and April. These data are already providing crucial information on movement patterns, distribution and habitat use on both daily and seasonal timescales. A vital aspect of the study will be in determining sex-specific patterns, with the possibility of males and females displaying different spatial behaviour and segregating for part of the year, with important implications for conserving this species elsewhere. The deployment of several ‘deep-water’ receivers further off the coastline may also provide information on the utilisation of deeper water by Angelsharks, which has not previously been observed in any detail.

Ultimately, the acoustic tagging project findings are significantly improving understanding of Angelshark ecology and will be used to inform and enhance the protection and conservation of Angelsharks in the La Graciosa Marine Reserve and further afield.

↑ The tagging procedure also includes taking a genetic sample.

↗ Angel Shark Project team.

→ Angelshark (*S. squatina*) restrained underwater before it is tagged with a coloured visual ID tag.

Photos by Nuno Vasco Rodrigues
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SCUBA diving surveys to deploy acoustic receivers and tag Angelsharks in La Graciosa Marina Reserve, Canary Islands

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Strengthening protection in the Canary Islands

In 2016, ASP: CI, alongside the IUCN SSC Shark Specialist Group, Submon, and Shark Trust, organised a workshop to develop the Angelshark Action Plan for the Canary Islands. The workshop brought together a multidisciplinary group of stakeholders (divers, scientists, conservation organisations, local and international shark experts alongside the Canary Island Government and Spanish Government) to identify and address the major threats to Angelshark populations. It has been a pivotal document to scale up Angelshark conservation efforts in the archipelago and has been used to prioritise conservation and research over the last five years.

Following the Action Plan process, the organising group worked closely with the Canary Island and Spanish Governments to encourage that Angelsharks were listed on the Spanish Endangered Species List, providing the national protection needed to safeguard the future of this species. Through close engagement and provision of data to support the listing, three species of Angel Shark *(S. aculeata, S. oculata, S. squatina*) were added to the Spanish Endangered Species List, under the category of "in danger of extinction" (the highest category within this legislation) in 2019. This listing reinforces the protection offered to the species under EU law and was an important goal for the project.

In 2021, the Canary Islands government and ASP will develop a Recovery Plan (RP) for Angelsharks. The RP will list specific measures and identify critical areas to improve species status in Canary Islands waters. Once this is developed and approved, the actions outlined in the RP will be included within Spanish law (Spanish Law 41/2010).

These major milestones are a key component of the wider Eastern Atlantic and the Mediterranean Angel Shark Conservation Strategy. The work and promising results from the Canary Islands serve as a model for projects in the broader range and have triggered the development of a growing network throughout the range.

Angel Shark Project: Wales

Angel Shark Project: Wales was established in 2018, led by ZSL and Natural Resources Wales (NRW), with a network of collaboration partners and stakeholders across Wales. The project aims to safeguard Angelsharks in Wales with fishers and coastal communities, using heritage, education and research.

The project has unlocked important historical knowledge about Angelsharks in Wales in the last three years, with over 2,100 records gathered dating back to 1812. Records were shared with the project through working closely with fishers and fishing associations, public engagement (including a series of Angelshark History Roadshows that travelled around Wales), citizen science archival research in libraries, archives and museums and digital online searches. In August 2020, these data were used to launch the Wales Angelshark Action Plan. This Action Plan sets out priority actions to work towards our vision of a thriving population of Angelsharks in Wales.

The project's current phase has started to deliver some of these priority actions, such as working closely with fishers in Wales and investigating Angelshark seasonal presence through an environmental DNA (eDNA) survey programme.

Angel Shark Project: Libya

In recent years, information gathered by Marine Biology in Libya showed that Angel Sharks are regularly sighted and found at fish markets throughout Libya, which has the longest coastline of any African country bordering the Mediterranean Sea. Thus, the need arose to launch Angel Shark Project: Libya (ASP:L) in 2020, a collaboration between Marine Biology in Libya, iSea, ULPGC, ZFMK and ZSL, to gather Angel Shark data at three major fish markets and to highlight the importance of Libya as a hotspot for Angel Sharks in the Mediterranean.

To date, almost 100 Angel Sharks have been reported. Genetic samples have been collected to feed into a more comprehensive genetic population study in the Mediterranean Sea. In addition, fishers have filled out questionnaires on Angel Shark catch, interactions by gear type, and locations.

Angel Shark Project: Greece

The Angel Shark Project: Greece was launched in May 2021, a collaboration between iSea, Shark Trust, ULPGC, ZFMK and ZSL, to investigate the importance of the Greek side of the Aegean Sea for all three Angel Shark species present in the Mediterranean *(S. aculeata, S. oculata, S. squatina).*

The recent discovery of several records of Angel Sharks in the Cyclades and Dodecanese Islands indicated that these areas are potentially highly important for the three species. In light of this situation, the Mediterranean Angel Sharks: SubRegional Action Plan (SubRAP) GSAs 22/23 (the Aegean Sea and Crete) was developed in line with the Mediterranean Angel Sharks: Regional Action Plan, aiming to advance Angel Shark conservation in Greece.

Saving the last Angel Shark in the Adriatic

In the Adriatic Sea, two species of Angel Shark *S. squatina* and *S. oculata* have been recorded. Angel Sharks were once highly targeted throughout the area, supporting important fisheries where they were caught using specialised nets called 'squaenere' or 'sklatare' (derived from local words for the species). However, there is a general lack of knowledge about the ecology and the conservation status of Angel Sharks in the Adriatic. No Angel Sharks have been captured in a scientific trawl survey since 1958.

A project led by the WWF Mediterranean Marine Initiative and WWF Adria is now investigating how far the current Marine Protected Area (MPA) network could help the recovery of Angel Sharks in Croatian waters of the Adriatic Sea. So far, both adult and juvenile *S. squatina* records were identified, suggesting they are still present in this part of the Adriatic. These findings indicate that there is potential for Angel Sharks to recover in the Adriatic and the wider Mediterranean if concerted, coordinated conservation actions are put in place.

Genetics

Whenever we tag an Angelshark in the Canary Islands, we also collect a small genetic sample which is analysed by our colleague Dr Kevin Feldheim from Field Museum - Pritzker Laboratory. Adult samples are used to compare the DNA of Angelsharks from different places and islands to see whether they are connected across the archipelago islands. In addition, samples from juvenile sharks are used to explore Angelshark reproductive behaviour, philopatry (whether Angelsharks return to a

Photos by Nuno Vasco Rodrigues | nunovascorodrigues.com

Photo by Mike Sealey

specific site across years), and population structure at nursery areas. In addition, we have gathered tissue samples from Wales, Ireland, West Africa, and across the Mediterranean to see whether the remaining Angel Shark populations are connected or are isolated units.

Other initiatives, together with regional partners, are also underway to use eDNA to confirm the presence of Angel Sharks across the range.

Angel Shark Conservation Network (ASCN)

In 2016, ZSL, ULPGC, ZFMK, IUCN SSC Shark Specialist Group, Shark Trust, and Submon set up the Angel Shark Conservation Network (ASCN) to facilitate dialogue and information sharing on Angel Shark conservation efforts across the range of S. aculeata, S. oculata, and S. squatina. The ASCN represents a community working to better protect Angel Sharks and has since become the hub for developing strategic Angel Shark conservation planning documents and providing updates on Angel Shark conservation and research through regular e-Bulletins to our network of subscribers.

Research led by the ASCN Partners to assess Angel Shark extinction risk found that the Sawback Angelshark range has declined by 51%, Smoothback Angelshark range by 48% and Angelshark range by 58%. To identify key actions needed to overcome major threats to the species, the ASCN has developed several action plans across different geographical scales via multidisciplinary workshops. The ASCN actively encourages individuals or organisations to get involved in delivering the action plans in collaboration.

The ASCN also hosts the Angel Shark Sightings Map (ASSM) to gather information on Angel Sharks across the East Atlantic and the Mediterranean Sea. The ASSM is open to members of the public and organisations to submit Angel Shark sightings data and has previously been used to understand species distribution, update IUCN Red List assessments, and test hypotheses around Angel Shark ecology, movement, and seasonality in some areas.

In 2020, the ASCN Partners co-organised the first International Angel Shark Day on the 26th of June, which will continue to be celebrated on the same date each year. This day aims to profile the 22 different species found worldwide, celebrate all the progress in Angel Shark conservation and research, and share facts, resources and talks from researchers and conservationists who work on the species.

To find out more information on the ASCN, ASSM or International Angel Shark Day, head to our website and sign up to receive our e-Bulletins.

Angel Shark Strategies and Conservation Documents:

The Shark Trust launched the Eastern Atlantic and Mediterranean Angel Shark Conservation Strategy in 2017 following development by the ASCN partners. It focuses on the three Critically Endangered Angel Shark species found in the region.

The Strategy is designed to guide future research, management, policy, and conservation to better protect and restore populations. Key goals are outlined to minimise fishing mortality, preserve critical habitat, and mitigate human disturbance. Four regions are covered in the Strategy, and two Regional Action Plans have been developed for these – the Angelshark Action Plan for the Canary Islands and the Mediterranean Angel Sharks: Regional Action Plan, both of which provide clear roadmaps for conservation action. In addition, several SubRegional Action Plans are in progress, led by Shark Trust, to facilitate further coordinated effort on a more local scale and ensure all stakeholders are fully engaged in the process.

In 2017, the Angelshark *(S. squatina)* was listed in Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). In 2018, the species was also included in Annex 1 of the CMS Sharks MOU, and the development of a CMS Action Plan is currently in progress, with the involvement of the Angel Shark Conservation Network.

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Las Teresitas, Tenerife. To date, this is the largest nursery area known for Angelsharks and one of our key monitoring sites for the past six years.
Photo by Angel Shark Project

↖ **ASP team taking measurements of a juvenile Angelshark.**
Photo by Michael Sealey

↑ **Night snorkel surveys are done in shallow nearshore areas to find potential Angel Shark nursery grounds.**
Photo by WWF Adria

←**Angel Shark catch in Libya showing a range of sizes (juveniles - adults).**
Photo by Sara Al Mabruk

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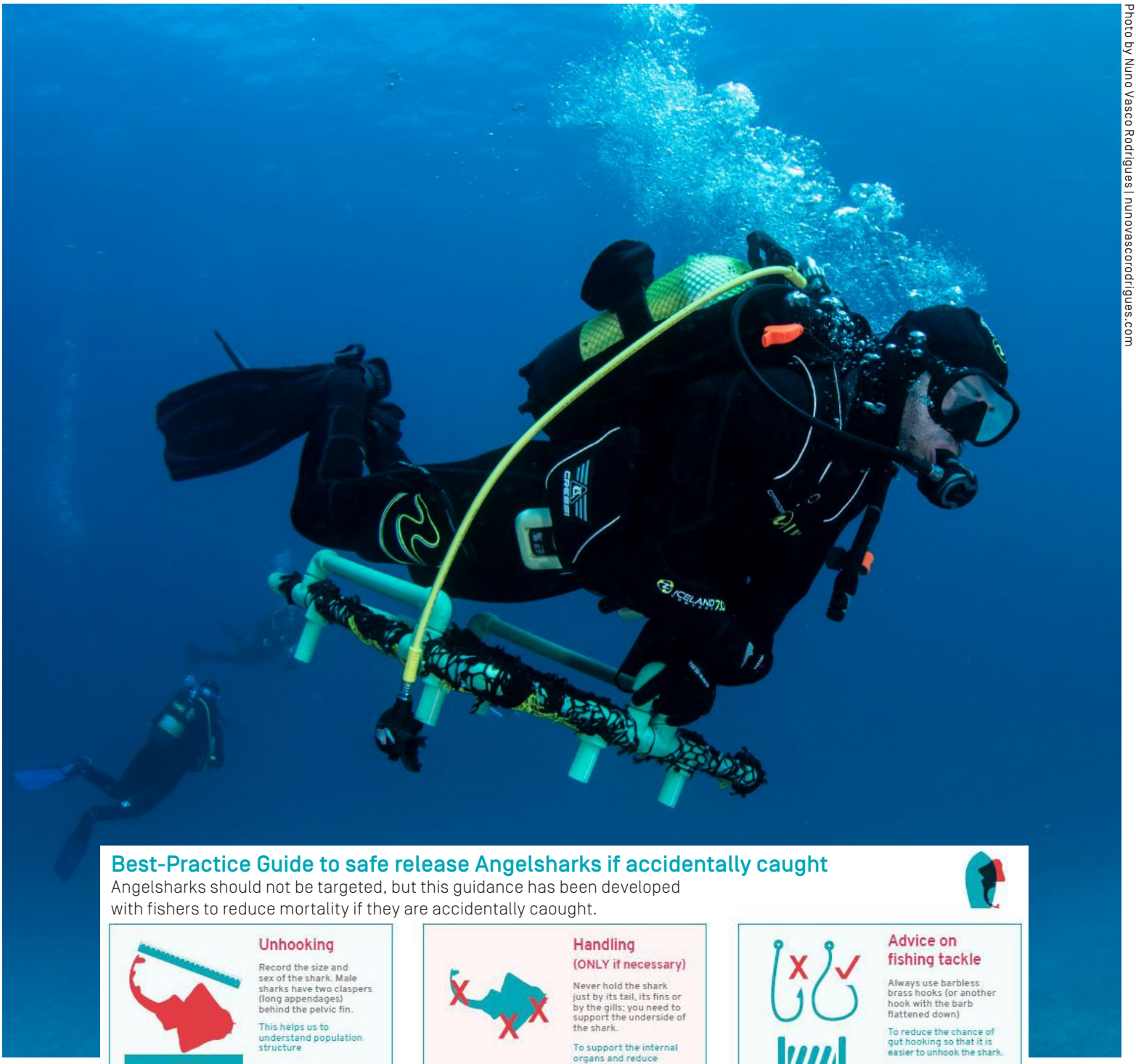

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Best-Practice Guide to safe release Angelsharks if accidentally caught

Angelsharks should not be targeted, but this guidance has been developed with fishers to reduce mortality if they are accidentally caought.

Unhooking

Record the size and sex of the shark. Male sharks have two claspers (long appendages) behind the pelvic fin.

This helps us to understand population structure

Unhook the Angelshark in the water on the side of the boat. If you have to cut the leader, cut it as close to the hook as possible.

Water supports the internal organs.

Handling (ONLY if necessary)

Never hold the shark just by its tail, its fins or by the gills; you need to support the underside of the shark.

To support the internal organs and reduce chance of injury.

Advice on fishing tackle

Always use barbless brass hooks (or another hook with the barb flattened down)

To reduce the chance of gut hooking so that it is easier to unhook the shark.

Use a strong line.

To reduce the likelihood of the line snapping and the shark trailing gear.

STRONG

Releasing

Release the shark as soon as possible after unhooking. Lower it into the water facing the tide or waves.

Forces oxygen through its gills so that it can quickly swim away.

Landing aboard the boat (ONLY if necessary)

All interaction with sharks should be minimised. If you need to land aboard the boat to unhook safely, use a large landing net. Never use a gaff.

To support the internal organs and reduce chance of injury.

Place it on a cool, wet, soft surface (e.g. a wet towel). Place a towel soaked in seawater over the eyes.

To keep it calm and stop thrashing.

Taking genetic samples

Contact **angelsharks@zsl.org** to be part of this work

Rub 3 genetic scrubs onto the Angelshark's skin. Seal in the provided genetic pack.

To collect genetic data to understand how the population is connected.

Reporting

Report your accidental capture on **angelsharknetwork.com/#map** or to **angelsharks@zsl.org**

We will use this information to better understand and conserve Angelsharks.

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Photo by Nuno Vasco Rodrigues | nunovascorodrigues.com

Lessons learned

We are proud to be part of this diverse network that has jointly managed to raise the profile of these hidden sharks. The work undertaken in the Canary Islands has inspired and has been replicated in other areas. In the past five years, Angel Shark records have been reported throughout the range. Some of these areas bring hope that these sharks have found refuges in the Northeast Atlantic and the Mediterranean Sea. Conservation efforts and legislation are already in place and underway in many sites. However, the key to success is the collaborative nature of these initiatives and the inclusion of all the stakeholders. We encourage everyone interested in the conservation of Angel Sharks to become part of this growing network.

Angel Sharks are peaceful sharks that can be observed and admired while SCUBA diving. In the Canary Islands, this shark is an emblematic species, attracting many divers. The ASP: CI developed a Code of Conduct for diving with Angelsharks.

Huber Arte Marinha

Alexandre Huber
IUCN SSC Shark Specialist Group | South America Regional Group | Member

I am a new member of the IUCN SSG. I was taken by surprise and honoured with the invitation to join the team of great professionals who dedicate their lives in favour of preserving the species of the planet!

I was born in Santos, State of São Paulo, Brazil. I'm a marine life artist and an environmental educator, Founder of Huber Arte Marinha in 2009.

My main goal in life is to make society, and especially children, aware of the importance of preserving the marine environment and the beautiful species that live in it.

Art is my tool to achieve my goals through the energy and beauty of marine species.

We don't protect what we don't know. I paint on large murals around Brazil, 89 currently, and I am an illustrator and author of children's books. That's what I love to do!


eucatex


INPA
AMPA
PETROBRAS AMBIENTAL

Photo by Debbie Wallace | debbiewallacephotography.com

Sand Tiger Shark South-west Atlantic Conservation Planning Workshop

Region Update: South America

Written by Dr Juan Martín Cuevas

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The population of the Sand Tiger Shark *(Carcharias taurus)* has declined by over 90% in the last 40 years from the waters of Brazil, Uruguay, and Argentina. In 2020, regional virtual workshops were convened by the Wildlife Conservation Society Argentina (WCS Argentina), with the collaboration of Fundación Vida Silvestre, for the Critically Endangered population of the Sand Tiger Shark in the Southwest Atlantic (SWA). The goal was to generate contributions and strategically plan for the conservation of this species. Both events were designed and facilitated by the IUCN SSC Conservation Planning Specialist Group (CPSG) | Center for Species Survival Brazil (CSS Brazil)).

The whole process was divided into two workshops. The first workshop was held over five days in two stages where 96 people attended the levelling phase and then 59 participated in the group work. These individuals then also contributed to the second workshop (three days). Representatives from Argentina, Brazil, and Uruguay were present from different sectors relevant to the conservation of the species, such as: aquariums, researchers, civil society organizations, government officials, museums, recreational fishing guides, and artisanal and industrial fishermen. Furthermore, current Shark Specialist Group members from these countries were also present including one of our Regional Vice-Chairs Patricia Charvet.

Following a series of dynamic presentations and virtual tools, the participants worked collaboratively on:

- Reaching a consensual 'Vision' for the future of the Sand Tiger Shark in the SWA as follows "The *Carcharias taurus* shark population/s is/are conserved in a long-term in the Southwest Atlantic, fulfilling its ecosystem role, by virtue of management measures coordinated and implemented through different local and regional instruments between Argentina, Brazil and Uruguay. These measures are based on scientific knowledge, participation and awareness of each stakeholder of the fishing sector and the society, respecting the intrinsic value of the species and its extreme susceptibility";
- Identifying the main challenges and threats for the conservation of the species;
- Defining general objectives aimed at achieving the 'Vision';
- Agreeing on specific objectives; and
- Recommending a series of actions to achieve the objectives set and to complement the existing National Plans of Action in the region.

During the workshops, it was recognized that cooperation between the three countries is essential to contribute to reducing the identified challenges and threats, which influence research, control, regulation, good fishing practices, education, and communication.

The main challenges for the conservation of the species include:

- Make visible the worrisome status of conservation of the sand tiger in the SWA.
- Working with different management and conservation measures among the three countries.
- Coordination and collaboration among the countries to generate key scientific information.
- Reconcile fishing practices and conservation for communities that depend on the species.

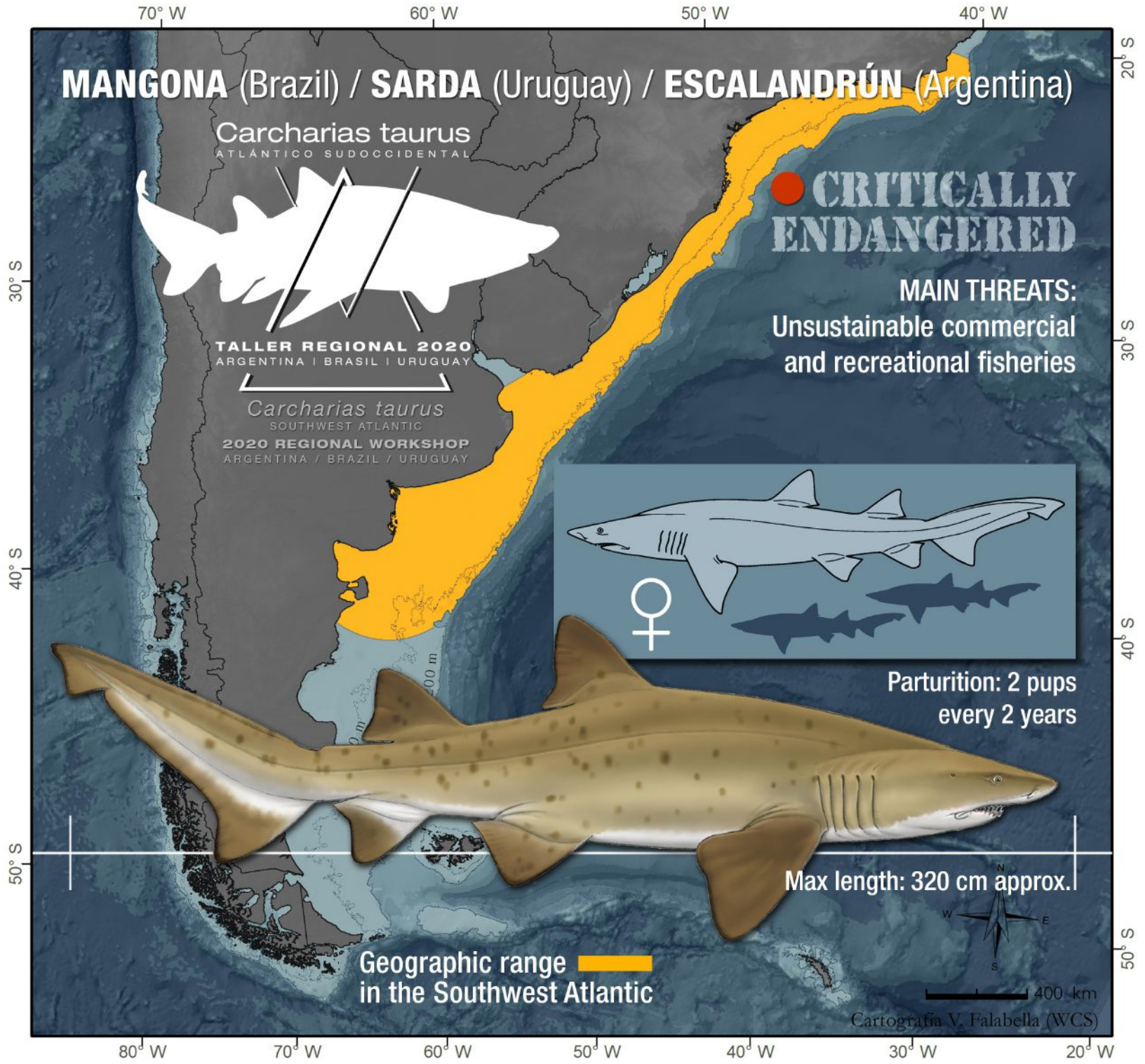
Some of the main proposed actions for the three countries include:

- Answer fundamental scientific questions for the recovery of Sand Tiger Sharks: How many populations are in SWA? Are sharks migrating through the seas of the three countries? Are there critical areas that should be protected?
- Highlight the importance of the Sand Tiger Shark for the resilience of the oceans and people's livelihoods, valuing the knowledge of coastal communities.
- Promote intra and intersectoral and multilevel coordination for the creation and implementation of effective management regulations.
- Promote good practices of artisanal and recreational fishing.
- Develop studies on the effectiveness of current management measures and monitoring the impact of fisheries as well as considering biological, ecological, social and economic dimensions.

Objectives and actions were agreed among almost 60 participants from multiple sectors and countries. Articulators and collaborators are already identified and enthusiastic about participating.

The implementation of this plan is the next step and the great challenge to overcome. In this sense, a website was created to coordinate actions during implementation, compile key information, and make the final report available to a broader public too: www.tallerctaurus.com.ar

WCSArgentina
Un programa de Wildlife Conservation Society



Number of objectives, actions and their priority identified during the workshop by each working group. NPOAs: National Plan of Actions.

Group	Objectives	Complementary Objectives in NPOAs	Actions	Complementary Actions in NPOAs	Priority High	Medium	Low
Education	5	8	12	9	9	2	1
Enforcement and control	4	-	10	3	2	5	3
Research	4	13	14	23	8	5	1
Fisheries	3	19	9	9	6	3	-
Total	16		45		25	15	4

Assessing River Jewels

Adult specimen of the Reticulate Freshwater Stingray (*Potamotrygon orbignyi*) on a sandy river beach.

Region Update South America

Photo by Patricia Charvet

Yan Torres

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Photo by Patricia Charvet

Adult specimens of the Xingu Freshwater Stingray (*Potamotrygon leopoldi*), one of the most valued species in the ornamental trade.

Elasmobranchs are known mainly for their marine and estuarine representatives; however, there is an existent lineage that successfully colonized South American freshwater environments. The subfamily Potamotrygoninae, or Neotropical Freshwater Stingrays, comprises 38 described species. These species are distributed in the main water basins and sub-basins of South America. Like many other elasmobranchs, they have low fertility, late maturity, and long lifespans. Those features make them susceptible to fisheries and environmental impacts.

The Potamotrygoninae species are exposed to an array of threats. Attractive and striking dorsal color patterns are a feature for some species that make them a target for the ornamental trade. Their sustainable exploration is always a challenge and a threat for this group. They are known as "river jewels" by many ornamental traders. Some species are also fished for consumption, and it is alarming the increase in fishing pressure in some areas. Moreover, habitat degradation by mining, agriculture (silting, agricultural chemicals runoff) and damming in different regions are also rising concerns. Climate change impacts on droughts, rainfall, and consequently on riverine water level affect the species since all species studied to date have their life cycle associated with flood-drought river dynamics.

There are very few conservation actions in place for these species with most being at countries' national level (e.g. ornamental trade export quotas). At the request of Brazil and Colombia, several Potamotrygonidae (23 species in Brazil and 8 in Colombia) were listed on the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) Appendix III after having been identified as in need of trade controls. For half of these species, the risk of extinction had not been previously evaluated, while others had been assessed as Data Deficient (DD) on the IUCN Red List of Threatened Species. At the end of 2020, the IUCN SSC Shark Specialist Group established a partnership with the IUCN Freshwater Biodiversity Unit (IUCN FBU) to help carry out the Potamotrygoninae assessments, especially because additional support was needed to map and calculate areas and extent of occurrence. South American specialists on freshwater stingrays were invited to help, contributing with their knowledge on the distribution, life history, threats and much other essential information needed to assess these river jewels.

This international working group is currently assessing the extinction risk of 38 potamotrygonins to have these evaluations ready by the end of 2021. The results will be an essential tool for helping develop management and conservation actions, hopefully ensuring the continuity of this unique evolutionary lineage.

Studying Silky Sharks in the Western Atlantic

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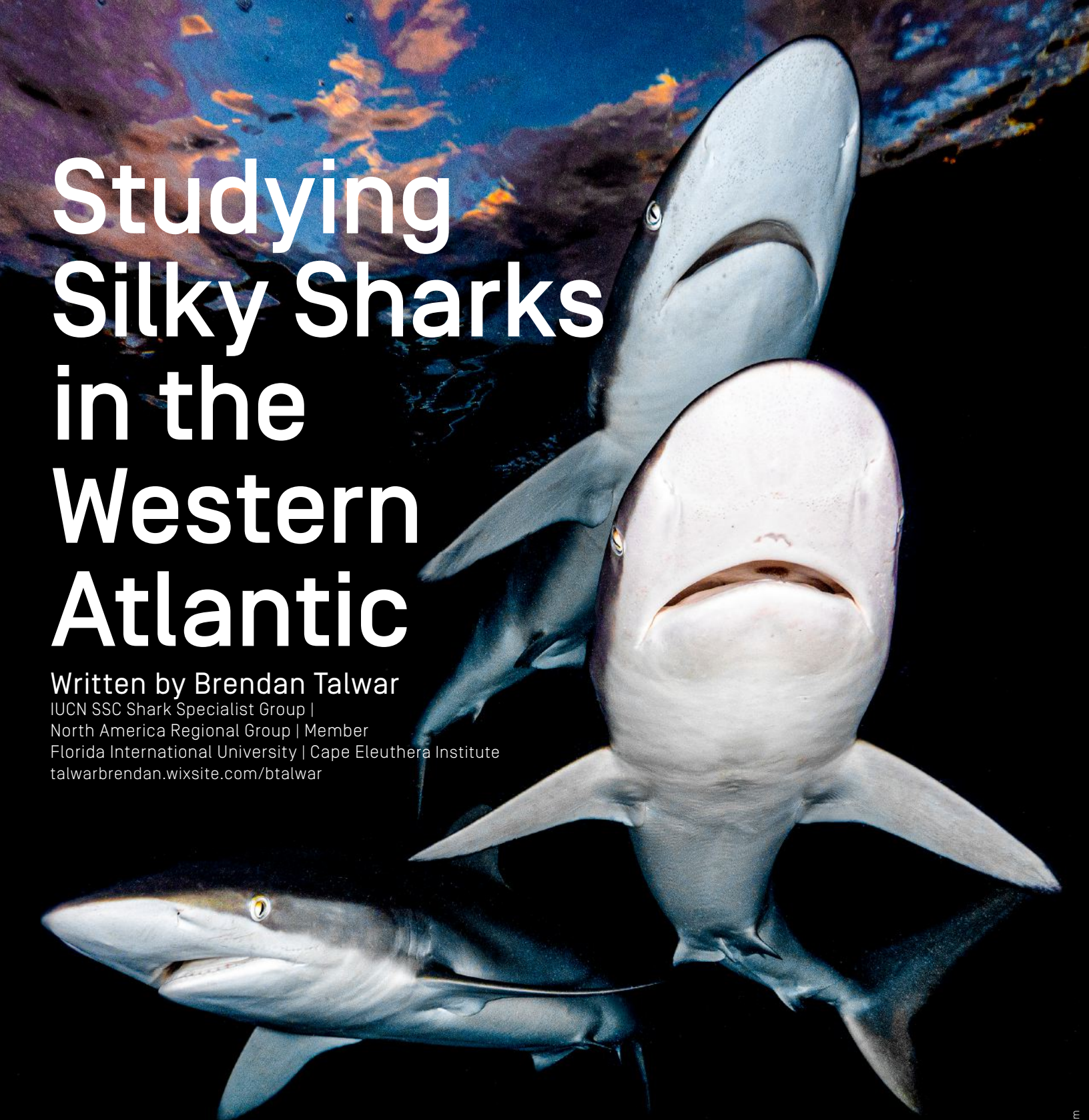

Photo by Debbie Wallace | debbiewallacephotography.com

Photo by Brendan Talwar

Region Update: North America

The Silky Shark (*Carcharhinus falciformis*) is one of the most abundant large sharks on the planet. Researchers have published numerous papers on silkies in the Pacific Ocean, Indian Ocean, and Mediterranean Sea that address diet, habitat use, post-release mortality, Fish Aggregation Device (FAD) -associated behaviors, and more. Additionally, a stock assessment has been conducted in the western and central Pacific. Based on evidence of their high susceptibility to capture in longline and purse seine fisheries, their prevalence in international trade (especially their fins), as well as significant declines in abundance, they were listed on Appendix II of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES), Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), assessed as Vulnerable on the IUCN Red List of Threatened Species, and banned from retention by multiple regional fisheries management organizations over the past nine years. Yet, despite it all, we know surprisingly little about Silky Sharks in the western Atlantic, where their abundance has likely declined between 46 and 98% in recent decades. Without understanding the ecology of this coastal-pelagic species, we will be challenged to tailor management strategies that seek to predict the effects of fishing and other disturbance on the ecosystems they call home and maximize their recovery.

Perhaps we know so little about Silky Sharks because they live at the interface of coastal and pelagic habitats, making it challenging to classify them succinctly. They are overshadowed by the Oceanic Whitetip Shark (*Carcharhinus longimanus*) in blue water, which has developed a folkloric reputation following naval tragedies. Silkies are equally curious and bold, although perhaps less intimidating, and the two species are often found sharing space and food. Along the coast, silkies are overshadowed by large coastal species such as the Tiger Shark (*Galeocerdo cuvier*) and Blacktip Shark (*C. limbatus*). Monitoring has also been a challenge for silkies, which are confused with the Night Shark (*C. signatus*), Dusky Shark (*C. obscurus*), and Galapagos Shark (*C. galapagensis*), among other carcharhinid relatives.

Still, Silky Sharks are impressive. They grow to over three meters long and manage to keep pace with tunas patrolling nutrient-poor habitats searching for food. They can dive hundreds of meters below the surface, possibly to chase squids and midwater fishes. They are remarkably smooth due to their tightly packed dermal denticles. They can be found following pilot whales, underneath fish aggregating devices (FADs) and oil rigs, along sargassum lines, above tropical coral reefs, and most places in between, sometimes alone and sometimes in tightly packed schools.

We know that Silky Sharks demonstrate significant variability in life history throughout the tropics and subtropics and suspect that they undergo ontogenetic shifts in habitat use and diet that take young individuals from the edge of the shelf to habitats far offshore later in life. They are often referred to as highly migratory and pelagic, but, increasingly, genetic analyses suggest a population structure in the western Atlantic resembling that of a coastal shark.

In an attempt to better understand this regionally enigmatic species, a group of researchers has been collecting data for nearly twenty years from South Carolina, in the eastern United States, to Belize, in Central America, with the bulk of data collection occurring since 2018. The project's primary goals have been to characterize Silky Shark movements and trophic ecology across as many size classes as possible. To date, over 25 satellite tags have been deployed on animals ranging from just one to two years old along the shelf to large adults lured away from their tuna travel companions by flakes of bonito. Along the way, tissue samples have been collected from potential prey and competitors, as well as faecal swabs, gut contents, blood, and muscle from Silky Sharks themselves. Preliminary tracks suggest that long-distance movements could be the exception, not the rule, and that Silky Sharks feed on a broad prey base with teleosts dominating their diet.

The project has served as a teaching tool to four semesters of high school students and over 100 visiting students at the Cape Eleuthera Island School in the eastern Bahamas and has leaned on and benefited from the knowledge and expertise of fishers in Haiti, Belize, and the US. In Belize, for instance, traditional shark fishers work in collaboration with researchers and the Fisheries Department to deploy tags on sharks caught using modified longlines. State and federal agencies, international management organizations, various universities, and many early career researchers have made this challenging work possible.

Hopefully, the results will allow us to piece together a foundational understanding of Silky Shark ecology in the region and contribute to critical habitat designations, stock delineation efforts, and ecosystem-based management plans that incorporate the nuanced ecology of the species. At the very least, they should provide a starting point for additional research and more informed management of this Vulnerable shark in the western Atlantic Ocean.

Region Update: Mediterranean

Shark catches in Albania

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Regional Vice-Chair

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Member

Photo by Alen Soldo

The Mediterranean is a region with relatively high diversity and abundance of elasmobranchs (sharks and rays). It is recognized as a region with the highest percentage of threatened sharks and rays in the world. Thus, having effective management of elasmobranchs is of the utmost importance, and it all starts with very detailed fisheries catch statistics. In general, fisheries statistics have been officially reported to the Food and Agriculture Organization of the United Nations (FAO) by its member countries since 1950. However, FAO data typically do not include catches from unregulated fisheries, discarded catches, nor from recreational, subsistence, or artisanal sectors. Furthermore, although directed fisheries exist for some elasmobranch species, it is estimated that incidental and discarded catches far outweigh their overall landings. Hence, even the catches that are reported to the FAO are not necessarily informative for stock management and conservation. Poor catch reporting of sharks and rays in the Mediterranean is a major and widespread problem. Many countries in this region report shark statistics without making any distinction at the species level or even fail to record some species. The reasons for that vary between countries. For example, for some countries in the Mediterranean, the governance structures are not in place to design and maintain accurate reporting. Consequently, the only reliable data on shark catches are derived from various scientific fishery research studies.

Albania is a Mediterranean country with a 380 km coastline, of which 284 km stretches along the Adriatic Sea in the north while the remaining 96 km belongs to the Ionian Sea. However, this is still vague as certain studies reported that the border between the Adriatic and the Ionian Sea could be further south, which results in a situation in which the entire Albanian waters should be considered a part of the Adriatic and not the Ionian Sea. The fishing fleet is relatively small and is concentrated in the four fishing ports of Saranda, Vlora, Durres, and Shengjin. Albania reported a total catch of 6,217 tons of marine fish and other organisms in 2017, of which, 40 tons were reported as elasmobranchs. The whole catch was related to the 'Smooth-hounds nei* *(Mustelus* spp.*)*' group, and the catch of other species was not reported. Previous data show that Albania regularly reported an average of 40 tons of 'Dogfish Sharks nei (Squalidae)' group, but has not reported this species group since 2011.

Another issue is with the previously reported landing of 'Angelsharks, Sand Devils nei' group (family Squatinidae), as Albania regularly reported in its catches, and the highest catch was in 2010 (78 tons). The last reported catch of Angel Sharks was in 2016, when a catch of 3 tons was declared. However, considering that Angel Sharks are very rare in the Adriatic Sea and that all three species of Angel Sharks present in the Mediterranean (Sawback Angelshark *(Squatina aculeata)* Cuvier, 1829, Smoothback Angelshark *(Squatina oculata)*, Bonaparte, 1840 and Angelshark *(Squatina squatina)*, Linnaeus, 1758) are assessed on the IUCN Red List of Threatened Species as Critically Endangered, it is highly possible that these records were a case of misidentification as presumed for some other Mediterranean countries. A similar explanation could be used for Guitarfishes (Rhinobatidae) as Albania reported 3 tons in 2008 and 2 tons in 2011 of these currently very rare species in the Adriatic Sea. Albania was also reporting the catches of 'rays, stingrays, mantas nei (Rajiformes)' group, but the last data are from 2011 when 30 tons were reported. The Albanian Institute of Statistics reports similar catches, based on data provided by the Albanian Ministry of Agriculture and Rural Development, where the only group of elasmobranchs for which catch was reported is 'Smooth-hounds nei'. The reported average annual catch in the period 2014-2017 was 37 tons for that group, while 5 tons was reported in 2018 and no catches in 2019.

Female Shortfin Mako Shark *(Isurus oxyrinchus)* with 70 cm TL and 5 kg bodyweight in the Bay of Porto Palermo, Himare, Albania on May 20, 2020

Considering the paucity of data on shark catches, especially the low taxonomic resolution of existing catch statistics to identify species-level trends of abundance, the research, funded by the Save Our Seas Foundation, was conducted to present, for the first time, the composition of shark species caught by commercial fishermen in Albanian waters.

In total, 20 shark species were observed belonging to pelagic and demersal species. Most were caught by bottom trawl. In contrast, large pelagic species, such as Bigeye Thresher *(Alopias superciliosus)*, Shortfin Mako *(Isurus oxyrinchus)* and Blue Shark *(Prionace glauca)*, were caught with pelagic longlines. Additionally, *P. glauca* was also caught with a pole line during purse seining operations. Some species such as the Sharpnose Sevengill Shark *(Heptranchias perlo)* and Sandbar Shark *(Carcharhinus plumbeus)*, were found stranded on a beach. Interviews with fishers revealed that all the sharks were just incidentally caught as none of these species were targeted. Hence, many sharks were landed alive on boats but later utilized and sold at the fishing markets.

During the research, no species belonging to the Rhinobatidae or Squatinidae families were caught, which proves that previous reports of high landings of these families were the case of misidentification.

*nei: a FAO term meaning 'not elsewhere included'; when it is not possible to identify the species and more than one species is included in the same group

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Photo by Melita Samoilys

Gillnets of large mesh sizes: a threat to sharks and rays

Written by Kennedy Osuka IUCN SSC Shark Specialist Group | Africa Regional Group | Member
CORDIO East Africa

Gillnets are widely used gears among Kenya's coastal artisanal fishers. However, their mesh sizes are inadequately monitored or regulated; therefore, their impacts on threatened species are poorly understood. For the first time, a team of researchers from Coastal Oceans Research and Development in the Indian Ocean - CORDIO - East Africa assessed the effects of different gillnet mesh sizes on fish and fishers' catches in Kenya's coastal waters. The study, which has been published in the African Journal of Marine Science, found that large mesh gillnets ranging from 20.3 to 30.5 cm in stretched-mesh sizes were the primary gillnet type that captured >60% of threatened shark and ray species. The proportion of species assessed as Near Threatened, Vulnerable, or Endangered on the IUCN Red List of Threatened Species was double that of the medium mesh sizes (7.6 to 12.7 cm stretched-mesh size).

The dominant species caught in medium and large mesh sizes were Mackerel Tuna *(Euthynnus affinis)* and the Vulnerable Coach Whipray *(Himantura uarnak)*. Other notable Vulnerable species captured in large mesh sizes comprised the Blacktip Reef Shark *(Carcharhinus melanopterus)*, Whitetip Reef Shark *(Triaenodon obesus)*, and Spotted Eagle Ray *(Aetobatus ocellatus)*. Endangered species included the Giant Manta Ray *(Mobula birostris)*. The Whitespotted Guitarfish *(Rhynchobatus djiddensis)* and Bluespotted Lagoon Ray *(Taeniura lymma)* that were recently assessed as Critically Endangered and Least Concern, respectively, also formed part of the landings. The observed dominance of threatened species highlights the need for focused gillnet management regulations. In other words, it contradicts the general recommendation of large mesh sizes for artisanal fishing. Thus, phasing them out in Kenya's coastal waters has a great potential of reducing the capture of threatened sharks and rays. This would also help in lowering the incidental capture of marine mammals and turtles. Instead, the least-damaging medium-mesh sizes should be promoted as an alternative.

Photos by Kennedy Osuka

Sharks and rays are highly susceptible to fishing mortality owing to their slow growth and late maturation. This, coupled with overexploitation and high demand for their products, has led to alarming declines in shark populations. The loss has potential ecological and socio-economic implications, including inversion of trophic pyramids and loss of livelihood activities such as tourist attractions and food resources. In Kenya, sharks are a target species for some artisanal fishers, such as those on the north coast, where there has been a shark fishery for centuries. To this resource user group, species protection measures, including changes in gillnet mesh sizes, need to be preceded by awareness-creation on the overall benefits of sharks to the ecosystem and the importance of their conservation. This is likely to reduce resistance to mesh size regulations recommended by the study.

Kenya has domesticated resolutions made by the Indian Ocean Tuna Commission (IOTC) on the capture, conservation, management and transhipment of sharks and rays in the Fisheries Management and Development Act 2016. However, no fisheries conservation and management measures are in place for any species of sharks and rays in the coastal fisheries. This calls for a proactive approach towards their management, and a ban of large mesh gillnets would be a step in the right direction.

Overall, shark and ray populations in Kenya appear to experience considerable exploitation pressure, which has led to substantial population declines. However, clear quantitative measures are lacking due to inadequate monitoring and little research. This coupled with a lack of species protection measures, suggests an urgent need to revise and implement monitoring and regulations for these threatened species.

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Osuka, K., Kawaka, J. A., & Samoilys, M. A. (2021). Evaluating Kenya's coastal gillnet fishery: trade-offs in recommended mesh-size regulations. *African Journal of Marine Science, 43(1)*, 15-29. *doi.org/10.2989/1814232X.2020.1857836*

Photo © TRAFFIC

TRAFFIC bites back at illegal wildlife traders with the world's first-ever 3D-printed replica shark fins

Frontline law enforcement officials can now harness pioneering technology to combat the trafficking in shark fins

Markus Burgener
IUCN SSC Shark Specialist Group | Africa Regional Group | Member
Senior Programme Coordinator | TRAFFIC Southern Africa

All photos © TRAFFIC

More than 40 shark and ray species have been listed in Appendix II of the Convention on International Trade in Wild Fauna and Flora (CITES). Listing in Appendix II requires permits to be issued confirming shipments of shark fins were obtained legally and sustainably. However, shark fins are often challenging to identify to a species level, and illegal traffickers use this to their advantage by falsely declaring shipments of fins as being from non-CITES listed species.

Accurately identifying CITES-listed species is vital for effective enforcement of CITES but is a massive challenge for frontline enforcement officials. As if that was not difficult enough, they must correctly identify wildlife such as shark fins alongside all the other contraband they are looking out for. Furthermore, many customs and other law enforcement agencies involved in combatting wildlife trafficking worldwide are understaffed and under-equipped.

Several excellent fin identification guides were developed to assist enforcement officials. However, identification is far easier if these officials also have access to real fins. Unfortunately, very few enforcement agencies have access to a comprehensive set of shark fins representing the fins of CITES-listed species in trade. Even where they do, the fins have quite a strong smell, and there is a risk of the fins degrading due to insect infestations.

Knowing this, TRAFFIC has created a set of 22 3D printed and painted replica fins to assist customs officials and enforcement officers globally in fin identification. The complete free online toolkit (www.traffic.org/3d-replica-shark-fins/) contains scan files and detailed painting guidance for ten shark and ray species and two ray families. All of them, except the Blue Shark *Prionace glauca*, are listed in CITES Appendix II.

Worldwide, law enforcement agencies and other stakeholders are now in a position to produce fin sets for training and fins for day-to-day use by law enforcement officials in situations where fin identification is required. The latter are printed with the shark's name and type of fin and a section where a dedicated QR code can be attached. When scanned with a cell phone, this code links to fin-specific web pages on the TRAFFIC website, which provide additional information and guidance on the identifying features for that species.

During trials, law enforcement officials in South Africa reviewing the replica fins and QR code concept strongly supported their use in building fin identification capacity.

- Blue Shark *Prionace glauca* (not a CITES-listed species)
- Bowmouth Guitarfish *Rhina ancylostoma*
- Common Thresher *Alopias vulpinus*
- Giant Guitarfish Family: Glaucostegidae
- Great Hammerhead Shark *Sphyrna mokarran*
- Oceanic Whitetip Shark *Carcharhinus longimanus*
- Porbeagle Shark *Lamna nasus*
- Scalloped Hammerhead Shark *Sphyrna lewini*
- Silky Shark *Carcharhinus falciformis*
- Shortfin Mako *Isurus oxyrinchus*
- Wedgefish Family: Rhinidae

For more information, please contact:
Markus Burgener: markus.burgener@traffic.org
Simone Louw: simone.louw@traffic.org

Blue and Mako Shark fins 3D being laser scanned, creating a digital representation of the real fins.
A visual representation is taken from a 3D scan of a Bowmouth Guitarfish caudal fin

The replica shark fins after 3D printing, using sintered nylon as printing compound (as seen from left to right: Bowmouth Guitarfish caudal fin, Oceanic Whitetip Shark dorsal fin, and Great Hammerhead Shark dorsal fin)

Replica shark fins after painting (as seen from left to right: Bowmouth Guitarfish caudal fin, Oceanic Whitetip Shark dorsal fin, and Great Hammerhead Shark dorsal fin)

Photo by Buddhi Makeshika

Researcher Sahan Thilakarathna conducting interviews with a fisher in Chilaw in 2019 on the west coast of Sri Lanka. Such interview surveys are an indispensable tool to understand the status of otherwise not documented species in fisheries landings surveys.

Region Update: Indian Ocean

Are we too late for the Sawfishes of Sri Lanka?

Written by Akshay Tanna

IUCN SSC Shark Specialist Group | Indian Ocean Regional Group | Member Blue Resources Trust

Sawfishes are amongst the most threatened marine taxa globally. While there is increasing information available on their occurrence and status worldwide, only a few studies have reported on them from the Indian Subcontinent. These include reports of landings from India, Pakistan and more detailed information gathered through traditional ecological knowledge surveys in Bangladesh.

Blue Resources Trust (BRT) has been conducting landing site and market surveys across Sri Lanka since August of 2017. Over 1,200 survey days across 70 landing sites have documented more than 22,000 individuals from >100 species of sharks and rays. However, despite sawfishes having featured in nearly all previous faunal checklists for Sri Lanka, no sawfish landings have yet been documented by the BRT research team.

An island-wide interview survey was conducted in 2019 with over 300 fishers and traders to gather information on their knowledge of sawfishes. These questionnaires were also designed to elicit comparable insights with previous studies on sawfishes from other countries.

Overall, older fishers (>50 years old) claimed they frequently saw sawfishes in the past but have rarely, or not at all, seen them in the last 30 years. Indeed, only ten out of 300 fishers had seen one within the last decade! In Sri Lanka, only 39% of respondents could identify sawfishes from images shown at the start of the interview, while this percentage was much more prominent in similar studies in the region: 79% in Bangladesh and 100% in the United Arab Emirates (UAE); indicating very little cultural knowledge of the existence of these species and suggesting a dramatic decline in their numbers. Only 10.7% of respondents in Sri Lanka had caught a sawfish in their lifetime, whereas 89.6% of respondents had caught sawfishes in the UAE. Alarmingly, while no respondent under 30 years of age could identify a sawfish in Sri Lanka, all respondents under 30 in the UAE could do so. Furthermore, despite the sizable trade in shark fins in Sri Lanka, most traders were unaware of the demand and potentially high prices of sawfish products and only spoke about the sale and consumption of meat.

These results indicate that, consistent with the situation across most of the world, sawfishes are now extremely rare in Sri Lanka. However, we found multiple local vernacular names indicating the historical presence of at least two different species. During interviews, the team was directed to Large-

tooth Sawfish, *(Pristis pristis)* rostra donated to churches by fishers. We also found rostra from two species, the Largetooth Sawfish and the Narrow Sawfish, *(Anoxypristis cuspidata)*, in the collections of the Faculty of Science, University of Peradeniya, Sri Lanka. However, no details could be found on the date and locality of the collection of the rostra. Coupled with information from older respondents and informal, anecdotal information collected during fishery surveys, it appears that sawfishes were not uncommon in Sri Lanka in the past and that populations have since dramatically declined.

Respondents primarily attributed declines in sawfishes to high fishing pressure. The perceived period of declines (early 1990s) coincided with the time of increased fishing effort and the development of the aquaculture industry in nearshore areas that also resulted in accelerated coastal degradation.

The authors concluded that while sawfishes are likely functionally extinct in Sri Lanka, regulations to protect them fully should be promulgated to fulfil the country's obligations as a Party to the Convention on the Conservation of Migratory Species of Wild Animals (CMS), where all sawfishes are listed in Appendix I, prohibiting the taking of these species. To encourage implementation and compliance of such measures, they must be followed up with adequate outreach and awareness programs to educate stakeholders, including fishers and fisheries officials, behind the reasoning for protecting these species, in addition to consequences of non-compliance. Furthermore, it is imperative to focus on protecting other threatened shark and ray species that are still captured and are subjected to enormous fishing pressure, such as the rhino rays, to ensure they do not suffer the same fate as sawfishes.

Acknowledgement:

This study was supported by the Pew Charitable Trusts, the Marine Conservation Action Fund of the New England Aquarium, the Ocean Park Conservation Foundation Hong Kong, and the Tokyo Cement Group, Sri Lanka.

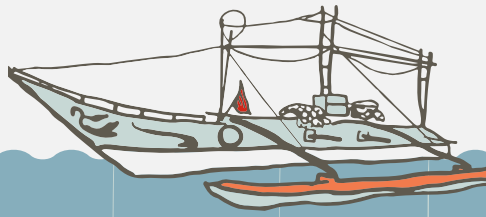
Reference:

Tanna, A., Fernando, D., Gobiraj, R., Pathirana, B.M., Thilakaratna, S., Jabado, R.W. 2021. Where have all the sawfishes gone? Perspectives on declines of these Critically Endangered species in Sri Lanka. *Aquatic Conserv: Mar Freshw Ecosyst.:* 1– 15. doi. *org/10.1002/aqc.3617*

Rostra from the collections of the Department of Zoology, Faculty of Science, University of Peradeniya, Sri Lanka. The two top rostra belong to the Green Sawfish, *Pristis zijsron*, and the other two belong to the Narrow Sawfish, *Anoxypristis cuspidata*. Details of the date and locality of origin of these rostra were not available. During the study, the team only came across rostra and photographs of recently landed Largetooth Sawfish, *Pristis pristis*.

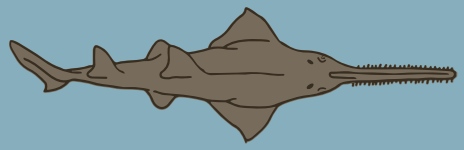
Photo by Chathurika Munasinghe

The Demise of Sawfishes in Sri Lanka



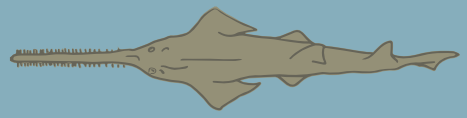
SAWFISHES IN SRI LANKA

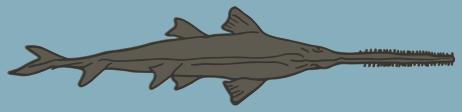
Referred to as "Dathi mora" in Sinhala, "Vela" in Tamil



CR Largetooth Sawfish
Pristis pristis

Green Sawfish
Pristis zijsron
CR





EN Narrow Sawfish
Anoxypristis cuspidata

BLUE RESOURCES TRUST

has been conducting fisheries surveys across Sri Lanka since 2017:

>1,200 survey days
>24,000 sharks + rays
>100 species
0 sawfishes

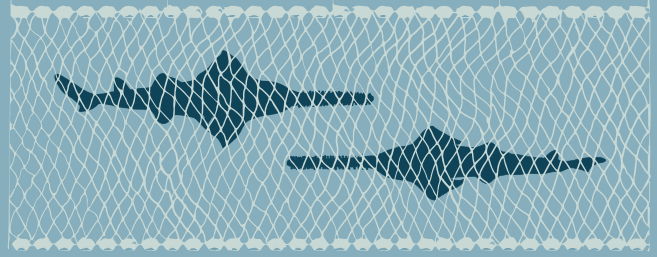
300 interviews with fishers conducted in 2019

110 had seen a sawfish

55 had not seen one since 1992

10 had seen one in the last 10 years

Sawfishes were last regularly encountered in the **EARLY 1990s.**



Respondents primarily attributed declines to **HIGH FISHING PRESSURE.**

The sawfish declines coincide with the time of increased fishing effort and the development of the aquaculture industry in nearshore areas that also resulted in accelerated coastal degradation.

RECOMMENDATIONS:

- Fully protect sawfishes
- Identify critical habitats + protected areas
- Education + awareness campaigns
- Proactive management for all sharks + rays

This study was supported by The Pew Charitable Trusts, Marine Conservation Action Fund of the New England Aquarium, Ocean Park Conservation Foundation Hong Kong, and the Tokyo Cement Group.

blue resources trust

ELASMOPROJECT

Source: Tanna, A., Fernando, D., Gobiraj, R., Pathirana, B.M., Thilakaratna, S., and Jabado, R.W., 2021. Where have all the sawfishes gone? Perspectives on declines of these Critically Endangered species in Sri Lanka. *Aquatic Conservation: Marine and Freshwater Ecosystems.* https://doi.org/10.1002/aqc.3617

Photo by Jie Zhang

The first record of a juvenile Megamouth Shark *(Megachasma pelagios)* found in a coastal area off mainland China.

Region Update: Asia

Written by Dr. Jie Zhang
IUCN SSC Shark Specialist Group | Asia Regional Group | Regional Vice-Chair
Institute of Zoology, Chinese Academy of Sciences

Photos by Heming Zhang

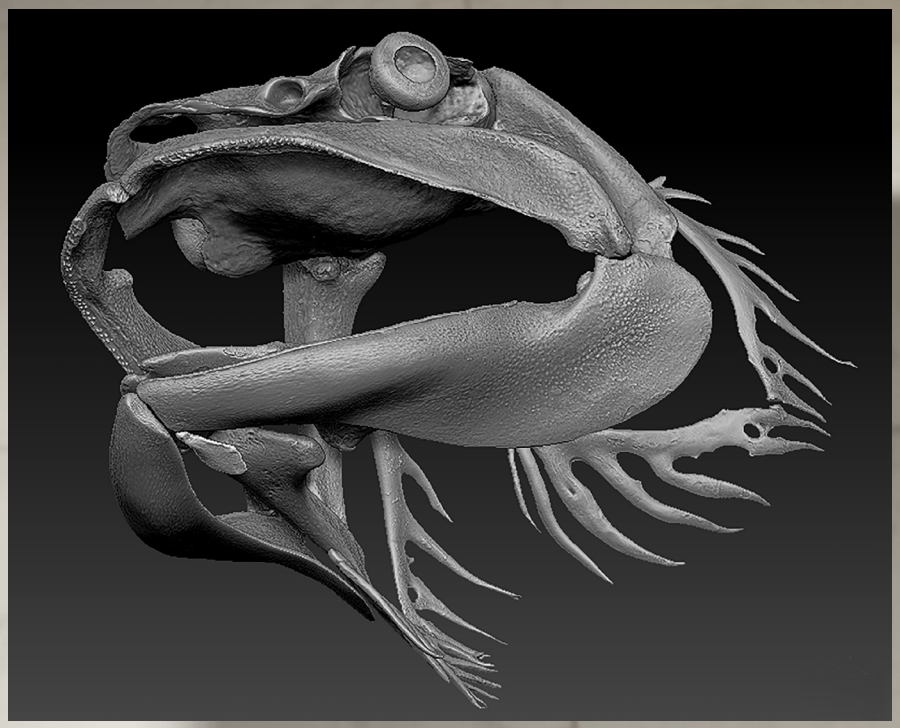
↑ A female juvenile Megamouth Shark from Lianjiang, China. Found on March 3, 2021

→ Lower jaw and tongue of the Megamouth Shark

The Megamouth Shark is a rare and pelagic filter-feeding shark. It is distributed globally with a hotspot known from the Kuroshio region, including the waters around Japan, Taiwan, and the Philippines. An individual of a juvenile Megamouth Shark was accidentally caught by a commercial fishing boat on the 13th of March 2021 in Lianjiang (119.80°E, 26.20°N), Fuzhou Province, China. This juvenile female measured 1.99 m in total length and weighed 33.15 kg. According to historical reports, it was the second and 126th record in China and the world, respectively. Among all individuals, only six juveniles have been recorded to this day: three males (1.80 m TL, 04 May 1995, 15°08' N, 18°22' W Dakar, Senegal; 1.90 m TL, 18 September 1995, 27°08' S,43°55' W Southern Brazil; 1.77 m TL, 13 March 2004, 05° 51' N, 95° 16' E Sumatra, Indonesia), two females (2.26 m TL, 16 November 2006, 27° 37' N, 114° 55' W Tortugas Bay, Baja California, Mexico; 1.99 m TL, 13 March 2021, 26.20° N, 119.80° E, Lianjiang, China), and one unsexed individual in Salaverry port, Peru (2.15 m TL, 24 June 2019, 08°22.5' S, 79°18.0' W). Thus, the individual found in China was the smallest female that has ever been recorded at the global level.

This specimen was found by a taxidermy artist, Heming Zhang, and was transported back to his workshop in Beijing. Unlike most Megamouth Sharks found until now, which present a dark grey body coloration, this juvenile shark had pink skin except for the dorsal surface of the head. This difference may be caused by the immaturity of its chromatophores and the many blood capillaries underneath its skin. The fish has jelly-like muscles that were extremely soft and flaccid.

This individual was so precious that scientists are making the best use of everything: more than 100 morphological measurements were taken from the shark based on 'Sharks of the World, Vol. 2' while tissue from various organs were collected and preserved. These will be used for biological and genetic studies by Dr Jie Zhang, Institute of Zoology, Chinese Academy of Science; the shark's skull was CT scanned in the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Science; and the specimen is also being used for popularization of science. The whole process, as mentioned above, as well as the introduction on shark biology and ecology, have been recorded by the Chinese National Geographic and uploaded to its official channel in Bilibili, which is one of the most influential video sites in China. The video has so far received over one million views and, consequently, positively affects shark awareness and conservation. The shark will be preserved as a specimen type in a museum with taxidermy, skeleton, and 3D scan models of its body and skeleton.



↑ 3D model of the Megamouth Shark skull

→ 3D printed model of the Megamouth Shark

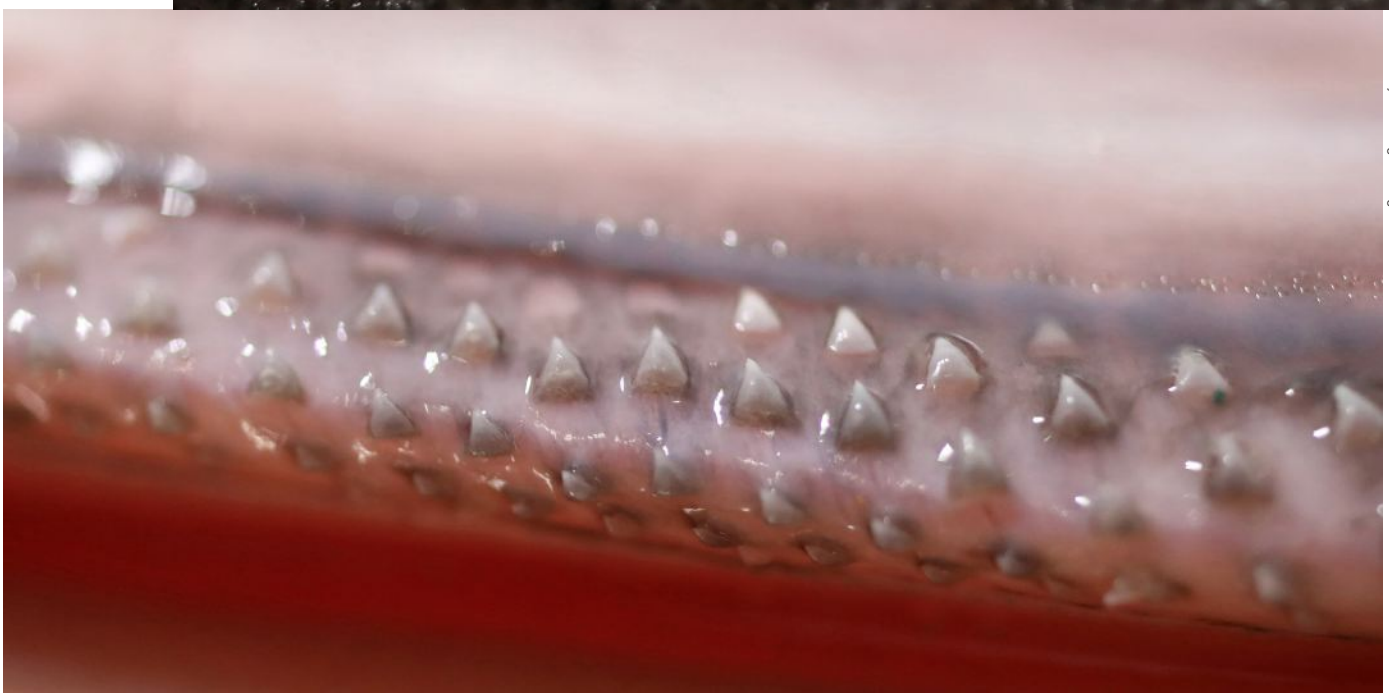
Photo by Heming Zhang

Photo by Kuang Wang

← Measurement of the Megamouth Shark

↙ Dermal denticles of the Megamouth Shark

↓ Tiny teeth of the Megamouth Shark



Photos by Heming Zhang

Unprecedented 10-year survey for Hong Kong shark fin consumption finds rapid move towards sustainable future

Written by Stan Shea IUCN SSC Shark Specialist Group | Asia Regional Group | Member
BLOOM Association | Hong Kong

Region Update: Asia

"Ten or twenty years ago, these results may have been difficult to imagine, but we had confidence that Hong Kong people would care about protecting species threatened with extinction and support marine conservation initiatives if they were given a chance to understand the reasons why, even if this meant they had to change some behaviours. That's why we decided to conduct these studies over a decade – so that we could see the changes take place".

A 10-year sociological survey research on Hong Kong's habits and attitudes regarding shark fin consumption revealed that Hongkongers are ready to embrace a more sustainable future by supporting government initiatives for conservation and making environmentally-friendly choices as consumers.

The research project led by BLOOM Association Hong Kong (BLOOM HK) and commissioned to the Social Sciences Research Centre of The University of Hong Kong (HKUSSRC) is the first of its kind to monitor long-term changes in the city's consumption, having conducted telephone interview surveys in 5-year intervals within the decade. The first survey was conducted in 2009/10, with two subsequent studies held in 2014/15 and 2019/20. Interviews targeted over 1,000 local Hong Kong citizens each year, and included detailed questions to find out respondent's frequency in consuming shark fin soup and other shark fin-related products, their thoughts on the issue, and their willingness to support lifestyles and developments within the city that move towards the protection of the ocean, and marine and even wildlife resources.

Consumption of shark fin soup

Results were encouraging and showed remarkable changes in Hong Kong in the past decade. When asked how often respondents ate shark fin soup in the past 5 years, 58.1% of respondents in the 2009/10 survey said their consumption "stayed the same". In the 2019/20 study, this percentage fell to 19.0%, and 53.9% of respondents reported a decrease in consumption (from 36.2% in 2009/10). A further 15.2% said they have stopped consumption. In the 2009/10 survey, 72.9% of respondents reportedly had shark fin soup at least once in the past 12 months, but in the latest survey, this percentage fell to 33.1%.

Consistently, more than 90% of respondents find it acceptable for shark fin soup to be excluded from both wedding banquets and corporate events. Some respondents in the 2019/20 survey even suggested that the dish should be replaced by sustainable seafood.

Regulation of shark fin and illegal wildlife trade, and the local marine environment

In the 2019/20 survey, 90.4% of respondents strongly agreed or agreed that the HKSAR Government should do more to regulate the international shark fin trade, and 89.3% strongly supported or supported the inclusion of illegal wildlife trade in Hong Kong's Cap. 455 Organised and Serious Crime Ordinance[1] (OSCO). Among all age groups, a higher proportion of respondents aged 18-29 showed strong support (95.9% "strongly agree" or "somewhat agree") for government efforts to do more to regulate the international shark fin trade, and 94.4% supported ("strongly support" or "support") the inclusion of illegal wildlife trade in OSCO. At the time of the survey, only 28 out of more than 500 species of sharks were regulated in international trade.

Less than 10% of Hong Kong's waters are designated as Marine Protection Areas (MPAs)[2]. Strong support was recorded (80.6% "strongly support" or "support") for increasing the size of MPAs in the territory. Again, the younger generation was most supportive of this suggestion, with 87.8% of the age range responding with "strongly support" or "support".

As an international trade hub, Hong Kong is at the centre of the global wildlife trade, especially for shark fin and other dried seafood products. There is hope that Hong Kong can also become a regional leader for responsible consumption and resource use.

[1] Currently, cases involving illegal wildlife trade are not investigated to identify if criminal gangs are behind the crime.

[2] To offer a comparison, at least 40% of Hong Kong's land area is designated as country park.

Highlights	2019/20	2014/15	2009/10
Percentage of respondents who have consumed shark fin soup at least once in the past 12 months	33.1%	44.1%	72.9%
Percentage of respondents who have decreased shark fin soup consumption in the past 5 years	53.9%	53.1%	36.2%
Percentage of respondents who have stopped eating shark fin soup in the past 5 years	15.2%	15.8%	Not asked
Percentage of respondents who said they stopped eating shark fin soup due to "environmental concerns" (out of respondents who have stopped eating shark fin soup)	52.7%	43.7%	Not asked
Percentage of respondents who found it "acceptable" or "very acceptable" to exclude shark fin soup from wedding banquet menus	94.8%	92.0%	78.4%
Percentage of respondents who found it "acceptable" or "very acceptable" to exclude shark fin soup from corporate events	92.7%	94.2%	Not asked
Percentage of respondents who would not knowingly eat a threatened species	96.1%	93.9%	Not asked
Percentage of respondents who find it "very acceptable" or "acceptable" that certain dishes (i.e. shark fin, bluefin tuna and black moss) are excluded from government official banquets for sustainability reasons	92.0%	92.0%	Not asked
Percentage of respondents who find it "very acceptable" or "acceptable" for all seafood to be sustainable in official government functions, wedding banquets and/or corporate banquets	>90%	Not asked	Not asked
Percentage of respondents who "strongly agree" or "somewhat agree" that the government should spend effort to regulate the international shark fin trade	90.4%	91.5%	Not asked
Percentage of respondents who "strongly support" or "support" including the illegal wildlife under Hong Kong's Organized and Serious Crimes Ordinance	89.3%	Not asked	Not asked
Percentage of respondents who "strongly support" or "support" increasing the size of Marine Protected Areas in Hong Kong	80.6%	Not asked	Not asked

This survey is supported by The Pew Charitable Trusts.

More results of the survey can be found at:
www.bloomassociation.org/en/bloom-hong-kong/research/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COMPARISON REPORT
THE 2009/10, 2014/15 AND 2019/20 SURVEYS ON SHARK CONSUMPTION HABITS AND ATTITUDES IN HONG KONG
WORTHLESS
HKD$1200/斤
BLOOM ASSOCIATION HONG KONG
JANUARY 2021
HO KA YAN, KATHLEEN
SHEA KWOK HO, STAN
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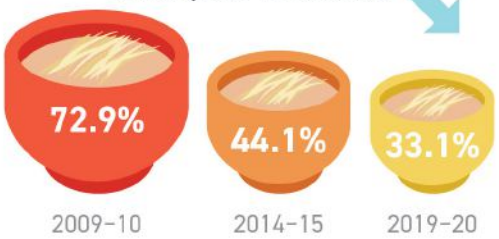
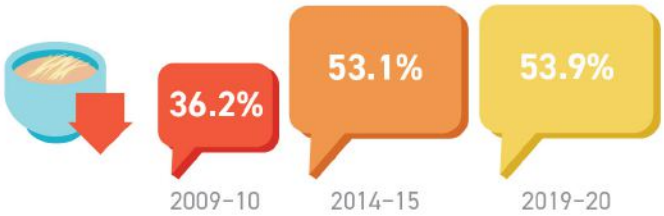
BLOOM

HONG KONG SHARK FIN CONSUMPTION TREND IN THE LAST 10 YEARS

Have consumed shark fin soup in the past 12 months

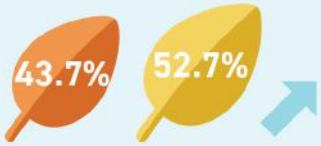


Decreased shark fin soup consumption in the past 5 years

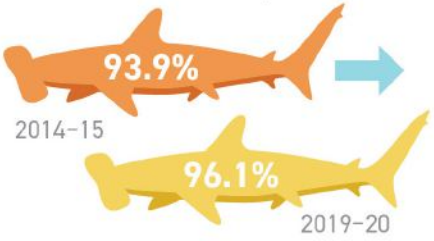


Stopped eating shark fin soup in the past 5 years*

Stopped eating shark fin soup **due to environmental concerns***



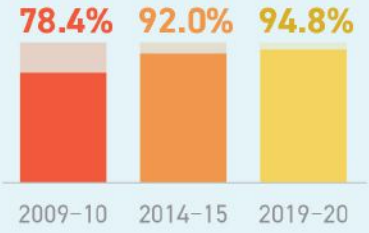
Would not knowingly eat a threatened species*



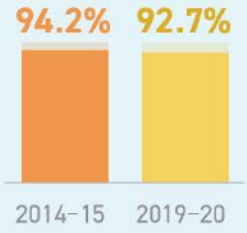
Very acceptable/acceptable...

to exclude shark fin soup in...

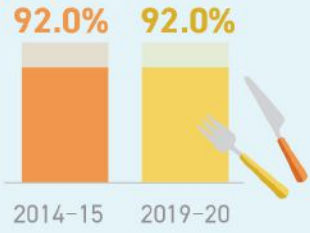
Wedding banquet menus



Corporate events*



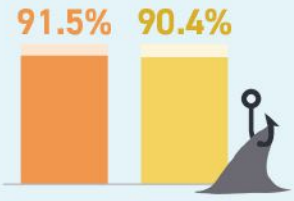
to exclude certain dish
(i.e. shark fin, bluefin tuna, black moss) in official government banquets for sustainability reasons*



for all seafood to be sustainable
in official government functions, wedding banquets and/or corporate banquets^

Strongly agree/somewhat agree...

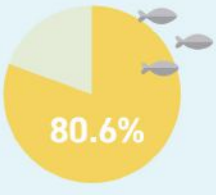
the government should spend effort to **regulate the international shark fin trade***



Strongly support/somewhat support...

including the illegal wildlife trade under **Hong Kong's Organized and Serious Crimes Ordinance**^

increasing the size of **Marine Protected Areas (MPAs)** in Hong Kong^



*Question not asked in 2009–10 survey. ^Question only asked in 2019–20 survey. 2009–10 2014–15 2019–20

Photo by Ranny Yuneni | WWF-ID

Region Update: Asia

3rd Indonesian Shark and Ray Symposium

Highlight: Wedgefishes and Guitarfishes are the most discussed species

Written by
Ranny Yuneni

IUCN SSC Shark Specialist Group | Asia Regional Group | Member
WWF Indonesia

Fahmi

IUCN SSC Shark Specialist Group | Asia Regional Group | Regional Vice-Chair
Indonesia Institute of Science

Indonesia is still struggling to conserve its shark and ray populations due to a lack of robust information and accurate scientific data needed to develop conservation policies and strategies. As part of ongoing efforts to manage the global decline of shark and ray populations, the Indonesian Ministry of Marine Affairs and Fisheries (MMAF), with support from WWF Indonesia, conducted the third national shark and ray symposium virtually on April 7–8, 2021 to update data and information related to studies on sharks and rays in Indonesia with a theme of 'Strengthening Collaboration and Synergy in Managing Shark and Ray Resources'.

This symposium was held as a platform to collect, highlight and update such imperative data as well as to identify the needs for shark and ray conservation, especially for priority species as part of the ratification of international agreements such as the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) and Regional Fisheries Management Organizations (RFMO). Furthermore, through this symposium, it was hoped that the need for a synergized, collaborative approach to shark and ray conservation would be recognized. The symposium also identified some supports from academics and non-governmental organizations to the government, especially in raising public awareness on the importance of sharks and rays.

Before the main event, there were several pre-workshop meetings conducted from April 5–6, 2021. One event was held in collaboration with the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF). This workshop attended by selected participants from six countries in the Coral Triangle aimed to increase their knowledge and capacity on Marine Protected Areas (MPA) for sharks and rays through Focus Discussion Groups and MPA Case study exercises.

Over 110 scientific articles were submitted and presented during the symposium, covering biology, ecology, socio-economics, management, and conservation topics. Most submitted articles focused on the biological and ecological aspects of sharks and rays (53.64%), primarily related to catch and landing data. It was also noted that the most discussed species during the symposium were the Whale Shark *(Rhincodon typus)*, and Guitarfishes and Wedgefishes (Order Rhinopristiformes).

Indonesia has made several efforts to manage its shark and ray populations from further declines by the formulation of effective policies in implementing the National Plan of Action (NPOA) for shark and ray conservation and proposing the full protection of several threatened shark and ray species. Based on the symposium, additional recommendations were made as follows:

1) Improve efforts in collecting shark and ray data including identifying critical habitats in relation to fishing grounds, using citizen science for data collection, using extractive and non-extractive methods to obtain biological and ecological data, updating the economic evaluation of sharks and rays, and understanding the rate of domestic and international consumption levels;
2) Use a standardized and legal format in collecting and reporting national shark and ray data that needs to be centralized by each institution;
3) Strengthen shark and ray management in Indonesia, such as in bycatch mitigation, multi-regional stock-based management, the formulation and enforcement of policies to fully protect threatened shark and ray species, developing regulations to manage shark and ray tourism, and regulating the capture of species listed in Appendix II of CITES;
4) Document scientific data and information to support shark and ray management to update the status of sharks and rays as well as lessons learnt from success stories of conservation management; and
5) Improve collaboration between stakeholders to increase capacity in priority locations.

Marine Historical Ecology (MHE) Working Group

Photo by Heike Zidowitz

Co-chairs:
Dr Manuel Dureuil
IUCN SSC Shark Specialist Group | Northern Europe Regional Group | Member

Heike Zidowitz
IUCN SSC Shark Specialist Group | Northern Europe Regional Group | Regional Vice-Chair

Studies looking into historical data often deliver forgotten pictures of elasmobranch occurrence and abundance. With a loss of knowledge of former population sizes and species diversity in some regions, a so-called shifting environmental baseline syndrome hinders setting accurate management targets, recovery goals, and conservation objectives for elasmobranchs. In the just commencing UN decade of ecosystem restoration (2021-2030), the use of historical data and Marine Historical Ecology (MHE) to reimagine and reconstruct former important elasmobranch habitats and diversity can be a very useful field of data analysis to define conservation objectives for their management and recovery, restoration, rewilding and even reintroduction. This working group promotes and encourages MHE in elasmobranch research to better inform their conservation in a wider spatiotemporal frame.

The tasks of this Working Group will be:

- Establish a (digital) workplace to connect, exchange information and collaborate with scientists working on historical data in elasmobranch research.
- Introduce members to the field of Marine Historical Ecology, provide an overview and easy access to the fundamental scientific literature of MHE.
- Collate available publications related to elasmobranch MHE to provide a comprehensive list of work and authors/researchers in this field and a central hub on data and information.
- Provide an overview and review of data collection methods for MHE (sources and data retrieval).
- Provide information on data presentation when lacking large datasets: qualitative-descriptive data, photographs and artwork, anecdotal descriptions, linguistic approaches, long-time trends, GIS and mapping, DNA analyses, and habitat modelling.
- Advance the understanding of the historical abundance, importance, occurrence, and threats of elasmobranchs and detect the shifting environmental baseline syndrome in fisheries and population data.
- Advance the understanding of suitable restoration measures and targets, as well as anthropogenic impacts and the assessment of the state of elasmobranchs.
- Highlight and present the potential of MHE to inform Red List assessments, restoration targets, conservation management and policies at conferences and through webinars.
- Complement the IUCN Rewilding Principles and Guidelines for Reintroductions and Other Conservation Translocations for elasmobranchs.

'What does restoration mean, what are meaningful restoration goals, and which species have occupied what areas and habitats in the past? Marine Historical Ecology deals with many pressing issues of current restoration efforts. This is highly visible in areas that have been exploited for hundreds of years, such as the North Sea in Europe and elsewhere. Let us make sure that the past is not forgotten and instead resurrect former elasmobranch numbers and presences.'

Photo by Zoya Tyabji

Gulper Sharks captured off the Andaman Islands, India and later processed for their liver oil.

The Use of Shark Liver Oil

Written by Dr Brit Finucci
IUCN SSC Shark Specialist Group | Deepwater Chondrichthyans Working Group | Chair

The use of sharks for their oil is not new. Globally, sharks have been targeted for their liver oil for centuries, and this product is an essential marine resource for many coastal communities. All shark livers contain a natural organic compound known as squalene. *Squalene* in the liver helps a shark maintain its buoyancy. This natural lipid or fat molecule is also used for many cosmetic, pharmaceutical, and technological applications, such as sunscreen products, anti-ageing supplements, and biofuels. Indeed, while the public is increasingly familiar with other shark traded products like fins or meat, most people are unaware that their everyday household products may contain squalene from a diversity of shark species. Although there are readily available plant-based and synthetic alternatives, shark-derived squalene is still in high demand as it is typically the most cost-effective source in terms of extraction. Yet, despite the presence of squalene in international trade for decades, virtually nothing is known of the shark liver oil trade. Furthermore, even though there is an ever-growing body of medical literature for its application in human health, its use has only recently been brought to light with the COVID-19 pandemic.

Historically, the shark liver oil trade has affected many shark species, especially deepwater ones that have the most concentrated and highest quality source of squalene in their livers. Deepwater sharks, species that spend most of their lifecycle at depths greater than 200 m, account for nearly half of the global shark diversity. They are also characterised by life histories (e.g. late maturity, low fecundity) that make these species unable to withstand exploitation. In fact, Gulper Sharks (genus *Centrophorus*) have been highly impacted due to localised population declines from targeted fisheries that have collapsed over short periods of time (less than 20 years). For example, at a fish landing site in Cochin, India, Gulper Shark landings declined by 60% over a three-year period, from 114 tonnes (t) in 2008 to 39 t in 2011. However, information on most fisheries where liver oil is extracted is often anecdotal and lacks quantitative data. Often, when a fishing area becomes depleted, fishers simply move onto new fishing grounds, offering little refuge or recovery for these species. When widespread collapse occurs, resulting actions, such as fisheries closures, can have detrimental effects on both the local fishing communities and the marine environment. Today, 75% of Gulper Sharks (nine species) are assessed at a very high or extremely high risk of extinction (Endangered or Critically Endangered) by the IUCN Red List of Threatened Species due to overfishing.

There is a lack of transparency on the source of shark liver oil and the species affected by the trade. Furthermore, while there have been reports that shark liver oil has been used to develop some of the COVID 19 vaccines, the scale of the squalene demand from the pharmaceutical industry to create COVID vaccines is unknown. Without this information, we cannot determine if shark liver oil is being obtained from a sustainable and legal source or address the effect the trade is likely having on sharks. The newly established IUCN SSC Shark Specialist Group Deepwater Chondrichthyans Working Group will be working towards establishing projects to collect information on national and international liver oil supply chains so we can better quantify the impacts of the shark liver oil trade and identify alternatives to reduce pressure on those species most at risk of extinction.

Take-home messages:

- Shark liver oil contains a natural organic compound known as squalene.
- Squalene is used in many cosmetic, pharmaceutical, and technological applications.
- Sharks may be targeted specifically for their shark liver oil (and sometimes for their meat) or retained as bycatch species and used for their liver oil.
- The shark liver oil trade has affected species highly susceptible to population decline, including the Basking Shark *(Cetorhinus maximus),* Greenland Shark *(Somniosus microcephalus),* Tope Shark *(Galeorhinus galeus),* and gulper sharks *(Centrophorus* spp.*)*. As a result, targeted fisheries for these species have collapsed over short periods.
- There is a lack of transparency on the source and trade route of shark liver oil, with much of it likely being sourced from unsustainable fisheries.
- Alternatives to shark-derived squalene, including synthetic-derived and plant-based squalene, are available and should be considered in the production of vaccines.
- With the growing global demand for vaccines, renewable energies, and alternative medicines, a failure to assess the impact of the use of squalene on shark populations may have long-term consequences by increasing targeted fisheries for these species and placing additional pressure on already susceptible populations.

Photo by Blue Resources Trust

Oil extraction of shark livers captured in the deepwater shark fisheries off Sri Lanka.

Photo by Zoya Tyabji

Gulper sharks captured off the Andaman Islands, India and later processed for their liver oil.

Assess Working Group Update

Upcoming IUCN Red List Sawfishes (family Pristidae) reassessments

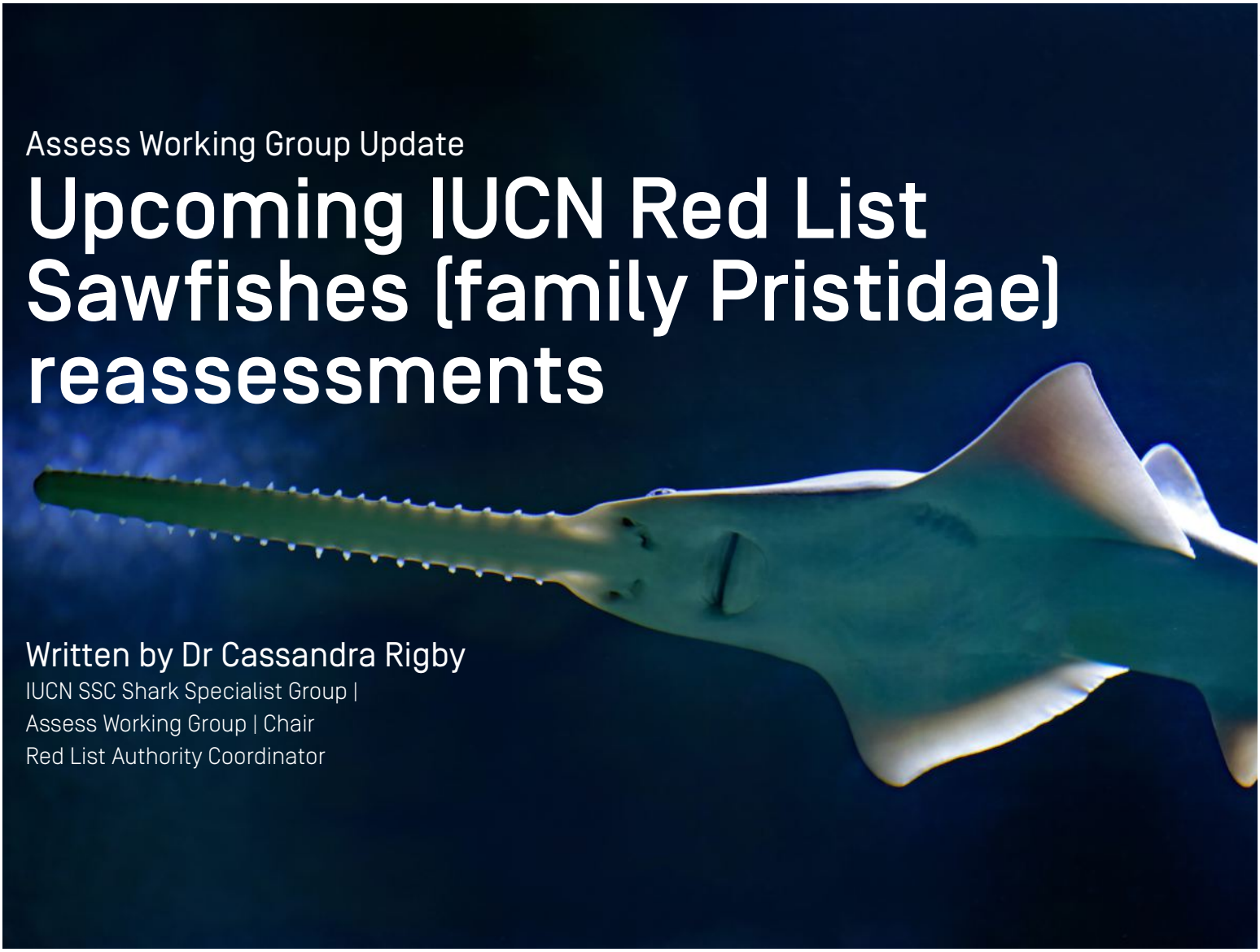


Photo by David Clode | Unsplash

Written by Dr Cassandra Rigby

IUCN SSC Shark Specialist Group |
Assess Working Group | Chair
Red List Authority Coordinator

The five species of Sawfishes were last assessed for the IUCN Red List of Threatened Species in 2012. As all Red List assessments have a lifespan of 10 years, the five species of Sawfishes are now due for reassessment.

To undertake these reassessments, the SSG Assess Working Group is planning a virtual workshop in ~September/October 2021. The purpose of this workshop is to bring together experts to:

- Collate and review available information on population trends, fisheries, threats, and pressures affecting sawfishes; and,
- Prepare draft Red List assessments for the five sawfish species.

From previously published Red List assessments, we have some sense of each species' taxonomy, biology, and distribution. Hence, this reassessment will focus on any new biology and range data and the degree of exposure to fisheries (target and incidental), levels of fishing effort, and species population trends. We will use all available information, including any aggregated catch data, trends in fishing effort, levels of exploitation and habitat changes, to assess species status.

If you have any new information from the past ten years that can contribute to these assessments and are interested in being involved, we would like to hear from you. Your level of involvement can range from contributing information to being closely involved as an assessor. To be considered as an Assessor, we will ask you to complete the online IUCN Red List training course at Online IUCN Red List Training.

Online Red List training

The IUCN Red List of Threatened Species is widely regarded as the world's most objective and comprehensive listing of species at risk of extinction. The SSG is responsible for assessing all known shark, ray, and chimaera species for the Red List. If you are interested in understanding the application of the IUCN Red List Categories and Criteria, there is a freely available online Red List Training course that we encourage all SSG members to at least have a look at: IUCN Red List Training.

The entire course consists of 7 modules and takes approximately 10 hours to complete. A certificate will be awarded upon achievement of a grade of >75% in a final exam (~2-3 hours). This course is necessary for any SSG members that wish to be a part of the Assess Working Group. If you are interested in Red Listing but are unsure what it entails, Modules 1 and 2 of this course give a good overview.

The Online course is available in: English, Spanish, French, Indonesian, Portuguese, Russian and Chinese.

If you are interested in being involved or would like more information on the assessment process or the online training course, please contact Cassandra Rigby, the SSG Red List Authority Coordinator and Assess Working Group Chair at CassandraRigby@IUCNSSG.com.

Human Dimensions Working Group update

Crash Course in the Human Dimensions of Shark Conservation

Hollie Booth and Dr Divya Karnad
IUCN SSC Shark Specialist Group | Human Dimensions Working Group | Co-Chairs

Photo by Kusuma Naira

It is increasingly recognised that effective and ethical shark conservation requires understanding and changing human behaviour; and engaging coastal communities, with full respect for the rights of indigenous and local people. However, many shark conservationists primarily receive biological training, and therefore need support for addressing these interdisciplinary challenges. To work towards addressing this, the Co-Chairs of the new SSG Human Dimensions Working Group are organising a week-long crash course in the Human Dimensions of Shark Conservation.

When?

There will be a series of five Zoom seminars held over a 2-week period starting Tuesday 27th July and ending Thursday 5th August. Specifically, the sessions will be on the following dates:

- Tuesday 27th July 2021
- Thursday 29th July 2021
- Tuesday 3rd August 2021
- Wednesday 4th August 2021
- Thursday 5th August 2021

Each session will start at 11am (UTC) and run for approximately 90 mins.

Where?

- Anyone who wants to participate will need to register via a Google Form at: docs.google.com/forms/d/e/1FAIpQLSfPS0t-sI9DZqe-Ldosk5tWG3wNvcrHViko4JD0G0erv6EYErg/viewform
- All sessions will be recorded and made available for those who can't attend

What?

We will aim to explore the following topics:

- Why human dimensions?
- An overview of socio-economic research methods
- Human dimensions application areas: understanding the socio-ecological situation
- Human dimensions application areas: designing interventions and changing behaviour
- How has human dimensions been useful in addressing specific management challenges and next steps

Who?

- The course is being co-ordinated by Hollie Booth and Divya Karnad, with the help of several external invited speakers. Contact us via HollieBooth@IUCNSSG.com or DivyaKarnad@IUCNSSG.com if you have any questions.
- The course will be open to non SSG members, so please feel free to invite others who may benefit from this course!

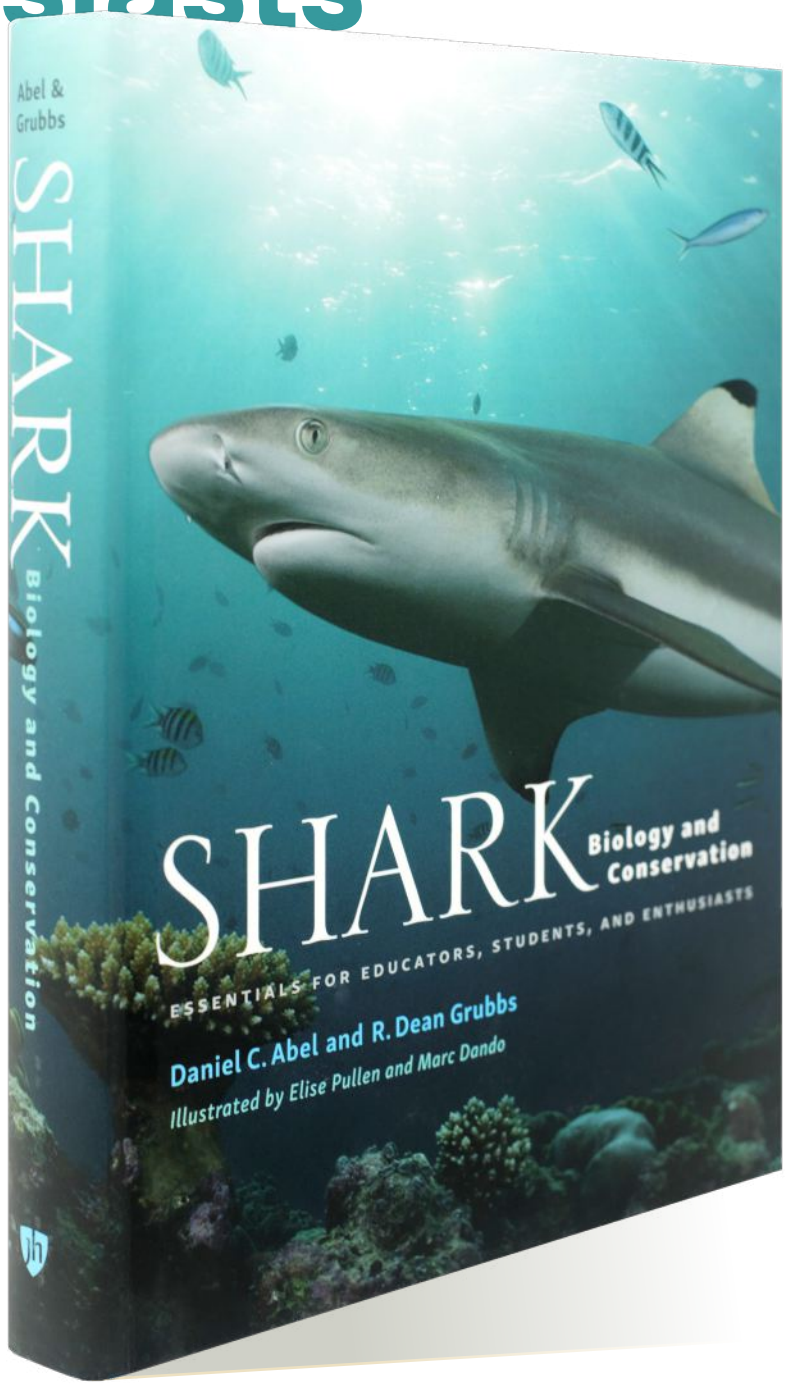
Recently published

Shark Biology and Conservation: Essentials for Educators, Students, and Enthusiasts

Written by Dr Daniel Abel[1] and Dr Dean Grubbs[2]

[1] Coastal Carolina University (CCU)

[2] IUCN SSC Shark Specialist Group | North America Regional Group | Member Coastal and Marine Laboratory (CML) | Florida State University (FSU)



In an era in which exceptional books about sharks already exist and more are forthcoming, why on earth would we think that what the market was missing was another book about sharks? Youthful indiscretion? Hardly.

The main reason we began the project that would develop into Shark Biology and Conservation: Essentials for Educators, Students, and Enthusiasts was our need for a textbook for the course in Shark Biology we had been team-teaching to Coastal Carolina University (CCU) students at the Bimini Biological Field Station and at CCU since 1996.

The main drawback to the course was the lack of a suitable textbook. To be sure, there are a number of exceptional books on sharks and their relatives. However, most shark-related non-fiction books for non-specialists are field guides, coffee table books, personal narratives, natural histories, stories of shark attacks, etc., written mainly for a general audience.

Highly specialized books on sharks are more technical, and their content and writing are more accessible to graduate students and specialists than to other students. These provide an exhaustive survey and synthesis of facts and concepts often accompanied by complex graphs and diagrams. Along with others in the shark research community, both of us use these texts regularly, but generally not as textbooks for our undergraduate courses. Indeed, without these technical books, *our book would not have been possible.*

The books closest to meeting our needs for accuracy and coverage, but in a form somewhat more accessible to our students were *Sharks, Skates, and Rays* by William Hamlett, *Biology of Sharks and Their Relatives*, edited by Jeffrey Carrier, John Musick, and Michael Heithaus, and Peter Klimley's *The Biology of Sharks and Rays*. Others included Greg Skomal's Shark Handbook, Sandford Moss' *Sharks: An Introduction for the Amateur Naturalist*, and a few more.

We highly recommend these outstanding books, but they were not written for the specific audience we had in mind and thus did not hit the sweet spot we were seeking.

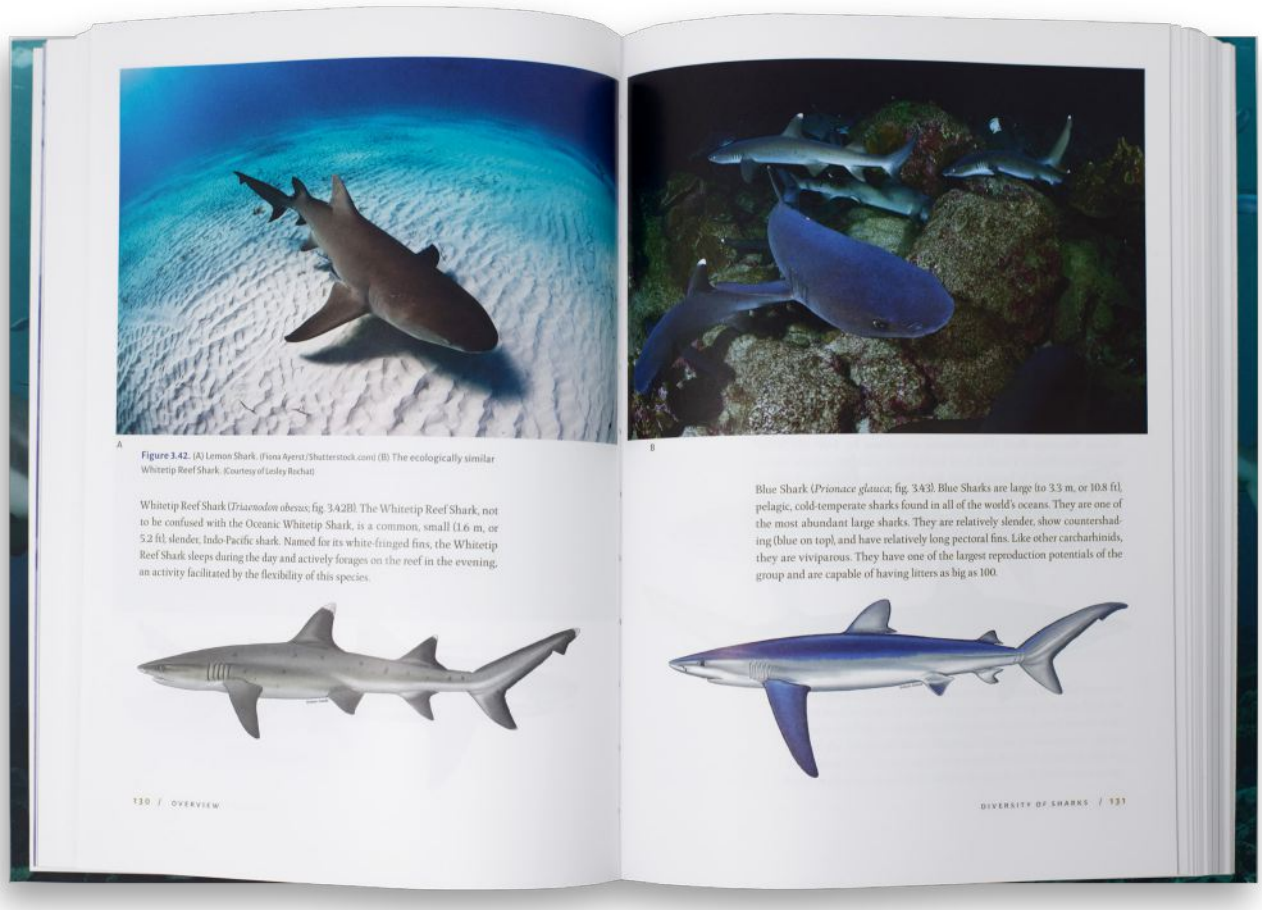
Moreover, as we contemplated writing a book for students in our shark biology course, we realized that the shark booklist probably could withstand a new title for a surprisingly broad market: advanced enthusiasts, educators, field biologists, naturalists, students, and marine biologists who might not have a background in fish biology or sharks. We envisioned a comprehensive, systematic overview of the diversity, evolution, ecology, behavior, physiology, anatomy, and conservation of sharks and their relatives written in a sufficiently detailed style but not *too* technical or intimidating.

We also wrote the book because we thought it would be fun and an outlet for our anecdotes and humor that we like to think are effective pedagogical tools.

Shark Biology and Conservation was published as a hardback and E-book by Johns Hopkins University Press in September of 2020 and is 448 pages long with 195 color photos, 83 color illustrations, six black-and-white photos, and 71 black-and-white illustrations. Despite its heft, the book's length and the number of figures were constrained by the publisher to make the book more affordable (US $49.95).

Most of the photos were generously donated by friends and colleagues, many of whom are professional photographers. The gorgeous cover photograph, which looks almost three-dimensional, was taken by Michael Scholl. Elise Pullen and Marc Dando expertly did the illustrations, and they are exquisite. Support from Michael Scholl and the Save Our Seas Foundation was pivotal both to the book's art program and to engaging contributing author Tristan Guttridge, who wrote the chapter on behavior.

The book follows a fairly traditional sequence of topics organized into four parts: Overview (Introduction, Evolution of Sharks,



Ways to Catch Sharks in Fisheries

There are four major categories of gear on which sharks and batoids (and other fishes as well) are caught, either intentionally or as bycatch (untargeted or unwanted catch; fig. 11.7).

- *Active entrapment* (seines, purse-seines, trawls)—targeting fish like pollack, cod, flounder, tuna, skates, and sharks. Trawl catches are typically multispecies except in some pelagic fisheries for small schooling fish like sardines.
- *Hook and line* (trolling, longlines)—targeting pelagic fish like Mahi-mahi, tuna, grouper, snapper, Spiny Dogfish, and other sharks.
- *Passive entrapment* (trap nets [tonnara], pound nets)—catching tuna and seabass as well as estuarine species.
- *Entanglement gear* (fixed and drift gillnets, trammel nets)—targeting tuna, mackerel, and estuarine fishes, and Spiny Dogfish. A variety of carcharhinid (e.g., Atlantic Sharpnose [*Rhizoprionodon terraenovae*], Blacktip [*Carcharhinus limbatus*], Blacknose [*C. acronotus*], Finetooth [*C. isodon*]) and Bonneteheads (*Sphyrna tiburo*) are targeted in the SE US gillnet fishery. Thresher sharks are caught in the Pacific Ocean using gillnets.

Overview of Shark Fisheries

Data on the annual catches of chondrichthyans as an assemblage (sharks, batoids, and chimaeras) are collated by FAO, based primarily on reports by regional organizations and member nations. Chimaera fisheries represent an insignificant proportion of the chondrichthyan catch, and thus we ignore them in our analyses below. Currently 70% of landings are sharks and about 30% batoids. Finally, the data reported below represent landings only and include only bycatch that was landed and not discarded at sea or unreported.

As a group, elasmobranch fisheries are less than 1% of the total marine capture fishery production. The catch of sharks and batoids reached a maximum of approximately 895,000 tonnes (1,970,000,000 lb) in 2003, representing a tripling of the catch rate of 1950 (fig. 11.8A). This increase was due to several factors, including increased demand and a transition to more modern, industrial-type fishing methods.

One caveat of shark fisheries is that reporting of catches is notoriously bad, in part because identification to species level is low or inaccurate, and about one-third of the elasmobranch catch is lumped together as sharks, rays, skates, and so on.

Facing page

Figure 11.7. Ways to catch sharks as well as sources of shark and ray bycatch. (Marc Dando. Used with permission from Save Our Seas Foundation © 2016)

- Barbeled Houndshark (F. Leptocharliidae)
  - a monotypic family, the single species being the Barbeled Houndshark (*Leptocharias smithii*).

Representative Species

Barbeled Houndshark (*Leptocharias smithii*). Found in the Eastern Atlantic, this demersal species is found to depths of 75 m (246 ft). It is yolk-sac placental viviparous.

- Houndsharks (F. Triakidae; fig. 3.35)
  - 47 species in nine genera of mostly coastal sharks, including the Leopard Shark (*Triakis semifasciata*; fig. 3.35A) and the Dusky Smoothhound (*Mustelus canis*; fig. 3.35B). They all have pavement dentition, a long, pointed snout, and arched mouth. They are pelagic from the surface to > 450 m (1475 ft), where they feed primarily on fish and squid. Triakids are found in the Atlantic, Pacific, and Mediterranean. Interestingly, about half the species are yolk-sac viviparous and half are placental viviparous. Triakids range from 50–200 cm (1.5–6.5 ft).

Representative Species

Spotted Houndshark (*Triakis maculata*). The Spotted Houndshark is a small, harmless coastal shark found in the Pacific off the coast of South America.

School Shark or Soupfin Shark (*Galeorhinus galeus*). Also known as the Vitamin Shark, this species is easily identified by the large lobe on the upper caudal fin. They have a slender body, long snout, and small second dorsal. Their vitamin A-rich liver led to their being the biggest shark fishery in California in the 1930s and 1940s.

Dusky Smoothhound or Smooth Dogfish (*Mustelus canis*; fig. 3.35). The Dusky Smoothhound (Smooth Dogfish) is a common placental viviparous species in the Northwest Atlantic. There are two subspecies, *M. canis canis* and *M. canis insularis*. The former is most common along the shallow continental shelf from New York to South Carolina, and it pups in shallow estuaries. Oddly, it was recently reported pupping at 400 m in the Gulf of Mexico, which means that the same subspecies utilized two very different depth regimes for giving birth. *Mustelus canis insularis* is the island form of the species and is found in the tropics in deeper waters.

- Weasel Sharks (F. Hemigalidae)
  - eight species, with a robust body and elongate, rounded snout. They live in inshore waters from the surface to 130 m (425 ft), where they feed on fish. They have unusual teeth. The group is placental viviparous and reaches 2.4 m (8 ft). They are all found in the Indo-Pacific.

Diversity of Sharks]; Adaptational Biology: How Sharks Work [Functional Anatomy of Sharks, Sensory Biology, Reproduction, Circulation, Respiration, and Metabolism, Thermal Physiology, Osmoregulation, and Digestion]; Ecology and Behavior [Ecology, Behavior and Cognition]; and Human Impacts [Fisheries, Climate Change and Other Human Impacts]. There is also an Appendix summarizing conservation policies and an Index.

Reviews of the book have been very generous. Blurbs featured on the back cover include these:

"My shelves are crammed with shark literature, from classic scientific texts to children's books, tall stories from fishermen, identification guides, and more, but none of these volumes are as comprehensive, accessible, and amusing as this book. It is hard to stop reading long enough to write: 'This is a classic—order your first edition copy NOW!'"

Sarah Fowler, OBE, Save Our Seas Foundation, coauthor of *Sharks of the World: A Fully Illustrated Guide*

"The latest book on shark biology and conservation, written by two of the most experienced shark biologists in the business. Covering a wide range of topics, this book is both highly entertaining and informative. I was surprised at how much I learned despite my many years of shark research."

Yannis P. Papastamatiou,
Florida International University

"Abel and Grubbs have produced a fine contemporary account of shark biology. Written in an accessible, conversational style, this book will be of keen interest to shark enthusiasts, students, and scientists alike."

John A. Musick, Co-chair (retired), IUCN Shark Specialist Group, Virginia Institute of Marine Science, coeditor of Sharks and Their Relatives II: Biodiversity, Adaptive Physiology, and Conservation

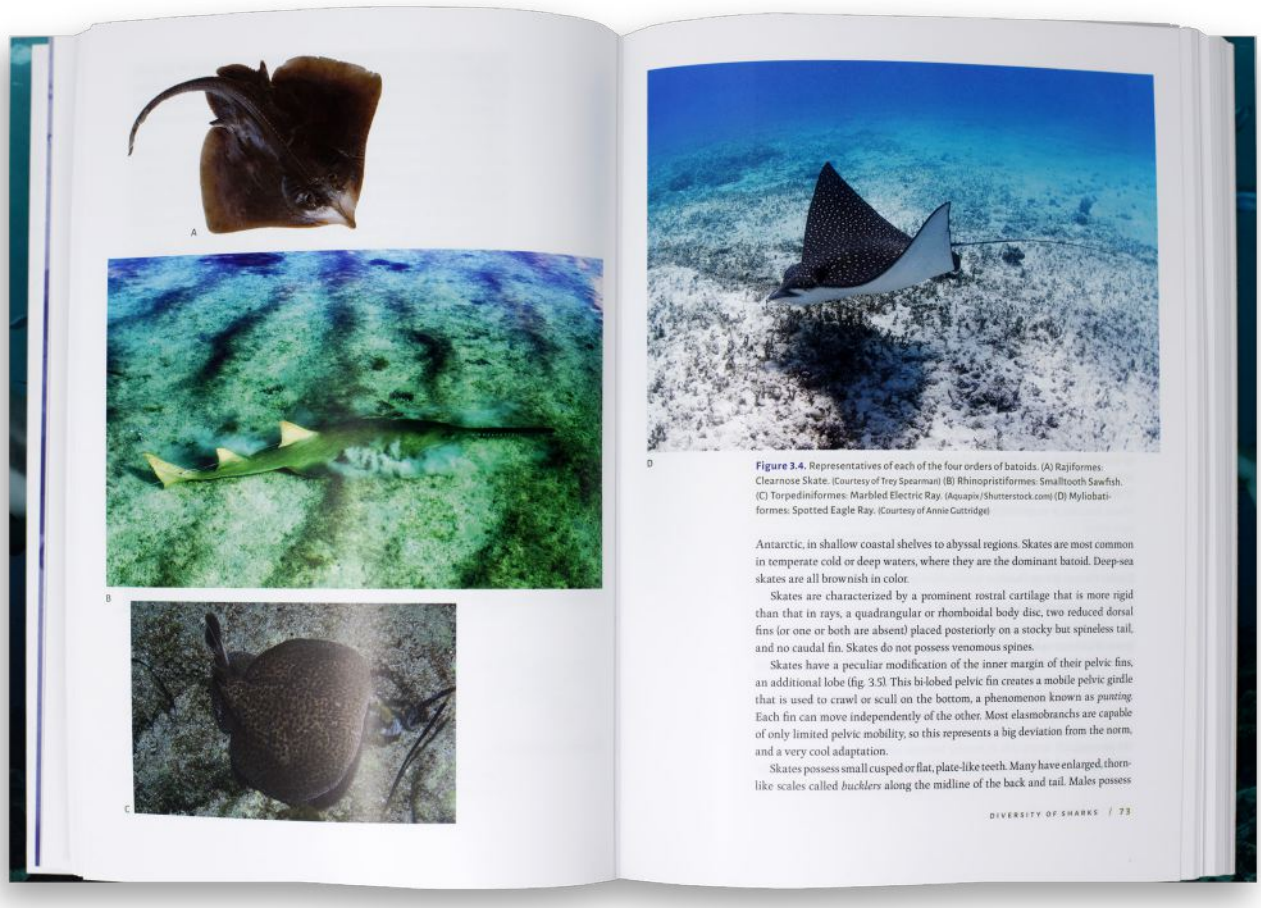
"Written in a disarming, jargon-free style, this book is highly accessible to a broad audience. At the same time, this is an authoritative, carefully researched text. It builds on the substantial experience of two highly regarded research biologists with a passion for elasmobranchs, and for communicating what they know about these animals in a straightforward way."

Gavin J. P. Naylor, Florida Program for Shark Research / Curator, Florida Museum of Natural History

"Authors write for two reasons: an overwhelming compulsion to tell a story or fill a void. Abel and Grubbs are uniquely motivated by both factors. They have written a much-needed story that they have been presenting to classes for more than twenty years. Read this story. It is flawless."

John F. Morrissey, Sweet Briar College, coauthor of *Introduction to the Biology of Marine Life*

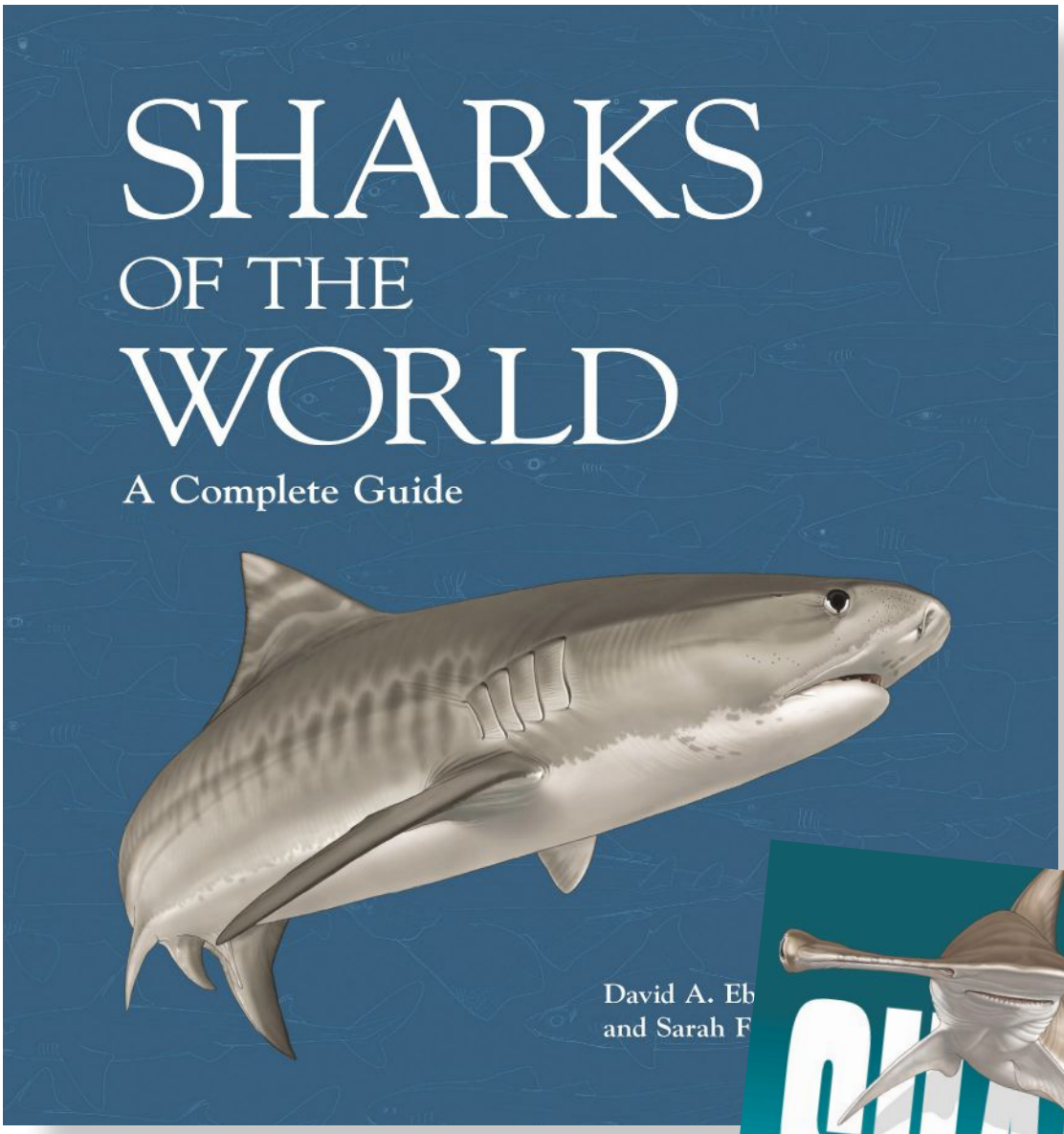
Shark Biology and Conservation is currently in its second printing. We have successfully used the book in our courses and feel that we achieved the goals we set for the book before we wrote the first sentence. Fortunately, writing about a group whose biology is so intriguing and whose conservation so vital was more a labor of love, awe, and respect than a prolonged task. We also know that errors may have escaped our eyes and omissions our notice. We'd like to hear from you if you discover either of these, in case there is a third printing or even a second edition.

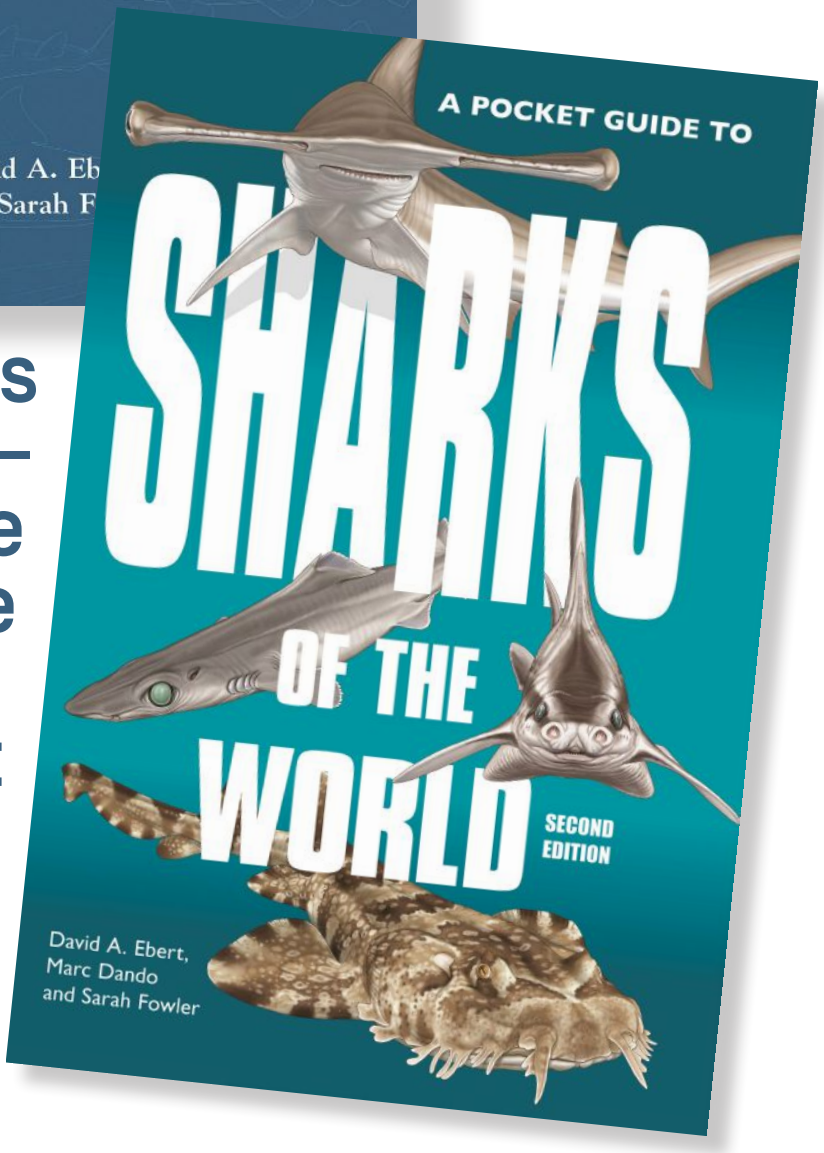


Dr. R. Dean Grubbs is a fish ecologist with >30 years of experience studying the biology and ecology of sharks and rays in coastal, pelagic and deep-sea environs and has taught college courses on the biology of sharks and rays for more than 25 years. Much of his research addresses specific biological gaps necessary for management and conservation coastal and deep-water sharks and rays, allowing him to bring real world experience into the classroom. Dean's interest in sharks stems from being raised on north Florida's Gulf coast. He received bachelor's degrees in Marine Science and Biology from the University of Miami and a doctoral degree in Fisheries Science from the College of William & Mary's Virginia Institute of Marine Science. Dean was a post-doctoral researcher and faculty member at the Hawaii Institute of Marine Biology before moving to Florida State University in 2007. He is now a Full Research Professor and the Associate Director of Research at Florida State University's Coastal and Marine Laboratory, where he maintains an active and highly collaborative lab and mentors graduate and undergraduate students. Dean also serves on numerous federal and international advisory panels such as the NOAA SEDAR Panel of Experts for shark management issues, the NOAA Smalltooth Sawfish Recovery Implementation Team and has been part of the International Union for the Conservation of Nature's Shark Specialist Group since 2001. Dean serves as a Scientific Advisor to the Save Our Seas Foundation and is the immediate past-President of the American Elasmobranch Society, the world's largest and oldest scientific society dedicated to the scientific study of elasmobranch fishes. Over the past decade, much of the research conducted by Dean and his students has focused in three areas 1) the ecology of smalltooth sawfish in Florida and the Bahamas, addressing questions directly related to promoting the recovery of this critically endangered species, 2) deep sea shark biology and ecology including response of deep sea communities to the Deepwater Horizon oil spill, and 3) ecology of coastal shark populations including investigating community structure, stock dynamics, post-release survival, and bycatch mitigation.

Dr. Daniel C. Abel is Professor of Marine Science at Coastal Carolina University in Conway, SC. He earned his M.Sc. in marine biology from the College of Charleston and his Ph.D. in marine biology from the University of California San Diego's Scripps Institution of Oceanography, and was a postdoctoral fellow in marine biomedicine at the Medical University of South Carolina. His research focuses on the physiology and ecology of sharks and rays. In addition to numerous scientific papers, he is co-author of the books Environmental Issues: Looking Towards a Sustainable Future (4th ed, Pearson.), Environmental Oceanography (Jones and Bartlett), Environmental Geology (Jones and Bartlett), and Shark Biology and Conservation. He has been an award-winning environmental columnist, was founding director of CCU's Sustainability Initiative from 2006 – 2012, and served on the board of directors of the Dogwood Alliance, a forest protection organization. He taught at sea and in > 30 countries on the M/V Explorer with Semester at Sea in spring 2010 and summer 2012, 2013, and 2014, and his annual Biology of Sharks course held at the Bimini Biological Field Station in the Bahamas has run for twenty-five years. He has appeared on CNN, CBC, CBS, NBC, The Weather Channel, and National Geographic documentaries. Dr. Abel is a Senior Fellow of the U.S. Partnership for Education for Sustainable Development, and is the inaugural Honors Distinguished Faculty Fellow at Coastal Carolina University. He is a native South Carolinian and resides in Pawley's Island, SC.

jhupbooks.press.jhu.edu/title/shark-biology-and-conservation nhbs.com/shark-biology-and-conservation-book





Sharks of the World – a Complete Guide & A Pocket Guide to Sharks of the World

For many people, the word "SHARK!" (capital letters and exclamation mark are almost obligatory) conjures up the image of a large dorsal fin cutting through the water surface, revealing the presence of a huge, fearsome, toothy predator beneath, rather than the vast array of sharks of all sizes, shapes, and colours that we know and love. Certainly, some sharks can get very big - the Whale Shark springs to mind - but about over 80% of known shark species are under 1.8m (~6 feet), and half of all species are less than 1 m (3 feet) long. There are even some 'Dwarf' sharks (species in the genera *Eridacnis, Etmopterus, Squaliolus*) that, when fully-grown, are no longer than a human hand. Many people assume sharks to be nearly uniformly greyish colour, but very few are so dull – who has heard of a pink shark with blue fins? Many more shark species have a brilliantly variegated pattern of bright orange and yellow spots and bands, and others glow in the dark depths of the ocean! These are just some of the 536 individually described and illustrated shark species you will find in the new Sharks of the World (Princeton University Press), due out this summer in Europe (22 June 2021) and North America (20 July 2021).

This >600-page book is the essential, comprehensive, easy to use and lavishly illustrated guide for anyone interested in these fascinating fishes. About 50 new species have been added since the previous edition was published, reflecting the continued rapid rate of scientific discoveries – over 20% of all known shark species have been described in the past 15 years. As

Skeleton

Sharks have a very simple internal skeleton formed from cartilage (the same substance that supports our ears and noses). Unlike bone, cartilage does not contain nerves or blood vessels. This strong material is lighter and more flexible than bone because it contains fewer minerals; it is made up mostly of proteins although the cartilage of older, larger sharks may become partly calcified, harder and more bone-like. The advantages of possessing a light, manoeuvrable skeleton include more efficient swimming (to catch prey or escape from predators) and the ability to exploit different habitats and hiding places. The swim bladders possessed by most teleosts developed to compensate for the weight of their heavy, bony skeletons and provide neutral buoyancy but, as already noted, these are not found in cartilaginous fishes.

Shark skeletons also have remarkably few individual parts. The head contains an unseamed, box-like skull (chondrocranium, or braincase), cartilaginous structures supporting the gills, and the jaws (which are thought to have developed from the first gill arch and are not attached to the skull). A long vertebral column runs the length of the body from the skull into the upper caudal lobe. This takes the form of a string of hourglass-shaped vertebrae (equally as strong and stiff as bone vertebrae) beneath an arch that protects the spinal cord. Finally, cartilaginous structures support the fins and, in males, the claspers. The lack of any connection between most of these skeletal parts makes sharks incredibly flexible; as a result, most species are capable of turning rapidly in a very tight circle.

Figure 15 illustrates the evolution of shark skulls. The braincase of a primitive cladodont (top left), fossilised in Lower Carboniferous limestone, contains just three elements. Later fossils have more, and living species are yet more complex. Over time, the snout (containing complex sensory organs) has moved forward, brain size increased, and the underslung lower jaw become more heavily muscled (see p. 28). However, even the most advanced living sharks have only ten cartilaginous elements in their braincase, compared with over 60 bones in a teleost fish skull, and 22 in the human cranium.

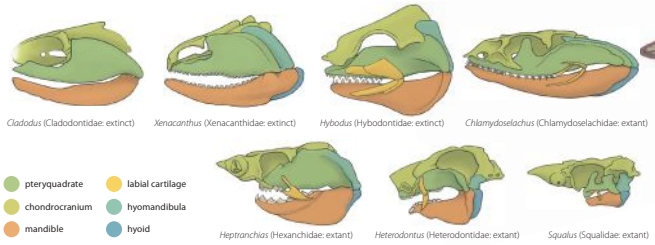


Figure 15: Skulls of elasmobranchs: earliest, top left, to modern, bottom right (after Schaeffer 1967).

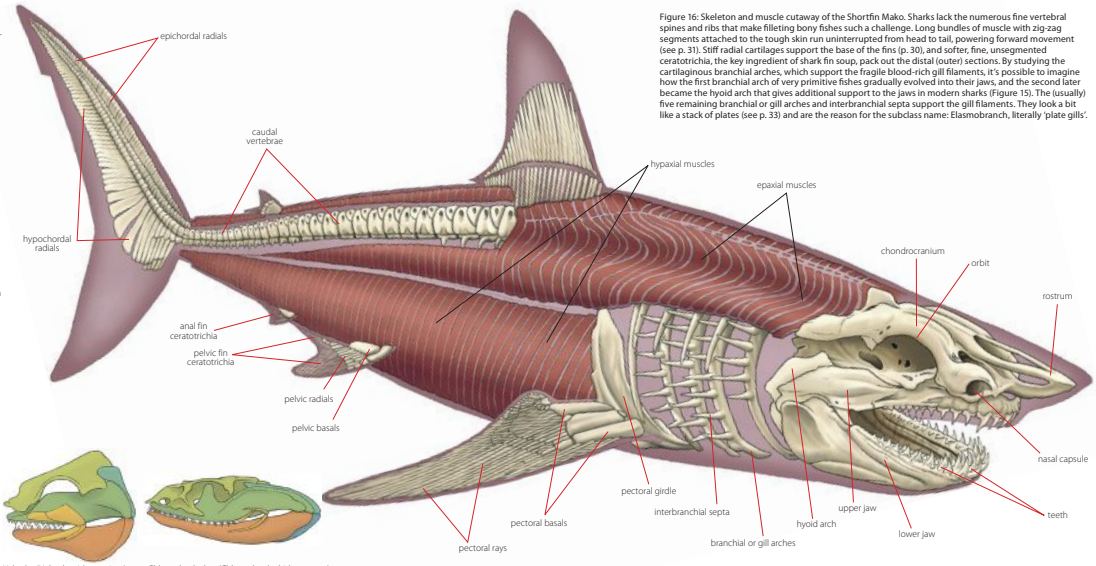


Figure 16: Skeleton and muscle cutaway of the Shortfin Mako. Sharks lack the numerous fine vertebral spines and ribs that make filleting bony fishes such a challenge. Long bundles of muscle with zig-zag segments attached to the tough skin run uninterrupted from head to tail, powering forward movement (see p. 31). Stiff radial cartilages support the base of the fins (p. 30), and softer, fine, unsegmented ceratotrichia, the key ingredient of shark fin soup, pack out the distal (outer) sections. By studying the cartilaginous branchial arches, which support the fragile blood-rich gill filaments, it's possible to imagine how the first branchial arch of very primitive fishes gradually evolved into their jaws, and the second later became the hyoid arch that gives additional support to the jaws in modern sharks (Figure 15). The (usually) five remaining branchial or gill arches and interbranchial septa support the gill filaments. They look a bit like a stack of plates (see p. 33) and are the reason for the subclass name: Elasmobranch, literally 'plate gills'.

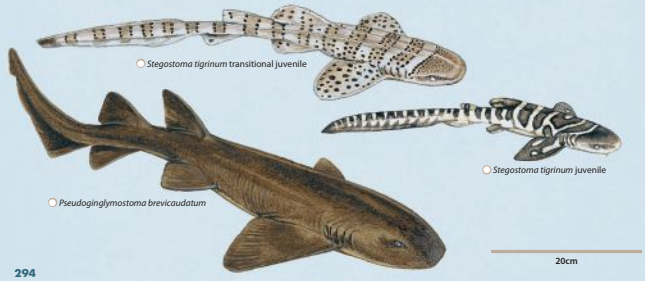
CARTILAGE, WHAT IS IT?

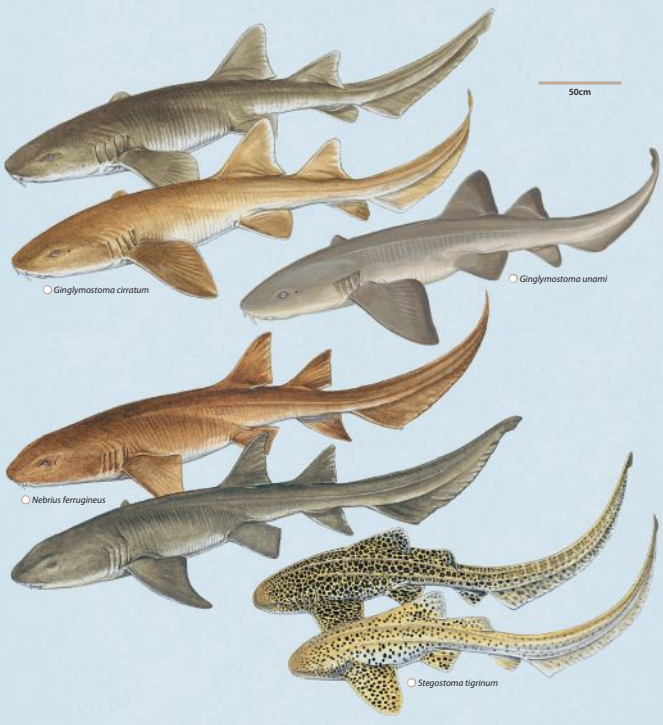
Cartilage is the smooth, stiff but flexible material that supports our ears and nose and covers the ends of bones to allow the joints to move freely. It is formed from special cells, called chondrocytes, surrounded by a flexible collagenous matrix. Cartilage does not contain nerves or blood vessels, so nutrients diffuse slowly through it and, if damaged, is slow to repair itself. Bone is much harder and heavier, because it contains minerals. The canals that carry blood vessels and nerves through bone give it a spongy appearance in cross section, compared with the uniform appearance of cartilage. Damaged bone is able to mend more quickly than damaged cartilage (as anyone with a torn knee cartilage can attest).

Plate 33 GINGLYMOSTOMATIDAE and STEGOSTOMATIDAE

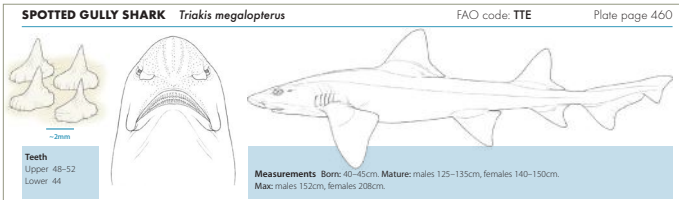
Head broad and flat, no lateral skin flaps, subterminal mouth in front of eyes, barbels, long nasoral grooves, small spiracles, small gills fifth almost overlaps fourth; precaudal tail much shorter than head and body; two spineless dorsal fins, second dorsal same level and size as anal fin, caudal fin with strong terminal lobe and subterminal notch.

- **Nurse Shark** *Ginglymostoma cirratum* — page 298
  Atlantic Ocean; 0–130m. Long barbels, tiny spiracles; dorsal fins broadly rounded, first dorsal fin larger than second dorsal and anal fins, interdorsal space 5.4–9.5% of TL, caudal fin longer than a quarter of total length; uniform yellow- to grey-brown, young with small dark light ringed ocellar spots and obscure saddles.
- **Unami Nurse Shark** *Ginglymostoma unami* — page 297
  East Pacific; 0–7m. Long barbels, tiny spiracles; dorsal fins broadly rounded, first dorsal fin origin before pelvic fin origin, free rear tip reaches second dorsal fin origin, interdorsal space 3.6–5.6% of TL; adults uniform yellow-brown, young with patterns of small dark spots.
- **Tawny Nurse Shark** *Nebrius ferrugineus* — page 299
  Indian, west and central Pacific Oceans; to 70m or more. Fairly long barbels, tiny spiracles; all fins angular, first dorsal fin larger than second dorsal and anal fins, first dorsal fin base over pelvic fin bases, caudal fin longer than a quarter of total length; uniform shades of brown, depending on habitat.
- **Shorttail Nurse Shark** *Pseudoginglymostoma brevicaudatum* — page 297
  West Indian Ocean; coral reefs to 20m. Short barbels, tiny spiracles; all fins rounded, first dorsal fin about same size as second dorsal and anal fins, caudal fin less than 20% of total length; uniform dark brown.
- **Zebra Shark** *Stegostoma tigrinum* — page 293
  Indian and west Pacific Oceans; to 62m (adult), and >90m (young). Large slender ridged body; small transverse mouth in front of eyes, small barbels, large spiracles; first dorsal fin set forwards on back, first dorsal fin larger than second, anal fin close to caudal fin, broad caudal fin about one-half the total length; distinct spotting in adults, young with unique vertical banding.





SPOTTED GULLY SHARK *Triakis megalopterus* FAO code: **TTE** Plate page 460

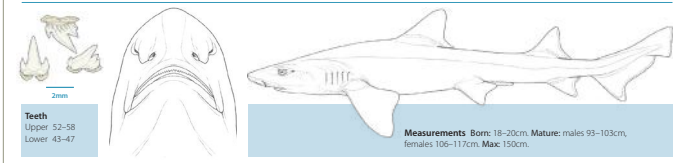


Teeth
Upper 48–52
Lower 44

Measurements **Born:** 40–45cm. **Mature:** males 125–135cm, females 140–150cm. **Max:** males 152cm, females 208cm.

Identification Broad, blunt snout. Widely separated, small, lobate anterior nasal flaps do not reach mouth. Large mouth; small, pointed teeth; upper labial furrows do not reach lower symphysis. Large, broad fins. First dorsal almost vertical. High interdorsal ridge. Pectorals falcate with concave posterior margin. Short, heavy caudal peduncle. Grey-bronze, usually many black spots; white below. No or few spots in young (some adults also plain).
Distribution Southeast Atlantic: southern Angola to South Africa. **Habitat** Shallow inshore to surfline, prefers sandy shores and rocks and crevices in shallow bays, 0–50m, usually less than 10m.
Behaviour Schools in summer, often many pregnant females present. Actively patrol very close to bottom in captivity, sometimes in midwater but rarely in the open.
Biology Viviparous, no yolk-sac placenta, 5–15 pups per litter (average 9–10); gestation is ~19–21 months, with a reproductive cycle of 2–3 years between pregnancies. Eats crabs, bony fishes, small sharks; larger sharks consume more fish, while smaller sharks feed mostly on crustaceans.
Status **IUCN Red List: Least Concern**. Locally common but range is heavily fished. Caught by sports anglers and commercial fishers, but low commercial value. Hardy in captivity.

BANDED HOUNDSHARK *Triakis scyllium* FAO code: **TTY** Plate page 460

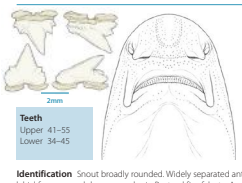


Teeth
Upper 52–58
Lower 43–47

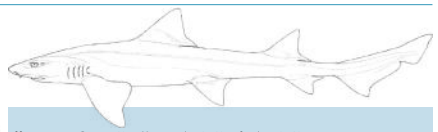
Measurements **Born:** 18–20cm. **Mature:** males 93–103cm, females 106–117cm. **Max:** 150cm.

Identification Fairly slender-bodied. Short, broadly rounded snout. Widely separated, lobate anterior nasal flaps do not reach mouth. Partly blade-like teeth; long upper labial furrows reach lower symphysis. Relatively narrow fins. First dorsal rear margin almost vertical. Pectoral fins triangular in adults. Brownish grey above, sparsely scattered, small, black spots and broad, dusky saddles in young; spots fading (sometimes absent) in adults.
Distribution Northwest Pacific: Russia (Peter the Great Bay), Japan, Koreas, China, Taiwan. Possibly Central Indo-Pacific: Philippines uncertain.
Habitat Continental and insular, close inshore, on or near bottom, 30–150m. Often in estuaries and shallow bays, on sand, seaweed and eelgrass flats.
Behaviour Seldom gregarious, but some gather in seabed resting areas.
Biology Viviparous, no yolk-sac placenta; 10–24 pups per litter (average 9–10). Males mature at 5–6 years, females at 6–7 years, with maximum age for males 15 years and females 18 years. Eats crustaceans and other invertebrates, and small fishes.
Status **IUCN Red List: Least Concern**. Common to abundant where it occurs. Often fished.

LEOPARD SHARK *Triakis semifasciata* FAO code: **LES** Plate page 460



Teeth
Upper 41–55
Lower 34–45



Measurements **Born:** 17–20cm. **Mature:** males 70–120cm, females 110–130cm. **Max:** ~180cm, one individual was estimated at 210cm.

Identification Snout broadly rounded. Widely separated anterior nasal flaps do not reach mouth. Upper labial furrows reach lower symphysis. Pectoral fins falcate. A unique pattern of striking black saddle marks and spots on a pale tan to greyish background, fading to whitish below. The centres of the saddle marks become lighter in adults.
Distribution Northeast Pacific: from southern Washington (USA) to the Gulf of California (Mexico). The latter population may be isolated; few Leopard Sharks are taken in the southern Gulf.
Habitat Cool to warm-temperate waters on the inshore and offshore continental shelf. Apparently well-adapted to poorly oxygenated waters, and most common on or near the seabed in bays and estuaries, from the intertidal to 20m. It may also occur on open coasts and around offshore islands, and down to a depth of 156m. Females give birth in water less than 1m deep, including over eelgrass beds.
Behaviour This is an active, strong-swimming shark, although it may also be seen resting on sand among rocks. Leopard Sharks form large, nomadic schools (sometimes associating with smoothhound sharks *Mustelus californicus* and *M. henlei*, North Pacific Spiny Dogfishes *Squalus suckleyi* and Bat Rays *Myliobatis californicus*). Most have a small home range, but some have been recorded travelling up to 150km. They may follow the tide in and out to feed on shallow mudflats. In captivity, Leopard Sharks form a loose social hierarchy: larger individuals maintain their dominant status by gently nipping the pectoral fins of smaller animals.
Biology Viviparous, no yolk-sac placenta, with a gestation of ~10–12 months. 1–37 pups per litter, increasing with the size of the mother. Age at maturity is 7–15 years (females older than males) and they may live for 30 years. Although sharks of the same age may vary in size, the older they are, the slower they grow: one shark tagged when 125cm long had only reached 129cm when recaptured 12 years later. Small sharks eat crabs and other benthic invertebrates, nipping siphons off clams and sucking worms out of the sediment, but large sharks may consume fishes and even other small sharks.
Status **IUCN Red List: Least Concern**. This is one of the most common sharks along the Pacific coast of North America and may be abundant where exploitation levels are low. There have been small fisheries for Leopard Sharks in California, mostly by sports anglers (the meat is good to eat, although older sharks may contain high levels of mercury) and for the aquarium trade, but this species is generally well managed. Bag limits and a minimum landing size are used to regulate the Californian sports fishery and reduce harvesting of small sharks for the aquarium trade. Virtually nothing is known about the Leopard Shark in the southern part of its range, in Mexico, where the population in the Gulf of California may be isolated from the population further north; however, this species makes up only a very small part of the small shark fishery off Baja California.

Leopard Shark, *Triakis semifasciata*.

Plate 32 HEMISCYLLIIDAE II – *Hemiscyllium*

- **Indonesian Speckled Carpetshark** *Hemiscyllium freycineti* page 288
  Central Indo-Pacific; shallow coral reefs and seagrass to 10m. Thick tail; small dark spots on snout, large and small dark spots on body, no white spots, moderately large dark epaulette spot without white ring or dark blotches; juveniles with dark paired fins (scattered spots in adults) and broad dark bands under head and encircling tail.
- **Gale's Epaulette Shark** *Hemiscyllium galei* page 289
  Central Indo-Pacific. Reefs, shallow water; 0–25m. Prominent white spots along margin of darker saddles along back, scattered white and dark spots along sides; 7–8 dark oval spots on sides between abdomen and caudal fin.
- **Papuan Epaulette Shark** *Hemiscyllium hallstromi* page 289
  Central Indo-Pacific. Bottom, inshore; to 30m Thick tail; no dark spots on snout, large sparse dark spots on body, moderately large black epaulette spot with white ring and black blotches, juveniles with black webbed paired fins (dusky in adults) and dark bands on tail.
- **Henry's Epaulette Shark** *Hemiscyllium henryi* page 290
  Central Indo-Pacific; rocky outcrops, seagrass to fringing coral reefs 0–30m or deeper. Numerous scattered spots over body including head and fins; distinct double ocelli on sides behind head.
- **Halmahera Epaulette Shark** *Hemiscyllium halmahera* page 290
  Central Indo-Pacific; 0–10m. Coral heads on sandy slope. Light brown, close-set clusters of 2–3 vertically arranged dark spots interspersed with scattered white spots; a few large dark spots on snout and between eyes, 1 spot over pectoral free rear margin with a U-shaped white margin below it.
- **Michael's Epaulette Shark** *Hemiscyllium michaeli* page 291
  Central Indo-Pacific; 0–20m. Fringing and patch reefs. Brilliant leopard pattern of spots covering body with large prominent spot behind and on sides of head; dark blotches on anterior dorsal fin margins; faint saddles on sides of body between pectoral and caudal fins.
- **Epaulette Shark** *Hemiscyllium ocellatum* page 291
  Central Indo-Pacific; coral, very shallow water to 50m. Thick tail; no dark spots on snout, small dark spots on body and unpaired fins, large black epaulette spot with white ring and black blotches; juveniles with black webbed paired fins (fade in adults) and dark bands on tail (light tail surface in adults).
- **Hooded Carpetshark** *Hemiscyllium strahani* page 292
  Central Indo-Pacific; coral, 3–18m. Thick tail; black mask on snout and head, white spots on body and fins over dark saddles and blotches, black epaulette spot partially merged with shoulder saddle, not completely ringed in white, paired fin margins white-spotted on black, dark rings round tail, juveniles no white spots with less bold markings.
- **Speckled Carpetshark** *Hemiscyllium trispeculare* page 292
  Central Indo-Pacific; coral, shallow water to 50m. Thick tail; small dark spots on snout, body and fins; numerous large and small dark spots separated by a reticular light network, no white spots, large black epaulette spot with white ring and 2 curved black blotches, dark saddles encircle back and tail; juvenile coloration unknown.

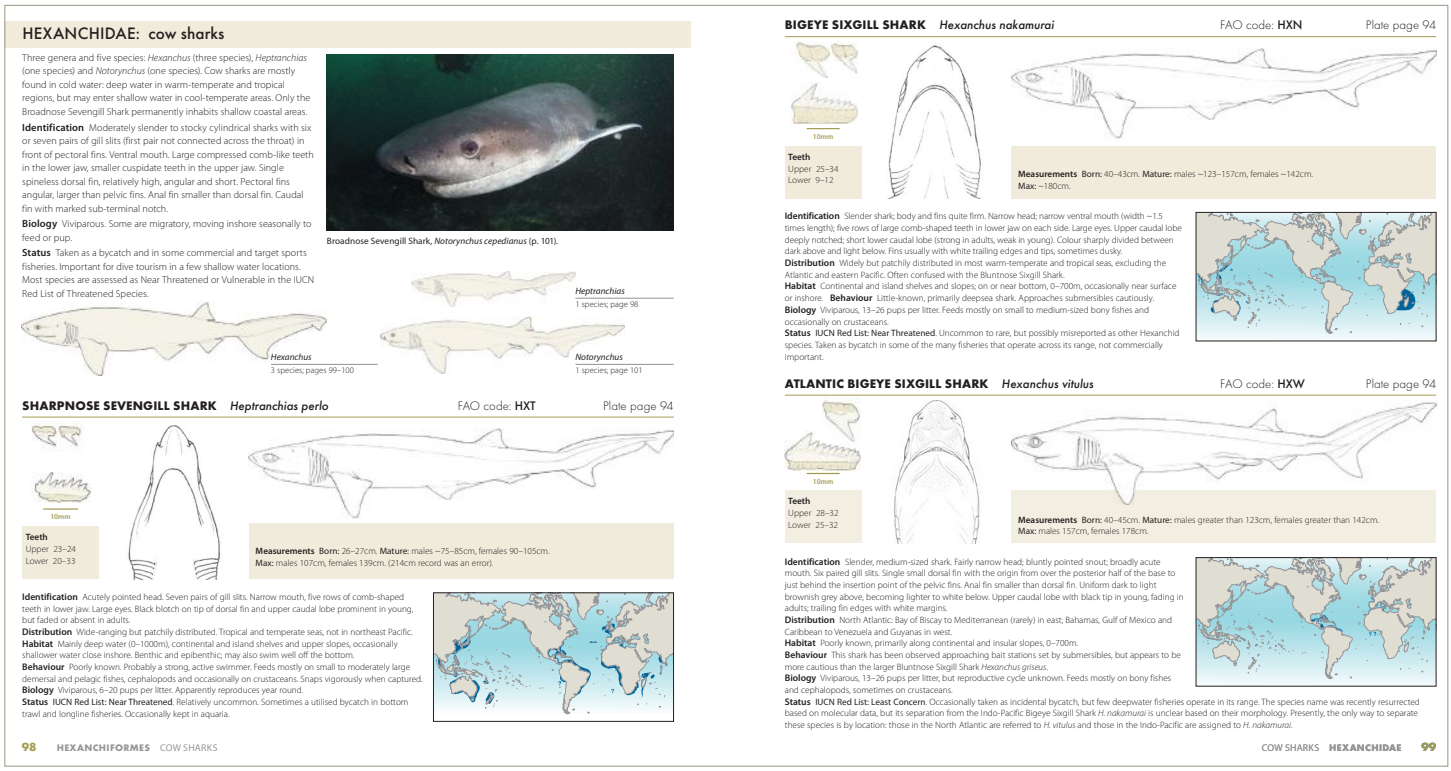
well as new illustrations and updated maps covering all known species to date, the introductory sections have also been completely revised and expanded. They start with a guide "How to use this book" and detailed illustrations showing all parts of a shark, introducing readers to all the named features used to identify sharks to species. The section on shark evolution and fossil sharks is greatly expanded, as are those on shark biology, including body structure, life history, behaviour, genetics, and some of the latest research (including suggestions for how readers can contribute). 'Sharks and People' describes shark legends, the various uses of sharks (in fisheries, recreational angling, shark watching and for food), shark encounters, and their status, conservation and management.

The species pages start with an illustrated key for each order and family of sharks, that directs readers to the correct section of the book for identifying any shark to species. There is a brief general introduction to each order, describing physical characteristics and the number of families within it. A few orders, bramble sharks (Echinorhiniformes), sawsharks (Pristiophoriformes), angelsharks (Squatiniformes), and the bullhead or horn sharks (Heterodontiformes), contain only a single family. Similarly, the family accounts include brief descriptions and summarise the number of genera and species contained. They are accompanied by beautifully illustrated colour plates of all the species within that family; the plates are a striking feature and really bring these sharks to life!

Every species account includes illustrations for the whole animal, the underside of its head, teeth, and a distribution map, accompanied by text on identification, distribution, habitat, behaviour, biology, and status. Some of the larger shark genera, *Squalus, Etmopterus*, and *Apristurus*, are arranged by clades or subgroups, with the key characters for each subgroup described in the family account introduction. Members of these genera can be extremely difficult to identify to species, even for experts, but a few external characters are provided that will assist a knowledgeable amateur naturalist to narrow the list of species options at least to within the correct clade.

Five appendices include a glossary that briefly explains the various technical terms used in the book, followed by maps of the world's oceans and seas, and instructions for taking accurate field observations and photographs (should you need expert help with the identification of any shark you encounter). A shark fin identification guide includes a key to common shark fins, and a section on tooth identification illustrates a variety of the tooth types associated with the different shark groups. The final sections provide lists of reference sources for the introduction, further reading, other identification guides, selected scientific societies, research and conservation organizations, online sources of information, and an index.

This book is an essential one-stop resource for anyone interested in learning about and/or identifying this enigmatic fish group. However, if it's too heavy for your pocket or rucksack, the new edition of *The Pocket Guide to Sharks of the World* is also published this year. It's half the size of the *'Complete Guide'*, but still includes all the colour plates and brief species descriptions, the essential 'How to use' instructions, illustrations of teeth, and much more.



HEXANCHIDAE: cow sharks

Three genera and five species: *Hexanchus* (three species), *Heptranchias* (one species) and *Notorynchus* (one species). Cow sharks are mostly found in cold water: deep water in warm-temperate and tropical regions, but may enter shallow water in cool-temperate areas. Only the Broadnose Sevengill Shark permanently inhabits shallow coastal areas.

Identification Moderately slender to stocky cylindrical sharks with six or seven pairs of gill slits (first pair not connected across the throat) in front of pectoral fins. Ventral mouth. Large compressed comb-like teeth in the lower jaw, smaller cuspidate teeth in the upper jaw. Single spineless dorsal fin, relatively high, angular and short. Pectoral fins angular, larger than pelvic fins. Anal fin smaller than dorsal fin. Caudal fin with marked sub-terminal notch.

Biology Viviparous. Some are migratory, moving inshore seasonally to feed or pup.

Status Taken as a bycatch and in some commercial and target sports fisheries. Important for dive tourism in a few shallow water locations. Most species are assessed as Near Threatened or Vulnerable in the IUCN Red List of Threatened Species.

Broadnose Sevengill Shark, *Notorynchus cepedianus* (p. 101).

Heptranchias 1 species; page 98

Hexanchus 3 species; pages 99–100

Notorynchus 1 species; page 101

SHARPNOSE SEVENGILL SHARK *Heptranchias perlo* FAO code: **HXT** Plate page 94

10mm

Teeth
Upper 23–24
Lower 20–33

Measurements **Born:** 26–27cm. **Mature:** males ~75–85cm, females 90–105cm. **Max:** males 107cm, females 139cm. (214cm record was an error).

Identification Acutely pointed head. Seven pairs of gill slits. Narrow mouth, five rows of comb-shaped teeth in lower jaw. Large eyes. Black blotch on tip of dorsal fin and upper caudal lobe prominent in young, but faded or absent in adults.
Distribution Wide-ranging but patchily distributed. Tropical and temperate seas, not in northeast Pacific.
Habitat Mainly deep water (0–1000m), continental and island shelves and upper slopes, occasionally shallower water close inshore. Benthic and epibenthic; may also swim well off the bottom.
Behaviour Poorly known. Probably a strong, active swimmer. Feeds mostly on small to moderately large demersal and pelagic fishes, cephalopods and occasionally on crustaceans. Snaps vigorously when captured.
Biology Viviparous, 6–20 pups per litter. Apparently reproduces year round.
Status **IUCN Red List: Near Threatened**. Relatively uncommon. Sometimes a utilised bycatch in bottom trawl and longline fisheries. Occasionally kept in aquaria.

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BIGEYE SIXGILL SHARK *Hexanchus nakamurai* FAO code: **HXN** Plate page 94

10mm

Teeth
Upper 25–34
Lower 9–12

Measurements **Born:** 40–43cm. **Mature:** males ~123–157cm, females ~142cm. **Max:** ~180cm.

Identification Slender shark; body and fins quite firm. Narrow head; narrow ventral mouth (width ~1.5 times length); five rows of large comb-shaped teeth in lower jaw on each side. Large eyes. Upper caudal lobe deeply notched; short lower caudal lobe (strong in adults, weak in young). Colour sharply divided between dark above and light below. Fins usually with white trailing edges and tips, sometimes dusky.
Distribution Widely but patchily distributed in most warm-temperate and tropical seas, excluding the Atlantic and eastern Pacific. Often confused with the Bluntnose Sixgill Shark.
Habitat Continental and island shelves and slopes; on or near bottom, 0–700m, occasionally near surface or inshore. **Behaviour** Little-known, primarily deepsea shark. Approaches submersibles cautiously.
Biology Viviparous, 13–26 pups per litter. Feeds mostly on small to medium-sized bony fishes and occasionally on crustaceans.
Status **IUCN Red List: Near Threatened**. Uncommon to rare, but possibly misreported as other Hexanchid species. Taken as bycatch in some of the many fisheries that operate across its range, not commercially important.

ATLANTIC BIGEYE SIXGILL SHARK *Hexanchus vitulus* FAO code: **HXW** Plate page 94

10mm

Teeth
Upper 28–32
Lower 25–32

Measurements **Born:** 40–45cm. **Mature:** males greater than 123cm, females greater than 142cm. **Max:** males 157cm, females 178cm.

Identification Slender, medium-sized shark. Fairly narrow head; bluntly pointed snout; broadly acute mouth. Six paired gill slits. Single small dorsal fin with the origin from over the posterior half of the base to just behind the insertion point of the pelvic fins. Anal fin smaller than dorsal fin. Uniform dark to light brownish grey above, becoming lighter to white below. Upper caudal lobe with black tip in young, fading in adults; trailing fin edges with white margins.
Distribution North Atlantic: Bay of Biscay to Mediterranean (rarely) in east; Bahamas, Gulf of Mexico and Caribbean to Venezuela and Guyanas in west.
Habitat Poorly known, primarily along continental and insular slopes, 0–700m.
Behaviour This shark has been observed approaching bait stations set by submersibles, but appears to be more cautious than the larger Bluntnose Sixgill Shark *Hexanchus griseus*.
Biology Viviparous, 13–26 pups per litter, but reproductive cycle unknown. Feeds mostly on bony fishes and cephalopods, sometimes on crustaceans.
Status **IUCN Red List: Least Concern**. Occasionally taken as incidental bycatch, but few deepwater fisheries operate in its range. The species name was recently resurrected based on molecular data, but its separation from the Indo-Pacific Bigeye Sixgill Shark *H. nakamurai* is unclear based on their morphology. Presently, the only way to separate these species is by location: those in the North Atlantic are referred to *H. vitulus* and those in the Indo-Pacific are assigned to *H. nakamurai*.

COW SHARKS HEXANCHIDAE 99

Sharks of the World–a Complete Guide is available 22 June 2021 in Europe and 20 July 2021 in North America. *A Pocket Guide to Sharks of the World* will be published 29 June 2021 in Europe, 3 August 2021 in North America.

Dave's social media @LostSharkGuy (Instagram), @LostShark (Facebook) and @LostSharkGuy (Twitter)

Marc's social media
@marc.dando.92 (Instagram), @dando_marc (Twitter)

Funding Opportunities 2021

2022-2024 EDGE Fellowship
www.edgeofexistence.org

One of the most effective ways ZSL's EDGE of Existence programme is working to secure the future of EDGE species is by awarding two year Fellowships to future conservation leaders ("EDGE Fellows") working on poorly-known EDGE fish, gymnosperms, bird, mammal, amphibian, reptile, shark or ray species.

The two-year Fellowship comprises of:

- A 4-week Conservation Tools training course at the beginning of the programme to provide Fellows with essential training in techniques to plan and implement their project;
- A grant of £10,000 to undertake a 2-year project on a top-priority EDGE species;
- Ongoing technical support via online modules, web-based tutorials/seminars, and field visits throughout the Fellowship;
- One-to-one support from a scientific advisor based at ZSL or a partner organisation;
- A 2-week Conservation Leadership training course in London on successful completion of Fellowship to help Fellows prepare for the next stage of their career.

You may be eligible for an EDGE Fellowship if you:

- Focus your work on an EDGE species included on the 2021 curated list.
- Are an early-career conservation biologist or wildlife manager (less than 10 years' experience).
- Are a resident of a country in which the proposed focal species occurs.
- We are only receiving applications from Asia & Pacific region islands in 2021

Applicants are strongly encouraged to discuss their projects with the EDGE team before applying, and we will be happy to provide feedback on draft applications submitted at least 3 weeks before the deadline.

The application is now open. All applications will be reviewed by a panel of experts. Successful applicants will be informed in October 2021.

Application deadline: 23:59 British Summer Time (BST) on **July 18, 2021**

Visit our website to learn more: www.edgeofexistence.org

ZSL's EDGE of Existence Programme is kindly supported by the Franklinia Fondation

Fondation Segré Conservation Action Fund
iucnsos.org/call-for-proposals/

IUCN Save Our Species is proud to announce its partnership with Fondation Segré in the framework of a new initiative: the Fondation Segré Conservation Action Fund.

Launched in 2021 for a duration of 5 years, The Fondation Segré Conservation Action Fund aims primarily at providing small grants to small and local Civil Society Organizations (CSOs) and young and early researchers to support conservation and research projects for all threatened animal species (terrestrial, freshwater and marine) and their habitats across Asia, the Pacific, Latin America and the Caribbean, Africa, and the Middle East. Projects that focus on actions identified in SSC Action plans for eligible species will be viewed favourably in the selection process.

The Fondation Segré Conservation Action Fund will make available two types of grants through yearly Calls for Proposals:

- Conservation Action Grants (speciesgrants.iucn.org) support on-the-ground conservation action with the goal of improving the status of threatened animal species and their habitats. Maximum grant size for Conservation Action Grants will be EUR 50'000 with a maximum duration of 12 months. These grants are open to all local and national Civil Society Organisations, as well as local or regional Non-Governmental Organisations, with a primary focus on local non-profit organisations.
- Research Support Grants (portals.iucn.org/sos/) support young and early scientists in their research to improve the knowledge on threatened species and their role in natural ecosystems. These grants intend to provide budding researchers the opportunity to develop into world class conservationists. Maximum grant size for Research Support Grants will be EUR 7,000 for a maximum duration of 12 months. Applicants have to be enrolled in a curriculum at an academic institution in order to apply.

Visit our website to learn more: iucnsos.org/call-for-proposals/

The application is now open. For any necessary clarification, please contact: saveourspecies@iucn.org

Application deadline: **August 31, 2021**

Upcoming Meetings 2021

All meetings are subject to change due to the impacts of the coronavirus (SARS-CoV-2 | COVID-19) situation that varies in location and time. Please visit the respective websites and communication from the organising host organisation for more information.

36th Annual Scientific Meeting
American Elasmobranch Society (AES)
July 21 – 27, 2021
Phoenix, AZ, USA
elasmo.org
asih.org/meetings

The American Elasmobranch Society is a non-profit organization that seeks to advance the scientific study of living and fossil sharks, skates, rays, and chimaeras, and the promotion of education, conservation, and wise utilization of natural resources.

IUCN World Conservation Congress
September 3 – 11, 2021
Marseille, France
iucncongress2020.org

The IUCN World Conservation Congress is where the world comes together to set priorities and drive conservation and sustainable development action. IUCN's 1300+ government, civil society and indigenous peoples' Member organisations vote on major issues, action which guides humanity's relationship with our planet for the decades ahead. IUCN's unique and inclusive membership gives the Congress a powerful mandate as it is not solely government or non-government, but both together.

IX National Symposium of Sharks and Rays
II Latin American Congress Sharks, Rays and Chimeras
The Sociedad Mexicana de Peces Cartilaginosos, A. C. (SOMEPEC)
September 6 – 10, 2021
Puebla, México
somepec.org/ix-simposium-ii-congreso-latinoamericano/

The Sociedad Mexicana de Peces Cartilaginosos, A. C. (SOMEPEC) is a non-profit organization that seeks to promote the scientific study of sharks and rays, as well as their rational use. Faithful to its objective of creating spaces for the exchange of experiences and advances in the different lines of research on sharks and rays, which are developed in Mexico and the rest of the world, it organizes the IX National Symposium of Sharks and Rays, and II Latin American Congress of Sharks, Rays and Chimeras.

Oceania Chondrichthyan Society (OCS)
8th World Fisheries Congress (WFC)
Session 58: "Global Status, Recent Developments and Future of Shark and Ray Fisheries"
September 20 – 24, 2021
Adelaide, Australia
oceaniasharks.org.au/wfc2020
wfc2020.com.au

The Oceania Chondrichthyan Society was founded in 2005 and is a joint venture between Australia, New Zealand, Papua New Guinea and the Pacific Islands to promote and facilitate education, conservation and scientific study of chondrichthyan fish.

The 8th World Fisheries Congress will be the largest gathering of research, industry and management sectors to discuss the latest advances in fisheries world-wide. The World Fisheries Congress is the key international fisheries conference. Aiming to foster cooperation and engagement in commercial, recreational and indigenous fisheries. Providing insightful presentations and inspiring forums on key developments needed to ensure the future sustainable development of the world's oceans, lakes, estuaries and rivers.

The goal of the "Global Status, Recent Developments and Future of Shark and Ray Fisheries" session is to assemble shark fisheries scientists from around the globe to discuss novel research and provide insight on how they study their local shark fisheries. This session will provide a platform for shark and ray scientists to discuss recent research techniques, findings, and their implications for the future of shark and ray fisheries.

24th Annual Scientific Meeting
European Elasmobranch Association (EEA)
November 3 – 5, 2021 (TBC)
Leiden, The Netherlands
eulasmo.org

The European Elasmobranch Association (EEA) is a non-profit umbrella organisation of European organisations dedicated to the study, management and conservation of sharks, skates, rays and chimaeras (cartilaginous fishes or chondrichthyans). The EEA is not a public membership body, but an association of national organisations within Europe and the North-east Atlantic, some of these are scientific bodies, others are public membership organisations. EEA member bodies take turns to host the annual scientific meeting.

6th Southern African Shark & Ray Symposium (SASRS)
November 17 – 19, 2021
Gansbaai, South Africa
sharkandraysymposium.com

The Southern African Shark and Ray Symposium is a biennial meeting of the academic community of Southern Africa who are currently conducting research on these taxa.

The SASRS will be composed of a combination of oral and poster presentations, workshops, and public events – with plenty of added fun and adventure planned for attendees. Keynote presentations will be scheduled throughout the Symposium.


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