SHARK NEWS

Newsletter
of the IUCN SSC Shark
Specialist Group
#7 | January 2023

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 Laurent Ballesta

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Photos by Laurent Ballesta | laurentballesta.com | andromede-ocean.com | gombessa-expeditions.com

Editorial

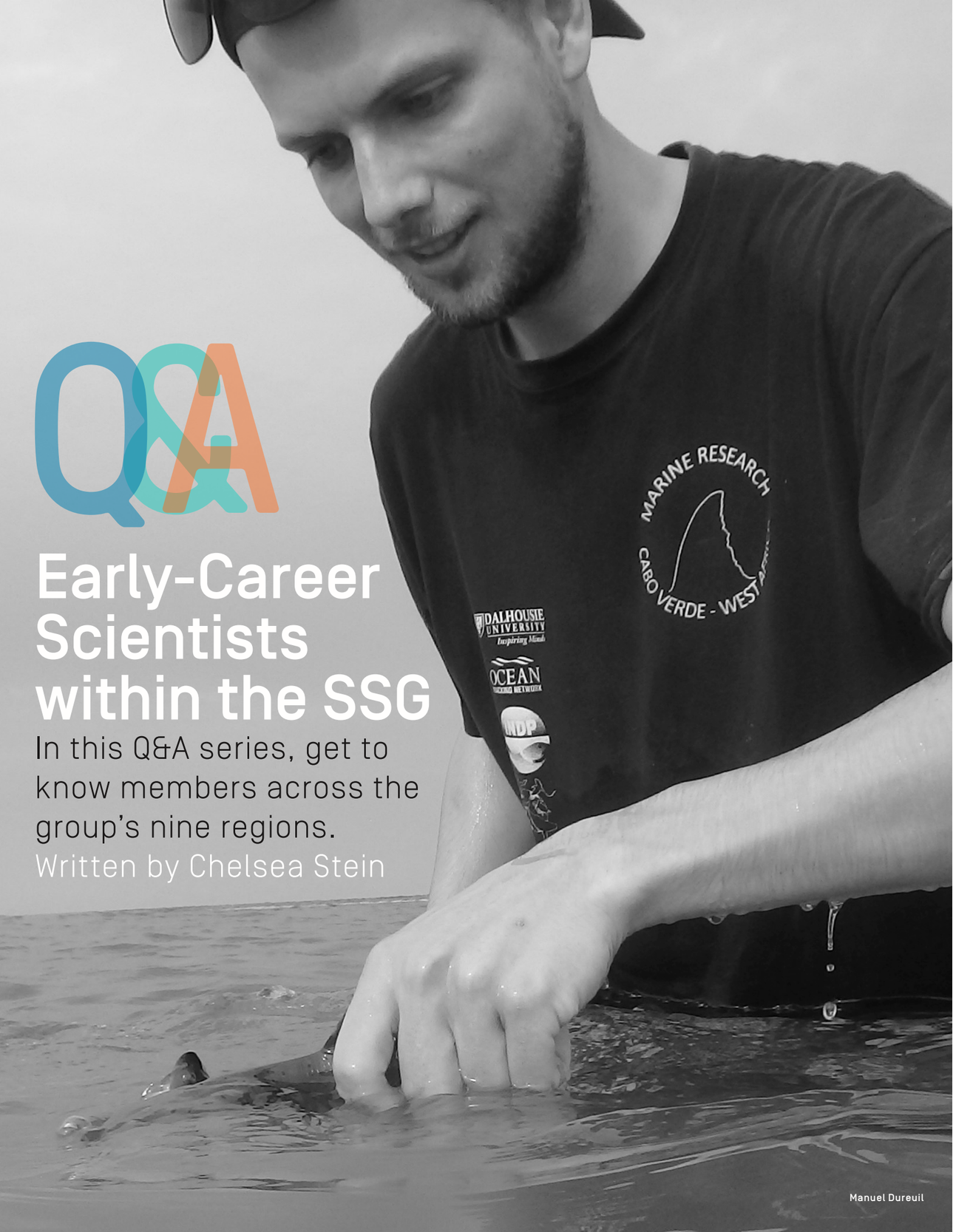
Artwork by Keith Witmer

A note from the Chair Rima Jabado

Dear readers,

This past year has felt like a year of catch-up – field work, meetings, conferences – everything has been moving so quickly. With the pandemic slowly receding in most countries, the pace of life picked up again. With this came travel to see new and wonderful places; a chance to reconnect with family, friends, and colleagues; enjoy conversations in the hallways of conferences; and, most importantly, some of the greatest wins for sharks and rays in history. Acknowledging that there are other significant wins for sharks in 2022, such as the quotas for Shortfin Makos in the South Atlantic or the protection of the Greenland Shark in the Northwest Atlantic, the one event most of you will have heard of is that 104 shark and ray species were listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). This was a giant step to regulate the trade of most shark species and a welcome global recognition of the need to conserve these species. We provide a list of the now 150 shark and ray species listed and look forward to working with many of you to ensure the effective implementation of these listings. Many of us also met in Valencia, Spain, on the sidelines of Sharks International. It felt somewhat surreal to see everyone together in person again, but it was great to come together a few days before the conference and talk sharks all day. Over 40 contributors from around the world gathered to update our Global Report on the Status of Sharks, Rays, and Chimaeras. I am so grateful to everyone who took the time to join us and those who couldn't participate in person but have been working extremely hard to ensure we have the best available information from around the world. Our feature story is the first of a series of fact sheets on human impacts on sharks and rays. Developed in collaboration with the Convention on Migratory Species (CMS), the first of these relates to overfishing, the biggest threat to this group, and provides an overview of impacts from industrial, artisanal, and recreational fisheries. But we also have lots more! We have a beautiful story from Iran where a team of early career scientists came together and travelled the whole coastline of the country to talk to fisher communities and gather information on shark fisheries and trade. Sadly, the stories recounted are similar to many areas globally where older fishers have seen drastic declines in these species over time. From Indonesia, we hear about efforts to develop and implement shark and ray bycatch mitigation technologies using electro-shields and the promising results of various trials. As the world's largest shark and ray fishing country, it's encouraging to see how the next steps of this work will include engagement with the fishing industry to test this technology at various sites. From the Mediterranean Sea, an overview of the species occurring in the Adriatic Sea highlights this area as a biodiversity hotspot but notes the local extinction of three species within this body of water. From Brazil, we are introduced to a new method that allows us to identify shark carcasses from illegal catches - by looking at the microanatomy of the skin! It's interesting to see how the skin structure of species can be so different, allowing them to separate between species. Our regular Q&A contributor Chelsea Stein introduces us to three more SSG early career scientists from various regions. We learn more about their respective work in Guatemala, Cabo Verde, and India. Once again, their work shows how passionate the new generation of shark scientists is. The Important Shark and Ray Area (ISRA) project has continued to move at a fast pace. We provide an update on progress with the newly developed selection criteria finally being applied to the first region of the world – the Central and South American Pacific. The results of the candidate areas identified will be made public shortly as we launch our new eAtlas and before we move to the Mediterranean region for our next workshop. We also look at the synergies between the ISRA project and SARRI, the Shark and Ray Recovery Initiative, and highlight the importance of collaborations across sectors and research groups to ensure we have data to support spatial planning and the development of recovery plans. This issue ends with a collection of beautiful imagery of feeding aggregations of Grey Reef Sharks in Fakarava, French Polynesia and street art or 'Artivism'. They say a picture is worth a thousand words, and I genuinely believe that with these collections of photographs and art, we can showcase even more how magnificent these species are and inspire ocean stewardship. As always, none of this would be possible without the support of SSG members and shark lovers worldwide who contribute to Shark News. And, of course, I continue to be extremely grateful to Michael and Peter Scholl, who make it a reality. → Rima

Photo by Laurent Ballesta | laurentballesta.com | andromede-ocean.com | gombessa-expeditions.com



Manuel Dureuil

Q&A

Early-Career Scientists within the SSG

In this Q&A series, get to know members across the group's nine regions.

Written by Chelsea Stein

With 237 members from 83 countries and territories, the IUCN SSC Shark Specialist Group (SSG) is one of the largest specialist groups within the IUCN Species Survival Commission. Across the group's nine regions, we have many early career scientists pursuing exciting work on shark, ray, and chimaera research, policy, and conservation.

This Q&A series will showcase some of these members, sharing their roles within the SSG and their ongoing work.

- Dr Ana Hacohen-Domené, professor and researcher at the Universidad del Valle de Guatemala, SSG Central America and Caribbean Region
- Dr Manuel Dureuil, co-founder of the Shark and Ray Conservation Centre (SHARCC), SSG Northern Europe Region
- Ms Sushmita Mukherji, a PhD student at the Institute for Marine and Antarctic Studies at the University of Tasmania, SSG Oceania Region

What type of research do you focus on?

Ana: For the last five years, my research has focused on studying and understanding Guatemala's Atlantic/Caribbean and Pacific shark and ray fisheries through monitoring landings and using molecular techniques; in collaboration with fishing communities and other colleagues.
Manuel: My work focuses on the life history, historical ecology, spatial ecology, restoration, and conservation biology of sharks.
Sushmita: I have been primarily working on shark and ray fisheries.

What project(s) are you currently working on?

Ana: Together with other colleagues, we continue to monitor Guatemala's shark and ray fisheries. In 2018, we started a project to identify the different species of elasmobranchs sold at markets and supermarkets in Guatemala through genetic analysis; to verify whether species are substituted in the marketed fishery products and to observe the mislabeling of fishery products. We have continued working on this project, increasing our sampling effort.
I oversee students working on their undergraduate thesis at the Universidad del Valle de Guatemala. We are determining the concentrations of heavy metals in commercially important sharks and rays and the presence of microplastics in these species.
Manuel: The two most significant projects I am currently working on are the Marine Historical Ecology Working Group of the IUCN SSC Shark Specialist Group, together with Heike Zidowitz, and the Cabo Verde Elasmobranch Research and Conservation Project initiated by myself and others in 2015.
Sushmita: I am primarily working on my PhD, which assesses the vulnerability and management of deep-sea sharks landed in data-poor fisheries. I will also be working on describing the bycatch of deep-sea sharks landed by fisheries in Australia's sub-Antarctic region (Heard Island and McDonald Islands).

As a member of the IUCN SSC Shark Specialist Group, what does your role involve?

Ana: I am a member of the Central America and Caribbean Region.
Manuel: In particular, the Marine Historical Ecology Working Group is becoming a more significant task for me and my work contributing towards the Global Status Report of sharks, rays, and chimaeras.
Sushmita: I am part of the Assess Working Group within the IUCN SSC Shark Specialist Group. As I am very young in the field, my role primarily involves providing assistance where required and, more recently, providing information on the deep-sea sharks landed by fisheries from southeast Australia.

What excites you about sharks, rays, and/or chimaeras?

Ana: In general, it surprises me how after so many years and so much research, we still have so much to discover. Sharks are amazing organisms. The great diversity of species and their adaptations to different habitats and different circumstances over time is captivating.
Manuel: Their incredible biology, in particular life history and spatial ecology, their outstanding beauty, and for many species, their conservation needs.
Sushmita: The life-history traits of sharks, rays, and chimaeras are particularly interesting to me. Sharks have life-history traits such as slow growth and late maturation, which makes them more vulnerable to fishing pressure. The complexity behind understanding these biological characteristics and striking a balance with the management expectations of fishing authorities and local communities is what really excites me about shark, ray, and chimaera science.

What is your favourite shark, ray, or chimaera species?

Ana: My favourite is the Whale Shark (*Rhincodon typus*) and Mobulas (family Mobulidae)
Manuel: My favourite ray is the Blackchin Guitarfish (*Glaucostegus cemiculus*). My favourite shark is the Common Thresher (*Alopias vulpinus*), yet I am passionate about all nature and love all animals; hence my favourite shark, ray, and animal is likely the one I see at the moment.
Sushmita: My favourite is the Grey Sharpnose Shark (*Rhizoprionodon oligolinx*).

What do you think is the biggest challenge for shark conservation versus the biggest opportunity?

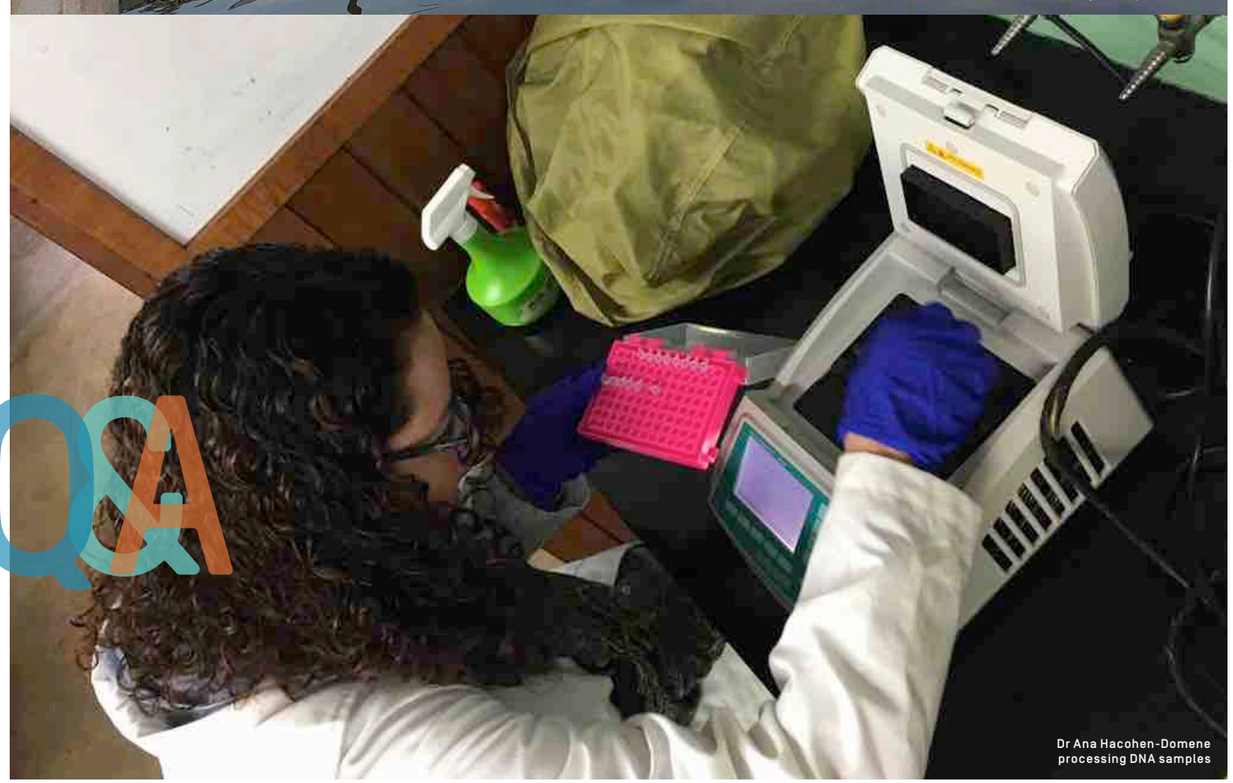
Ana: I believe that, although there is still much to be done, the educational efforts, as well as the research that everyone in the IUCN's regions has carried out, have helped a lot to change the misperception that people have about sharks. With the coastal communities that I have had the opportunity to work with, people not only see sharks as a source of income or food but also understand the role they play in their ecosystem and the importance of conserving them because of our ongoing work.

In the case of Guatemala, little by little, with the group of colleagues working in the country, we have made progress in generating previously non-existent information about this group. We have a great diversity of species, particularly in the Caribbean region, considering that we are a small country. We still have a long way to go in research, management, and conservation, but we have made progress... slowly but surely.
Manuel: Big challenges are creating truly protected areas free of harmful anthropogenic use in critical habitats and migratory corridors, bringing back lost habitats and locally extirpated species, remembering and documenting what was once there, eliminating bycatch, and restoring populations for species with very low productivity. An opportunity for conservation is to bring sharks and rays into new legislation, such as restoration laws that are currently proposed.
Sushmita: I think the biggest challenge with shark conservation is managing multiple stakeholders' expectations while maintaining the biological sustainability of shark populations. However, the biggest opportunity is learning from local communities and fishers about the historical trends in populations.

Sushmita interviewing local fishers and traders on shark and fisheries in West Bengal, India

Spadenose Sharks *Scoliodon laticaudus* are some of the most commonly fished species in India
Photo by Sushmita Mukherji

Part of the fishing fleet
Photo by Cristopher Avalos



Dr Ana Hacohen-Domene processing DNA samples

Back in port, after a day of fishing
Photo by Cristopher Avalos

What is something you are looking forward to this year?

Ana: I am looking forward to continuing to collaborate with my colleagues and advancing shark research in Guatemala. Also, as a new IUCN SSC SSG member, I am excited to contribute to conservation efforts regionally and globally.
Manuel: I am looking forward to finally starting an acoustic tagging project of Blackchin Guitarfish in Cabo Verde that was delayed because of the COVID-19 pandemic.
Sushmita: I am really looking forward to the update on the "Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes" report that the IUCN SSC SSG has been working on. It is a very useful and important document that will provide crucial information on the overall status of global shark fisheries.

What is one fun fact about you?

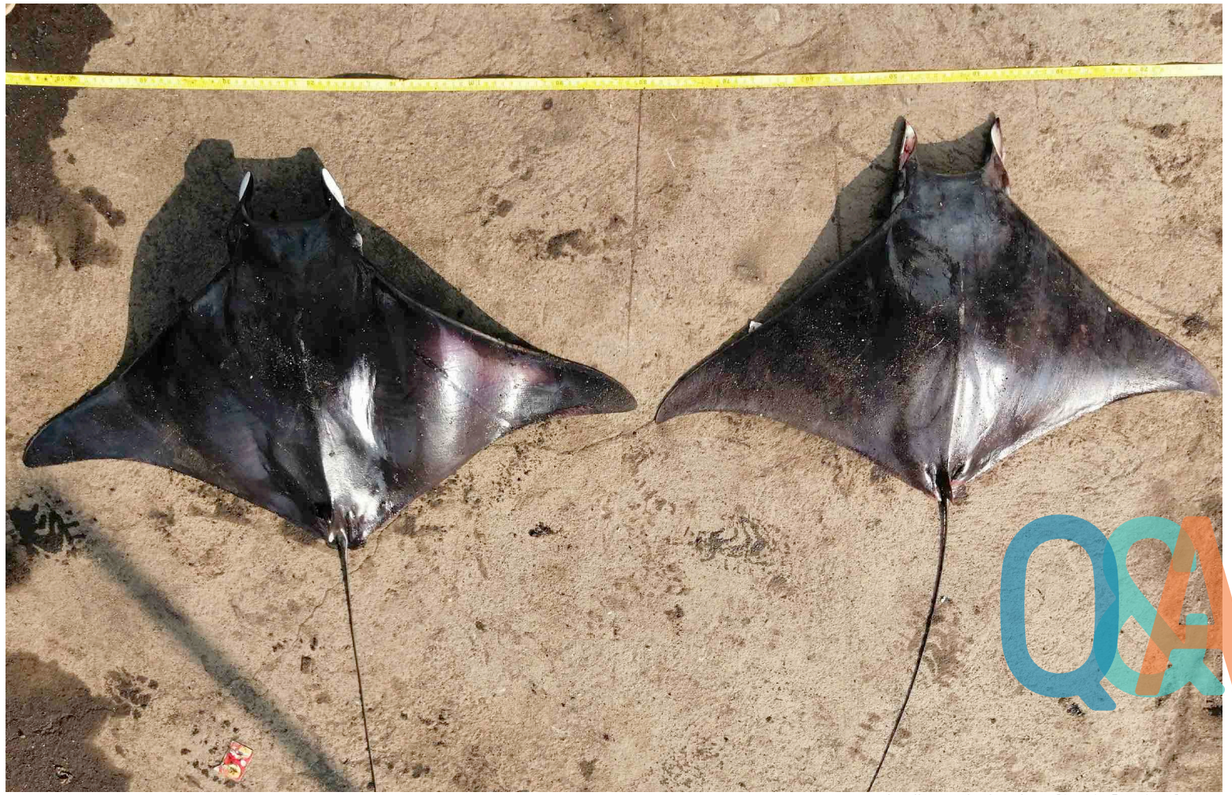
Ana: When I am cold, I talk fast... that is what people tell me. Also, every semester, when I get a new group of students and introduce myself, the subject comes up: I am a marine biologist and work with sharks. Still, nobody believes that there are actually sharks in Guatemala! So, I spend a lot of time in the first class sharing about a subject I love.
Manuel: I did not grow up anywhere near the ocean.
Sushmita: In my spare time, I have become very interested in weather patterns, particularly storm cells. Living in Far North Queensland, Australia, for six years helped my interest in storms to develop rapidly as Australia's outback produces some of the most spectacular storms. Now, living in Tasmania, this interest has turned to follow the aurora australis (southern lights), which we are so lucky to see regularly down in Tasmania.

Conducting landing monitoring and taking data from a landed Mobula
Photo by Francisco Polanco

Photo by Natascha Wosnick

Shark News: ***How can we keep up with your work?***

Ana: You can keep up with my work through my research gate profile: researchgate.net/profile/Ana-Domene
Manuel: You can keep up with my work by following the SHARCC Facebook page: facebook.com/sharccngo and through my Google Scholar profile: scholar.google.com/citations?user=afuta5gAAAAJ&hl=de
Sushmita: You can keep up with my work on Twitter: @sush_mukherji

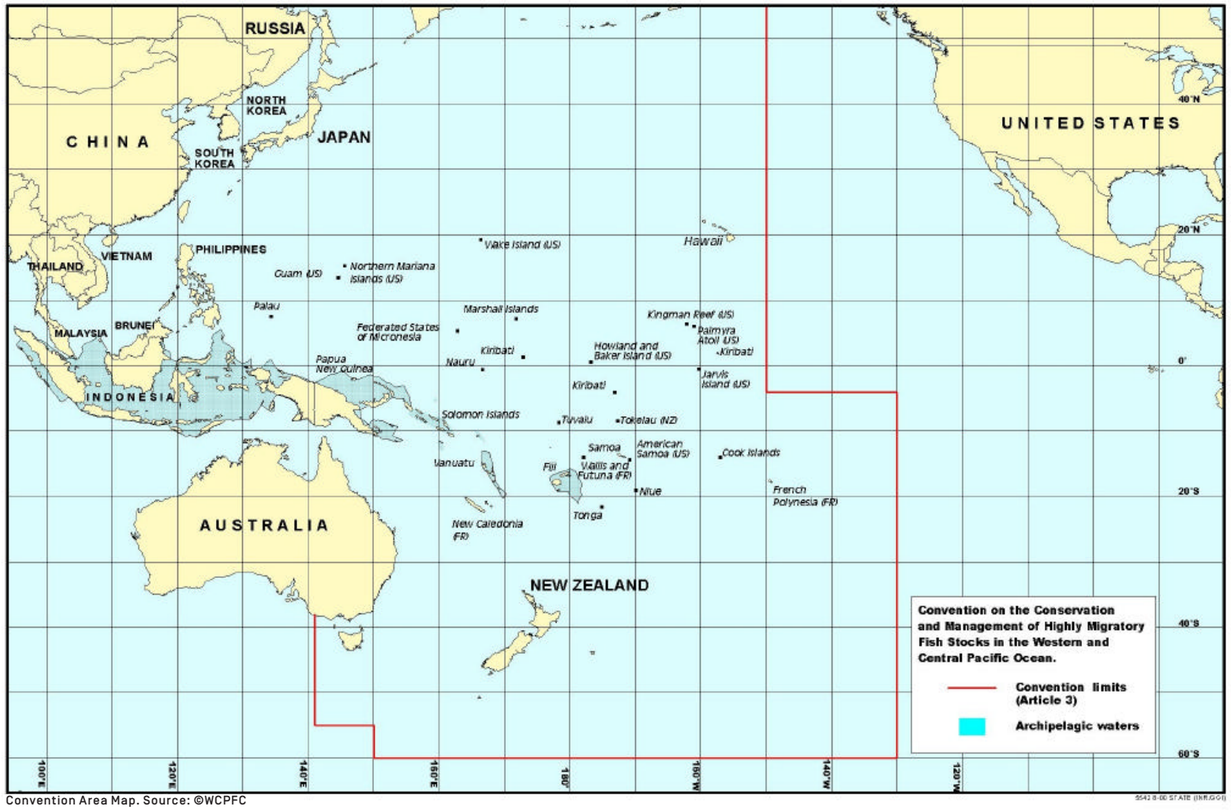


Landing monitoring of rays Photo by Francisco Polanco

Ray fishing in a community of the Pacific of Guatemala Photo by Cristopher Avalos

Ray fishing in a community of the Pacific of Guatemala Photo by Cristopher Avalos

A day of fishing in a landing area of the pacific Photo by Cristopher Avalos



Convention Area Map. Source: ©WCPFC

Sharks* and the Western and Central Pacific Fisheries Commission (WCPFC)

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

Written by Alexandra Morata
IUCN SSC Shark Specialist Group | Programme Officer

Reviewed by Chelsey Young
NOAA National Marine Fisheries Service
IUCN SSC Shark Specialist Group | North America Regional Group | Regional Vice Chair

What is the WCPFC?

The Western and Central Pacific Fisheries Commission (WCPFC) is an international fisheries agreement that seeks to ensure the long-term conservation and sustainable use of highly migratory fish stocks (i.e., tunas, billfishes, marlins, and sharks) in the western and central Pacific Ocean (WCPO) through effective management. It was established by the Convention for the Conservation and Management of Highly Migratory Fish Stocks on 19 June 2004 and provided a legal framework for fisheries management within the WCPO region. The main aim is to address management problems in high-seas fisheries across the WCPO region. This includes unregulated fishing, over-capitalization, excessive fleet capacity, vessel re-flagging to escape controls, insufficiently selective gear, unreliable databases, and insufficient multilateral cooperation with respect to the conservation and management of highly migratory fish stocks.

Structure of WCPFC

The governing body of the WCPFC Convention is known as the Commission, which comprises representatives from Commission members, cooperating non-members and participating territories (collectively, CCMs).

The Secretariat and four subsidiary bodies support the work of the Commission. The Scientific Committee (SC) ensures that the Commission has the best available scientific information to identify stock status and develop advice, to implement appropriate conservation and management measures. The Technical and Compliance Committee (TCC) (also known as "enforcement" committee) reviews members' adherence to Commission decisions and monitors individual countries' implementation of those measures. The TCC also makes recommendations to the Commission. The Northern Committee (NC) makes recommendations to the Commission on species that are mostly found in the Convention Area north of 20°N. The Finance and Administration Committee deliberates over the Commission's budget.

Additionally, the Commission and the Secretariat are further supported with technical services from other existing regional institutions, namely the Secretariat of the Pacific Community (SPC), Pacific Islands Forum Fisheries Agency (FFA) and the International Scientific Committee for Tuna and Tuna-like species in the North Pacific Ocean (ISC).

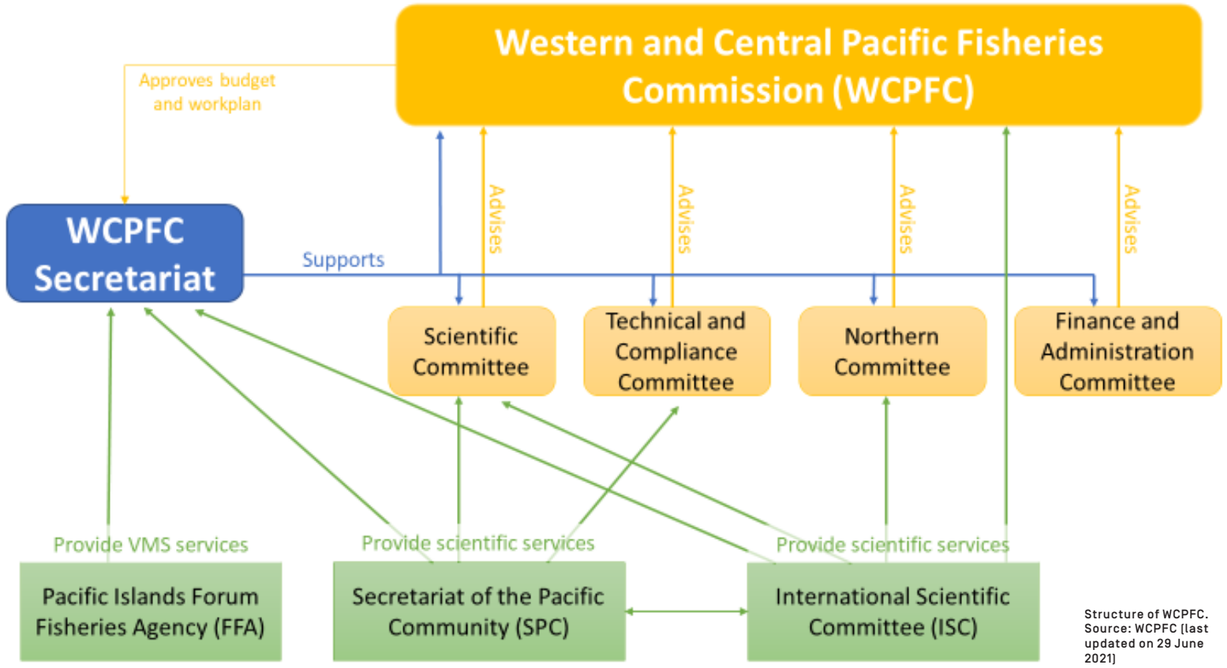
Decisions taken by the Commission are generally made by consensus. In cases where decisions have to be taken by vote, a "two-chamber system" applies. The Pacific Islands Forum Fisheries Agency (FFA) members of the Commission comprise one chamber, while the non-FFA members form the other chamber. Decisions are taken by a three-fourths majority of those present and voting in each chamber. Two or fewer votes can defeat no proposal in either chamber.

CCMs and Observers

Contracting Parties to the Convention (also known as "Members") include Pacific Island countries and countries who fish in Pacific waters (all waters of the Pacific Ocean bounded to the south and east by a line drawn from the south coast of Australia) within the Convention Area. They have voting power within WCPFC and are legally bound to the Conservation and Management Measures (CMMs) and Resolutions.

List of member countries having ratified WCPFC.
***= signed but not ratified.**

Country	Entry into force	Country	Entry into force
Australia	2004	New Zealand	2004
Canada	2005	Niue	2004
China	2004	Palau	2005
Cook Islands	2004	Papua New Guinea	2004
European Union	2005	Philippines	2005
Fiji	2004	Samoa	2004
France	2005	Solomon Islands	2004
Indonesia	2001*	Chinese Taipei	2004
Japan	2005	Tonga	2004
Kiribati	2004	Tuvalu	2004
Korea, Republic of	2004	United Kingdom	2004
Marshall Islands, Rep. of	2004	United States of America	2007
Micronesia, Fed. States of	2004	Vanuatu	2005
Nauru	2004		



Structure of WCPFC. Source: WCPFC (last updated on 29 June 2021)

Participating Territories are Pacific countries in the WCPO region which have not ratified the Convention but are allowed to participate and speak in Commission meetings. However, they do not have voting power. These include the U.S. Territories of American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, French Polynesia, New Caledonia, Tokelau, and Wallis and Futuna.

Cooperating Non-members (also known as "Non-parties" or "non-contracting cooperating Parties") are States that have not signed the Convention but have an interest in fishing in the WCPO region. To have this status, a consensus is required from the Contracting Parties. Current non-parties include Curacao, Ecuador, El Salvador, Liberia, Nicaragua, Panama, Thailand, and Vietnam.

Observers are intergovernmental, nongovernmental, other regional fishing bodies, or States interested in WCPFC. They may attend Commission meetings but do not have voting rights or permission to speak. Any input they wish to share with members of the Commission has to be provided through the Secretariat.

Which Shark Species are covered by WCPFC?

To ensure the long-term conservation and sustainable use of sharks, CMM 2019-04 clarified that it applies to: (i) sharks listed in Annex 1 of the 1982 Convention and (ii) any other sharks caught in association with fisheries managed under the WCPF Convention (see Table 2). According to WCPFC, 62 shark species are caught in these fisheries, with 14 of these considered "key species".

Table 2: Shark species caught in fisheries managed under WCPFC.
*** indicates that the taxonomy of these species has been updated since they were listed, and changes have been made to their names. † indicates WCPFC "Key species"**

Order	Family	Scientific Name	Common Name
archarhiniformes	Carcharhinidae	*Carcharhinus albimarginatus*	Silvertip Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus altimus*	Bignose Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchos*	Grey Reef Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus brachyurus*	Copper Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus brevipinna*	Spinner Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus falciformis†*	Silky Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus galapagensis*	Galapagos Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus leucas*	Bull Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus limbatus*	Blacktip Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus longimanus†*	Oceanic Whitetip Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus melanopterus*	Blacktip Reef Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus obscurus*	Dusky Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus plumbeus*	Sandbar Shark
Carcharhiniformes	Carcharhinidae	*Carcharhinus tilstoni*	Australian Blacktip Shark
Carcharhiniformes	Carcharhinidae	*Galeocerdo cuvier*	Tiger Shark
Carcharhiniformes	Carcharhinidae	*Prionace glauca†*	Blue Shark
Carcharhiniformes	Carcharhinidae	*Triaenodon obesus*	Whitetip Reef Shark
Carcharhiniformes	Sphyrnidae	*Eusphyra blochii†*	Winghead Shark
Carcharhiniformes	Sphyrnidae	*Sphyrna lewini†*	Scalloped Hammerhead
Carcharhiniformes	Sphyrnidae	*Sphyrna mokarran†*	Great Hammerhead
Carcharhiniformes	Sphyrnidae	*Sphyrna zygaena†*	Smooth Hammerhead
Carcharhiniformes	Triakidae	*Galeorhinus galeus*	Tope
Hexanchiformes	Hexanchidae	*Heptranchias perlo*	Sharpnose Sevengill Shark
Hexanchiformes	Hexanchidae	*Hexanchus griseus*	Bluntnose Sixgill Shark
Hexanchiformes	Hexanchidae	*Notorynchus cepedianus*	Broadnose Sevengill Shark
Lamniformes	Alopiidae	*Alopias pelagicus†*	Pelagic Thresher
Lamniformes	Alopiidae	*Alopias superciliosus†*	Bigeye Thresher
Lamniformes	Alopiidae	*Alopias vulpinus†*	Common Thresher
Lamniformes	Cetorhinidae	*Cetorhinus maximus*	Basking Shark
Lamniformes	Lamnidae*	*Carcharodon carcharias*	White Shark
Lamniformes	Lamnidae*	*Isurus oxyrinchus†*	Shortfin Mako
Lamniformes	Lamnidae*	*Isurus paucus†*	Longfin Mako
Lamniformes	Lamnidae*	*Lamna ditropis*	Salmon Shark
Lamniformes	Lamnidae*	*Lamna nasus†*	Porbeagle
Lamniformes	Megachasmidae	*Megachasma pelagios*	Megamouth Shark
Lamniformes	Odontaspididae	*Odontaspis noronhai*	Bigeye Sand Tiger
Lamniformes	Pseudocarchariidae	*Pseudocarcharias kamoharai*	Crocodile Shark
Myliobatiformes	Dasyatidae	*Bathytoshia brevicaudata**	Smooth Stingray
Myliobatiformes	Dasyatidae	*Hemitrygon akajei**	Red Stingray
Myliobatiformes	Dasyatidae	*Pteroplatytrygon violacea*	Pelagic Stingray
Myliobatiformes	Mobulidae	*Mobula birostris**	Oceanic Manta Ray
Myliobatiformes	Mobulidae	*Mobula eregoodoo**	Longhorned Pygmy Devil Ray
Myliobatiformes	Mobulidae	*Mobula kuhlii*	Shorthorned Pygmy Devil Ray
Myliobatiformes	Mobulidae	*Mobula mobular**	Spinetail Devil Ray
Myliobatiformes	Mobulidae	*Mobula tarapacana*	Sicklefin Devil Ray
Myliobatiformes	Mobulidae	*Mobula thurstoni*	Bentfin Devil Ray
Myliobatiformes	Urolophidae	*Urolophus cruciatus*	Banded Stingaree
Myliobatiformes	Urolophidae	*Urolophus viridis*	Greenback Stingaree
Orectolobiformes	Rhincodontidae	*Rhincodon typus†*	Whale Shark
Orectolobiformes	Stegostomidae	*Stegostoma tigrinum*	Zebra Shark
Squaliformes	Centrophoridae	*Centrophorus squamosus*	Leafscale Gulper Shark
Squaliformes	Dalatiidae	*Dalatias licha*	Kitefin Shark
Squaliformes	Dalatiidae	*Isistius brasiliensis*	Cookie-cutter Shark
Squaliformes	Etmopteridae	*Etmopterus granulosus*	Southern Lanternshark
Squaliformes	Somniosidae	*Centroscymnus owstonii*	Roughskin Dogfish
Squaliformes	Somniosidae	*Centroselachus crepidater**	Longnose Velvet Dogfish
Squaliformes	Somniosidae	*Scymnodon plunketi*	Plunket's Shark
Squaliformes	Somniosidae	*Zameus squamulosus*	Velvet Dogfish
Squaliformes	Squalidae	*Squalus acanthias*	Spiny Dogfish
Squaliformes	Squalidae	*Squalus brevirostris*	Japanese Shortnose Spurdog
Squatiniformes	Squatinidae	*Squatina tergocellata*	Ornate Angel Shark
Torpediniformes	Torpedinidae	*Tetronarce nobiliana**	Great Torpedo Ray

Key species are those designated as priorities for conservation and management. Sharks are designated as "key species" based on whether they are at high risk from fishing activities based on Ecological Risk Assessment projects, easily identified, and frequently reported in annual catch data provided by CCMs. Currently, there are a total of 14 "key shark species". In 2008, the first sharks designated as key shark species included the Blue Shark (*Prionace glauca*), Oceanic Whitetip Shark (*Carcharhinus longimanus*), mako sharks (*Isurus* spp.) and thresher sharks (*Alopias* spp.). The Silky Shark (*Carcharhinus falciformis*) was added in 2009, Porbeagle (*Lamna nasus*) and hammerhead sharks (family Sphyrnidae) in 2010, and the Whale Shark (*Rhincodon typus*) in 2012.

SC-08: Process for Designating WCPFC Key Shark Species for Data Provision and Assessment

Due to the rapid addition of sharks as key shark species, a process was devised to evaluate proposals on whether nominated key shark species are designated for the purposes of data provision and/or assessment. When key shark species are designated for data provision, scientific data (i.e., estimates of annual catches and catch and effort data) are collected from WCPFC's managed fisheries and are provided to the Commission. When key shark species are designated for an assessment, they are included in WCPFC's Shark Research Plan (See figure 3).

Conservation and Management Measures (CMMs) and Resolutions

Conservation and Management Measures (CMMs) describe binding decisions relating to conservation and management measures addressed to members of the Commission and Cooperating non-members. In contrast, Resolutions describe non-binding statements and recommendations addressed to members of the Commission and Cooperating non-members.

CMMs and Resolutions are structured as "CMM 20xx-yy" and "Res. 20xx-yy", respectively, where "xx" refers to the year it was implemented, and "yy" is the order it was listed that year.

Supplementary Materials are provided, along with their corresponding CMM, as guidelines to follow in case certain species are caught.

Supplementary Materials are structured as "suppl_CMM 20xx-yy", where "xx" refers to the year the CMM was implemented, and "yy" is the order the CMM was listed that year.

The first CMM focused on sharks was CMM 2006-05: Conservation and Management Measure for Sharks in the Western and Central Pacific Ocean, which has been updated and replaced frequently since then.

CMM 2019-04: Conservation and Management Measure for Sharks

Vessels of CCMs are encouraged to implement the FAO International Plan of Action for the Conservation and Management of Sharks, and to minimize bycatch and practice the safe release of sharks. Vessels licensed to fish for sharks are required to 'fully utilize' any caught sharks and ban shark finning. Each shark carcass is individually bagged with its fins for identification purposes and must be stored on board. However, this CMM shall not prejudice the sovereignty and sovereign rights of coastal States; thus, alternative measures can be applied and are to be described to the Commission. This CMM replaces and consolidates all previous CMMs for sharks.

Full utilization: "Retention by the fishing vessel of all parts of the shark excepting head, guts, vertebrae and skins, to the point of first landing or transhipment."

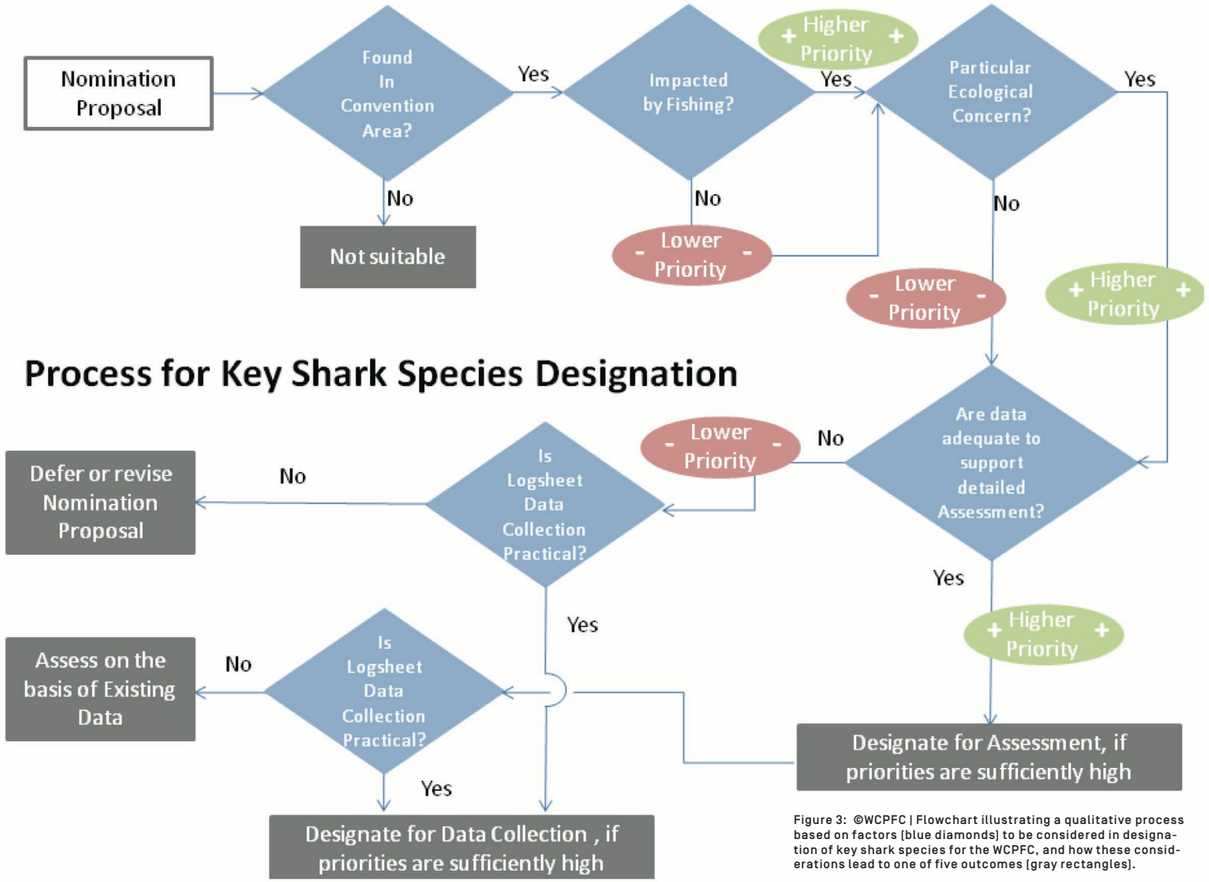


Figure 3: ©WCPFC | Flowchart illustrating a qualitative process based on factors (blue diamonds) to be considered in designation of key shark species for the WCPFC, and how these considerations lead to one of five outcomes (gray rectangles).

Finning: "Removing and retaining all or some of a shark's fins and discarding its carcass at sea."

Additionally, this measure specifically states that, if caught, Oceanic Whitetip Sharks (C. longimanus) and Silky Sharks (C. falciformis) should be immediately released alive and unharmed (see below suppl_CMM 2019-04: Best handling practices for the safe release of Sharks (other than Whale Sharks and Mantas/Mobulids), while taking into consideration the safety and practicability of the crew. If unintentionally caught and brought to land, the sharks are to be surrendered at the point of landing to governmental authorities and be donated for domestic human consumption (selling or bartering of either species is prohibited). However, biological samples of the Oceanic Whitetip Sharks and Silky Sharks can be taken, provided it is for research and documented to the Commission.

Whale Sharks (*Rhincodon typus*) should be immediately released alive and unharmed (see below suppl_CMM 2019-04: Guidelines for the safe release of encircled Whale Sharks) while taking into consideration the safety and practicability of the crew. It is prohibited to barter or sell Whale Sharks.

The following species are covered by the WCPFC CMM 2019-04:

Alopias superciliosus (Bigeye Thresher)	*Lamna nasus* (Porbeagle)
Carcharhinus falciformis (Silky Shark)	*Prionace glauca* (Blue Shark)
Carcharhinus longimanus (Oceanic Whitetip Shark)	*Rhincodon typus* (Whale Shark)
Cetorhinus maximus (Basking Shark)	Family Sphyrnidae
Hexanchus griseus (Bluntnose Sixgill Shark)	Other sharks caught in association with fisheries managed under the WCPF Convention
Isurus oxyrinchus (Shortfin Mako Shark)	

CMM 2019-05: **Conservation and Management Measure on Mobulid Rays caught in association with fisheries in the WCPFC Convention Area**

This CMM prohibits vessels fishing in WCPFC's Convention Area from targeting, retaining on board, transhipping, or landing any part or whole carcass of mobulid rays. If unintentionally caught, vessels are to release the mobulid ray alive and unharmed (see below suppl_CMM 2019-04: Best Handling Practices for the Safe Release of Mantas and Mobulids) while taking into consideration the safety and practicability of the crew. If unintentionally caught and brought to land, the rays are to be surrendered at the point of landing to governmental authorities and be donated for domestic human consumption (selling or bartering of mobulid rays is prohibited).

The following species are affected by the WCPFC CMM 2019-05:

Family Mobulidae

Res. 2005-03: **Resolution on Non-target fish species**

CMMs are encouraged to avoid catching non-targeted species to a practicable extent and, if caught, are to be released unharmed.

The following species are affected by the WCPFC CMM 2019-04:

Alopias superciliosus (Bigeye Thresher)	*Lamna nasus* (Porbeagle)
Carcharhinus falciformis (Silky Shark)	*Prionace glauca* (Blue Shark)
Carcharhinus longimanus (Oceanic Whitetip Shark)	*Rhincodon typus* (Whale Shark)
Cetorhinus maximus (Basking Shark)	Family Mobulidae
Hexanchus griseus (Bluntnose Sixgill Shark)	Family Sphyrnidae
Isurus oxyrinchus (Shortfin Mako Shark)	Other sharks caught in association with fisheries managed under the WCPF Convention

suppl_CMM 2019-04: **Guidelines for the Safe Release of encircled Whale Sharks**

When a Whale Shark is encountered in a purse seine net, the net roll must be immediately stopped, and the Whale Shark must be released. The following actions are not recommended when releasing encircled Whale Sharks:

- Vertically lifting sharks by their tail;
- Pulling sharks by a loop hooked around its gill or holes bored into a fin;
- Gaffing;
- Leaving attached any towing ropes;
- Brailing Whale Sharks larger than 2 meters; and
- Brailing Whale Sharks onto the deck.

suppl_CMM 2019-04: **Best Handling Practices for the Safe Release of Mantas & Mobulids**

Do's:

- Release rays while they are still free-swimming whenever possible (e.g., back down procedure, submerging corks, cutting net).
- It is preferable that larger rays (>60 kg), that are too large to be lifted safely by hand are brailed out of the net and released using a purpose built large-mesh cargo net or canvas sling or similar device (Note: It is preferable that release nets or devices are prepared prior to each set.)
- It is preferable that small (< 30 kg) and medium rays (30–60 kg) are handled by two or three people and carried by the sides of their wings or preferably using a purpose-built cradle/stretcher while ensuring the safety of the crew.
- When entangled in netting, carefully cut the net away from the animal and release to the sea as quickly as possible while ensuring the safety of the crew.

Don'ts:

- Do not leave a ray on deck until hauling is finished before returning it to the sea.
- Do not punch holes through the bodies of rays (e.g., to pass a cable or line through for lifting the ray).
- Do not gaff, drag, carry, lift or pull a ray by its "cephalic lobes" or tail or by inserting hooks or hands into the gill slits or the spiracles.

suppl_CMM 2019-04: **Best Handling Practices for the Safe Release of Sharks (other than Whale Sharks and Mantas & Mobulids)**

Purse Seine

Do's:

If in purse seine net:

- Release sharks while they are still free-swimming whenever possible (e.g., back down procedure, submerging corks, cutting net)
- For sharks that cannot be released from the purse seine net, consider removing them using a hook and line.
- If in brail or on deck:
- For sharks that are too large to be lifted safely by hand out of the brailer, it is preferable they are released using a purpose-built large-mesh cargo net or canvas sling or similar device. If the vessel layout allows, these sharks could also be released by emptying the brail directly on a ramp held up at an angle that connects to an opening on the top deck railing, without need to be lifted or handled by the crew.
- Generally, small sharks are fragile and need to be handled very carefully. If this can be done safely, it is best to handle and release them with two people, or one person using both hands.
- When entangled in netting, if safe to do so carefully cut the net away from the animal and release to the sea as quickly as possible with no netting attached.

Don'ts:

- Do not wait until hauling is finished to release sharks. Return them to the sea as soon as possible.
- Do not cut or punch holes through the shark's body.
- Do not gaff or kick a shark and do not insert hands into the gill slits.

CMM/Resolution/ Supplementary material	Title	Date issued	Status
Res. 2005-03*	Resolution on Non-target fish species	16 Dec 2005	Active
CMM 2006-05	Conservation and Management Measure for Sharks in the Western and Central Pacific Ocean	15 Dec 2006	Replaced by CMM 2008-06
CMM 2008-06	Conservation and Management of Sharks	12 Dec 2008	Replaced by CMM 2009-04
CMM 2009-04	Conservation and Management for Sharks	11 Dec 2009	Replaced by 2010-07
CMM 2010-07	Conservation and Management Measure for Sharks (I)	8 Feb 2011	Replaced by CMM 2014-05
CMM 2011-04	Conservation and Management Measure for Oceanic Whitetip Shark	1 Jan 2013	Replaced by CMM 2019-04
CMM 2012-04	Conservation and Management Measure for Protection of Whale Sharks from Purse Seine Fishing Operations	1 Jan 2014	Replaced by CMM 2019-04
CMM 2013-08	Conservation and Management Measure for Silky Shark	1 Jul 2014	Replaced by CMM 2019-04
CMM 2014-05	Conservation and Management Measures for Sharks (II)	1 Jul 2015	Replaced by CMM 2019-04
CMM 2019-04*	Conservation and Management Measure for Sharks	11 Dec 2019	Active
CMM 2019-05*	Conservation and Management Measure on Mobulid Rays caught in association with fisheries in the WCPFC Convention Area	11 Dec 2019	Active
suppl_CMM 2019-04*	Guidelines for the safe release of encircled Whale Sharks	8 Dec 2015	Active
suppl_CMM 2019-04*	Best Handling Practices for the Safe Release of Mantas & Mobulids	3 May 2021	Active
suppl_CMM 2019-04*	Best handling practices for the safe release of Sharks (other than Whale Sharks and Mantas/Mobulids)	14 Dec 2018	Active

Longline
Do's:

- The preference is to release all sharks while they are still in the water, if possible. Use a dehooker to remove the hook or a long-handled line cutter to cut the gear as close to the hook as possible (ideally leaving less than 0.5 meters of line attached to the animal).
- If de-hooking in the water proves to be difficult, and the shark is small enough to be accommodated in a dip net, bring it on board and remove as much gear as possible by using a dehooker. If hooks are embedded, either cut the hook with bolt cutters or cut the line at the hook and gently return the animal to the sea.
- For all sharks that are brought on deck, minimize time before releasing to the water.

Don'ts:

- Do not strike a shark against any surface to remove the animal from the line.
- Do not attempt to dislodge a hook that is deeply ingested and not visible.
- Do not try to remove a hook by pulling sharply on the branchline.
- Do not cut the tail or any other body part.
- Do not gaff or kick a shark, and do not insert hands into the gill slits.

Additional Recommendation

Knowing that any fishing operation may catch sharks, several tools can be prepared in advance (e.g., canvas or net slings or stretchers for carrying or lifting, large mesh net or grid to cover hatches/hoppers in purse seine fisheries, long handled cutters, and de-hookers in longline fisheries).

There are currently two active CMMs, one resolution, and three supplementary materials that specifically cover ten shark species/groups, indicated by "*" in the table above. A summary of the information contained in active CMMs pertaining to a shark species or species group is provided.

The complete list of current CMMs and Resolutions of the WCPFC can be downloaded here (wcpfc.int/system/files/booklets/31/CMM%20and%20Resolutions.pdf)

Photo by Brooke Pyke | Ningaloo Reef Photos

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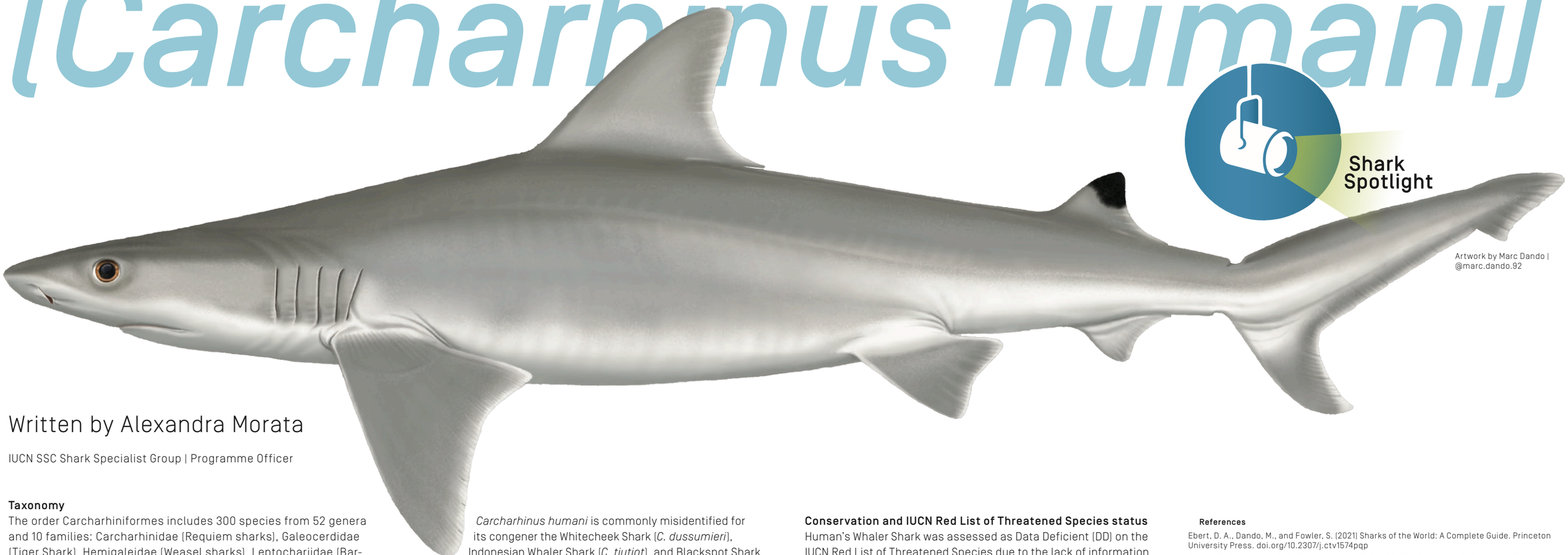
Human's Whaler Shark
(Carcharhinus humani)



Artwork by Marc Dando | @marc.dando.92

Written by Alexandra Morata

IUCN SSC Shark Specialist Group | Programme Officer

Taxonomy

The order Carcharhiniformes includes 300 species from 52 genera and 10 families: Carcharhinidae (Requiem sharks), Galeocerdidae (Tiger Shark), Hemigaleidae (Weasel sharks), Leptochariidae (Barbeled Houndshark), Proscylliidae (Finback catsharks), Pseudotriakidae (False catsharks), Pentanchidae (Deepsea catsharks) and Scyliorhinidae (Catsharks), Sphyrnidae (Hammerhead sharks) and Triakidae (Houndsharks).

Carcharhinus humani (White & Weigmann 2014), commonly known as Human's Whaler Shark, belongs to the family Carcharhinidae and is one of 35 species in the species-rich *Carcharhinus* genus. The species was named after the late Dr Brett Human, who contributed to shark research and taxonomy in South Africa and Oman.

Morphology

The Human's Whaler Shark is a relatively small-bodied shark, reaching a maximum of 94.6 cm in total length (TL). It is characterised by its narrow and rounded snout, tall first dorsal fin, and a black blotch on its second dorsal fin.

Carcharhinus humani is commonly misidentified for its congener the Whitecheek Shark (*C. dussumieri*), Indonesian Whaler Shark (*C. tjutjot*), and Blackspot Shark (*C. sealei*). However, it can visually be distinguished from *C. dussumieri* and *C. tjutjot* when compared with their smoother basal cusplets on their teeth and their narrower and falcate first dorsal fin. *Carcharhinus humani* is also distinct from *C. sealei* by the colouration of their second dorsal fins; *C. humani* has a black blotch on the tip, while *C. sealei* has most of its fin coloured in black.

Distribution and Range

Human's Whaler Shark has a patchy distribution across the western Indian Ocean. It has been recorded from Bahrain, Kuwait, Mozambique, Seychelles, South Africa, and Yemen (off the Socotra Islands). It is reported from depths between 0 – 43 meters in inshore and offshore waters. However, a Madagascar specimen was found on the surface of a deepwater area (to 1,260 m depth).

Conservation and IUCN Red List of Threatened Species status

Human's Whaler Shark was assessed as Data Deficient (DD) on the IUCN Red List of Threatened Species due to the lack of information regarding its population, the small number of specimens recorded, and the difficulty in identifying the species in the areas it occurs. This species is likely threatened, considering fishing pressure across its distribution. In the southwestern Indian Ocean, small sharks that occupy the continental shelf, including *C. humani*, are more susceptible to fishing pressure than other shark species in the region. Furthermore, the Whitecheek Shark (*C. dussumieri*) is known to be caught in the Arabian/Persian Gulf waters. Since both species have overlapping ranges and are easily confused, it is likely that *C. humani* is also caught but remains unreported.

There are currently no species-specific management measures directed towards the conservation of *C. humani*. However, some existing fisheries management measures might benefit the species. For example, shark fishing is banned in Kuwait, and seasonal trawl bans are in place in Kuwait and Bahrain.

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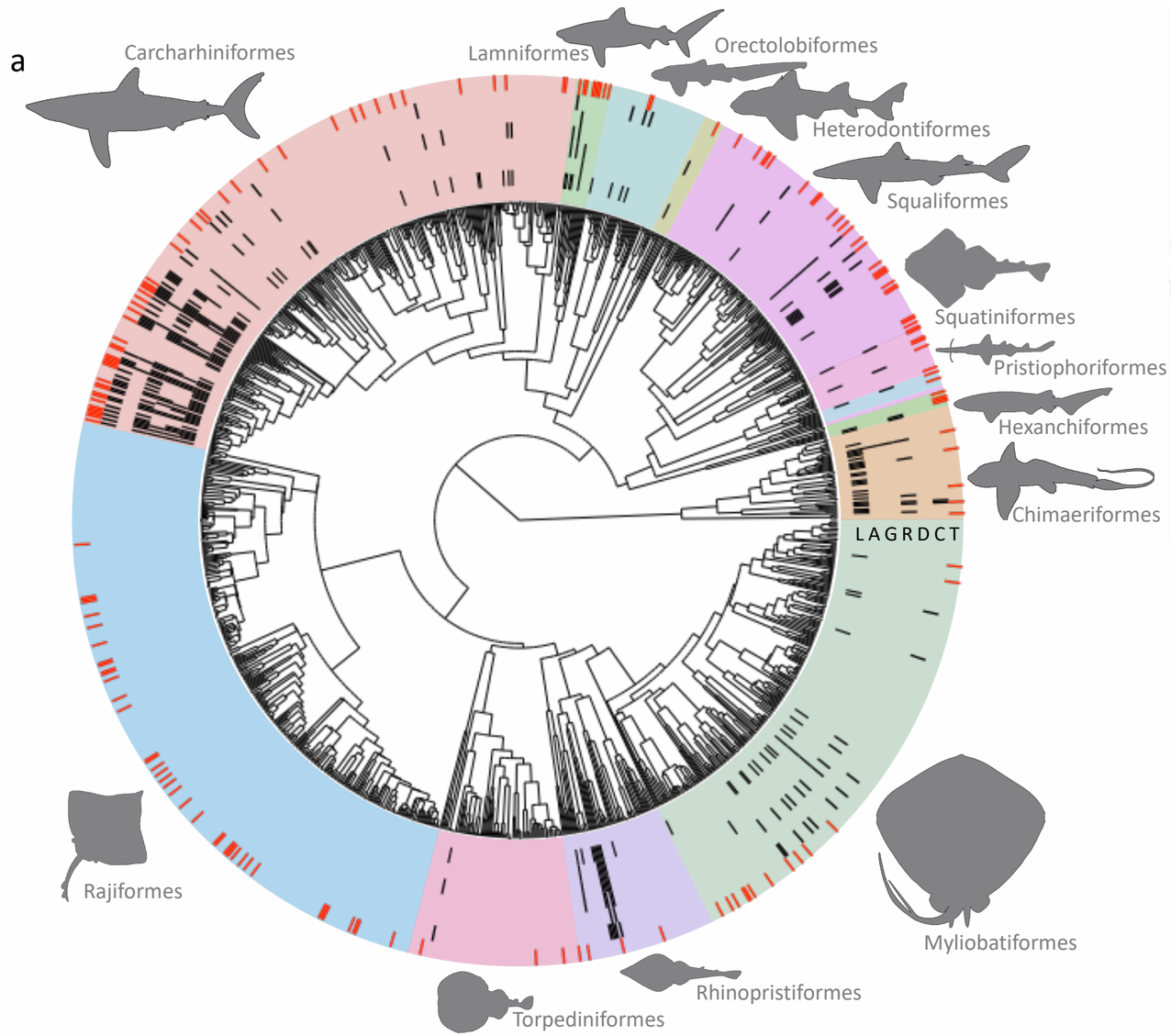
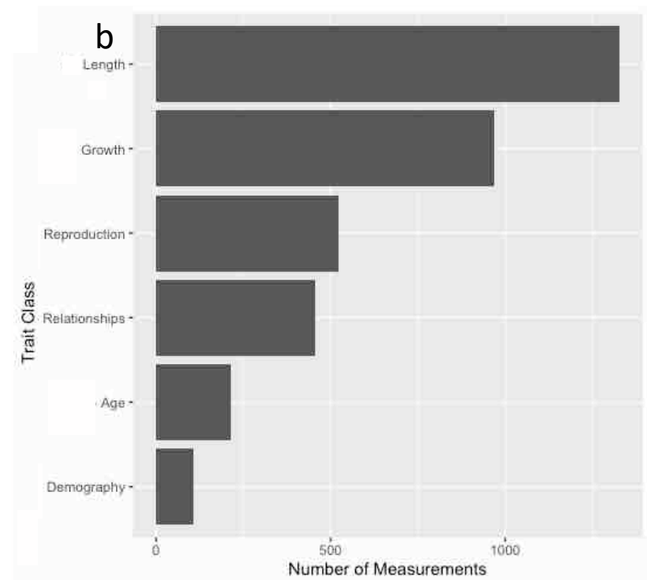
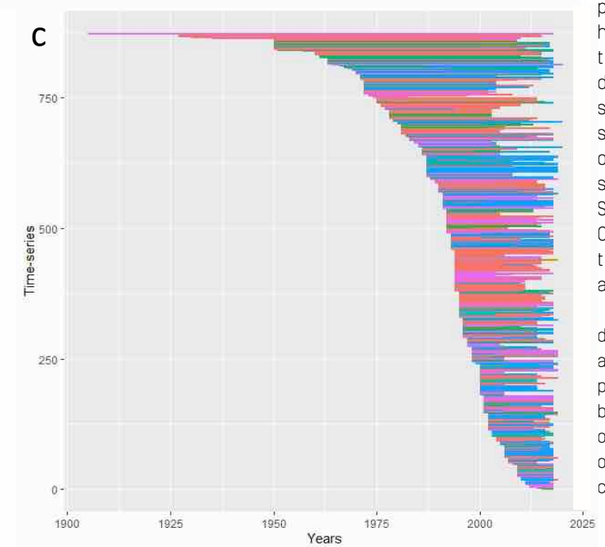
Sharkipedia

A curated open-access database of shark and ray life history traits and abundance time-series







Written by Chris Mull

Postdoctoral Fellow | Integrated Fisheries Lab | Department of Biology | Dalhousie University

SHARKIPEDIA
elasmobranch traits & trends

Sharks and rays (henceforth "sharks") are one of the most charismatic, evolutionarily distinct, and threatened lineages of vertebrates, comprising around 1,200 species. Globally one third of sharks are estimated to be threatened with extinction, with overfishing being the primary driver of declines. This overfishing often occurs in the absence of reliable data on the intrinsic biology and population abundance of exploited species, hampering efforts to make informed conservation and management decisions. Access to reliable information is particularly challenging in low-capacity countries or for stakeholders outside of government and academia, where institutional access to data can be limited. This inconsistent access to data can reduce the speed and effectiveness of shark conservation and management planning. With increasing calls for science-based fisheries management and successful listings of shark species under international conservation agreements, such as Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Convention on the Conservation of Migratory Species of Wild Animals (CMS), access to reliable information on key biological traits and trends is paramount for establishing biological reference points.

To accelerate shark and ray conservation and science, we developed "Sharkipedia" as a curated open-source database and research initiative to make all published biological traits and population trends accessible to everyone. The Sharkipedia database is built on three main tenants: (1) that the data be completely open-access and searchable, (2) that all data are traceable to the original source, and (3) that all data are curated to ensure accuracy. We developed the database schema so that all data on Traits

Data Summary. Summary of traits and trends data available in the databases. (a) The taxonomic distribution of data on life history traits: (L) Length, (A) Age, (G) Growth, (R) Reproduction, (D) Demography, (C) Relationships, and (T) Trends. (b) The number of measurements within each trait class. (c) The summary of taxonomy and length of available time series. The colour of the time series indicates the taxonomic order corresponding to panel a.

and Trends are tied to the backbone taxonomy of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™ and the bibliography of "Shark-References". Sharkipedia currently hosts information on 58 life history traits from 274 sources, for 170 species, from 39 families, and 12 orders related to length (n=9 traits), age (8), growth (12), reproduction (19), demography (5), and allometric relationships (5), as well as 871 population time-series from 202 species. The data in Sharkipedia can be crucial for identifying species or areas of concern and highlight future research priorities to address critical knowledge gaps. The Sharkipedia database is a living project with new data added every day.

Sharkipedia was designed to be user-friendly, community-driven, and scalable. While it is currently focused on information for management and conservation applications, we plan to incorporate additional traits in the future to cover the impact of fisheries, ecological roles of sharks and map all data to species ranges and jurisdictional boundaries. At the recent Sharks International conference in Valencia, Spain, we had significant interaction and uptake with delegates, and with new users signing up, contributing data, and providing excellent ideas for future directions. Sharkipedia has profound potential to support the rapidly growing data demands of fisheries management and international trade regulation as well as anchoring vertebrate macroecology and macroevolution. To learn more, read our recent data descriptor, and get involved, please visit Sharkipedia.org and sign up today.

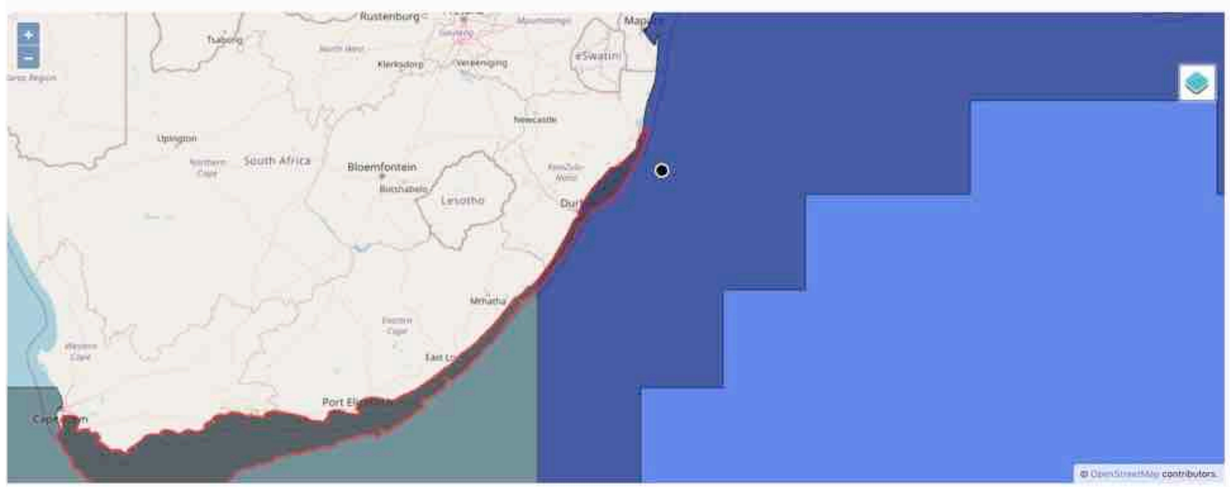
Project Principal Investigators: Dr Christopher Mull (Dalhousie), Dr Nathan Pacoureau (Simon Fraser University), Dr Holly Kindsvater (Virginia Tech), and Dr Nicholas Dulvy (Simon Fraser University). This work was supported by the Shark Conservation Fund, U.S. National Science Foundation, and the Save Our Seas Foundation.

Carcharhinus limbatus - dudley2006

Edit | Report Error | Download as CSV

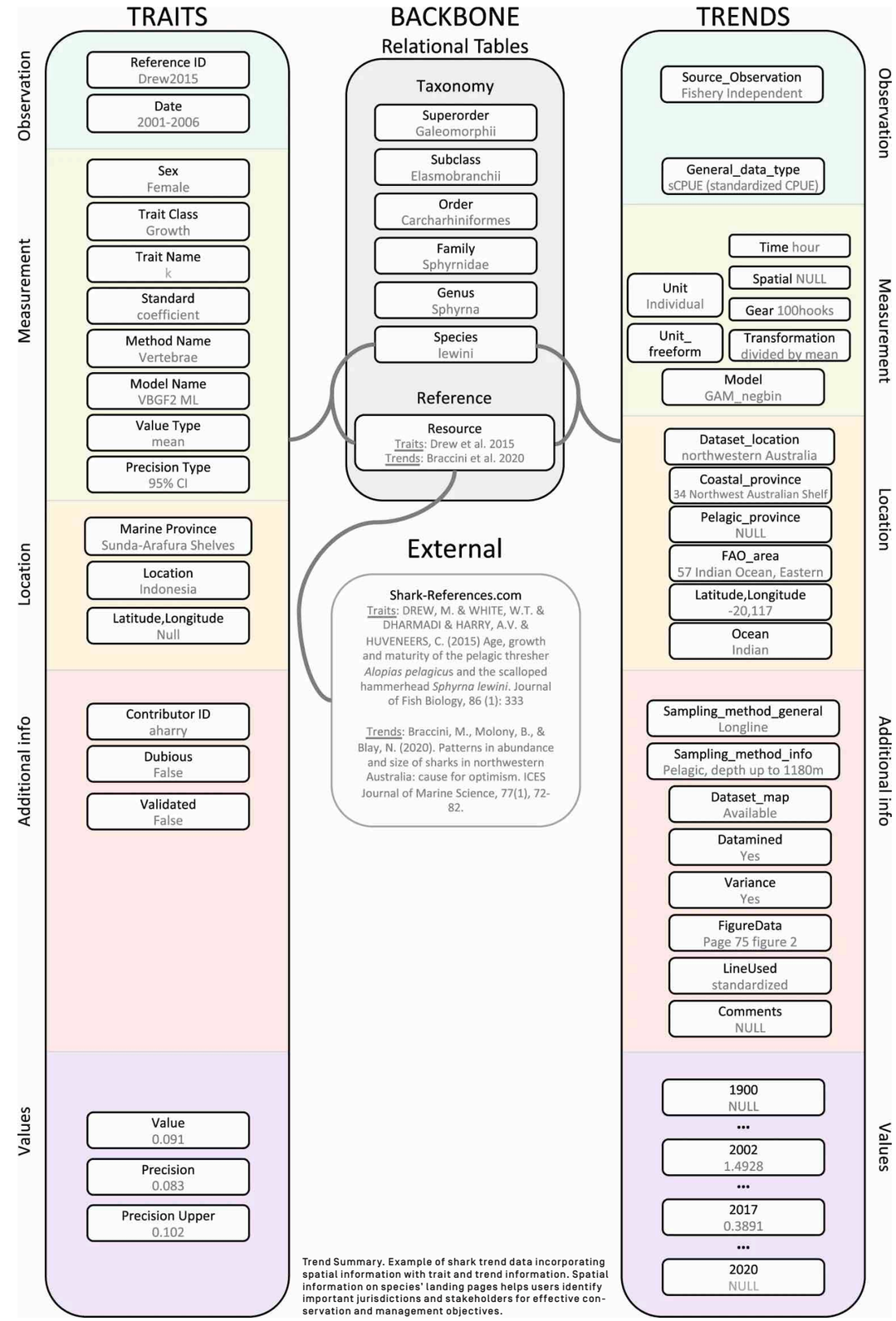
Species	Carcharhinus limbatus
Superorder	Galeomorphii
Order	Carcharhiniformes
Subclass	Elasmobranchii
Family	Carcharhinidae
IUCNcode	

Source observation	other
General data type	sCPUE
Unit	individual per km per net
Unit freeform	
Unit transformation	
Sampling Method general	bather_protection_net



Year	Value
1978	2.7509
1979	2.7085
1980	3.944
1981	3.4684
1982	2.8627

Ocean	Indian
Name	Kwazulu-Natal coast South-Africa
Latitude	-29.0
Longitude	33.0
PPOW	



Trend Summary. Example of shark trend data incorporating spatial information with trait and trend information. Spatial information on species' landing pages helps users identify important jurisdictions and stakeholders for effective conservation and management objectives.

THE IMPACTS OF OVERFISHING ON SHARKS AND RAYS

Dr. Simon J. Pierce

CMS

CMS SHARKS MOU

Overfishing refers to when fish are removed from a population faster than they can replace themselves through reproduction.

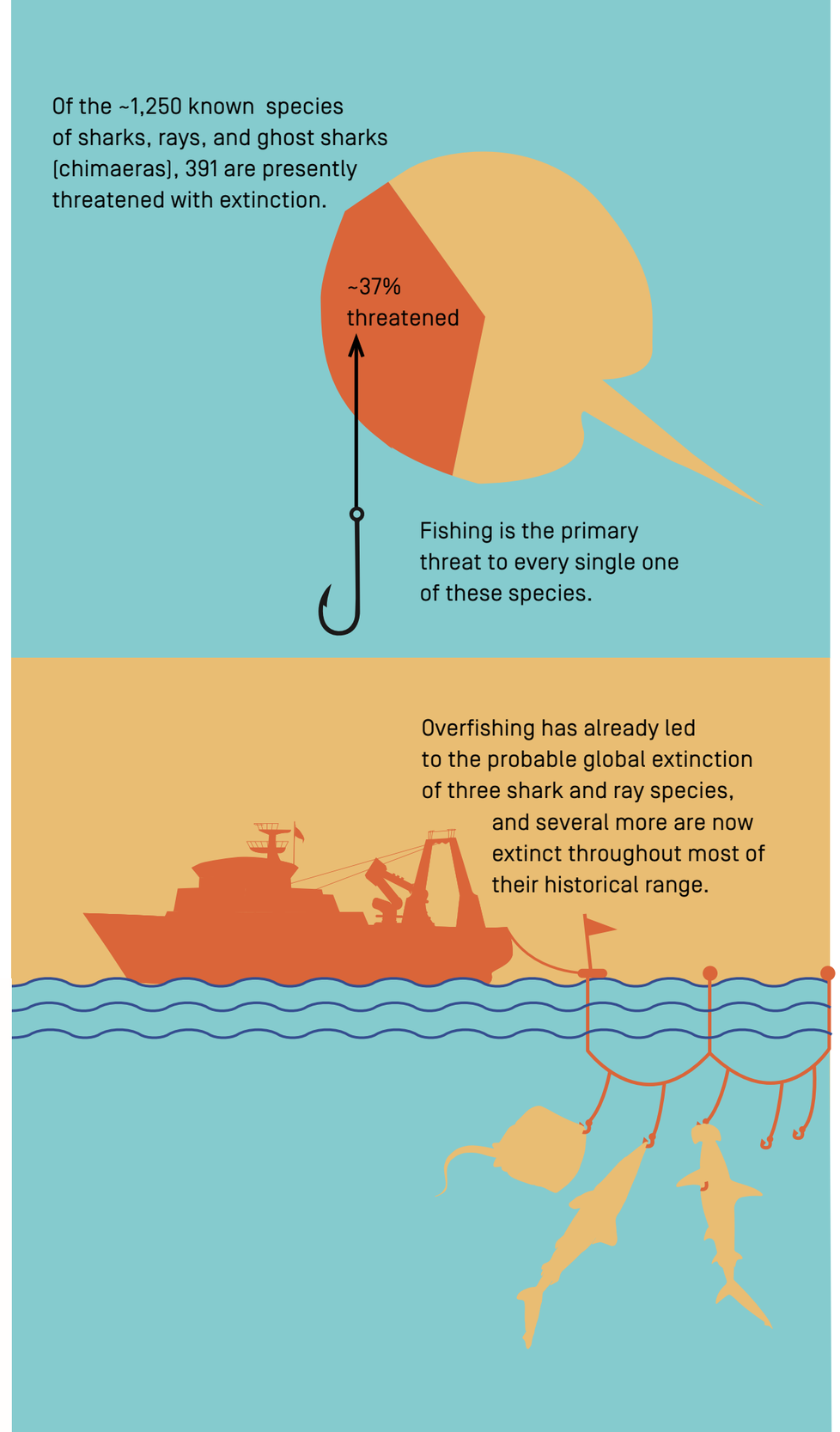
Of the approximately 1,250 known species of sharks, rays, and ghost sharks (chimaeras), 391 are presently threatened with extinction. Fishing is the primary threat to every single one of those threatened species. Overfishing has already led to the probable global extinction of a third of all shark and ray species, and several more are now extinct through most of their historical range. All the sharks and rays listed on the Convention on the Conservation of Migratory Species of Wild Animals (CMS) are there primarily because their populations drastically declined due to overfishing.

Of course, wild fisheries are also a vital protein source for people. This has been the case for millennia, with evidence of fisheries traced back at least 40,000 years. Contemporary excavations of archaeological sites routinely identify sharks and rays that are no longer present in those countries, particularly distinctive animals like sawfish (family Pristidae), which are now presumed to be extinct in more than half of the 90 nations in which they were historically found. However, even with this long history of exploitation, it is only over the past century that catch rates have dramatically accelerated. The rise of motorized vessels and other fishing technologies has allowed for the use of larger nets and more hooks on longlines, boats to operate further from shore, and opened global markets enabling the routine regional and international trade of fish products.

The contemporary harvest of sharks and rays is estimated at approximately 1.5 million tonnes annually. This is driven largely by the demand for fins and meat for consumption, while other derivatives such as liver oil, gill plates (for Manta and Devil Rays), cartilage, and skin for leather are sometimes sold as well. That said, it is important to keep in mind that a large proportion of shark and ray landings are from incidental catches in fisheries targeting teleost species, such as purse seine and longline fisheries for tuna or gillnets for coastal species. In fisheries science, the term target generally refers to the desired catch. The terminology used for accidentally caught species can vary between fisheries and has been somewhat controversial. However, the terms byproduct and bycatch usually refer to species that are not targeted, are caught accidentally, and are either retained for sale or discarded (dead or alive). There are a number of well documented targeted shark and ray fisheries around the world, but almost all shark and ray species, from 20 m Whale Sharks (*Rhincodon typus*) to 20 cm Dwarf Lanternsharks (*Etmopterus perryi*), many with no commercial value, are accidentally caught.

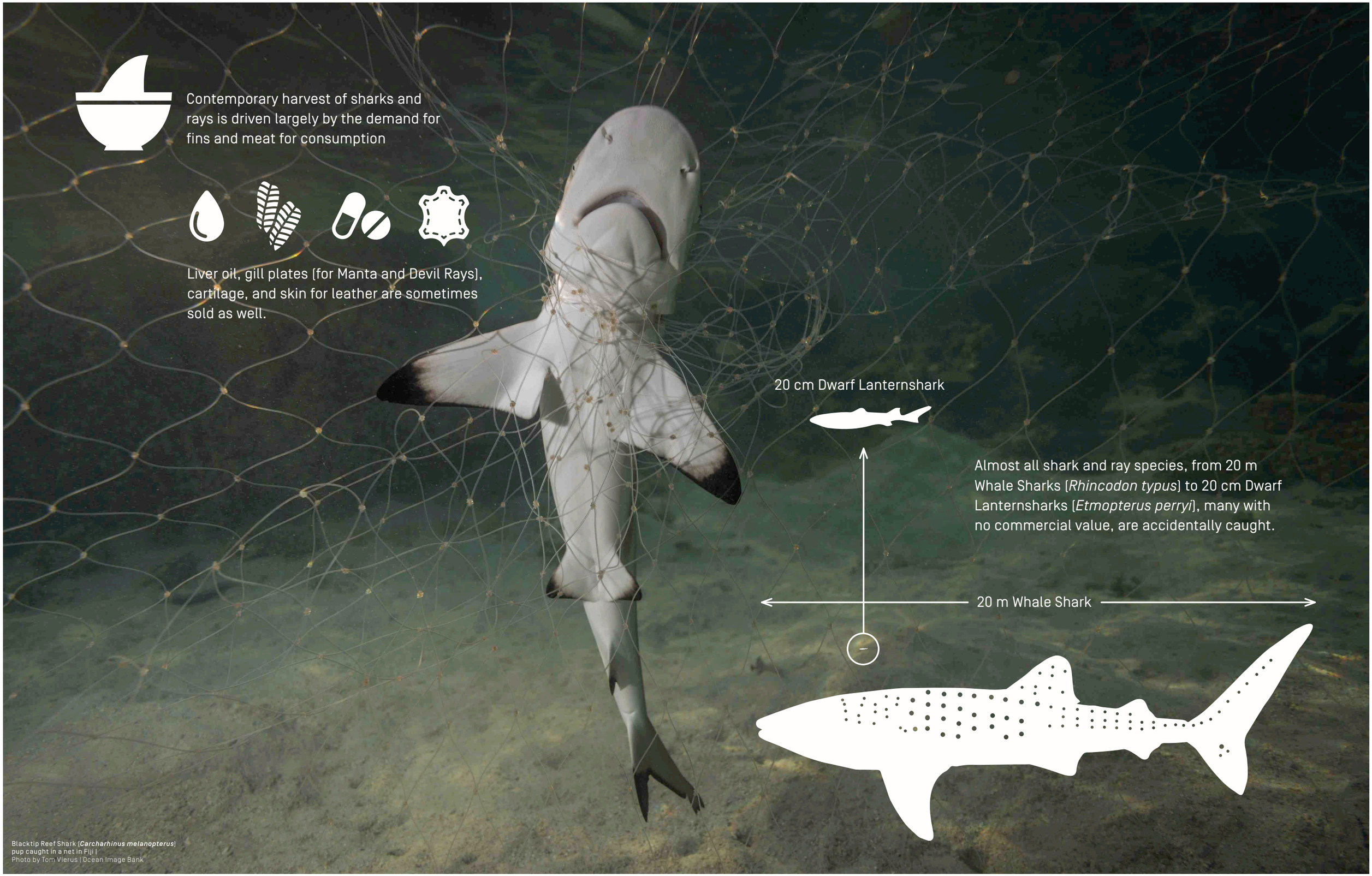
At a high level, shark, ray, and chimaera (ghost sharks) fisheries can be categorized as recreational, artisanal, or industrial. These labels represent a continuum, rather than a strict demarcation, but provide useful context to the diverse fisheries that catch these species. Recreational fishing, or sport fishing, is broadly defined as catching fish as a leisure activity, either for personal consumption or for the perceived challenge (e.g., where the fish are intended to be released alive). Artisanal fisheries, also referred to as small-scale or subsistence fisheries, are here defined as those involving relatively small vessels (usually less than 20 m in length), fishing in national waters, generally for less than a week at a time. The catch may be for local consumption, export, or both. Industrial, or commercial fisheries, use larger, often more technologically advanced vessels capable of multi-day trips, and aim to sell their catch for a profit.

In this fact sheet, we will look at the general characteristics of these fisheries and the threat they pose to sharks and rays, with a particular focus on those listed on CMS and the Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MOU), and identify some of the proven approaches we can use to help shark and ray populations recover, without diminishing the contribution of fishing to food security.



Title | Whipray (*Pateobatis* sp.) caught in an artisanal net fishery in Tanzania | Simon Pierce

The infographics in this factsheet are based off of published literature and are intended as visual representation only.



Blacktip Reef Shark (***Carcharhinus melanopterus***) pup caught in a net in Fiji | Photo by Tom Vierus | Ocean Image Bank

Recreational Fisheries

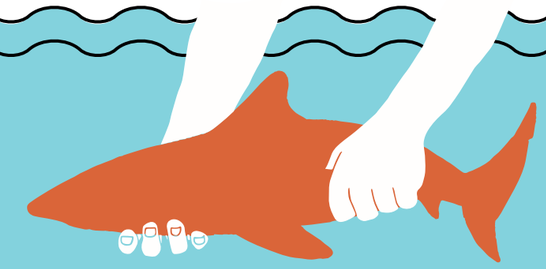
The worldwide recreational catch of sharks and rays is poorly documented. Overall, the reported recreational harvest for all fish is approximately 1% of the total global fish catch. In these fisheries, most sharks and rays – typically 70–100% – are released after capture, rather than retained, so they are not included in this total. The majority of recreational shark and ray fishing takes place on the subtropical and tropical coasts of high-income countries, with the best data available from Australia and the USA, although anglers routinely target sharks and rays in other countries too.

A major national survey of recreational shark and ray fishing in Australia in 2000–2001 found that anglers catch over 1.2 million sharks and rays per year, releasing around 80% alive. More recently, dedicated monitoring efforts in Western Australia (WA) found that 33 shark and ray species were caught, dominated by the Dusky Shark (*Carcharhinus obscurus*). Catch reconstructions found the annual recreational catch to be increasing over time, from 14 tonnes (t) in the early 1940s to 83 t in 2017–2018. An estimated 17,000 individual sharks and rays from all species are caught by recreational anglers in WA each year, with about 82% of them released. Aside from the Dusky Shark, catches of other CMS-listed species were considered negligible (less than 1 tonne in 2017–2018), and the recreational catch was assessed as being unlikely to impact overall shark and ray stocks. In comparison, the industrial catch of sharks and rays in WA is around 1,000 t.

However, there were some catches of species assessed as Critically Endangered on the IUCN Red List of Threatened Species, including sawfishes (family Pristidae), Scalloped Hammerheads (*Sphyrna lewini*), and Oceanic Whitetip Sharks (*Carcharhinus longimanus*), which could warrant management attention, especially since some are highly susceptible to post-release mortality even if released alive.

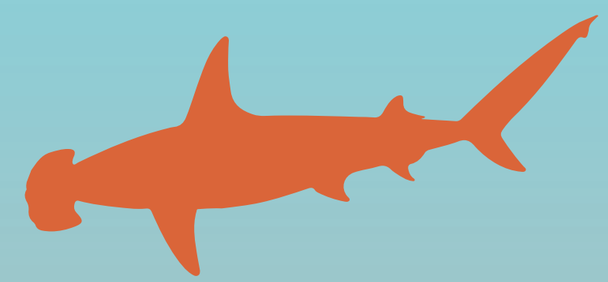
Recreational fishing for sharks is also popular in Florida, USA. The total recreational catch of sharks in Florida was estimated at 733,000 in 1986. A recent study surveyed the 18,000 anglers (as of December 2020) that held permits for recreational shore-based shark fishing. The 856 respondents caught 9,617 sharks over a 12-month period in 2019–2020. Shore-based shark fishing is rapidly growing in participation, increasing around 60% from 2019 to 2020. The most commonly caught CMS-listed species was the Great Hammerhead (*Sphyrna mokarran*; 309 sharks), but Scalloped Hammerheads,

Dusky Sharks, and Shortfin Mako Sharks (*Isurus oxyrinchus*) have also been documented from this fishery. Hammerheads and Dusky Sharks are mandated release species, and release rates overall are thought to exceed 80%.



70-100% of sharks and rays are typically released after capture rather than retained in recreational fisheries.

Pregnant and gravid sharks and rays as diverse as Largetooth Sawfish (*Pristis pristis*), Angelsharks (*Squatina squatina*), and Blue Sharks (*Prionace glauca*), commonly abort their young due to capture stress.



Hammerhead Sharks are known to have a relatively high rate of post-release mortality due to the stress of capture.

Therefore, the possibility of negative population-level effects needs to be considered when there is recreational fishing pressure on key shark and ray habitats, such as inshore nursery areas, or on Critically Endangered species.

Adult Angelshark (*Squatina squatina*)
Photo by Michael Sealey

The high release rate of sharks and rays in recreational shark fisheries around the world can create opportunities for data collection on poorly known species. For example, Whitespotted Wedgefish (*Rhynchobatus djiddensis*) are targeted by shore anglers along the eastern coast of South Africa, and have primarily been released since 1995. Marker tags were provided to participating anglers, and over 4,700 individual wedgefish were tagged and released between 1984 and 2017. Three hundred and forty recaptures were reported, providing valuable information on the movements of the species, as well as data on population structure and abundance.

Whitespotted Wedgefish are generally a hardy species, with a high survival rate when handled carefully. However, other species are susceptible to capture stress, injury, or post-release mortality, adding pressure on sharks and rays that are already threatened by other processes. Pregnant and gravid sharks and rays as diverse as Largetooth Sawfish (*Pristis pristis*), Angelsharks (*Squatina squatina*), and Blue Sharks (*Prionace glauca*), commonly abort their young due to capture stress. Hammerhead Sharks, in particular, are known to have a relatively high rate of post-release mortality due to the stress of capture. Therefore, the possibility of negative population-level effects needs to be considered when there is recreational fishing pressure on key shark and ray habitats, such as inshore nursery areas, or on Critically Endangered species.

Artisanal Fisheries

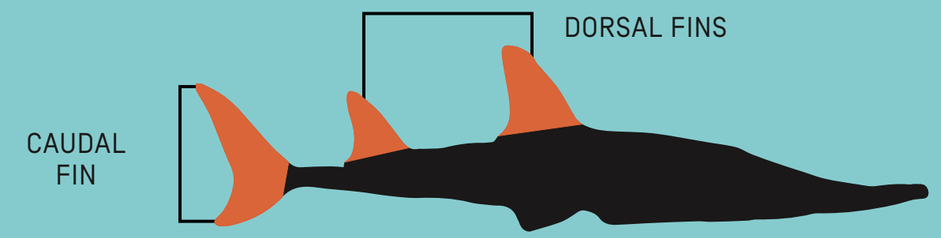
Artisanal fisheries are an important economic sector and a vital contributor to food security in most coastal areas around the world. In many developing countries where fish consumption is important, much of the catch, including shark and ray meat, is consumed domestically. For example, locally-caught fish accounts for 60–70% of the animal protein eaten by people in the Union of Comoros, while the artisanal fleet accounts for over 80% of the national fish catch in Madagascar.

While artisanal fisheries are sometimes called 'small-scale', they can still have a large footprint in coastal areas. Fishing pressure has increased in line with rapid human population growth. For example, the estimated number of non-motorised fishing vessels in Madagascar rose from 2,471 in 1950 to 52,561 in 2016. This trend is replicated all over the world. By 2019, Oman had over 25,000 artisanal boats, Bangladesh about 67,600 vessels, and there are now over 600,000 artisanal fishing vessels in Indonesia. The impact of these fisheries is only increasing with time.

Sharks and rays have always been a common byproduct of these fisheries, but the rapid rise in demand and price for shark and shark-like ray fins has led to increased targeting of some species, and severe population declines as a result. In particular, the shark-like rays (order Rhinopristiformes), including sawfishes, guitarfishes, and wedgefishes, are now among the world's most threatened ocean wildlife. Wedgefish species include the CMS- listed Bottlenose Wedgefish (*Rhynchobatus australiae*) and two species on the Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MOU), the Whitespotted Wedgefish and Smoothnose Wedgefish (*Rhynchobatus laevis*). Wedgefishes are caught using a variety of fishing techniques, live in shallow coastal waters, and are extremely valuable. Aside from their meat, which is reportedly sold at high prices locally and internationally, the two dorsal and caudal fins of this group have been considered the most expensive 'shark fins' for at least 200 years in China. Large wedgefishes have been sold for up to US$680 each, while prices for their fins can reach as high as US$964 per kg in Asian markets. These high prices have driven fishers to target these species in many regions of the world as well as high levels of retention if caught as bycatch.

Many artisanal fisheries keep their operating costs low by sharing profit from catches, rather than paying fixed salaries for labour. Catching even a small number of high-value sharks or rays can be a major boost to income, incentivizing the continued targeting of these species even as they edge closer to extinction with steep population declines. All except one of the 17 wedgefishes and giant guitarfishes were recently assessed as Critically Endangered. These 16 species are all inferred to have undergone population reductions of more than 80% over the last 30–45 years. The intensity of fishing pressure on coastal and shelf waters leaves little refuge for this unique group.

Wedgefishes are caught using a variety of fishing techniques, live in shallow coastal waters, and are extremely valuable.



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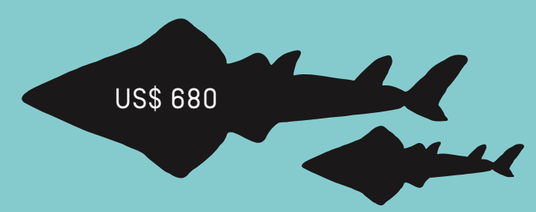


Large wedgefishes have been sold for up to US$ 680 each

Prices for wedgefishes fins can reach as high as US$ 964 per kg in Asian markets

These high prices have driven fishers to target these species in many regions of the world as well as high levels of retention if caught as bycatch.

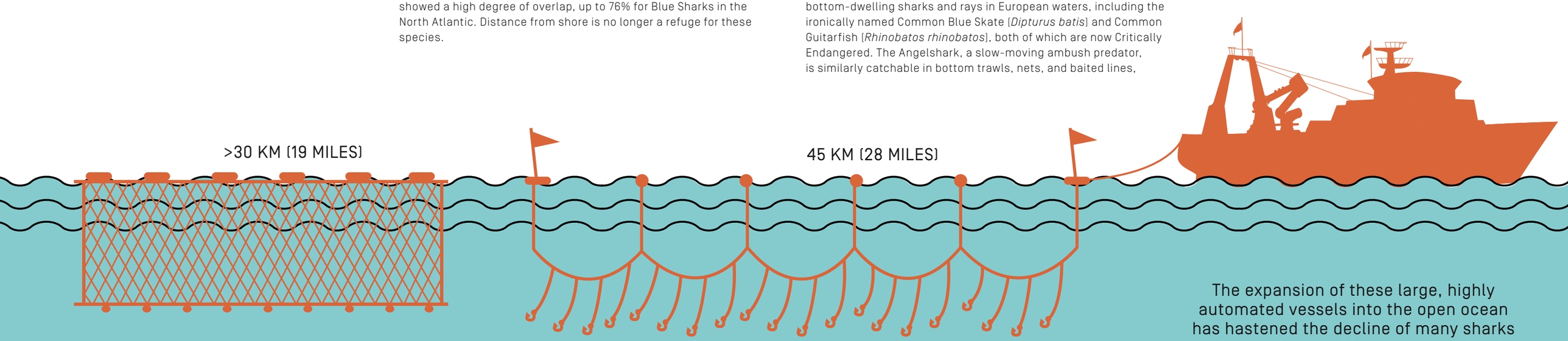
Industrial Fisheries

Industrial fisheries are another immediate global threat to many sharks and rays. Modern industrial fishing vessels tend to be large, can operate around the clock, and are often capable of extended trips (in both time and distance) into international waters, with many ships having onboard processing and freezing facilities. Depending on target species, some vessels have the capacity to deploy huge nets, often exceeding 30 km (19 miles) in length, while an average longline set in US waters is 45 km (28 miles). The expansion of these large, highly automated vessels into the open ocean has hastened the decline of many sharks and rays whose habitats were previously inaccessible to fisheries.

Most industrial fishing did not start regularly targeting sharks in international waters until the 1950s. Large pelagic sharks now account for 52% of the reported shark catch worldwide. The abundance of the 31 open ocean shark and ray species declined by 71% from 1970 to 2018 due to an 18-fold increase in relative fishing pressure over that period. While oceans cover huge areas, sharks and rays are not evenly distributed; major oceanographic features, such as the Gulf Stream in the North Atlantic and the East Australian Current in the southern Pacific Ocean, aggregate multiple pelagic shark species together. The industrial fleet is well aware of this, and fishing effort is concentrated on these productive areas. A recent major tracking study, aggregating 1,804 satellite tracks from 23 pelagic shark species, compared shark occurrence hotspots to the position of industrial fishing vessels. Sharks and shark fishers showed a high degree of overlap, up to 76% for Blue Sharks in the North Atlantic. Distance from shore is no longer a refuge for these species.

The open ocean is the world's largest habitat, and many oceanic sharks and rays were historically common. Oceanic Whitetip Sharks, for instance, were described in the 1964 'Natural History of Sharks' as being "extraordinarily abundant, perhaps the most abundant large animal... on the face of the earth''. Twenty-four of these 31 species are now threatened with extinction. The formerly abundant Oceanic Whitetip has suffered a >98% reduction in numbers; they are now Critically Endangered.

Industrial fisheries that accidentally catch slow-growing sharks and rays can remain profitable even while species decline to local or global extinction. The Angelshark is a good example of this scenario. As fishing effort and capabilities increased during the 20th century, there was a well-documented decline of large bottom-dwelling sharks and rays in European waters, including the ironically named Common Blue Skate (*Dipturus batis*) and Common Guitarfish (*Rhinobatos rhinobatos*), both of which are now Critically Endangered. The Angelshark, a slow-moving ambush predator, is similarly catchable in bottom trawls, nets, and baited lines, which operate through most of its coastal habitat in Europe and northwestern Africa. Initially, Angelsharks were caught in targeted fisheries, but as their numbers plummeted these fisheries were no longer viable. However, the numbers of faster-breeding teleost species that shared their coastal habitat, such as Anglerfish (*Lophius* spp.), remained high, so these fisheries could catch and market these fish to operate profitably despite the declining shark catches. The Angelshark is also now Critically Endangered, extinct through most of its historical range, with no recorded industrial landings of the species in the North Sea since the 1970s. The species remains relatively common only in the Canary Islands, where trawl fishing has been prohibited since 1986.



The expansion of these large, highly automated vessels into the open ocean has hastened the decline of many sharks and rays whose habitats were previously inaccessible to fisheries.

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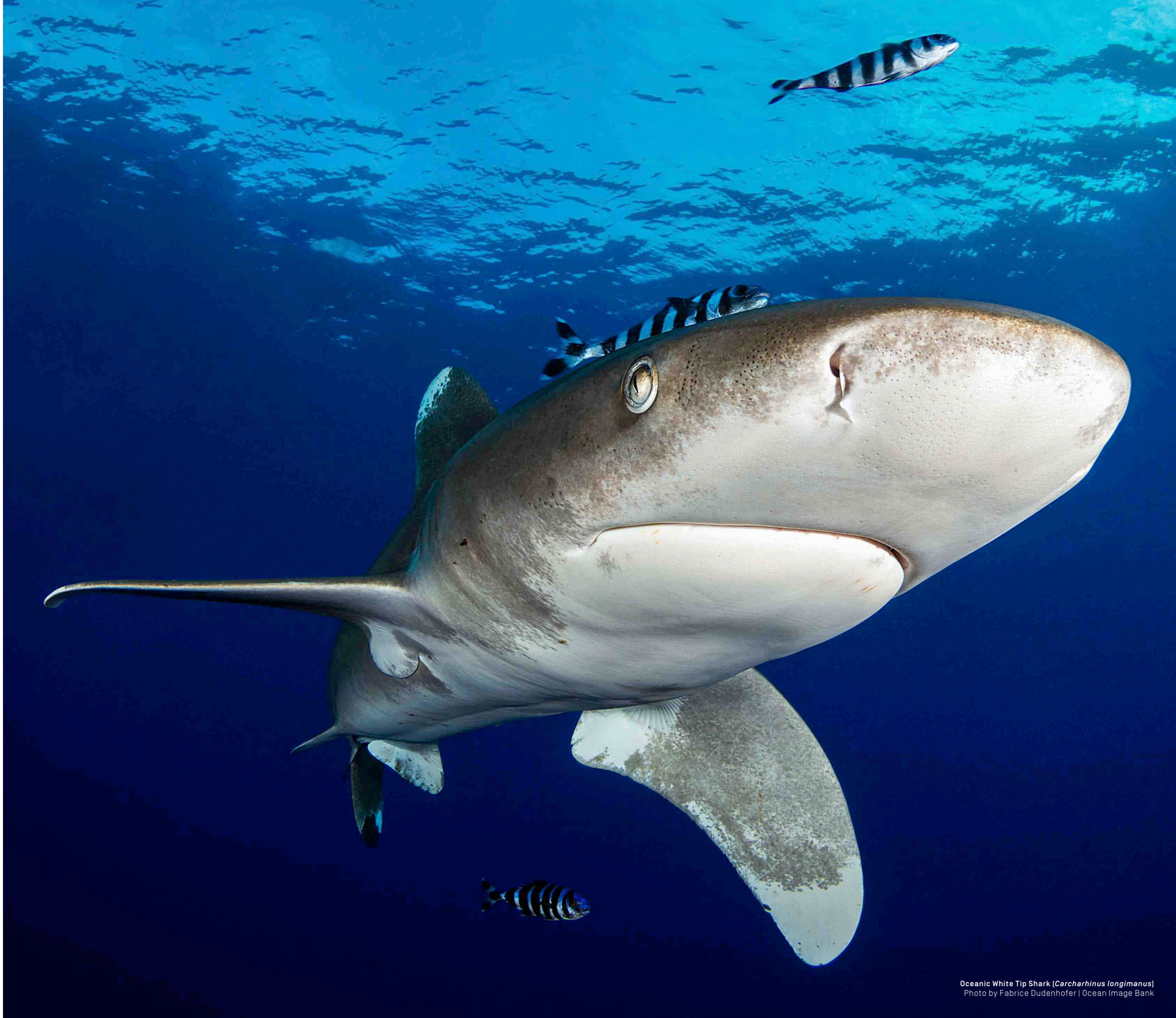
Looking Forward

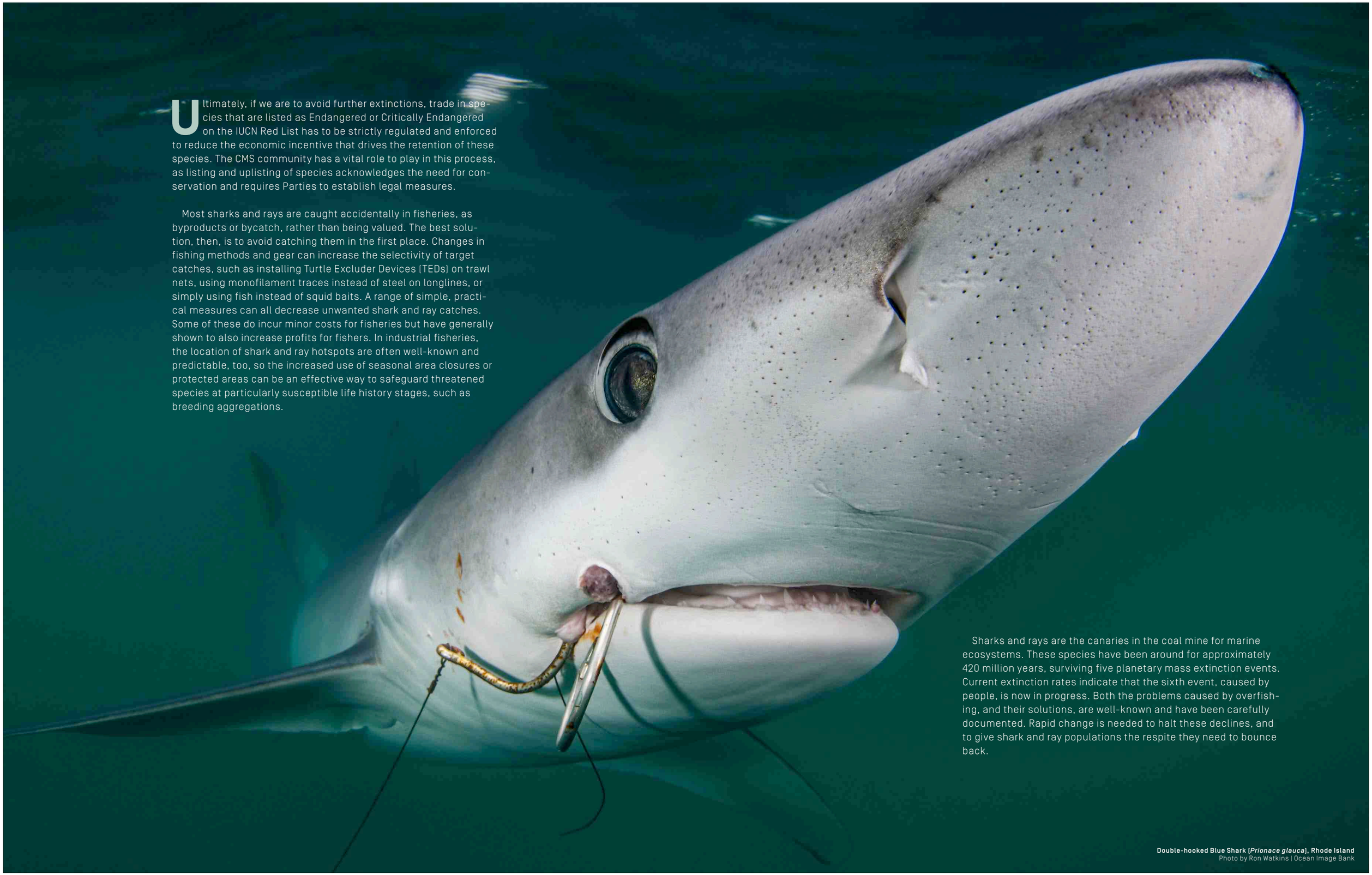
In many countries, shark and ray landings make an important contribution to food security. For millions of people living in developing countries, fish are not an optional complement to a rich variety of foodstuffs, but a critical protein source. Fishes contain micronutrients that help to prevent nutrient-deficiency diseases, a leading cause of infant mortality worldwide. However, targeted fisheries for sharks and rays are the exception, not the rule. Most sharks are accidentally caught in fisheries targeting fast-growing teleost or invertebrate species. Even pelagic sharks and rays, which make up the bulk of the international trade in shark products, are typically caught in fisheries targeting more valuable tuna and billfish species. These fishes are two to three-fold more productive than sharks and rays, so they are often more resilient to overfishing and can rebound faster in response to management initiatives. In contrast, the slow breeding rate of most sharks and rays means that recovery times from even modest overfishing can take decades.

Sustainable shark and ray fisheries are demonstrably possible. The small Common Thresher Shark (*Alopias vulpinus*) fishery in the northeast Pacific, and Spiny Dogfish (*Squalus acanthias*) in the northwest Atlantic, are two widely accepted examples amongst CMS-listed species. However, the high bar that such a designation requires – regular, published stock assessments and a science-based management plan – have seldom been met outside industrial fisheries, in high-income countries, overseen by well-resourced fisheries management agencies. Even wealthy countries, though, generally view the reduction of threatened species bycatch as a secondary consideration to maintaining catches of valuable target species. Perversely, only 46% of open ocean fisheries would even be profitable without major government subsidies to industrial fishing companies. In addition, many artisanal fisheries are largely unmanaged, and few data are available on catches. Striving to make all shark fisheries sustainable is a laudable goal, but it is unlikely to happen fast enough to prevent the rapid decline of many sharks and rays to ecological and global extinction.

International trade in shark and ray products is a primary driver of overexploitation. Much of this trade has historically been for luxury goods, such as shark fin soup, that play no meaningful role in food security. Many CMS-listed sharks and rays are also listed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which generally prohibits (Appendix I) or regulates (Appendix II) international trade of listed sharks and rays. The species listed in Appendix II can be legally traded if the exporting country can demonstrate that products are derived from a population that is managed for sustainability. However, less than 5% of shark and ray species are currently listed on international treaties, and a significant amount of international trade in listed species still evades this process by exploiting illegal channels and mislabelling.



Oceanic White Tip Shark (*Carcharhinus longimanus*)
Photo by Fabrice Dudenhofer | Ocean Image Bank



Ultimately, if we are to avoid further extinctions, trade in species that are listed as Endangered or Critically Endangered on the IUCN Red List has to be strictly regulated and enforced to reduce the economic incentive that drives the retention of these species. The CMS community has a vital role to play in this process, as listing and uplisting of species acknowledges the need for conservation and requires Parties to establish legal measures.

Most sharks and rays are caught accidentally in fisheries, as byproducts or bycatch, rather than being valued. The best solution, then, is to avoid catching them in the first place. Changes in fishing methods and gear can increase the selectivity of target catches, such as installing Turtle Excluder Devices (TEDs) on trawl nets, using monofilament traces instead of steel on longlines, or simply using fish instead of squid baits. A range of simple, practical measures can all decrease unwanted shark and ray catches. Some of these do incur minor costs for fisheries but have generally shown to also increase profits for fishers. In industrial fisheries, the location of shark and ray hotspots are often well-known and predictable, too, so the increased use of seasonal area closures or protected areas can be an effective way to safeguard threatened species at particularly susceptible life history stages, such as breeding aggregations.

Sharks and rays are the canaries in the coal mine for marine ecosystems. These species have been around for approximately 420 million years, surviving five planetary mass extinction events. Current extinction rates indicate that the sixth event, caused by people, is now in progress. Both the problems caused by overfishing, and their solutions, are well-known and have been carefully documented. Rapid change is needed to halt these declines, and to give shark and ray populations the respite they need to bounce back.

Double-hooked Blue Shark (*Prionace glauca*), Rhode Island
Photo by Ron Watkins | Ocean Image Bank

Further reading

Shark recreational fisheries: Status, challenges, and research needs. Gallagher AJ, Hammerschlag N, Danylchuk AJ, Cooke SJ (2017) Ambio 46(4): 385–98.

The thin edge of the wedge: Extremely high extinction risk in wedgefishes and giant guitarfishes. Kyne PM, Jabado RW, Rigby CL, Gore MA, Pollock CM, Herman KB, Cheok J, Ebert DA, Simpfendorfer CA, Dulvy NK (2020) Aquatic Conservation: Marine and Freshwater Ecosystems 30(7): 1337–61.

Half a century of global decline in oceanic sharks and rays. Pacoureau N, Rigby CL, Kyne PM, Sherley RB, Winker H, Carlson JK, Fordham SV, Barreto R, Fernando D, Francis MP, Jabado RW, Herman KB, Liu K-M, Marshall AD, Pollom RA, Romanov EV, Simpfendorfer CA, Yin JS, Kindsvater HK, Dulvy NK (2021) Nature 589(7843): 567–71.

Bright spots of sustainable shark fishing. Simpfendorfer CA, Dulvy NK (2017) Current Biology 27(3): R97–8.

Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. Dulvy NK, Pacoureau N, Rigby CL, Pollom RA, Jabado RW, Ebert DA, Finucci B, Pollock CM, Cheok J, Derrick DH, Herman KB (2021) Current Biology 31(21): 4773–87.

Hammerhead Shark in fishing net, Hawaii
Photo by Toby Matthews | Ocean Image Bank

Sharks featured prominently at the convention center. Shirley Binder, Panama | CITES CoP19 | November 17, 2022

Jorge Rodriguez Romero, EU | CITES CoP19 | November 24, 2022

Photos by IISD/ENB | Diego Noguera

Plenary view | CITES CoP19 | November 24, 2022

A Historic Win for Sharks and Rays

By Dr Rima Jabado
IUCN SSC Shark Specialist Group | Chair

As I walked in the hallways of the Panama City Convention Center for almost two weeks, delegates were calling the event 'the reptile COP'. But I will always remember it as 'the shark COP'. It's hard to believe that after decades of shark scientists sounding the alarm about the impact of trade on shark populations, 104 species got listed. This brings us to 150 shark and ray species listed on the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It represents almost 13% of all known shark and ray species but, more importantly, about 70% of all shark species currently found in the international fin trade. It was historic, to say the least!

Photos by IISD/ENB | Diego Noguera

Dr Cassandra Rigby (SSG Red List Authority Coordinator) giving an intervention on the shark proposals as part of the official IUCN delegation.

Hosted in beautiful Panama City, the event took place from November 14 to 25. It brought together almost 4,000 people, including representatives of the European Union and the 183 signatory countries to CITES, along with experts in conservation and international trade from around the world. Discussions focused on the trade of hundreds of species, including frogs, birds, reptiles, trees, rhinos, elephants, cats, eels, turtles, hippos, and tortoises… but I was focused on the outcomes of four proposals – 37, 38, 39, and 40 – those related to the listing of sharks and rays on Appendix II.

Species listed on Appendix II are those that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. International trade may be authorized by granting an export permit or re-export certificate. Permits or certificates can only be issued if relevant authorities are satisfied that certain conditions are met and, above all, that trade will not be detrimental to the survival of the species in the wild. Below is a summary of the proposals and how they passed.

Proposal CoP19 Prop. 37 to include the remaining 54 species from the family Carcharhinidae spp. in Appendix II. This family consists of 56 species, but the Oceanic Whitetip Shark (*C. longimanus*) and Silky Shark (*Carcharhinus falciformis*) were already listed in 2013 and 2017, respectively. This proposal was probably the most controversial one, and it was put to a vote. With a vote of 88 Parties in favour, 29 against and 17 abstentions, the proposal was accepted, with the entry into effect of the inclusion in Appendix II delayed by 12 months.

Proposal CoP19 Prop. 38 to include all remaining species in the family Sphyrnidae in Appendix II. This family consist of nine species, but the Great Hammerhead (*Sphyrna mokarran*), Scalloped Hammerhead (*S. lewini*), and Smooth Hammerhead (*S. zygaena*) were already listed in 2013. This proposal was accepted by consensus.

Proposal CoP19 Prop. 39 to include the freshwater stingrays *Potamotrygon wallacei, P. leopoldi, P. albimaculata, P. henlei, P. jabuti, P. marquesi*, and *P. signata* in Appendix II. Although the family consists of over 30 species, only seven were proposed, and this proposal was accepted by consensus.

Proposal CoP19 Prop 40 to include the family Rhinobatidae in Appendix II. None of the 37 species from this family had previously been proposed, and this proposal was put to a vote. The proposal was accepted with 101 Parties in favour, 14 against, and 13 abstentions.

Some might disagree that this was a historical moment – but those that have worked tirelessly for decades know how important this step is. We all acknowledge that these listings will not save sharks, but they are progress and key to ensuring we can finally work towards having traceability in the trade in shark products. They also highlight the global political recognition of the threatened status of these species and their need and value for conservation. Listings will close several loopholes created previously created where fins of certain non-listed species could not be differentiated from listed species (e.g., for some hammerhead species). They will also relieve the burden for many customs officials who have to identify non-CITES-listed species from those listed in bags with hundreds or thousands of fins.

For now, these listings essentially mean that most shipments of shark fins being traded will require a permit. So, to make this a truly historic win, we need to ensure effective implementation. This will require more work to build capacity of wildlife, fisheries, and customs staff in fisheries and trade data collection, the development of non-detriment findings, and overall monitoring. There is still a lot to do, but after seeing how non-government organizations and governments (with SSG members in most groups and/or delegations) worked together and supported each other, and how funders stepped up to support the work, I am convinced that we can and will make a difference.

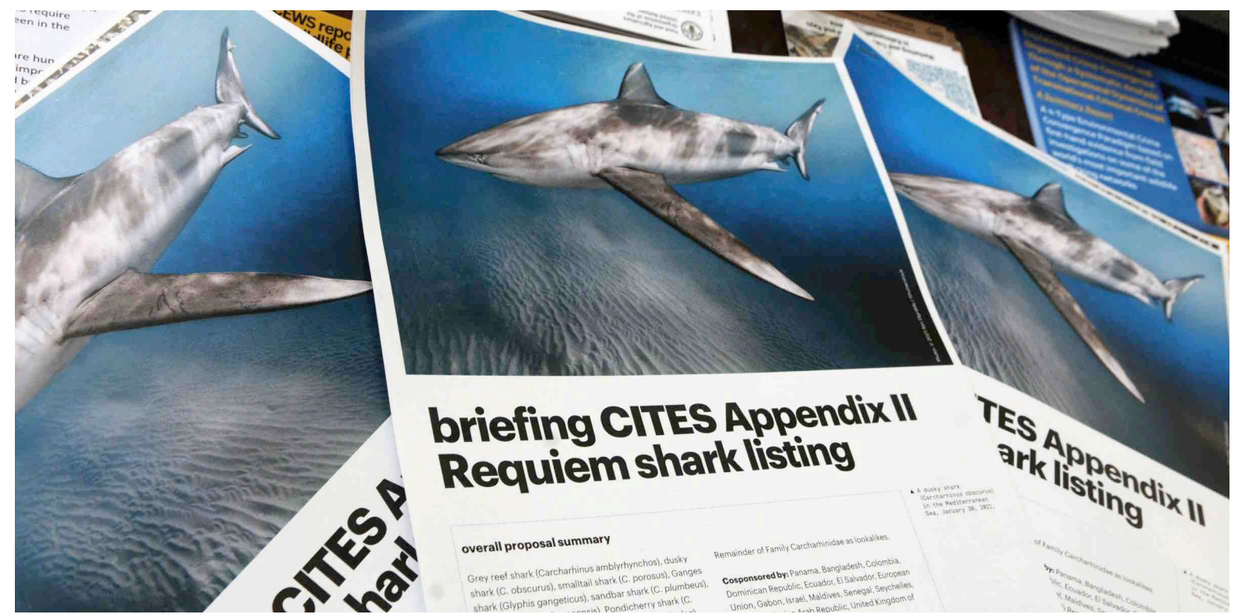
The table provided summarises all shark and ray species now listed on Appendix I (all commercial trade prohibited) and II of CITES, along with the year they were listed. The IUCN Red List of Threatened Species (www.iucnredlist.org) was used to extract the common names and global extinction risk status for each species (CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; DD – Data Deficient; LC – Least Concern; NE – Not Evaluated).

No.	Order	Family	Scientific Name	Common name (English)	IUCN Status	App I	App II
1	Carcharhiniformes	Carcharhinidae	*Carcharhinus acronotus*	Blacknose Shark	EN	-	2022
2	Carcharhiniformes	Carcharhinidae	*Carcharhinus albimarginatus*	Silvertip Shark	VU	-	2022
3	Carcharhiniformes	Carcharhinidae	*Carcharhinus altimus*	Bignose Shark	NT	-	2022
4	Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchoides*	Graceful Shark	VU	-	2022
5	Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchos*	Grey Reef Shark	EN	-	2022
6	Carcharhiniformes	Carcharhinidae	*Carcharhinus amboinensis*	Pigeye Shark	VU	-	2022
7	Carcharhiniformes	Carcharhinidae	*Carcharhinus borneensis*	Borneo Shark	CR	-	2022
8	Carcharhiniformes	Carcharhinidae	*Carcharhinus brachyurus*	Copper Shark	VU	-	2022
9	Carcharhiniformes	Carcharhinidae	*Carcharhinus brevipinna*	Spinner Shark	VU	-	2022
10	Carcharhiniformes	Carcharhinidae	*Carcharhinus cautus*	Nervous Shark	LC	-	2022
11	Carcharhiniformes	Carcharhinidae	*Carcharhinus cerdale*	Pacific Smalltail Shark	CR	-	2022
12	Carcharhiniformes	Carcharhinidae	*Carcharhinus coatesi*	Australian Blackspot Shark	LC	-	2022
13	Carcharhiniformes	Carcharhinidae	*Carcharhinus dussumieri*	Whitecheek Shark	EN	-	2022
14	Carcharhiniformes	Carcharhinidae	*Carcharhinus falciformis*	Silky Shark	VU	-	2017
15	Carcharhiniformes	Carcharhinidae	*Carcharhinus fitzroyensis*	Creek Whaler	LC	-	2022
16	Carcharhiniformes	Carcharhinidae	*Carcharhinus galapagensis*	Galapagos Shark	LC	-	2022
17	Carcharhiniformes	Carcharhinidae	*Carcharhinus hemiodon*	Pondicherry Shark	CR	-	2022
18	Carcharhiniformes	Carcharhinidae	*Carcharhinus humani*	Human's Whaler Shark	DD	-	2022
19	Carcharhiniformes	Carcharhinidae	*Carcharhinus isodon*	Finetooth Shark	LC	-	2022
20	Carcharhiniformes	Carcharhinidae	*Carcharhinus leiodon*	Smoothtooth Blacktip Shark	EN	-	2022
21	Carcharhiniformes	Carcharhinidae	*Carcharhinus leucas*	Bull Shark	NT	-	2022
22	Carcharhiniformes	Carcharhinidae	*Carcharhinus limbatus*	Blacktip Shark	NT	-	2022
23	Carcharhiniformes	Carcharhinidae	*Carcharhinus longimanus*	Oceanic Whitetip Shark	CR	-	2013
24	Carcharhiniformes	Carcharhinidae	*Carcharhinus macloti*	Hardnose Shark	NT	-	2022
25	Carcharhiniformes	Carcharhinidae	*Carcharhinus melanopterus*	Blacktip Reef Shark	VU	-	2022
26	Carcharhiniformes	Carcharhinidae	*Carcharhinus obscurus*	Dusky Shark	EN	-	2022
27	Carcharhiniformes	Carcharhinidae	*Carcharhinus obsoletus*	Lost Shark	CR	-	2022
28	Carcharhiniformes	Carcharhinidae	*Carcharhinus perezi*	Caribbean Reef Shark	EN	-	2022
29	Carcharhiniformes	Carcharhinidae	*Carcharhinus plumbeus*	Sandbar Shark	EN	-	2022
30	Carcharhiniformes	Carcharhinidae	*Carcharhinus porosus*	Smalltail Shark	CR	-	2022
31	Carcharhiniformes	Carcharhinidae	*Carcharhinus sealei*	Blackspot Shark	VU	-	2022
32	Carcharhiniformes	Carcharhinidae	*Carcharhinus signatus*	Night Shark	VU	-	2022
33	Carcharhiniformes	Carcharhinidae	*Carcharhinus sorrah*	Spottail Shark	NT	-	2022
34	Carcharhiniformes	Carcharhinidae	*Carcharhinus tilstoni*	Australian Blacktip Shark	LC	-	2022
35	Carcharhiniformes	Carcharhinidae	*Carcharhinus tjutjot*	Indonesian Whaler Shark	VU	-	2022
36	Carcharhiniformes	Carcharhinidae	*Glyphis gangeticus*	Ganges Shark	CR	-	2022
37	Carcharhiniformes	Carcharhinidae	*Glyphis garricki*	New Guinea River Shark	VU	-	2022
38	Carcharhiniformes	Carcharhinidae	*Glyphis glyphis*	Speartooth Shark	VU	-	2022
39	Carcharhiniformes	Carcharhinidae	*Isogomphodon oxyrhynchus*	Daggernose Shark	CR	-	2022
40	Carcharhiniformes	Carcharhinidae	*Lamiopsis temmincki*	Broadfin Shark	EN	-	2022
41	Carcharhiniformes	Carcharhinidae	*Lamiopsis tephrodes*	Borneo Broadfin Shark	EN	-	2022
42	Carcharhiniformes	Carcharhinidae	*Loxodon macrorhinus*	Sliteye Shark	NT	-	2022
43	Carcharhiniformes	Carcharhinidae	*Nasolamia velox*	Whitenose Shark	EN	-	2022
44	Carcharhiniformes	Carcharhinidae	*Negaprion acutidens*	Sharptooth Lemon Shark	EN	-	2022
45	Carcharhiniformes	Carcharhinidae	*Negaprion brevirostris*	Lemon Shark	VU	-	2022
46	Carcharhiniformes	Carcharhinidae	*Prionace glauca*	Blue Shark	NT	-	2022
47	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon acutus*	Milk Shark	VU	-	2022
48	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon lalandii*	Brazilian Sharpnose Shark	VU	-	2022
49	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon longurio*	Pacific Sharpnose Shark	VU	-	2022
50	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon oligolinx*	Grey Sharpnose Shark	NT	-	2022
51	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon porosus*	Caribbean Sharpnose Shark	VU	-	2022
52	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon taylori*	Australian Sharpnose Shark	LC	-	2022
53	Carcharhiniformes	Carcharhinidae	*Rhizoprionodon terraenovae*	Atlantic Sharpnose Shark	LC	-	2022

No.	Order	Family	Scientific Name	Common name [English]	IUCN Status	App I	App II
54	Carcharhiniformes	Carcharhinidae	*Scoliodon laticaudus*	Spadenose Shark	NT	-	2022
55	Carcharhiniformes	Carcharhinidae	*Scoliodon macrorhynchos*	Pacific Spadenose Shark	NT	-	2022
56	Carcharhiniformes	Carcharhinidae	*Triaenodon obesus*	Whitetip Reef Shark	VU	-	2022
57	Carcharhiniformes	Sphyrnidae	*Eusphyra blochii*	Winghead Shark	EN	-	2022
58	Carcharhiniformes	Sphyrnidae	*Sphyrna corona*	Scalloped Bonnethead	CR	-	2022
59	Carcharhiniformes	Sphyrnidae	*Sphyrna gilberti*	Carolina Hammerhead	DD	-	2022
60	Carcharhiniformes	Sphyrnidae	*Sphyrna lewini*	Scalloped Hammerhead	CR	-	2013
61	Carcharhiniformes	Sphyrnidae	*Sphyrna media*	Scoophead Shark	CR	-	2022
62	Carcharhiniformes	Sphyrnidae	*Sphyrna mokarran*	Great Hammerhead	CR	-	2013
63	Carcharhiniformes	Sphyrnidae	*Sphyrna tiburo*	Bonnethead Shark	EN	-	2022
64	Carcharhiniformes	Sphyrnidae	*Sphyrna tudes*	Smalleye Hammerhead	CR	-	2022
65	Carcharhiniformes	Sphyrnidae	*Sphyrna zygaena*	Smooth Hammerhead	VU	-	2013
66	Lamniformes	Alopiidae	*Alopias pelagicus*	Pelagic Thresher	EN	-	2017
67	Lamniformes	Alopiidae	*Alopias superciliosus*	Bigeye Thresher	VU	-	2017
68	Lamniformes	Alopiidae	*Alopias vulpinus*	Common Thresher	VU	-	2017
69	Lamniformes	Cetorhinidae	*Cetorhinus maximus*	Basking Shark	EN	-	2003
70	Lamniformes	Lamnidae	*Carcharodon carcharias*	Great White Shark	VU	-	2005
71	Lamniformes	Lamnidae	*Isurus oxyrinchus*	Shortfin Mako	EN	-	2019
72	Lamniformes	Lamnidae	*Isurus paucus*	Longfin Mako	EN	-	2019
73	Lamniformes	Lamnidae	*Lamna nasus*	Porbeagle Shark	VU	-	2013
74	Myliobatiformes	Mobulidae	*Mobula alfredi*	Reef Manta Ray	VU	-	2013
75	Myliobatiformes	Mobulidae	*Mobula birostris*	Oceanic Manta Ray	EN	-	2013
76	Myliobatiformes	Mobulidae	*Mobula eregoodoo*	Longhorned Pygmy Devil Ray	EN	-	2017
77	Myliobatiformes	Mobulidae	*Mobula hypostoma*	West Atlantic Pygmy Devil Ray	EN	-	2017
78	Myliobatiformes	Mobulidae	*Mobula kuhlii*	Shortfin Pygmy Devil Ray	EN	-	2017
79	Myliobatiformes	Mobulidae	*Mobula mobular*	Spinetail Devil Ray	EN	-	2017
80	Myliobatiformes	Mobulidae	*Mobula munkiana*	Munk's Pygmy Devil Ray	VU	-	2017
81	Myliobatiformes	Mobulidae	*Mobula tarapacana*	Sicklefin Devil Ray	EN	-	2017
82	Myliobatiformes	Mobulidae	*Mobula thurstoni*	Bentfin Devil Ray	EN	-	2017
83	Myliobatiformes	Potamotrygonidae	*Potamotrygon albimaculata*	Tapajós Freshwater Stingray	NE	-	2022
84	Myliobatiformes	Potamotrygonidae	*Potamotrygon henlei*	Bigtooth River Stingray	LC	-	2022
85	Myliobatiformes	Potamotrygonidae	*Potamotrygon jabuti*	Pearl Freshwater Stingray	NE	-	2022
86	Myliobatiformes	Potamotrygonidae	*Potamotrygon leopoldi*	Xingu Freshwater Stingray	DD	-	2022
87	Myliobatiformes	Potamotrygonidae	*Potamotrygon marquesi*	Marques Freshwater Stingray	NE	-	2022
88	Myliobatiformes	Potamotrygonidae	*Potamotrygon signata*	Parnaíba Freshwater Stingray	DD	-	2022
89	Myliobatiformes	Potamotrygonidae	*Potamotrygon wallacei*	Wallace's Freshwater Stingray	NE	-	2022
90	Orectolobiformes	Rhincodontidae	*Rhincodon typus*	Whale Shark	EN	-	2003
91	Rhinopristiformes	Glaucostegidae	*Glaucostegus cemiculus*	Blackchin Guitarfish	CR	-	2019
92	Rhinopristiformes	Glaucostegidae	*Glaucostegus granulatus*	Sharpnose Guitarfish	CR	-	2019
93	Rhinopristiformes	Glaucostegidae	*Glaucostegus halavi*	Halavi Guitarfish	CR	-	2019
94	Rhinopristiformes	Glaucostegidae	*Glaucostegus obtusus*	Widenose Guitarfish	CR	-	2019
95	Rhinopristiformes	Glaucostegidae	*Glaucostegus thouin*	Clubnose Guitarfish	CR	-	2019
96	Rhinopristiformes	Glaucostegidae	*Glaucostegus typus*	Giant Guitarfish	CR	-	2019
97	Rhinopristiformes	Glaucostegidae	*Glaucostegus younholeei*	Bangladeshi Guitarfish	CR	-	2019
98	Rhinopristiformes	Pristidae	*Anoxypristis cuspidata*	Narrow Sawfish	EN	2007	-
99	Rhinopristiformes	Pristidae	*Pristis clavata*	Dwarf Sawfish	EN	2007	-
100	Rhinopristiformes	Pristidae	*Pristis pectinata*	Smalltooth Sawfish	CR	2007	-
101	Rhinopristiformes	Pristidae	*Pristis pristis*	Largetooth Sawfish	CR	2007	-
102	Rhinopristiformes	Pristidae	*Pristis zijsron*	Green Sawfish	CR	2007	-
103	Rhinopristiformes	Rhinidae	*Rhina ancylostomus*	Bowmouth Guitarfish	CR	-	2019
104	Rhinopristiformes	Rhinidae	*Rhynchobatus australiae*	Bottlenose Wedgefish	CR	-	2019
105	Rhinopristiformes	Rhinidae	*Rhynchobatus cooki*	Clown Wedgefish	CR	-	2019
106	Rhinopristiformes	Rhinidae	*Rhynchobatus djiddensis*	Whitespotted Wedgefish	CR	-	2019

No.	Order	Family	Scientific Name	Common name [English]	IUCN Status	App I	App II
107	Rhinopristiformes	Rhinidae	*Rhynchobatus immaculatus*	Taiwanese Wedgefish	CR	-	2019
108	Rhinopristiformes	Rhinidae	*Rhynchobatus laevis*	Smoothnose Wedgefish	CR	-	2019
109	Rhinopristiformes	Rhinidae	*Rhynchobatus luebberti*	African Wedgefish	CR	-	2019
110	Rhinopristiformes	Rhinidae	*Rhynchobatus mononoke*	Japanese Wedgefish	NE	-	2019
111	Rhinopristiformes	Rhinidae	*Rhynchobatus palpebratus*	Eyebrow Wedgefish	NT	-	2019
112	Rhinopristiformes	Rhinidae	*Rhynchobatus springeri*	Broadnose Wedgefish	CR	-	2019
113	Rhinopristiformes	Rhinidae	*Rhynchorhina mauritaniensis*	False Shark Ray	CR	-	2019
114	Rhinopristiformes	Rhinobatidae	*Acroteriobatus andysabini*	Malagasy Blue-spotted Guitarfish	NE	-	2022
115	Rhinopristiformes	Rhinobatidae	*Acroteriobatus annulatus*	Lesser Guitarfish	VU	-	2022
116	Rhinopristiformes	Rhinobatidae	*Acroteriobatus blochii*	Bluntnose Guitarfish	LC	-	2022
117	Rhinopristiformes	Rhinobatidae	*Acroteriobatus leucospilus*	Greyspot Guitarfish	EN	-	2022
118	Rhinopristiformes	Rhinobatidae	*Acroteriobatus ocellatus*	Speckled Guitarfish	DD	-	2022
119	Rhinopristiformes	Rhinobatidae	*Acroteriobatus omanensis*	Oman Guitarfish	DD	-	2022
120	Rhinopristiformes	Rhinobatidae	*Acroteriobatus salalah*	Salalah Guitarfish	NT	-	2022
121	Rhinopristiformes	Rhinobatidae	*Acroteriobatus stehmanni*	Socotra Blue-spotted Guitarfish	NE	-	2022
122	Rhinopristiformes	Rhinobatidae	*Acroteriobatus variegatus*	Stripenose Guitarfish	CR	-	2022
123	Rhinopristiformes	Rhinobatidae	*Acroteriobatus zanzibarensis*	Zanzibar Guitarfish	NT	-	2022
124	Rhinopristiformes	Rhinobatidae	*Pseudobatos buthi*	Spadenose Guitarfish	VU	-	2022
125	Rhinopristiformes	Rhinobatidae	*Pseudobatos glaucostigmus*	Speckled Guitarfish	VU	-	2022
126	Rhinopristiformes	Rhinobatidae	*Pseudobatos horkelii*	Brazilian Guitarfish	CR	-	2022
127	Rhinopristiformes	Rhinobatidae	*Pseudobatos lentiginosus*	Freckled Guitarfish	VU	-	2022
128	Rhinopristiformes	Rhinobatidae	*Pseudobatos leucorhynchus*	Whitesnout Guitarfish	VU	-	2022
129	Rhinopristiformes	Rhinobatidae	*Pseudobatos percellens*	Chola Guitarfish	EN	-	2022
130	Rhinopristiformes	Rhinobatidae	*Pseudobatos planiceps*	Pacific Guitarfish	VU	-	2022
131	Rhinopristiformes	Rhinobatidae	*Pseudobatos prahli*	Gorgona Guitarfish	VU	-	2022
132	Rhinopristiformes	Rhinobatidae	*Pseudobatos productus*	Shovelnose Guitarfish	NT	-	2022
133	Rhinopristiformes	Rhinobatidae	*Rhinobatos albomaculatus*	Whitespotted Guitarfish	CR	-	2022
134	Rhinopristiformes	Rhinobatidae	*Rhinobatos annandalei*	Bengal Guitarfish	CR	-	2022
135	Rhinopristiformes	Rhinobatidae	*Rhinobatos austini*	Austin's Guitarfish	DD	-	2022
136	Rhinopristiformes	Rhinobatidae	*Rhinobatos borneensis*	Borneo Guitarfish	EN	-	2022
137	Rhinopristiformes	Rhinobatidae	*Rhinobatos holcorhynchus*	Slender Guitarfish	DD	-	2022
138	Rhinopristiformes	Rhinobatidae	*Rhinobatos hynnicephalus*	Ringed Guitarfish	EN	-	2022
139	Rhinopristiformes	Rhinobatidae	*Rhinobatos irvinei*	Spineback Guitarfish	EN	-	2022
140	Rhinopristiformes	Rhinobatidae	*Rhinobatos jimbaranensis*	Jimbaran Guitarfish	EN	-	2022
141	Rhinopristiformes	Rhinobatidae	*Rhinobatos lionotus*	Smoothback Guitarfish	EN	-	2022
142	Rhinopristiformes	Rhinobatidae	*Rhinobatos manai*	Papuan Guitarfish	LC	-	2022
143	Rhinopristiformes	Rhinobatidae	*Rhinobatos nudidorsalis*	Bareback Guitarfish	DD	-	2022
144	Rhinopristiformes	Rhinobatidae	*Rhinobatos penggali*	Indonesian Guitarfish	EN	-	2022
145	Rhinopristiformes	Rhinobatidae	*Rhinobatos punctifer*	Spotted Guitarfish	NT	-	2022
146	Rhinopristiformes	Rhinobatidae	*Rhinobatos ranongensis*	Ranong Guitarfish	VU	-	2022
147	Rhinopristiformes	Rhinobatidae	*Rhinobatos rhinobatos*	Common Guitarfish	CR	-	2022
148	Rhinopristiformes	Rhinobatidae	*Rhinobatos sainsburyi*	Goldeneye Shovelnose Ray	LC	-	2022
149	Rhinopristiformes	Rhinobatidae	*Rhinobatos schlegelii*	Brown Guitarfish	EN	-	2022
150	Rhinopristiformes	Rhinobatidae	*Rhinobatos whitei*	Philippine Guitarfish	CR	-	2022

Some of the SSG members attending COP19 on various delegations. From left to right: Sarah Fowler, Daniel Fernando, Akshay Tanna, Carlos Polo, Patricia Charvet, Elisabeth Fahrni Mansur, Stan Shea, Rachel Graham, Rima Jabado, Samantha Sherman, Cassandra Rigby, Colin Simpfendorfer, Sonja Fordham, Glenn Sant, Fahmi, Alifa Haque, Lisa Hoopes. Photo | Ian Campbell



The Future of Shark Conservation is Collaboration

A conservation legacy is achieved through collaboration with a range of extraordinary partners, including governments, non-government organizations, scientists, local and Indigenous communities.

Written by Melissa Cristina Márquez for WWF International

The rustling of papers. The flurry of fingers over a laptop's keyboard. The smell of Colombian coffee almost cancelling out the various voices talking.

In some industries - and even within marine science - there is a culture of 'every person for themselves.' But there is no room for that here in this Bogotá meeting room where 38 experts have gathered to protect better one of our planet's most threatened predators: sharks (referring to sharks, rays, and chimaeras). The most recent global IUCN Red List of Threatened Species™ assessment of sharks estimated that over one-third of species (37%, range 32.6–45.5%) are threatened with extinction (i.e., considered Critically Endangered, Endangered, or Vulnerable). Three-quarters of oceanic species are threatened with extinction, and all but one of the 16 species of wedgefishes (family Rhinidae) and giant guitarfishes (family Glaucostegidae) face a very high risk of extinction. It's safe to say that most current measures for protection and improvement to shark habitats are not working. "We have the opportunity to [turn things around for them] if we work on the right initiatives. We've gone through the fisheries work... the trade route... and they work. Still, we need new complementary approaches if we want to make a difference faster," explains Dr Rima Jabado, a marine scientist with over two decades of experience in fisheries, threatened species research, and conservation-focused projects around the world, founder of the Elasmo Project and Chair of the IUCN SSC Shark Specialist Group.

Enter the Shark and Ray Recovery Initiative (SARRI) and Important Shark and Ray Areas (ISRAs), two different projects with strong synergy and opportunities to achieve more. As a result of the partnership between leading conservationists and scientists - including members of The World Wide Fund for Nature (WWF), the Elasmo Project, James Cook University (JCU), and the Wildlife Conservation Society (WCS) - SARRI aims to recover 23 Endangered and Critically Endangered species in some of their last hotspots by introducing 'shark recovery zones' in the next decade. Other actions tailored to each location and species will enhance existing management measures, such as mitigation measures to reduce bycatch. Yet these 'shark refuges' seldom stop at national borders; efforts to conserve threatened species and ecosystems frequently span large spatial scales and cross multiple boundaries, making conservation outcomes conditional on the decisions made across multiple jurisdictions. It can get complex when you consider anthropogenic impacts.

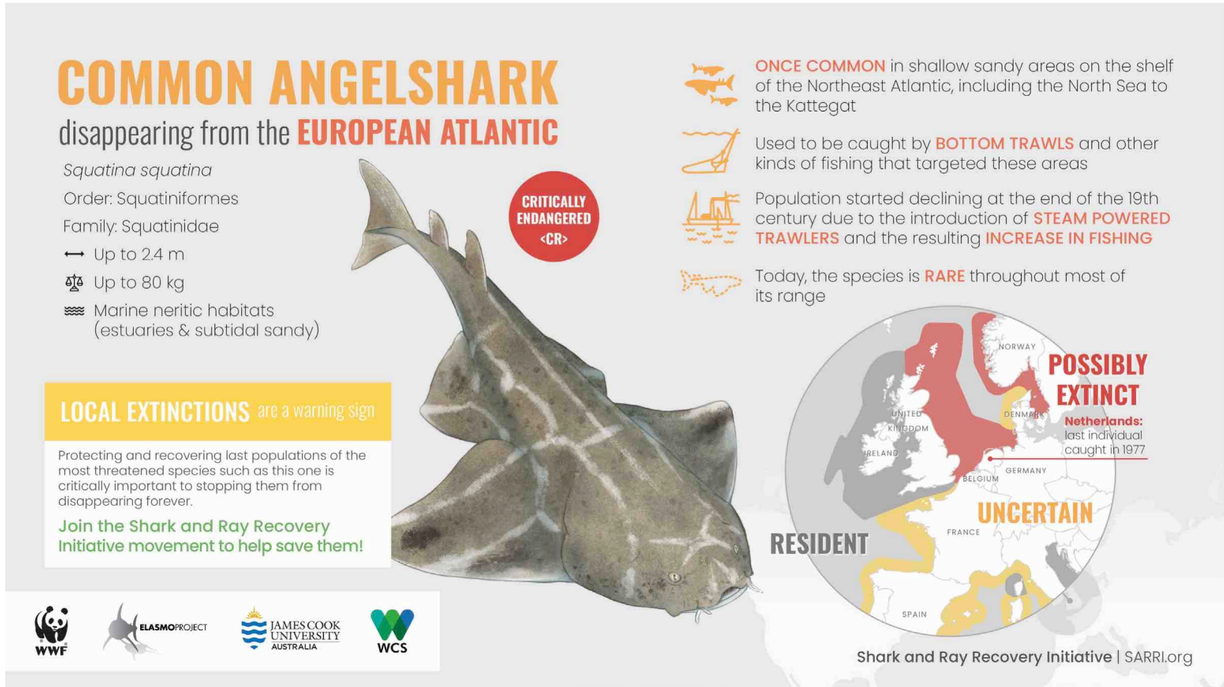
This is why ISRAs have taken human-based activities out of the equation. "That's the whole approach with the ISRAs – they are biocentric. We need to identify these important areas regardless of if they are important for [human activities] or not," says Jabado. Area-based protection is a cornerstone for halting the loss of biodiversity. The number of initiatives focused on identifying key sites or seascapes of importance for biodiversity conservation has proliferated in recent decades. ISRA is one of these innovative approaches, ensuring that discrete portions of habitats (which have been marked as critical to shark species) are delineated and used in various location-based and global conservation and management initiatives. Separate from marine protected areas (MPAs), they have no legal or regulatory mandate associated with them, and ISRA Criteria target multiple aspects of shark biology and ecology (e.g., species vulnerability, distribution, abundance, and key life cycle activities) as well as high diversity and endemicity areas.

Jabado points out that this large-scale approach has the potential to improve management efficiency by identifying knowledge gaps but also priority areas for conservation, leading to more efficient conservation plans by informing action in areas that have the highest 'global' benefits, leading to a potentially higher return on investment of conservation funds. According to Jabado, other animals - including marine mammals and birds - have had biocentric critical habitat maps created. When government overlap these maps, she believes they won't have to prioritize species-specific conservation and can instead rely on these priority areas for targeted management, leading to saved conservation resources. In cases where neighbouring countries share ecological "hotspot" regions or biomes and, therefore, multiple threatened species or conservation features, this is a particularly valuable tool.

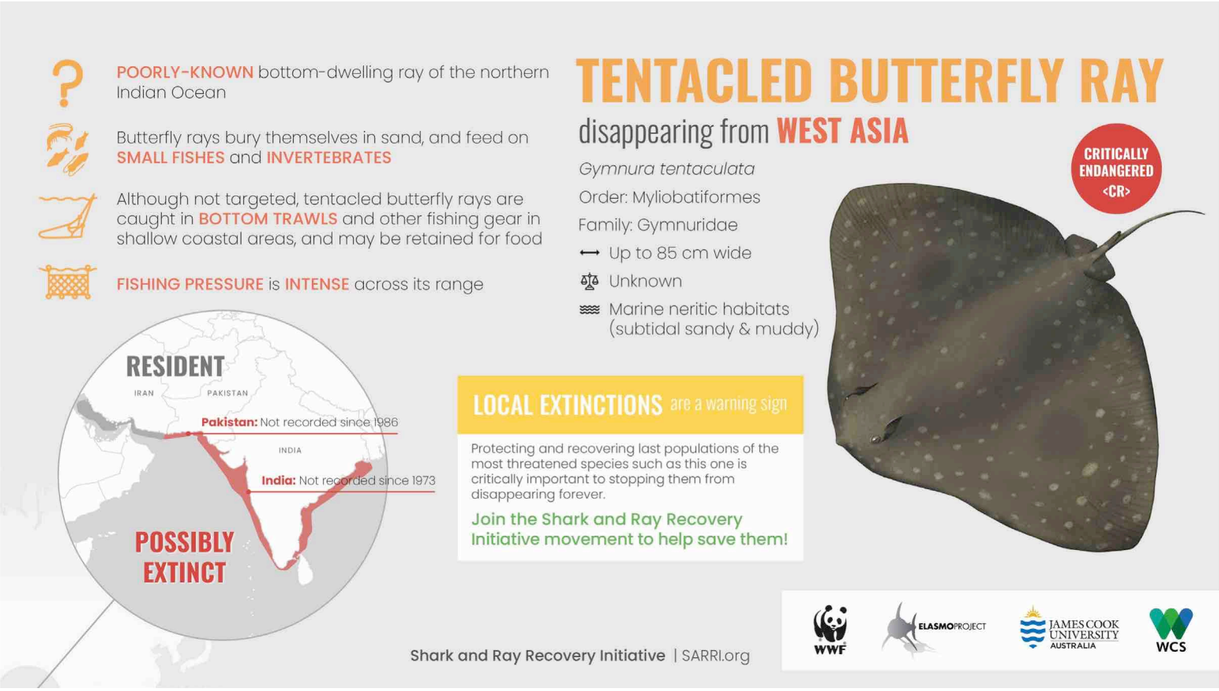
With the finalization of the ISRA Criteria, the ISRA project has moved forward to assess the first region against these criteria and identify the first ISRAs in the world, which brings us back to the packed room in South America. "ISRAs can be delineated with the support of the IUCN SSC Shark Specialist Group members and their networks. We will be going to different parts of the world, identifying the most important areas for these species. Hopefully, national governments will take this on and redesign their already established marine protected areas (MPAs) or delineate new ones while considering this new information," Jabado says. One of ISRA's main goals is to attract the attention of policy- and decision-makers who design and develop these MPAs, which makes it especially poignant that the Colombian government sent out representatives to sit in with the experts. Today, less than 3% of the global ocean is protected in MPAs with strong regulations to safeguard biodiversity. In response, the Convention on Biological Diversity's Post-2020 Framework wants to safeguard at least 30% of the ocean in a network of highly or fully protected, well-managed MPAs and other effective area-based conservation measures by 2030. "[We were] in the Eastern Tropical Pacific because most of these countries have achieved their 30x30 commitments [...] and we're here to make sure the areas they are protecting can also consider sharks."

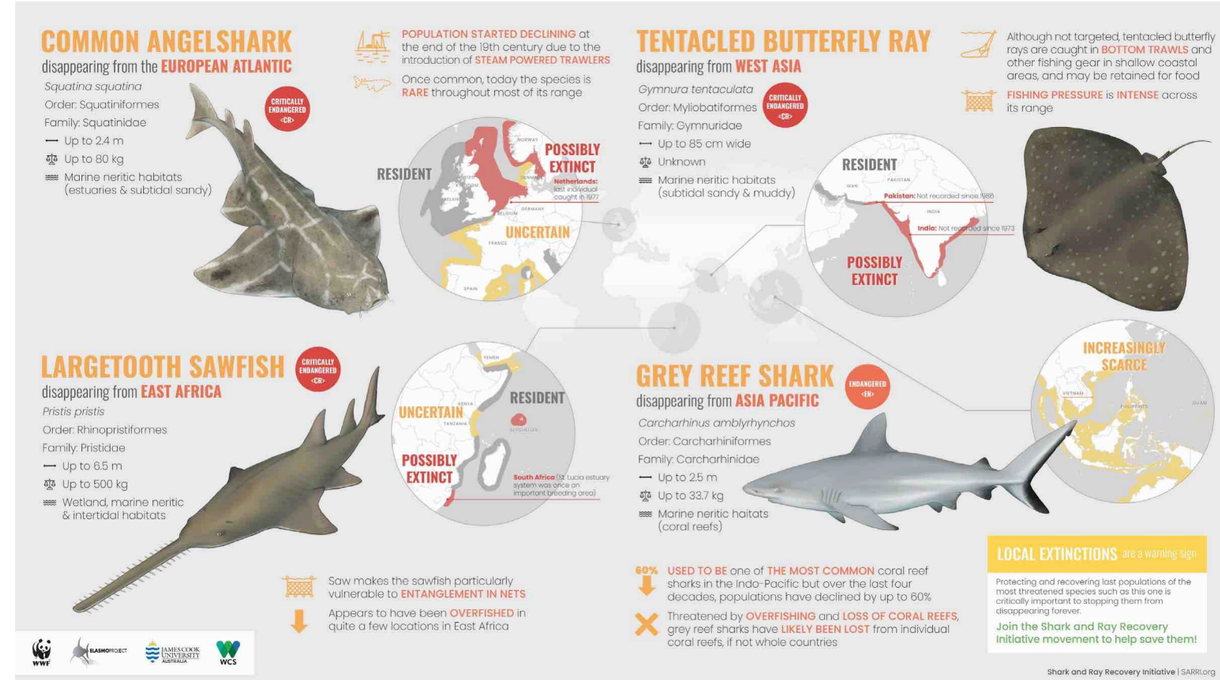
"While SARRI focuses more on "how to recover highly threatened species," ISRAs focus more on "what areas should we protect to recover these species." The hope is areas delineated as ISRAs will become more influential in guiding SARRI site selection over time as more are completed. Currently, SARRI sites are being selected based on existing data indicating that viable populations of the focal species still exist and if there are in-country teams interested in recovering them. Dr Andy Cornish, a SARRI co-founder, admits that these approaches will "likely [not] benefit those species that do not have distinct critical habitats where animals aggregate."

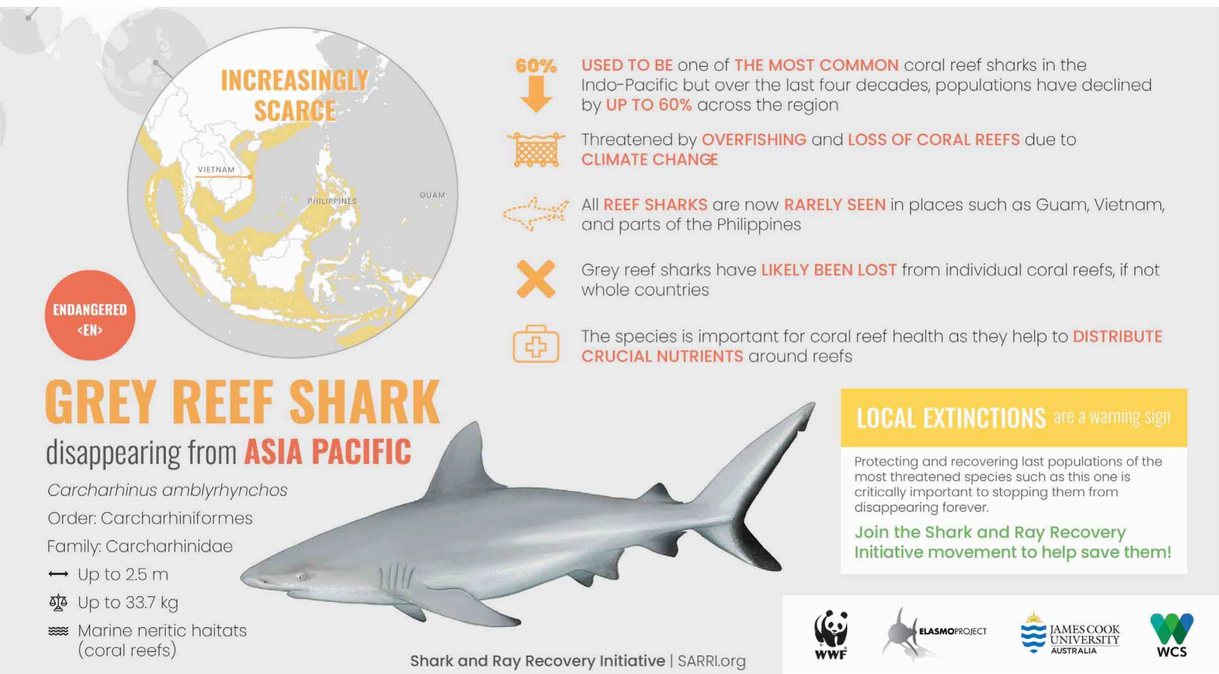
There is one other major drawback for these projects: they both rely on available data to make their decisions, and that sometimes doesn't exist for the rare and threatened species. As part of their efforts to recruit regional habitat use data from scientists, both projects plan to attend scientific conferences and policy meetings

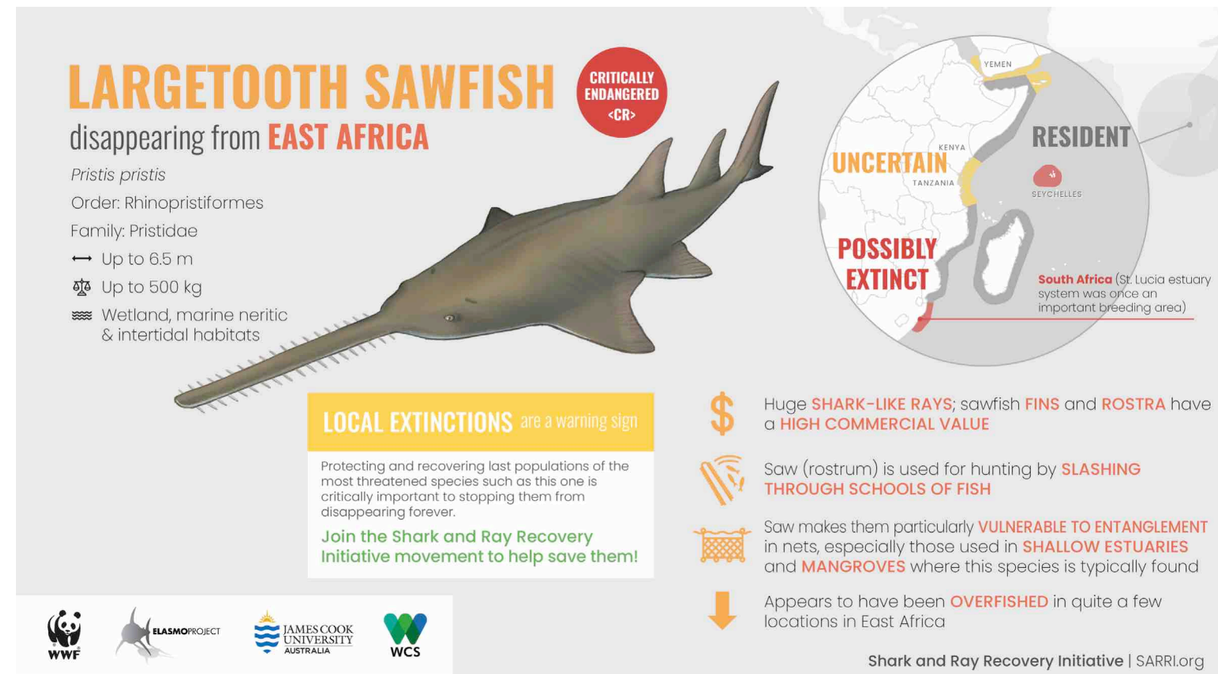


to build awareness. Interested parties are also encouraged to contribute research - particularly studies addressing habitat use in one of the 12 remaining ISRA regions - and feedback to ISRA when the call for submissions opens to help identify critical habitats for recovering sharks, rays, and chimaeras. In addition, the SARRI and ISRA teams want governments to be aware of them and utilize the maps and reports they generate for policymakers and stakeholders. Through well-guided collaboration, these initiatives hope to demonstrate the possibility for a better understanding of biocentric management and creating opportunities for compromise and progress.









First workshop identifies 73 candidate Important Shark and Ray Areas in Central and South American Pacific Region

By Chelsea Stein

On October 3-7, 2022, 55 experts came together to map critically important areas for sharks, rays, and chimaeras.

History was made last October when the Important Shark and Ray Areas (ISRA) workshop was held in Bogota, Colombia – the first event of its kind in the world for sharks, rays, and chimaeras (hereafter, 'sharks'). For one week, 55 scientists and experts came together to identify and map critical habitats for sharks, specifically in the Central and South American Pacific Region – from Baja California in Mexico to the southern tip of Chile.

"Our vision is a world where sharks, rays, and chimaeras are valued and managed sustainably," Dr Rima Jabado, IUCN Species Survival Commission Shark Specialist Group (SSG) chair and organizer of the event, said. Many of the attendees were SSG members from its South America and Central America, and the Caribbean regions. Still, some represented other groups, task forces, and governmental units, which allowed for a holistic conversation. "We know that knowledge enables action, so we tried also to bring together experts from outside the SSG to participate in this event and inform the process."

The workshop's efforts were centred around the goal of boosting conservation efforts for sharks through the delineation of critical habitats. This expert-driven process may have been overlooked in other marine conservation efforts in the past. The process has been modelled after the Important Marine Mammal Areas (IMMA), an initiative that has been working since 2016 to delineate critical habitats for marine mammals globally.

As Rima noted, "Most Marine Protected Areas around the world today were set up to manage different species – they were not necessarily set up for sharks. We want to identify and delineate habitats that are important for sharks and ensure governments have the tools to make decisions and design protected areas with these species in mind."

How to put sharks on the map

To accomplish this, legwork began ahead of the workshop as attendees were asked to identify preliminary Areas of Interest (pAoI), looking at swaths of the water in the region where sharks are known to be moving through, breeding or mating, feeding, resting, or aggregating, etc. With 54 pAoI proposed prior to the meeting, the workshop kicked off with breakout groups deliberating on which areas should be considered going forward (because they meet the ISRA Criteria) and dubbed as candidate ISRAs (cISRAs).

The groups used numerous data sources to try and fill knowledge gaps on the species using the areas, homing in on those considered threatened on the IUCN Red List of Threatened Species™ and those with enough data.

"We held four workshops in total, with over 100 attendees from 47 countries, to understand and create the ISRA Criteria," said Dr Peter Kyne, ISRA Project team member. "We also pulled from the Key Biodiversity Areas (KBAs) to ensure the criteria are aligned with other similar processes and to account for the biodiversity of sharks and the biological and ecological needs of the species."

Mexican marine ecologist Dr Emiliano Garcia Rodriguez added, "We are working together to understand how the habitat is being used, what information is available to draw a boundary around the area, and then how pAoIs might overlap, and how they might be able to be combined. After this process, we decide if there is enough research for the pAoI to become a cISRA or if it should just be an important area with more work needed to fill in knowledge gaps."

Part of the task was also to examine the existing MPAs in the region – a total of 164 – to assess whether those areas were established with sharks in mind. Because as Rima explained, much can be done to benefit the marine environment outside those protected areas.

"I wanted to understand where the MPAs are in comparison to where the cISRAs that we are proposing are and where they overlap," Rima said. "I imagined less than 20% of the MPAs would actually benefit sharks in this region."

Throughout the week's sessions, the attendees were literally putting sharks on the map, deciding on the shapes and sizes of the important areas in the Pacific around Central and South America, considering not only where they might be positioned geographically but also spatially – because depth and placement in the water column are important factors too.

Much care and attention were given to the details to ensure the areas could be managed over time. Attendees were deciding on geographically recognizable names for the areas; creating a summary about each area containing geographic location, a list of all the qualifying species and the habitat features they use in the area; and providing citations and references to establish a strong science-based approach for widespread implementation.

Outcomes from the workshop – and what's ahead

At the workshop's culmination, the attendees reached a consensus of 73 cISRAs and seven Areas of Interest for the region. And for the subsequent three months, these cISRAs have been under scrutiny, receiving a rigorous independent review from a panel of individuals with an in-depth understanding of species, habitats, and the ISRA Criteria. Without involvement in the ISRA identification process, the reviewers communicate feedback and ultimately approve or reject the areas. The hope is that with approvals, the areas officially become ISRAs and can be published online on the ISRA eAtlas.

In addition, two papers are planned as an outcome of the workshop. One, led by Emiliano, will cover the knowledge gaps around the region's areas. The other, led by Dr Mark Priest, coral reef and marine scientist, will outline the overlap between MPA and ISRAs. These papers will work in tandem to illuminate where more research is needed to expand the ISRA work in the future.

"Hopefully, these findings will trigger further research," Rima noted, "and in 10 years, we can repeat this process in this region with a lot more information."

To Rima's point, given what data were available in 2022, there was some bias at this workshop toward larger, charismatic, and well-studied species. Nonetheless, it is a starting point; this workshop highlights further opportunities.

"It's been a steep learning curve to see how this process can work and be implemented," Rima continued. "We simply don't have data to delineate ISRAs for all 190 or so species that we know occur in the region, but we have to keep moving and contribute to conservation issues for where sharks are now. Unfortunately, a lot of the information we have about how they use the habitats is for coastal areas. Hopefully, this process and our results will generate funding for new research areas and inspire younger scientists to explore more species and areas."

Looking at the horizon, this workshop is only the beginning. Twelve other regions of interest have been identified around the world, and the Shark Conservation Fund has funded the next four to undergo the ISRA identification process. Plans are in motion for early 2023 to hold the next workshop in the Mediterranean, using this one as an example.

Over the next few years, Rima says the whole ocean will be mapped to paint a comprehensive picture for governments faced with conservation decisions. These decision makers will be able to see all of the biodiverse areas in our oceans and waterways – and use that information in parallel with IMMAs – to establish additional MPAs and identify KBAs, and, importantly, create guidelines and policies that are effective and protective for sharks and other marine wildlife.

"When you consider that 70% of the Earth is water and only 2.8% is considered highly protected or fully protected, you see just how small this percentage is," she said. "We must reduce shark mortality over time and move things at the policy level. With this workshop as a first example, hopefully, it will be easier for us to show people what can be done and what it means in terms of conservation and area-based management for sharks, rays, and chimaeras."

Writing Retreat on the sideline of Sharks International 2022 in Valencia, Spain

Written by Rima Jabado
IUCN SSC Shark Specialist Group | Chair

Alexandra Morata
IUCN SSC Shark Specialist Group | Program Officer

Front cover of original Fowler et al. 2005 status report

A roadmap for future policy and research actions for sharks, rays, and chimaeras

The IUCN SSC Shark Specialist Group (SSG) hosted a first Global Report Writing workshop on Tuesday 18th, and Wednesday 19th of October, on the sidelines of the Sharks International 2022 conference in Valencia, Spain. This allowed to bring together contributors and members from around the world to work together and receive nation/region-specific input as they work towards developing a new roadmap for future policy and research actions for sharks, rays, and chimaeras.

Seventy-eight contributors attended the Global Report Writing Retreat Workshop, with 47 attending in-person and 31 joining online, from all nine SSG regions (i.e., Africa, Asia, Central America and the Caribbean, Indian Ocean, Mediterranean, North America, Northern Europe, Oceania, and South America). The majority of in-person attendees came from the Indian Ocean (n=7), North America (n=7), Northern Europe (n=6), and Oceania (n=6) regional groups. The workshop provided an opportunity for those contributing to the report to discuss information related to chondrichthyan status, conservation, local ongoing research projects, and policy status.

Once complete, the global report will provide an overview of the current status of sharks, rays, and chimaeras around the world from the national level perspective. This information is expected to lead to rational and responsible management, improved funding allocation, and identifying research priorities to secure the conservation of sharks, rays, and chimaeras around the world. The report will form the basis of a comprehensive resource documenting progress in data collection, fisheries management, as well as changes in the characteristics of products, trade, and economics of exploitation. Essentially, it will be an update to the existing publication by Fowler et al. (2005) on the global status of these species.

Overall, the report now covers 173 countries and territories, and 267 contributors from around the world have volunteered to contribute and have started working on their respective sections. The country-level details written during the workshop will be published in the main report, which will be available online through the SSG website and as an official IUCN publication.

The Save Our Seas Foundation and The Georgia Aquarium funded the workshop. We are grateful to them and to all the contributors from around the world that are working hard to ensure each section of the report is complete with the most up-to-date information.

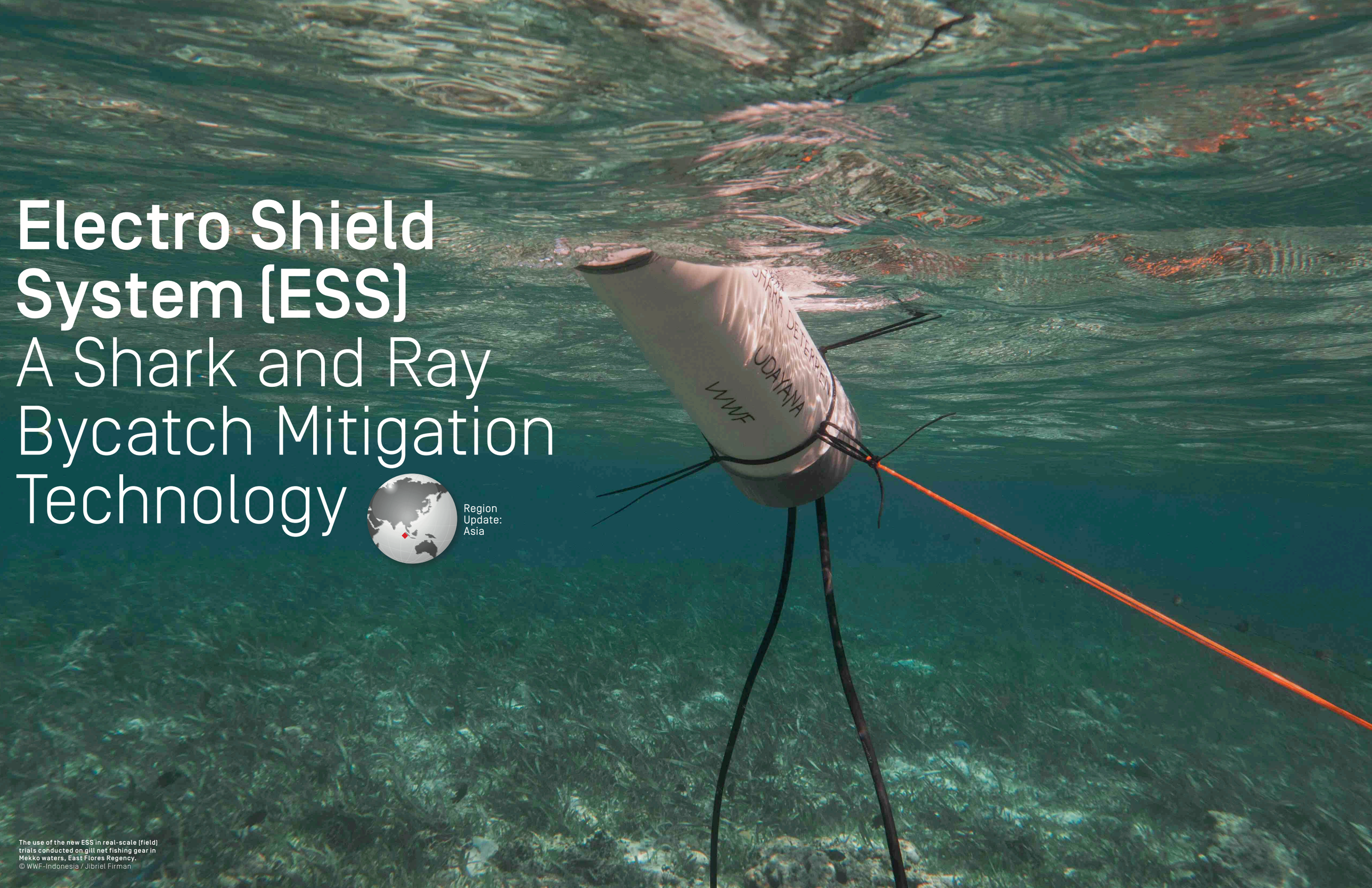
An additional writing retreat workshop is planned for early 2023 (funded by the Mohamed Bin Zayed Foundation) to bring together contributors from Asia, as this region was the most underrepresented at the workshop. This will ensure improved representation and an opportunity for regional contributors to come together to consolidate information.

Contributors to the Global Report who participated in person
Photo by Javier Guallart

Electro Shield System (ESS)

A Shark and Ray Bycatch Mitigation Technology

Region Update: Asia



The use of the new ESS in real-scale (field) trials conducted on gill net fishing gear in Mekko waters, East Flores Regency.
© WWF-Indonesia / Jibriel Firman

Written by Chaerul Ahadi

Endangered, Threatened, and Protected Species (ETP)
Bycatch Specialist | WWF-Indonesia

Ranny R. Yuneni

National Coordinator for Marine ETP Species | WWF-Indonesia
IUCN SSC Shark Specialist Group | Member | Asia Region

Bycatch needs our attention, and it is crucial to increase public awareness of the issue, especially among fishers and coastal communities. Bycatch significantly impacts the decline of threatened species in marine ecosystems. In Indonesia, where unselective fishing gear is still commonly used, bycatch affects sharks and rays and other ecologically related species.

These fisher and coastal communities can understand the long-term effect of using unselective gears by building their awareness. Fishers also need to know how to prevent and mitigate bycatch by modifying their fishing gear to be more selective or by adding technologies to prevent Endangered, Threatened and Protected (ETP) species from getting caught.

One hundred seventeen different shark species can be found in Indonesia. Some of these are rare and threatened, as revealed by the International Union for Conservation of Nature's Red List of Threatened Species™ status. External factors, especially human activity, cause low population numbers for some shark and ray species in Indonesia. Fishing is one of the biggest causes behind population declines in the country. The primary driver pushing the fishing industry to target these animals is the high demand for sharks and rays on the market (especially for fins and gills). Second to this is bycatch from large-scale fisheries and advanced unselective fishing gear. If this continues, shark and ray populations in Indonesia will continue to decline.

Developing the Electro Shield System as a Shark Bycatch Mitigation Technology

One of the alternatives to mitigate bycatch is by developing technologies or modifying fishing gear and operations. The Marine and Fisheries Program of WWF-Indonesia and Brawijaya University responded to this challenge in 2014 by developing a shark bycatch mitigation technology called the "Electro Shield System" (ESS). The ESS utilizes sharks and rays' ampullae of Lorenzini – sense organs in their snouts allowing them to detect electric fields.

Quoting from Thomas et al. (2022), "[...] anatomical features that all Chondrichthyes share are paired pectoral fins and ampullae of Lorenzini, which are used to sense electrical fields within their environment."

The fishing gear chosen for the implementation of the ESS is a gill net. Gill nets are one of the most unselective fishing gear that are commonly used in Indonesia. This type of gear has wide coverage and can prevent fish from escaping certain areas, including sharks and rays.

The development of the ESS started at the Smart Gear Competition 2013 (www.smartgear.org) hosted by WWF-Indonesia and Indonesia's Ministry of Marine Affairs and Fisheries in Semarang, Central Java. The concept was initiated by the Brawijaya University students, whose idea was based on the premise of disturbing sharks' ampullae of Lorenzini with electro pulses. A year later, the first prototype was made as a collaboration between WWF-Indonesia and the Brawijaya University students.

The development of the ESS prototype continued from 2017 to 2018. During that time, ESS was ready to be used for initial trials. Tests included frequency and electric current strength tests for rays and the durability of the technology design in a net cage and a

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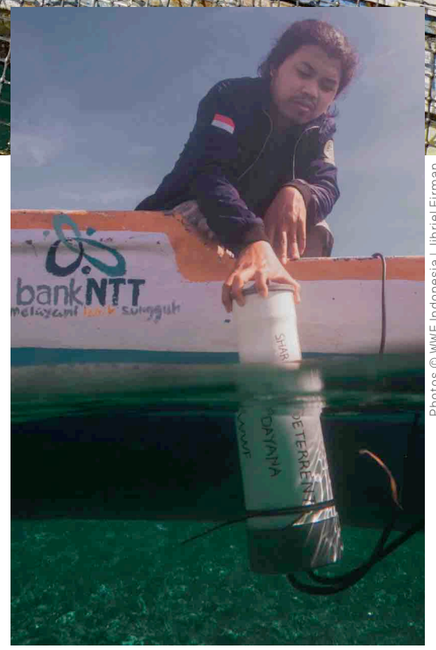
The New ESS Shark Mitigation Tool is ready to be used to reduce shark bycatch.
© WWF-Indonesia / Siti Yasmina Enita

Lab-scale trial of the new ESS conducted in the Serangan floating net cage with sharks. These trials were conducted to find the most optimal current strength or frequency setting to deter the sharks.
© WWF-Indonesia / Novi Anastasya



Photos © WWF Indonesia | Jibriel Firman

gill net. Results showed that the initial ESS prototype was too big to be used for fishing operations and had difficulties surviving in the water as the technology was not waterproof enough. These issues were addressed and fixed in 2021.

The New Electro Shield System

The development of the latest ESS was a collaboration between WWF-Indonesia and the Udayana University robotic club, the "Robotec Unud". The creation of the new ESS began with overhauling the prototype – it was redesigned, and some parts were replaced with more durable components. The new ESS is four times more compact or 25% smaller than the previous version. In terms of weight, the latest ESS is 2.2 kg, while the previous one was 10 kg.

The latest ESS was lab-tested and real scale-tested. We tested the frequency settings and current strength in a shark net cage in Bali and fishing operation with gill nets around Mekko Island in East Nusa Tenggara. The test showed that the optimal frequency to deter sharks was between 50 to 100 Hz with 500 mA of current strength. Based on the net cage test, 90% of the sharks in the net cage showed a desirable response to the ESS (the initial number was only 20%). The number of torn gill nets from shark bites was also reduced, with zero shark bycatch found during the real scale test. Fishers also testified that the newest version of the ESS was easier to use.

After the tests, we created three more copies of the 2021 version of the ESS. These three ESS devices will later be used for more trials in different areas of Indonesia. The future trials will also act as a platform to introduce the technology to the fishing industries in the designated areas. We also hope that thanks to the trials, more people in the fishing industry will become aware of the bycatch issue and more familiar with the ESS as a shark bycatch mitigation alternative. We also hope that more stakeholders are involved in producing the ESS so that the manufacturing cost will be reduced and small-scale fishers can afford to use the technology.

More information: Ranny R. Yuneni (ryuneni@wwf.id)

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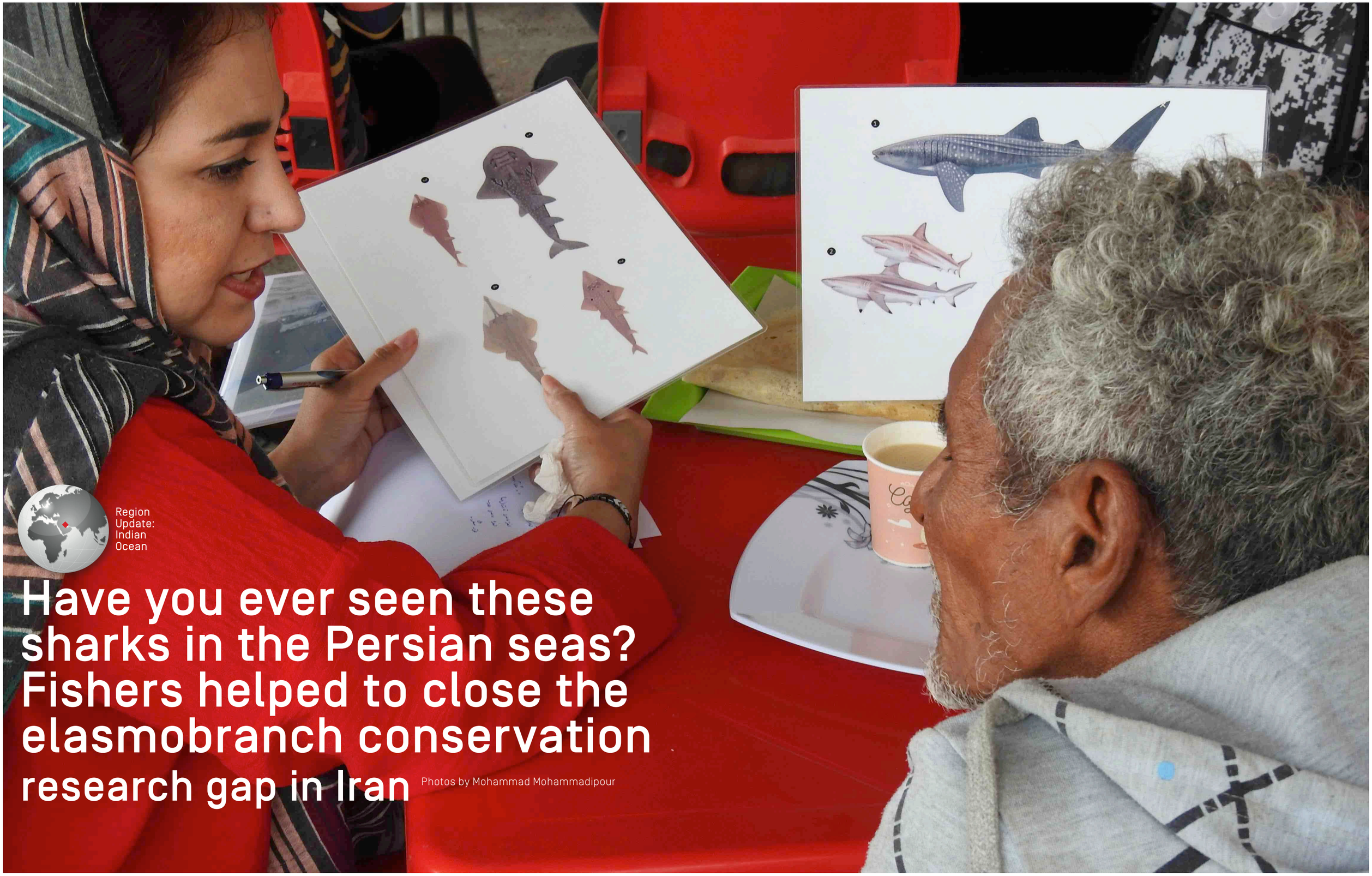

Region Update: Indian Ocean

Have you ever seen these sharks in the Persian seas? Fishers helped to close the elasmobranch conservation research gap in Iran

Photos by Mohammad Mohammadipour

Written by
Mohsen Rezaie-Atagholipour

Qeshm Environmental Conservation Institute (QECI)
IUCN SSC Shark Specialist Group | Indian Ocean Regional Group | Member

Two of the interviewers, Hanieh (at the left), and Amir Mozafar (at the right), are enjoying their breakfast (some local bread named Tomoshi) in a beach café in Bandar-e-Abbas with a fisherman who is enthusiastically talking about his observations of the marine wildlife.

Ali Reza (at the left) is asking a Baloch fisher (in the mid) about sharks, and another fisherman (at the right) is curiously approaching them to be the next interviewee. Fishers seemed very generous to share their observations, even more than many scientists. We were not expected to offer a co-authorship or a funded project. Everything we needed to know about marine wildlife, we just asked!

Instead of expensive advanced research equipment made by cutting-edge technologies, we were armed with file-bags full of interview forms, Species ID cards, and writing materials, all worth less than $1000. Nonetheless, we collected a magnificent amount of data for sharks and rays using these tools.

Earlier this year, we organized a team of eight researchers named “8-oceans” and journeyed along the whole southern Iranian coastline, aiming to learn about threatened marine wildlife, including sharks and rays. We organized this survey to address gaps in our knowledge of diversity, distribution, abundance, and fisheries of threatened marine wildlife within national waters, which is one of the biggest challenges in developing practical marine conservation plans in the country. However, if we had wanted to significantly close this research gap alone, we would have employed a team of research professionals with cutting-edge technologies to work in the field for years. But we had none of these. Most of the team members were not skilled researchers but recently graduated students. We were mainly armed with paper, writing materials, a camera, a few dissection kits, and a couple of fish measuring boards. Except for our camera, all of our tools for the 21st-century survey could compare with the equipment that ichthyologists such as Peter Artedi used in the 18th century.

Nonetheless, there was no place for worry. Backup forces, ready to help, were waiting for us on the shore. Fishers, whose fishing activities are known as the biggest threat to marine wildlife, helped us to close this conservation research gap in the Persian seas.

It is a story that has been successfully repeated several times worldwide. Many of you might have done it already in your region. However, in the following text, I narrate it as it happened in my country, Iran. But first, I am going to start with a background for readers interested in learning a bit more about this golden opportunity.

Background

We, marine biologists, are not going to the ocean every day of our life. Marine fieldwork is naturally labor-intensive and extraordinarily expensive. Even if some of us lived in a science utopia where research grants grow on trees, our primary job as scientists would not be just to collect data from beyond the waves but to analyze them behind the screens. Fishers, on the other hand, go to the ocean for as many days as they can, and interestingly, they are as observant as marine biologists. Although biologists observe to feed their curiosity, fishers do it to make a living. When and where are fish aggregating? Do these grounds change over time? Which animals are usually seen together? For example, when you see Whale Sharks (*Rhincodon typus*), what other fishes might be there in the area? etc. Only sharp-eyed fishers with those answers catch enough fish worth a fishing trip; others bring an empty fuel tank.

Therefore, there is a magnificent mine of information about marine biodiversity that fishers have built day after day through years and generations. The fascinating point is that, if you ask, they will generously share all their knowledge with you. I am sure those of you who previously talked with these kind and welcoming people agree with me that the most challenging part of asking fishers about marine wildlife is usually not to force them to start talking but to stop them. They even post their observations freely on social media. In Iran, their most extensive Instagram page comprises over 145,000 followers.

Not surprisingly, since marine biologists recognized this golden opportunity, they have been extensively cooperating with social scientists to develop questionnaires aiming to mine the fishers' historical marine biodiversity dataset.

How has it been carried out in Iran?

In Iran, there had not been any similar survey helping us set a baseline. Therefore, successful international experiences were used to develop practical models. Fortunately, two of QECI's scientific advisors, Dr Nicolas Pilcher and Dr Rima Jabado, had successfully mobilized and led teams that interviewed thousands of fishers in several countries. During a series of workshops, we carefully built interviewing forms suitable for use in Iran.

Dr Ali Reza Rastgoo, a marine biologist, working on the ecology and fisheries of rays, kindly joined me to head up the team. Dr Majid Askari Hesni, a marine biologist and university professor, also helped me employ ambitious and motivated volunteers from a list of registered students. The team members were then trained about methodology, and we finally started our journey in mid-February 2022.

For one month, our team, divided into two four-person subteams, visited more than 45 coastal towns, villages, and islands distributed along the 1400 km southern Iranian coastline and collected more than 700 interviews about sharks, guitarfishes and wedgefishes, other rays, marine turtles, and cetaceans. Questions were mainly focused on boat and gear characteristics, bycatch species, target catches, trade, distribution, changes in abundance, and acceptable management measures.

Fishers' perceptions of sharks

Most of our questions focused on fishers' observations. These data will be analyzed and published in a scientific report to build capacity for developing conservation plans and management measures. However, at the end of each interview, we also asked some questions about fishers' perceptions of sharks and rays as we were curious to learn what they think of these fishes. Their answers amazed us.

We asked them, "Do you think sharks will always be in our waters?". About one-third of fishers told us that they think if overfishing keeps continuing, sharks will be gone and will not always be in Iranian waters. Almost the same proportion of fishers had the same idea for guitarfishes and wedgefishes. However, they were more optimistic about stingrays and other batoids. Only one-fifth thought rays will not always be in the national waters.

We also asked them, "Do you think having sharks around is important?" We repeated the same question for guitarfishes, wedgefishes, and other rays. More than 80% of fishers believed having all groups of elasmobranchs in our waters is essential. When asked "why?", some fishers spoke ecologically and referred to the food chain. They told us that because fish feed on each other, if one of them disappears, marine communities will collapse.

More than 80% of fishers thought that all sharks and rays should be protected and would want to be consulted or involved in government initiatives to protect these threatened fishes. We hope decision-makers and policymakers take this opportunity while developing management measures and rules.

Never-forgotten shark memories

There are a few other findings that I would share with you here, which might not have a place in scientific and technical reports, but I am sure shark lovers will enjoy reading them. They are never-forgotten shark memories we have gotten from this journey.

A glimpse of hope for sharks

One night, all team members were gathered at the camp to serve dinner and talk about their daily experiences, the marine biologist, Dr Alireza Rastgoo, came to us with a heart-breaking and never-forgotten shark memory:

- The beach was almost empty; all the fishermen had gone to the sea. It didn't seem like a time for having a good interview. But things don't happen the way you expect them to. A man sat alone on the sand next to the piles of fishing nets and was staring at the sea. I gently approached him, and he kindly welcomed me. When I showed him the photos of the sharks and asked if he had ever seen them, he suddenly started shedding tears. "I used to catch lots of them! But the ocean is almost empty of them. They are all gone," the fisherman said while he was crying. I was shocked and could say nothing. He got calm after a couple of minutes and added, "But I have now changed my job and given up my boat and my fishing nets. I have done all for my little son. I hope when he's grown up, he will still be able to see sharks in the sea". On that beach next to all those fishing nets, I found a glimpse of hope for sharks.

Full of hope and fears

For Hanieh Rostamabadi, a recently graduated genetics student whose love for the ocean and people pushed her to join our team voluntarily, the journey was full of hope and fears for sharks:

- Sometimes you do not get used to some repetitions. Sentences like "it's been a long time since I saw sharks" were like a sharp dagger that pressed deeper into my heart every time. On the other hand, from time to time, fishermen warmed my heart. In a village, some fishers told me that traditionally their community would not support a fisher if he intentionally caught sharks. In another village, shark hunting was considered a big sin. One time when I was talking with a group of fishers, they regretfully started apologizing to the sea for their unsustainable fishing habits in the past. They had vowed that they would never use bottom trawling again. Before this journey, I had thought fishermen were heartless people who just think about killing fish, but soon after I started talking with them, I realized most of them love the ocean and its creatures more than I do.”

A lesson from the past to the future

I can never forget the evening we were in the cultural museum of Bandar-e-Kong, a coastal village in the eastern Persian Gulf. The first thing that caught our eyes immediately after our arrival in that place was the large stuffed sharks', fins, and jaws that hung on almost every wall. Every evening, old fishermen sat in the yard and talked about the far past. When we asked them about the stuffed sharks and jaws, they told us that more than a half-century ago, that place used to be the house of one of the most well-known Iranian shark-fin traders. "For the years before his death, fishers had been bringing fins from everywhere along the Iranian coastline. There were always piles of fins in every corner of the yard," an 80-years fisherman said. Even picturing that for a moment made my blood run cold. "We have not been seeing such large sharks for decades, " the fishermen added, regretfully pointing to one of the fins hanging on the wall behind him.

At that moment, I realized how essential it is to document the history of sharks and rays in the oceans. Maybe our ancestors would have never done it to sharks if they had been able to see the future. But they couldn't, as we are still not. However, in contrast to them, we can see the past, and maybe if people can imagine how our oceans were glorious with sharks before, they will care more about these mysterious marine predators. Nonetheless, this history is still extensively undocumented and is already just inside the minds of old fishers. Before it is gone, we should ask them to tell us.

Acknowledgements
We are indebted to Dr Majid Askari Hesni, Associate Professor of Shahid Bahonar University, Dr Nicolas Pilcher, Executive Director of Marine Research Foundation, and Dr Rima Jabado, Chair of the IUCN SSC Shark Specialist Group and lead scientist of the Elasmo Project. They have kindly advised QECI's team on this project. This amazing and highly productive journey would have never started without the kind and timely support of several sponsors, including (in alphabetical order): A Future For Nature Award dedicated to M. R-A, Idea Wild for providing a laptop for M. R-A, Marine Conservation Action Fund (Anderson Cabot Center for Ocean Life in New England Aquarium), and Prince Bernhard Nature Fund.
Sharing is caring. Fishers generously shared their experiences with us; why don't we? If you are going to develop a similar project in your area and you think our experience of this journey can help you in any way, my team and I will be happy to hear from you. Please do not hesitate and email me: Mohsen Rezaie-Atagholipour at mra@qeci.org .

Darya (at the right) is asking an old fisherman with half of a century of fishing experience about sharks and rays. The fisherman is trying to memorize sharks and rays from his childhood when he was a little boy and used to go fishing with his dad.

We, a gender-balanced team of 8 researchers, journeyed along the whole southern Iranian coastline to interview fishers about sharks and rays and other threatened marine wildlife. Here in this picture, we are in the mangrove forest of Gavater, a small coastal border village at the junction of Iran and Pakistan, and the last place we visited on our journey. From left to right: Najmeh Sabbah, Amir Mozafar Hosseini, Hanieh Rostamabadi, Ali Reza Rastgoo, Darya Rafiee, Haleh Ali Abedi, Mohsen Rezaie-Atagholipour, Mohammad Mohammadipour.

Ali Reza, the second person from the right, is asking the captain about the sharks, and the crews are landing small sharks from the boat on the beach sands. Hanieh, the first person on the right, sitting on the sands and getting ready to measure sharks. Sometimes when you ask a fisher "have you ever seen these sharks?", they reply: "yes, here you are"!

Fisherwomen are too rare in southern Iran. In This journey, we met just one of them (at the left), who here in this picture is enthusiastically talking about her observations with Hanieh (at the right).

Hanieh, one of the interviewers, standing on a landing site next to a barrel contained an adult spotted eagle ray (*Aetobatus ocellatus*). She is waiting to interview fishers after they finish their job.

In the yard of the cultural museum of Bandar-e-Kong, a coastal village in the eastern Persian Gulf, when we asked this 80-years old retired fisherman about the stuffed shark fins hung on the wall, he and his friends told us that far years ago the place used to be one of the main shark fin trade hotspots at the southern Iranian coastline.

Microanatomy of shark skin as a novel method to identify elasmobranch carcasses from illegal catches in southern Brazil

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IUCN SSC Shark Specialist Group | South America Region | Member

Region Update: South America

All photos by Marioxis Macías-Cuyare

Preparation of skin samples for scanning electron microscopy after being subjected to carbon and gold sputtering.

I have been working with elasmobranch fishes since 2016. In 2018, I got my Bachelor of Science degree as a biologist at the Universidad de Carabobo in Venezuela, where I am from. The subject of my thesis was the biology of the Endangered shark, Smalleye Smoothhound (*Mustelus higmani*) (Macías-Cuyare et al. 2020). Immediately after, I moved to southern Brazil, where I obtained a Master's degree at Universidade Federal do Rio Grande (FURG), under the supervision of Dr Maria Cristina Oddone, lead research of the Laboratório de Pesquisa em Chondrichthyes in FURG. My master dissertation dealt with a poorly known shark, Southern Sawtail Catshark (*Galeus mincaronei*), endemic to Brazil. In that opportunity, apart from studying several aspects of its, we analyzed the morphology of dermal denticles of that species, attributing several functions to the different morphologies (Macías-Cuyare and Oddone 2022). Currently, we are working on my PhD project entitled "Comparative Ecomorphology of dermal denticles in elasmobranchs from coastal and oceanic ecosystems of southern Brazil".

The thesis project is supported by the research project "Estudo da morfologia do dentículo dérmico como caráter de importância taxonômica em espécies de tubarões e raias ameaçadas de extinção do Sul do Brasil (code PROPESP/FURG, PESQ - 1778)". Samples analyzed come from specimens (carcasses) confiscated from illegal fisheries events, in which traditional identification by morphological characters is not possible. In this respect we are working in collaboration with the local Ambiental Patrol (PATRAM) of Rio Grande, through the project "Efetivação das normativas de proibição de pesca de espécies de condrictes ameaçados de extinção no Estado do Rio Grande do Sul (code PROEX/FURG, EXT-109)". In addition, samples are being collected by onboard observers and landings sampling of the research Project "Projeto SALVAR: Ciência para a conservação dos tubarões e raias do Sul e Sudeste do Brasil".

This project also deals with one of the most remarkable elasmobranch characteristics: the structure of their skin. These structures in the skin are known as placoid scales or dermal denticles, which cover the entire body with tiny scales, structurally similar to teeth, where their base is embedded in the integumentary surface (Kemp 1999, Lang 2009). Elasmobranch skin has even been used as inspiration for technologies that help to reduce drag and prevent parasites from settling on their rigid structures. Dermal denticles can widely vary in shape, size and density (among species) and sexual dimorphism. Differences can also be observed through ontogeny (Reif 1985, Crooks et al. 2013). Furthermore, elasmobranch skin represents an important taxonomic identification tool (Kanagusuku et al. 2021). Also, studying these structures makes it possible to obtain information on species ecology and habitat use (Lang 2009).

In southern Brazil, most elasmobranch species are fully protected by law, including landing capture prohibition, transport, storage, handling, and commercialization. In fact, almost 54 species are classified regionally such as Data Deficient (DD), Critically Endangered (CR), Endangered (EN), Near Threatened (NT) and Vulnerable (VU), are protected, and their capture is prohibited at state and federal levels (Vooren and Klippel 2005, ICMBio 2016).

Recently in this region, the importance of dermal denticles for obtaining biological information from the exclusive economic zone (EEZ) has been demonstrated by two studies from Dr Oddone's lab, mainly for conservation purposes. The first attempt to solve the problem of shark carcasses identification from illegal fisheries was that of Rota (2022) (undergraduate thesis), who demonstrated that dermal denticles are an important taxonomic tool in commercial fisheries, especially in the absence of external morphological characters for species identification. The author identified the Angular Angelshark Squatina guggenheim, at the species level, from a remnant of skin present on a piece of muscle already processed for human consumption. He also described dermal denticle morphology for several other species regionally protected by law. The second, by Macías-Cuyare and Oddone (2022), the morphological pattern of the dermal denticles of *G. mincaronei* was under study. This species is a poorly known, endemic, and Vulnerable deep-shark species. Three types of dermal denticles were identified along the shark body with morphologies related to functions like defence, and abrasion resistance, apart from generalized functions. According to their dermal denticle morphology, this species would have generalist habits and may inhabit rocky environments. Furthermore, dermal denticle morphology in *G. mincaronei* was sexually dimorphic.

Studies on elasmobranch species identification using dermal denticles represent a fast and more economical alternative than genetic techniques (Shivji et al. 2002, Gilligan and Otway 2012). The main reason is that the dermal denticles maintain their intact structure regardless of post-capture processing, either freezing or drying or even preservation in fixatives (Applegate 1967, Gilligan and Otway 2012). In fisheries landings, elasmobranchs are eviscerated according to different types of cuts, making identification by species or genus difficult or impossible (Vooren et al. 2003). The evisceration of elasmobranchs makes correct identification difficult since evisceration patterns can be highly diverse, even for the same species. This makes the recording and enforcement of legally protected elasmobranch catches in fishing ports difficult at national and international levels (Vooren and Klippel 2005, Gilligan and Otway 2012). Sharks and rays are cut and eviscerated using different methods; sharks are landed as carcasses without heads, viscera, and large fins; and rays have many variations of cut related to the morphological variation of this group, e.g., in guitarfishes, only the tail is landed as this is the part of the body that is commercialized. For Rajiformes, just the pectoral fins are landed (Vooren and Klippel 2005). This makes the recording and enforcement of legally protected elasmobranch catches in fishing ports difficult at national and international levels (Vooren and Klippel 2005, Gilligan and Otway 2012). However, we can identify these carcasses through dermal denticle analysis, which allows the identification of protected species by law in commercial or illegal fishing catches (Gilligan and Otway 2012).

This project aims to study the comparative morphology and morphometry of the dermal denticles of the elasmobranch from the coastal and oceanic ecosystems of southern Brazil, related to their ecological patterns of lifestyles and habitat use of the species and establishing possible functional morphologies, including sexual dimorphism and ontogeny.

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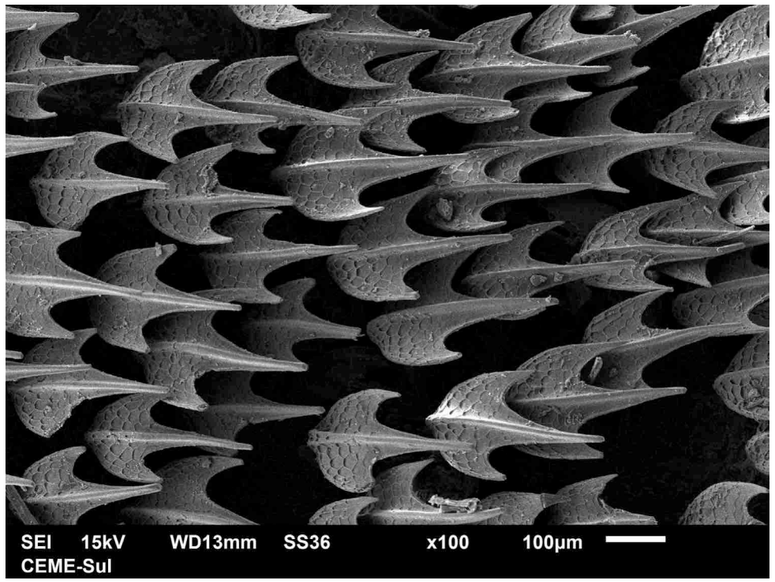
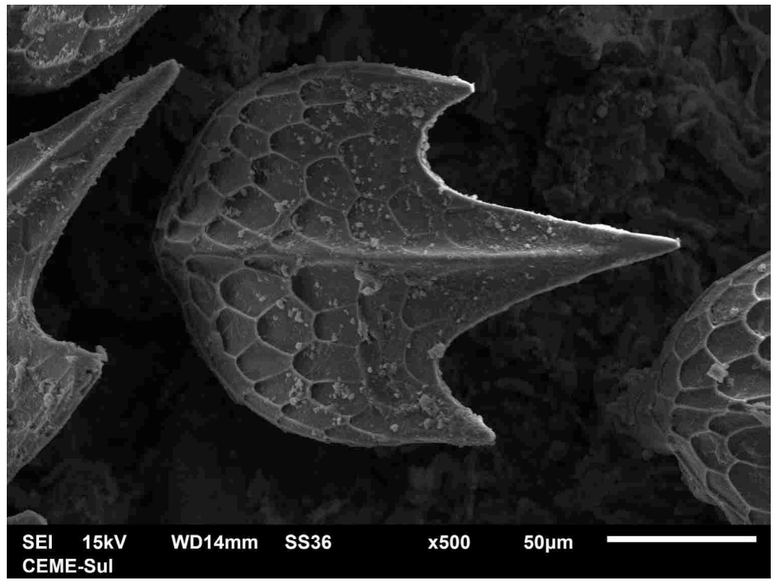
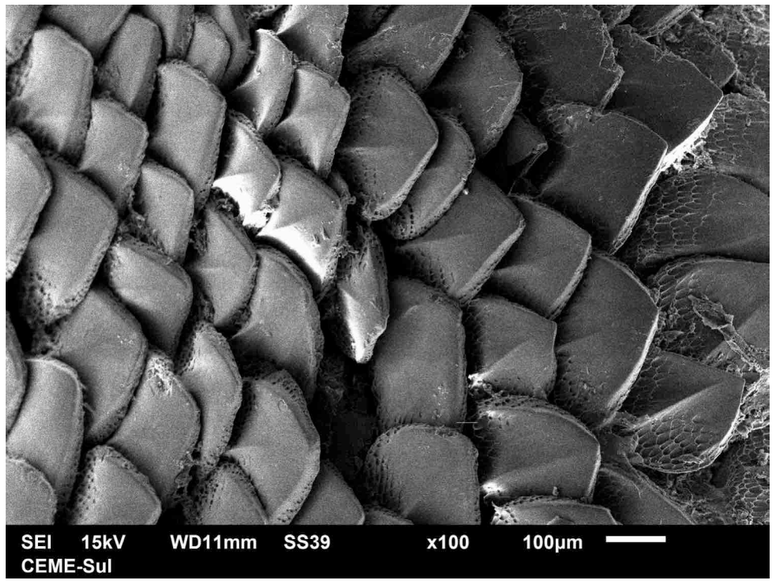
Shark skin removal process.

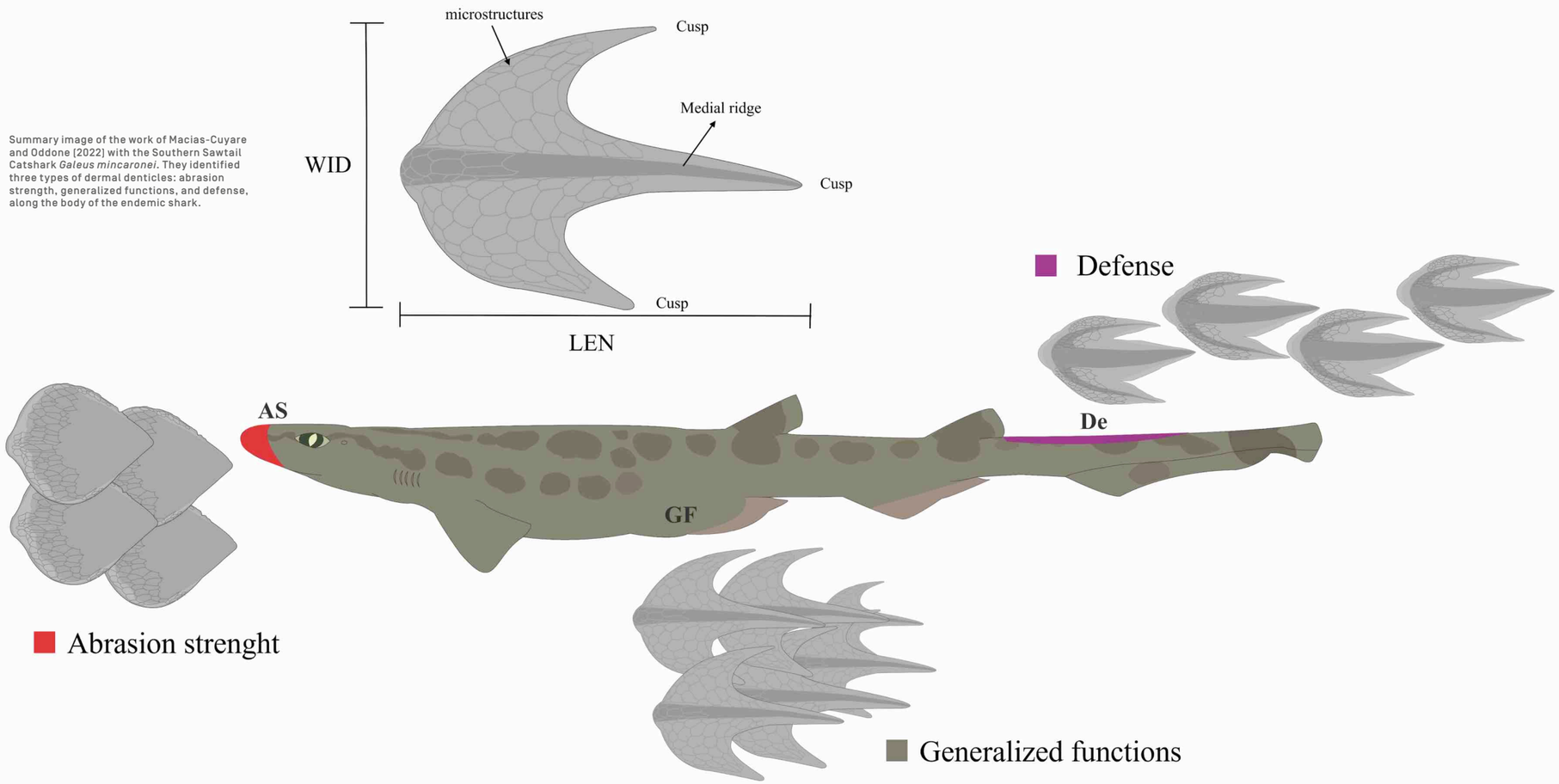
Visualization of body skin (left), dorsal fin denticle (middle) and nostril skin (right) samples under the scanning electron microscope.



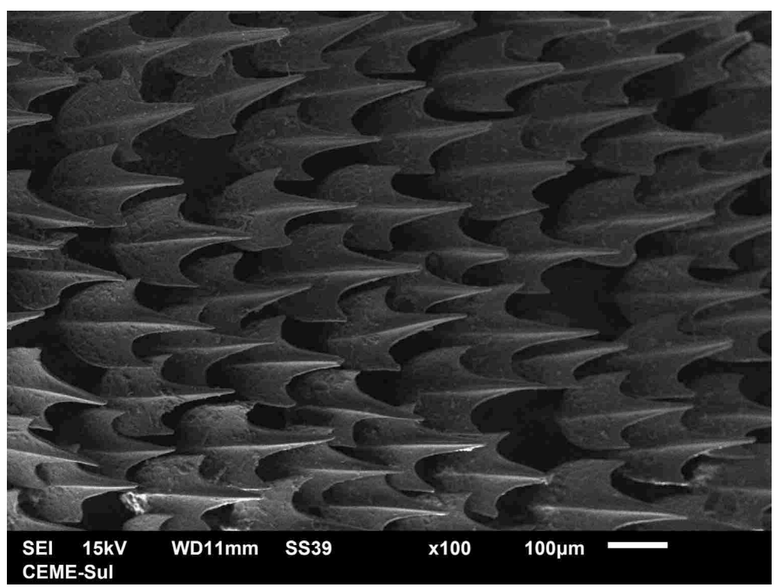


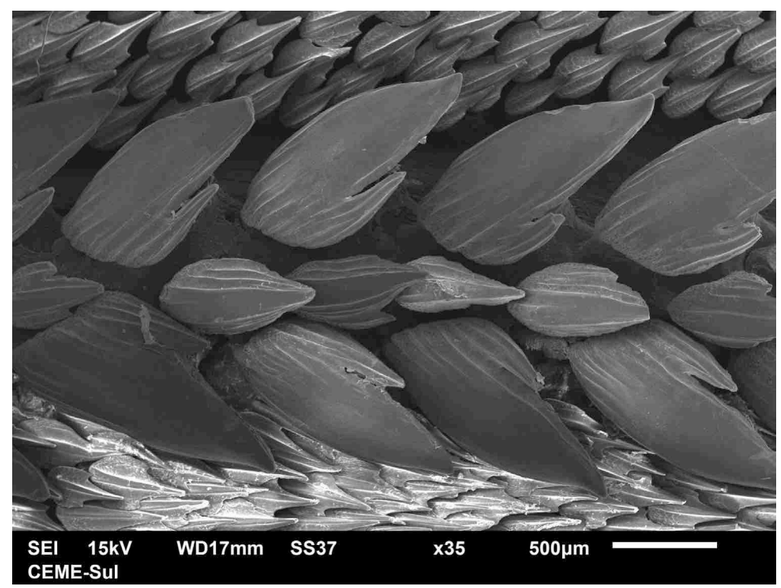


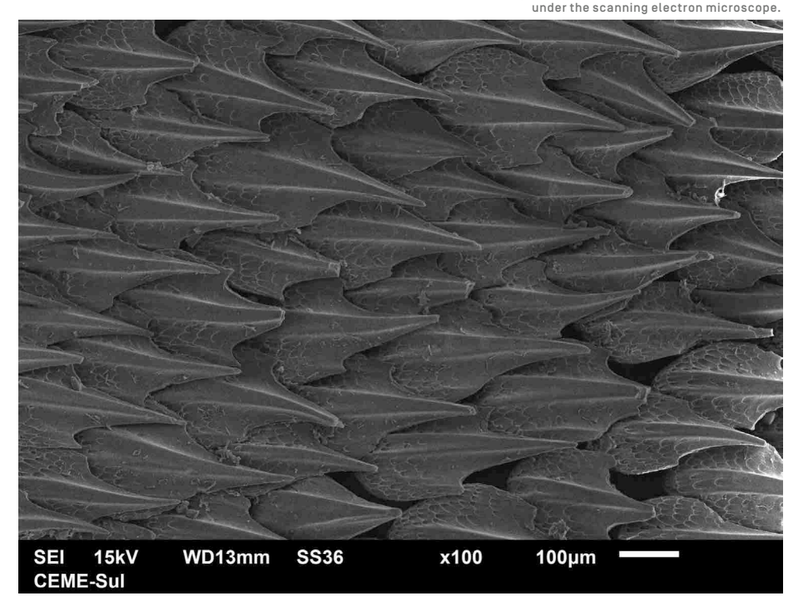
Summary image of the work of Macias-Cuyare and Oddone [2022] with the Southern Sawtail Catshark *Galeus mincaronei*. They identified three types of dermal denticles: abrasion strength, generalized functions, and defense, along the body of the endemic shark.



Visualization of the pectoral fin (left), caudal crest (middle) and caudal fin (right) skin samples under the scanning electron microscope.

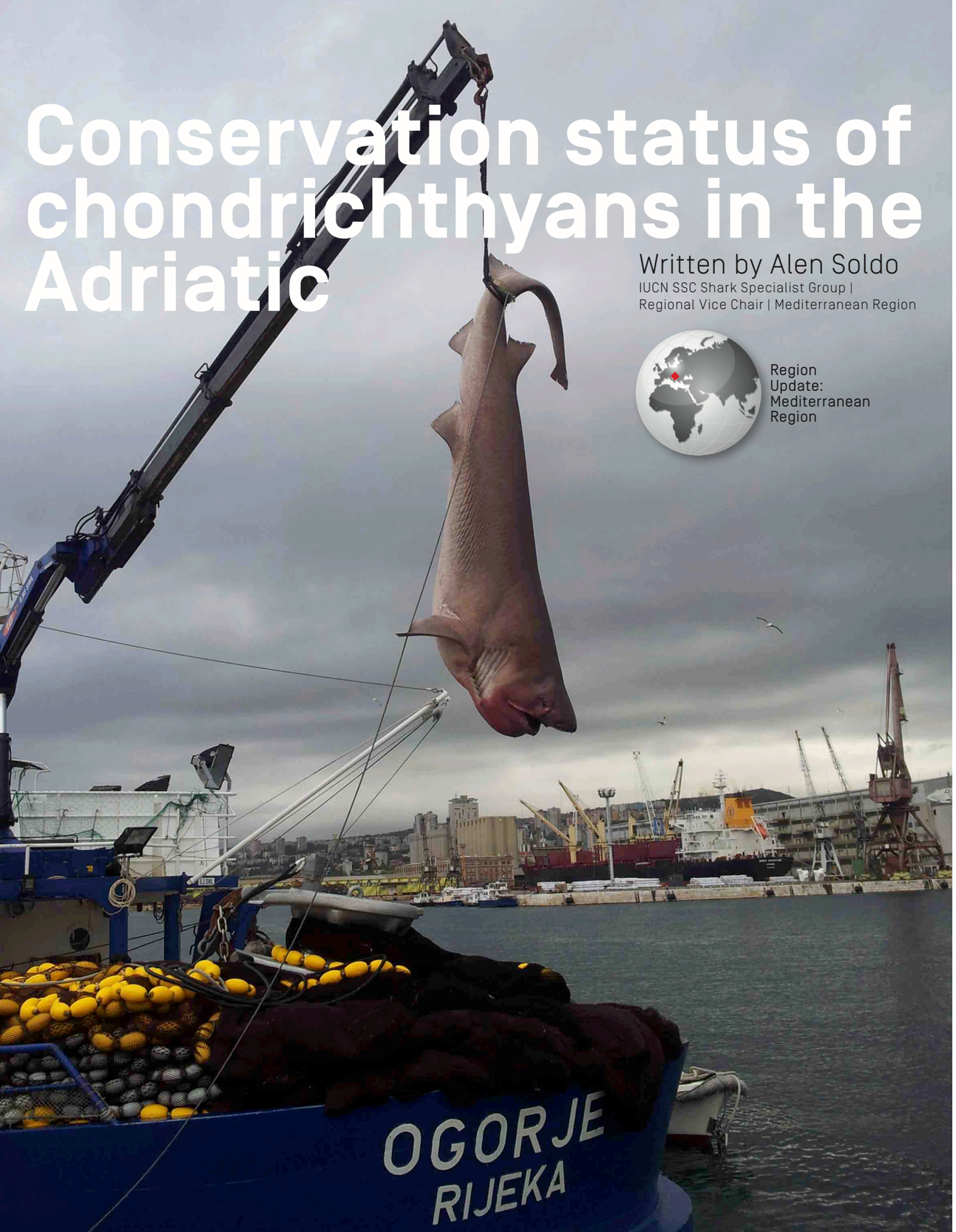






Conservation status of chondrichthyans in the Adriatic

Written by Alen Soldo
IUCN SSC Shark Specialist Group | Regional Vice Chair | Mediterranean Region



Region Update: Mediterranean Region

The average primary production of the Mediterranean Sea is much lower than commonly observed in most oceanic areas. The exception is in the Adriatic Sea, especially its northern region, due to an extraordinary concentration of medium nutrients from the river run-off. Several topographic characteristics determine the oceanographic properties of the Adriatic Sea. The northern Adriatic Sea is a shallow shelf. At the same time, the open south and central Adriatic are characterized by two pits: the Jabuka Pit (maximum depth 270 m) and the South Adriatic Pit (maximum depth 1233 m). It is usually recognized that the Adriatic Sea is separated from the Ionian Sea in the south by the 72 km wide Strait of Otranto. However, the exact border between the Adriatic and the Ionian Sea has been reported differently in various studies. Recently published papers usually recognize the border between the Adriatic and the Ionian Sea following the International Hydrographic Organization, which established that the whole Albanian waters belong solely to the Adriatic Sea.

The Adriatic Sea can be considered a well-studied Mediterranean area considering that a systematic study of the Adriatic ichthyofauna began in the first quarter of the 19th century. This resulted in a high number of publications listing fish species. The recently updated list of Adriatic fishes consists of 444 species in the Adriatic Sea, corresponding to 58.5% of the fish species reported for the Mediterranean. However, only a few focused on chondrichthyans, a class that includes sharks, rays, and chimaeras. Serena et al. (2020) stated that 60% of Mediterranean chondrichthyans are recorded in the Adriatic Sea.

On the one hand, that percentage is low compared to other Mediterranean regions as the highest number of Mediterranean chondrichthyans has been reported in the western area (84%), followed by the central Mediterranean Sea (81%), and the eastern Mediterranean Sea (78%). Only the Black Sea, with only 13% of species represented, has a low number. On the other hand, the Adriatic Sea is considered the main Mediterranean biodiversity hotspot for chondrichthyans in terms of the diversity score, although it has to be noted that the diversity score is weighed by the surface of each sector; thus, this result derives mainly due to the relatively small area of the Adriatic Sea.

Besides checklists, the conservation status of chondrichthyans has rarely been investigated, although chondrichthyans are the most threatened group of marine fish in the Mediterranean Sea. The recent IUCN Red List of Threatened Species demonstrated the susceptibility of chondrichthyans in the Mediterranean and the general lack of data. Indeed, from more than half of the species assessed, 39 out of 73 species are considered regionally threatened (Critically Endangered, Endangered, or Vulnerable), while 13 species are considered Data Deficient. Consequently, it is presumed that the threat level may be even worse given that the same integrated effects of unsustainable fishing, pollution, and habitat destruction also affect all Data Deficient species. The result is that more than 71% of chondrichthyans in the Mediterranean Sea may be threatened and are subjected to an elevated risk of extinction. Therefore, the Mediterranean is considered a world priority region for conservation action for chondrichthyans and a range of fishery management measures for protection are currently granted to chondrichthyan fish species under various regional and international conventions that are also applied in the Adriatic Sea. However, on the other hand, a limited number of species are generally considered, and only a few countries have developed their own national legislation focused on chondrichthyans.

In the Mediterranean Sea, including the Adriatic, 24 species of chondrichthyans are protected under recommendation GFCM/36/2012/3 (later amended to GFCM/42/2018/2) of the General Fisheries Commission of the Mediterranean (GFCM). This recommendation aims to protect those species of sharks and rays listed in Annex II of the Protocol of the Barcelona Convention on specially protected areas and biological diversity in the Mediterranean. Under this binding rule for all GFCM member countries, these species cannot be "retained on board, transhipped, landed, transferred, stored, sold or displayed or offered for sale", but rather, "they must be released unharmed and alive to the extent possible", and States must guarantee "high protection against fishing activities".

These GFCM recommendations have been implemented into several European Union (EU) regulations, particularly Regulation (EU) 2015/2102 and are thus binding for the EU countries of the Adriatic Sea (Croatia, Italy, and Slovenia). Perhaps an even higher level of protection is given to the species listed in Annex I of Regulation (EU) 2019/1241, as it is prohibited for EU vessels to fish for, retain on board, transship, land, store, sell, display or offer for sale these species for all EU waters. However, most of these regulations are limited to commercial fisheries, while their application to recreational fisheries, which also have a high impact on chondrichthyans, particularly large pelagic species, is dubious. Croatia is the only Adriatic country that has produced national legislation related to the chondrichthyans, and strictly protected species status has been given to 23 species of sharks and rays. Strictly protected species status is the highest level of protection in Croatia. The Criminal Code of Croatia regulates any harm toward listed species, and offenders may be punished by imprisonment.

Most chondrichthyan species are not targeted species in the Adriatic Sea but are caught mainly as bycatch by longlines and other fishing gear used in tuna, small pelagic fish, and swordfish fisheries. Smaller chondrichthyans are also often the bycatch of trawl and other bottom fishing gear. In some areas seasonally, mainly during the spring, houndsharks (Triakidae) are targeted with gillnets, but only a few fishers are involved in this fishery.

A recently published paper by Soldo & Lipej (2022) aimed to provide an updated and annotated checklist of the chondrichthyans occurring in Adriatic waters and, for the first time, present an assessment of their presence and conservation status. Based on that study, a total of 60 chondrichthyan species from 27 families and 42 genera were included in the new checklist representing species that are permanently living in the Adriatic Sea, those occasionally entering, as well as the species that were recorded previously but are now considered regionally extinct. The list contains 33 species of sharks, 26 species of rays, and one chimaera. Overall, 33 species were considered rare, eight as occasional, 15 as common, and only four as abundant in the Adriatic Sea. Considering sharks and rays separately, rare presence was established equally for both groups, as 16 sharks and 16 rays were assessed as rare. Assessment of the conservation status revealed that three species previously recorded in the Adriatic Sea are now considered Extinct in the Wild or Regionally Extinct (namely Smoothback Angelshark *Squatina oculata* Bonaparte, 1840, Smalltooth Sawfish *Pristis pectinata* Latham, 1794 and Common Guitarfish *Rhinobatos rhinobatos* (Linnaeus, 1758)). Hence, 21 species were assessed as Critically Endangered, eight were Endangered, and ten were Vulnerable. Six of the remaining species were Near Threatened, and the same number of species were Least Concern and Data Deficient.

The 60 species listed represent 68% of the recorded species in the Mediterranean Sea, which is higher than that reported by Serena et al. (2020). It is probably due to new species records in the Adriatic Sea. This means that the Adriatic Sea is an even more significant Mediterranean biodiversity hotspot in terms of the diversity

score than previously considered. Still, from a conservation point of view, it is also the area of the Mediterranean where the chondrichthyans are at the highest threat level. An assessment of the conservation status of Adriatic species revealed that 70% (42 out of 60) are regionally threatened, including three species that are now considered Regionally Extinct, which is significantly higher than in other areas of the Mediterranean.

Considering that the principal driver of chondrichthyan decline and regional extinction is overfishing, the Adriatic countries must adopt some management measures. Hence, efforts should be increased to identify critical habitats of chondrichthyans as proper management measures enforced in mating areas and pupping, and nursery grounds are essential for their protection and restoration.

More on this study can be found at:
Soldo, Alen, and Lovrenc Lipej. 2022. "An Annotated Checklist and the Conservation Status of Chondrichthyans in the Adriatic" Fishes 7, no. 5: 245. doi.org/10.3390/fishes7050245

Figure 1.
The division of Adriatic chondrichthyans according to their
Presence status

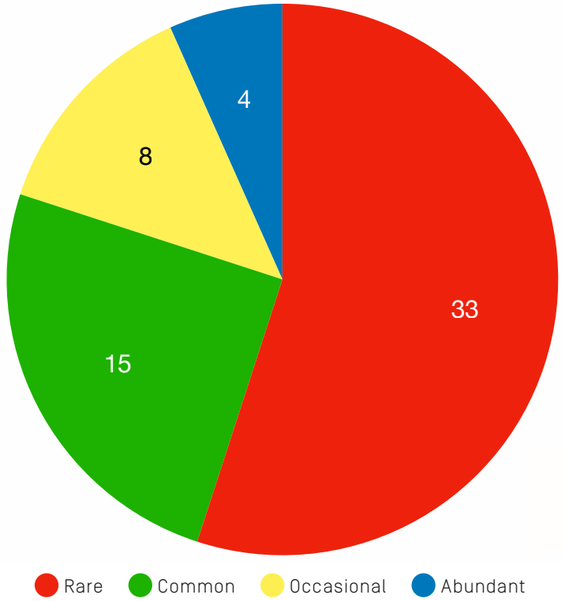
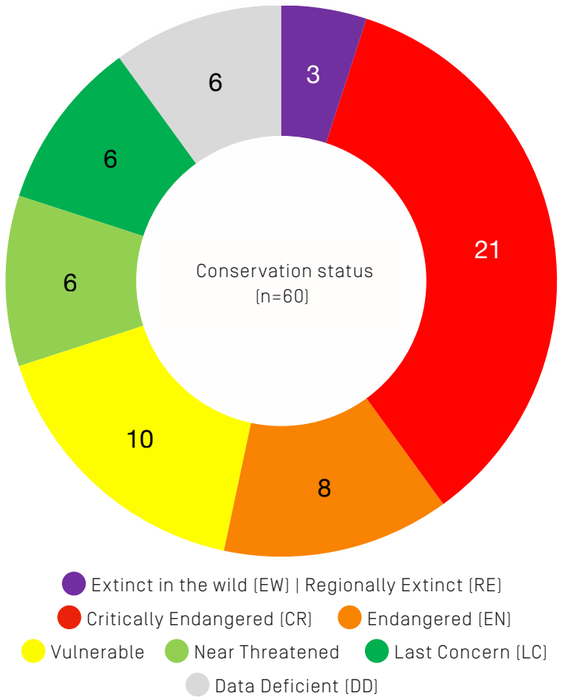


Figure 2.
The division of Adriatic chondrichthyans according to their
Conservation status



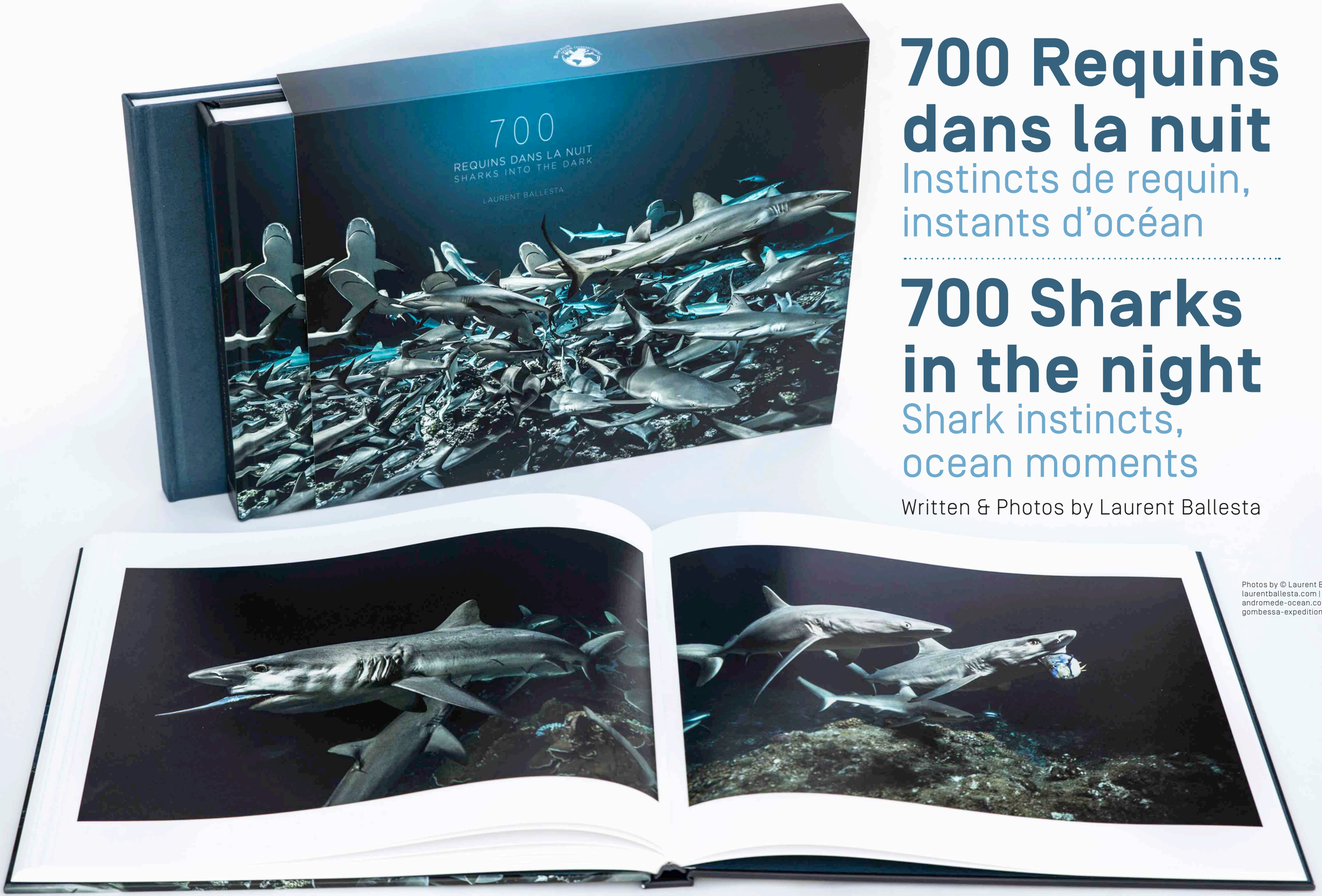
700 Requins dans la nuit

Instincts de requin, instants d'océan

700 Sharks in the night

Shark instincts, ocean moments

Written & Photos by Laurent Ballesta



Photos by © Laurent Ballesta | laurentballesta.com | andromede-ocean.com | gombessa-expeditions.com

Souvent, *je fais ce rêve d'insouciance: je pars en plongée comme un botaniste en forêt, comme un alpiniste en montagne, sans l'inquiétude du manque d'air, ou de l'accident de décompression. Je rêve de m'affranchir de la respiration artificielle, de ne plus devoir rejoindre la surface et de pouvoir vagabonder sur un territoire sauvage, de m'imprégner de lui sans contrainte de temps. Je rêve de vivre l'esprit libre ma passion sous-marine, simplement et sans limite, d'arpenter la vallée des requins, et recommencer encore; comme si l'aventure se nourrissait de routine... percer le mystère des lieux... et plus encore, tenir ces promesses faites à l'enfance.*

I often have this carefree dream: I go diving like a botanist in the forest, like a mountaineer in the mountains, without worrying about running out of air or having a decompression accident. I dream of freeing myself from artificial breathing, of not having to return to the surface and of being able to wander through a wild territory, to immerse myself in it without time constraints. I dream of living my underwater passion with a free mind, simply and without limits, of walking through the valley of the sharks, and starting again; as if adventure was nourished by routine... piercing the mystery of the places... and more than that, keeping those promises made during childhood.

Nous *sommes de retour à la Passe Sud de l'atoll de Fakarava. C'est la 4e expédition menée ici. En 2014, j'y ai effectué pour la première fois une plongée de 24 heures à 20 mètres. J'étais déterminé, mais en vérité, je cachais ma fébrilité. J'avais peur d'être trop vite épuisé, et de devoir abandonner. Il me fallait alors effectuer les 6 heures de paliers de décompression imposées par les 87% d'hélium que je respirai. Le stress des premiers instants m'avait simplement fait oublier la chance d'être là. Ce lieu est unique, le moment l'était aussi : les mérous s'étaient donnés rendez-vous par milliers, là où des requins les attendent par centaines quand tombe la nuit. J'avais la chance d'être parmi eux, de pouvoir les observer durant toute une journée et toute une nuit.*

We are back at the South Pass of Fakarava Atoll. This is the 4th expedition here. In 2014, I made my first 24-hour dive here to 20 metres. I was determined, but in truth I was hiding my excitement. I was afraid I would be exhausted too quickly, and have to give up. I then had to make the 6 hours of decompression stops imposed by the 87% helium I was breathing. The stress of the first moments had simply made me forget how lucky I was to be there. This place is unique, so was the moment: groupers had gathered by the thousands, where sharks wait for them by the hundreds when night falls. I was lucky enough to be among them, to be able to observe them for a whole day and night.

During the first expedition, the figures from our daily counts came out for the very first time: 18,000 groupers and 700 sharks, the highest density known to date for both species. On each expedition, we repeated the exercise in order to compare the data of the two populations.

***Lors** de la première expédition, les chiffres issus de nos comptages quotidiens sont tombés pour la toute première fois : 18 000 mérous et 700 requins, soit la plus grande densité connue à ce jour pour les 2 espèces. A chaque expédition, nous avons répété l'exercice afin de comparer les données des deux populations.*

Toute *l'année, les mérous sont solitaires sauf à cette période où ils cohabitent par milliers car, dans quelques jours maintenant, ceux qui auront échappé aux requins se reproduiront tous en même temps. Pour la 4e fois consécutive nous sommes au rendez-vous. Après des dizaines d'heures de veille sous-marine, nous avons l'intuition d'avoir enfin compris l'instant exact où doit avoir lieu la reproduction. Les 3 dernières années ont laissé un sentiment de « raté » d'être arrivé trop tard et de n'avoir vu que la queue de la comète. Aujourd'hui, nous sommes enfin prêts et à l'heure, je crois.*

All year round, groupers are solitary except at this time of year when they live together by the thousands because, in a few days now, those that have escaped the sharks will all reproduce at the same time. For the 4th consecutive time we are there. After dozens of hours of underwater surveillance, we have the intuition to have finally understood the exact moment when the reproduction must take place. The last 3 years have left us with the feeling of having arrived too late and having only seen the tail of the comet. Now we are finally ready and on time, I think.

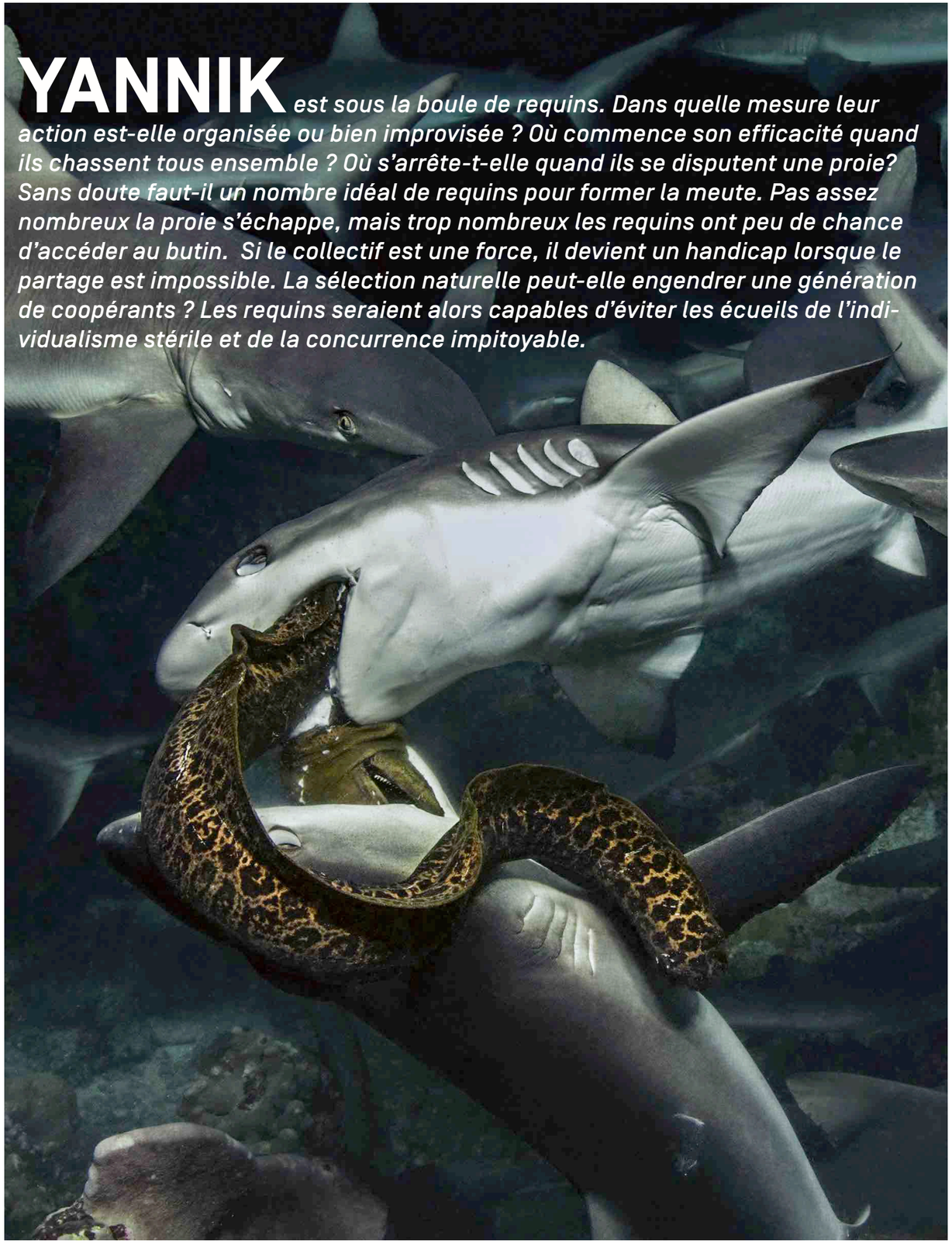
We dive every night. During the day, the sharks form three groups that we call "walls". These walls form in specific places in the main current veins. Each time a shark leaves the current vein, it comes back in, like a bird does in V-shaped flights during migration. But at night they leave the water column and patrol the bottom of the channel. In 2014 we kept our distance. In a flash, the pack swoops down on the prey and, in its momentum, pulverises a mass of coral. The accelerations are lightning fast, and we, as immobile spectators, were stunned. The spectacle sometimes imposes a respectful reverence: the folding of the knees against the chest. Sure the stress is permanent, but our eyes shine in the darkness.

Nous *plongeons toutes les nuits. Le jour, les requins froment trois groupes que nous appelons « les murs ». Ces murs ce forment dans des endroits précis dans les veines de courant principales. A chaque fois qu'un requin sort de la veine de courant, il vient s'y replacer, comme un oiseau le fait dans les vols groupés en V pendant les migrations. Mais la nuit, ils quittent la colonne d'eau et patrouillent le fond de la passe. En 2014, nous gardions nos distances. En un éclair, la meute fond sur les proies, et, dans son élan, pulvérise un massif de corail. Les accélérations sont fulgurantes, et nous, spectateurs immobiles, étions sidérés. Le spectacle impose parfois une révérence respectueuse : le repli des genoux contre la poitrine. Sûr que le stress est permanent, mais nos yeux brillent dans la pénombre.*

Year after year, dive after dive, an intuition is forged: we will not be bitten. In the midst of their mad rush, we are obstacles, not targets. Encouraged by this impression, we get closer and closer to them. Unthinkable the first year, we are now evolving inside the pack.

ANNÉE *après année, plongée après plongée, une intuition se forge : nous ne serons pas mordus. Au milieu de leurs courses folles, nous sommes des obstacles et non des cibles. Ragaillardis par cette impression, nous les approchons de plus en plus près. Inenvisageable la première année, nous évoluons aujourd'hui à l'intérieur de la meute.*

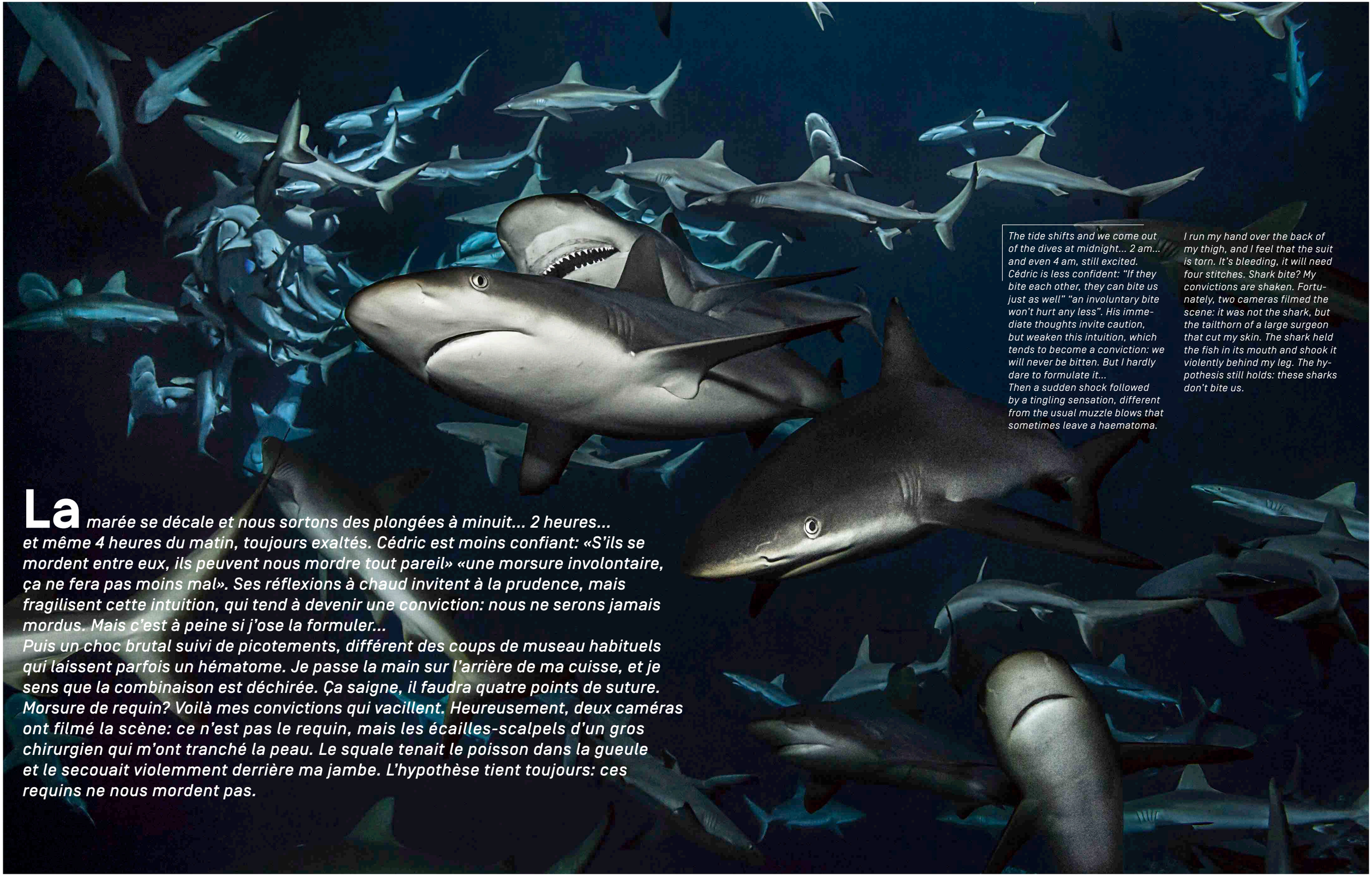
YANNIK *est sous la boule de requins. Dans quelle mesure leur action est-elle organisée ou bien improvisée ? Où commence son efficacité quand ils chassent tous ensemble ? Où s'arrête-t-elle quand ils se disputent une proie? Sans doute faut-il un nombre idéal de requins pour former la meute. Pas assez nombreux la proie s'échappe, mais trop nombreux les requins ont peu de chance d'accéder au butin. Si le collectif est une force, il devient un handicap lorsque le partage est impossible. La sélection naturelle peut-elle engendrer une génération de coopérants ? Les requins seraient alors capables d'éviter les écueils de l'individualisme stérile et de la concurrence impitoyable.*



Yanick is under the ball of sharks. How organised or improvised is their action? Where does its effectiveness begin when they are all hunting together? Where does it end when they fight over prey? There must be an ideal number of sharks to form a pack. Not enough sharks escape, but too many sharks have little chance of getting the prey. If the collective is a strength, it becomes a handicap when sharing is impossible. Can natural selection produce a generation of cooperators? Sharks would then be able to avoid the pitfalls of sterile individualism and ruthless competition.

Sous *nos yeux, la meute des 700 requins en pleine action agit comme un seul individu gigantesque muni de 700 mâchoires. A l'inverse, le requin gris, isolé, est maladroit et inefficace. Son salut réside dans la meute, quand tous ensemble ils synchronisent leur action. Je crois qu'il faut oublier le vieux cliché de la frénésie anarchique. Nos quatre années d'observations et d'arrêts sur image nous laissent penser le contraire. Il y a peut-être beaucoup plus de coordination, d'organisation, de tactique, qu'on ne l'avait envisagé jusque là...*

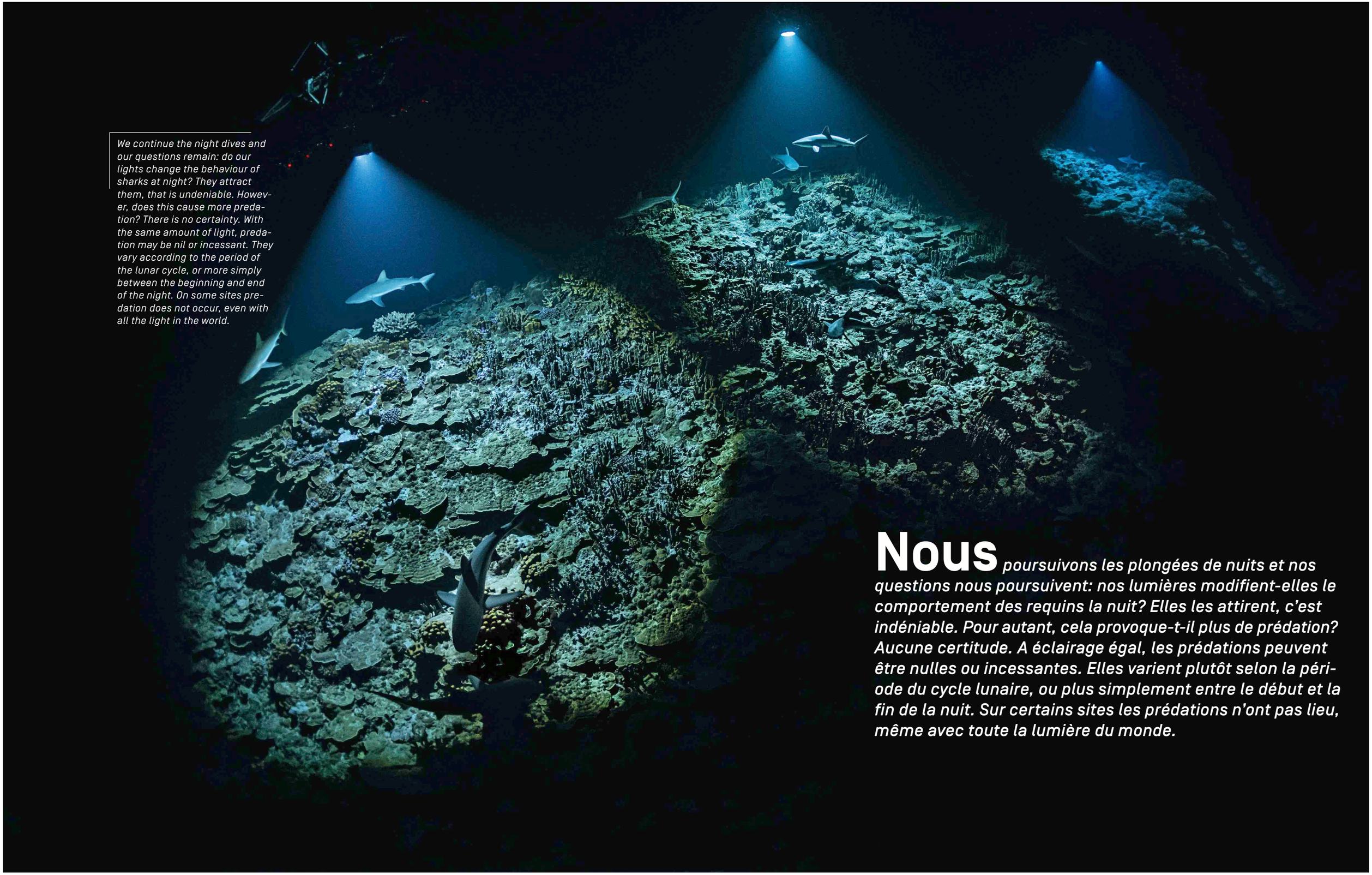
Before our very eyes, the pack of 700 sharks in action acts as one gigantic individual with 700 jaws. The isolated grey shark, on the other hand, is clumsy and ineffective. Its salvation lies in the pack, when all together they synchronise their action. I think we should forget the old cliché of anarchic frenzy. Our four years of observations and freeze-frames suggest otherwise. There is perhaps much more coordination, organisation and tactics than we had previously thought...



The tide shifts and we come out of the dives at midnight... 2 am... and even 4 am, still excited. Cédric is less confident: "If they bite each other, they can bite us just as well" "an involuntary bite won't hurt any less". His immediate thoughts invite caution, but weaken this intuition, which tends to become a conviction: we will never be bitten. But I hardly dare to formulate it...
Then a sudden shock followed by a tingling sensation, different from the usual muzzle blows that sometimes leave a haematoma.

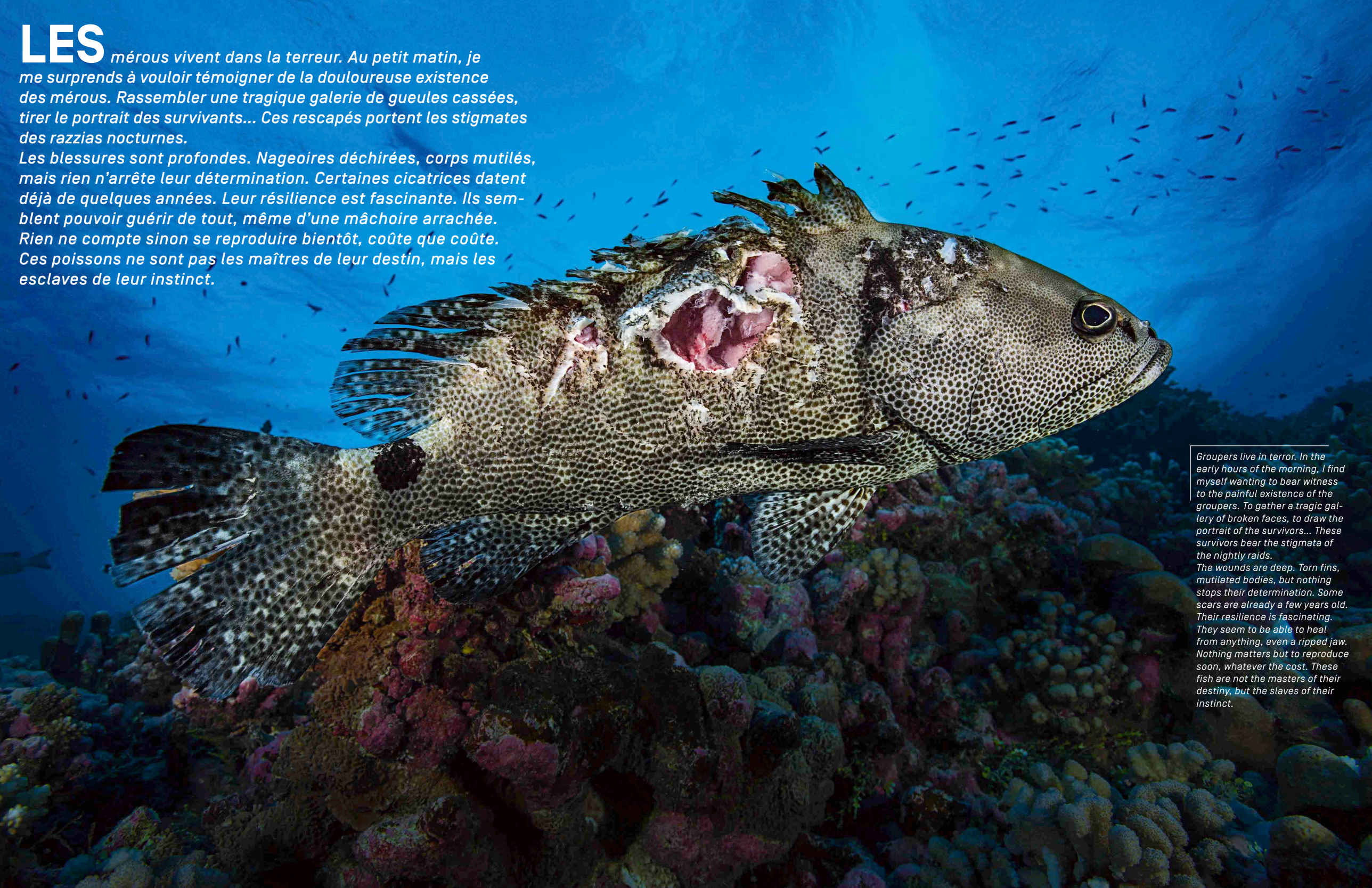
I run my hand over the back of my thigh, and I feel that the suit is torn. It's bleeding, it will need four stitches. Shark bite? My convictions are shaken. Fortunately, two cameras filmed the scene: it was not the shark, but the tailthorn of a large surgeon that cut my skin. The shark held the fish in its mouth and shook it violently behind my leg. The hypothesis still holds: these sharks don't bite us.

La marée se décale et nous sortons des plongées à minuit... 2 heures... et même 4 heures du matin, toujours exaltés. Cédric est moins confiant: «S'ils se mordent entre eux, ils peuvent nous mordre tout pareil» «une morsure involontaire, ça ne fera pas moins mal». Ses réflexions à chaud invitent à la prudence, mais fragilisent cette intuition, qui tend à devenir une conviction: nous ne serons jamais mordus. Mais c'est à peine si j'ose la formuler...
Puis un choc brutal suivi de picotements, différent des coups de museau habituels qui laissent parfois un hématome. Je passe la main sur l'arrière de ma cuisse, et je sens que la combinaison est déchirée. Ça saigne, il faudra quatre points de suture. Morsure de requin? Voilà mes convictions qui vacillent. Heureusement, deux caméras ont filmé la scène: ce n'est pas le requin, mais les écailles-scalpels d'un gros chirurgien qui m'ont tranché la peau. Le squale tenait le poisson dans la gueule et le secouait violemment derrière ma jambe. L'hypothèse tient toujours: ces requins ne nous mordent pas.



We continue the night dives and our questions remain: do our lights change the behaviour of sharks at night? They attract them, that is undeniable. However, does this cause more predation? There is no certainty. With the same amount of light, predation may be nil or incessant. They vary according to the period of the lunar cycle, or more simply between the beginning and end of the night. On some sites predation does not occur, even with all the light in the world.

Nous *poursuivons les plongées de nuits et nos questions nous poursuivent: nos lumières modifient-elles le comportement des requins la nuit? Elles les attirent, c'est indéniable. Pour autant, cela provoque-t-il plus de prédation? Aucune certitude. A éclairage égal, les prédations peuvent être nulles ou incessantes. Elles varient plutôt selon la période du cycle lunaire, ou plus simplement entre le début et la fin de la nuit. Sur certains sites les prédations n'ont pas lieu, même avec toute la lumière du monde.*



LES *mérous vivent dans la terreur. Au petit matin, je me surprends à vouloir témoigner de la douloureuse existence des mérous. Rassembler une tragique galerie de gueules cassées, tirer le portrait des survivants... Ces rescapés portent les stigmates des razzias nocturnes.*
Les blessures sont profondes. Nageoires déchirées, corps mutilés, mais rien n'arrête leur détermination. Certaines cicatrices datent déjà de quelques années. Leur résilience est fascinante. Ils semblent pouvoir guérir de tout, même d'une mâchoire arrachée.
Rien ne compte sinon se reproduire bientôt, coûte que coûte.
Ces poissons ne sont pas les maîtres de leur destin, mais les esclaves de leur instinct.

Groupers live in terror. In the early hours of the morning, I find myself wanting to bear witness to the painful existence of the groupers. To gather a tragic gallery of broken faces, to draw the portrait of the survivors... These survivors bear the stigmata of the nightly raids.
The wounds are deep. Torn fins, mutilated bodies, but nothing stops their determination. Some scars are already a few years old. Their resilience is fascinating. They seem to be able to heal from anything, even a ripped jaw. Nothing matters but to reproduce soon, whatever the cost. These fish are not the masters of their destiny, but the slaves of their instinct.

Pendant *leur grand rassemblement, les mérous dépensent une énergie folle. Ils se battent, paradent, courtisent, sans même plus se nourrir. Les femelles, le ventre dilaté par les œufs qu'elles portent, gardent leur tenue camouflage. Les mâles, eux, l'ont quittée. Ils portent désormais le costume gris des affaires sérieuses. Ils ont consenti au sacrifice, à présent ils exigent un bénéfice. Les mâles mordent les femelles. La reproduction ne saurait plus tarder.*

During their big gathering, the groupers spend a lot of energy. They fight, parade, court, without even feeding. The females, their bellies enlarged by the eggs they are carrying, keep their camouflage outfit. The males, on the other hand, have left it. They now wear the grey suits of serious business. They have made the sacrifice, now they demand a profit. The males bite the females. Reproduction is just around the corner.

Enfin. *Après trois semaines d'efforts et de risques, la femelle malmenée se décide et bondit à la verticale entrainée par le mâle dominant. Elle expulse un épais nuage d'œufs qu'il s'empresse de féconder. Il doit faire vite pour être le premier, car dans la micro seconde qui suit, plusieurs opportunistes con vergent vers le couple. A leur tour, ils inondent la scène de leur semence.*

Seul l'arrêt sur image permet de voir cette priorité du mâle dominant, une courte avance gagnée au prix de farouches rivalités. Trois semaines de combats pour un privilège d'une fraction de seconde.

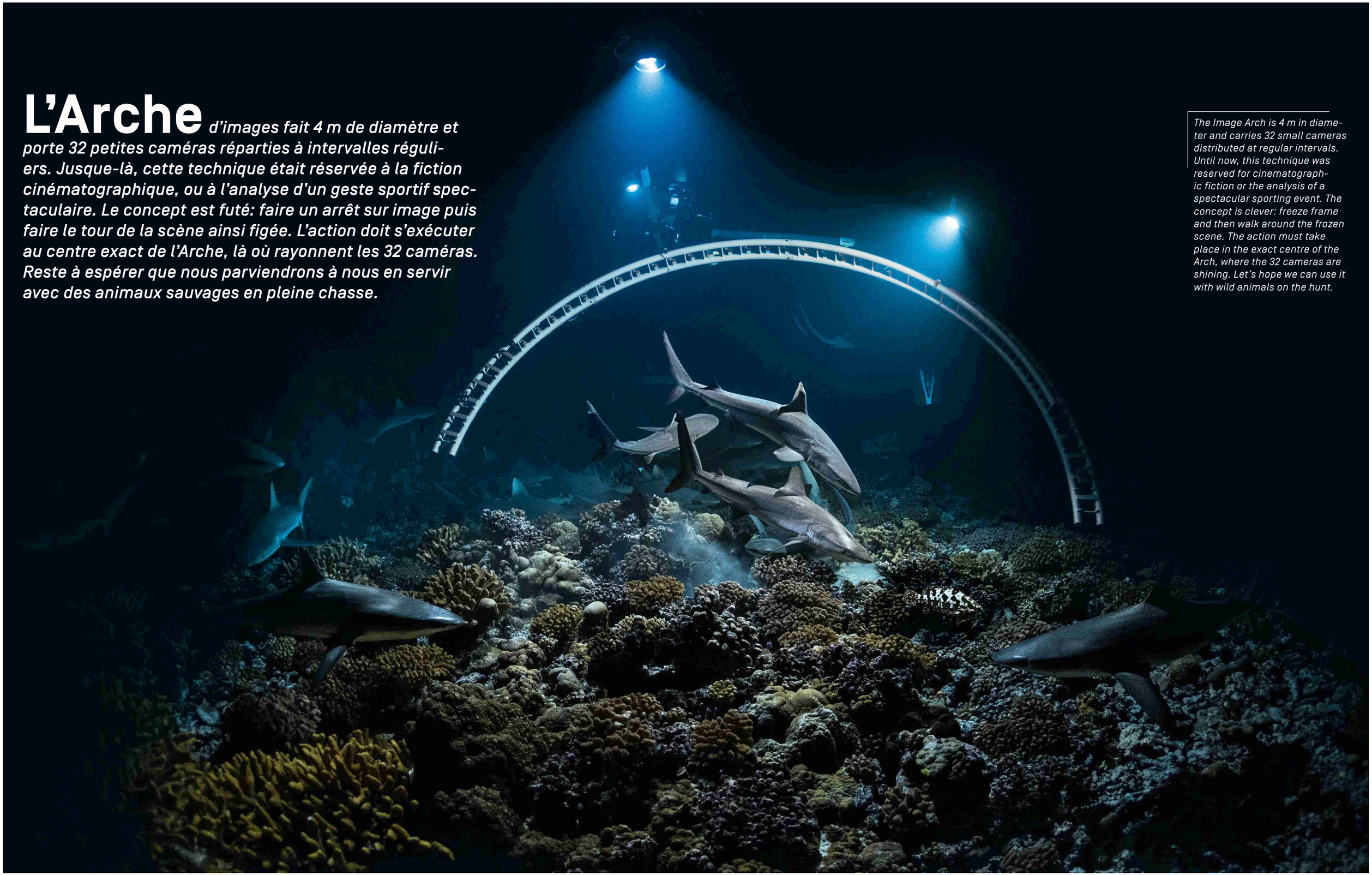
At last. After three weeks of effort and risk, the battered female makes up her mind and leaps upwards, led by the dominant male. She expels a thick cloud of eggs which he hastens to fertilise. He has to be quick to be the first, because in the microsecond that follows, several opportunists converge on the couple. In turn, they flood the scene with their seed. Only the freeze frame allows us to see this priority of the dominant male, a short lead won at the price of fierce rivalries. Three weeks of fighting for a split-second privilege.

La reproduction est passée mais nous continuons les plongées de nuit. Les chasses sont tellement rapides que je ne les découvre souvent qu'après la plongée, de retour à terre. Au petit matin, quand je regarde enfin les images réalisées au cœur de la nuit, j'ai le sentiment d'avoir volé ces instantanés lors de plongées jusque-là interdites par la prudence, ou par l'ignorance. On confond parfois les deux.

The breeding season is over but we continue the night dives. The hunts are so fast that I often only discover them after the dive, back on land. In the early morning, when I finally look at the images taken in the middle of the night, I have the feeling that I have stolen these snapshots during dives that were previously forbidden by prudence, or by ignorance. Sometimes we confuse the two.

Afin *d'en comprendre davantage sur ces chasses qui nous fascinent, nous avons imaginé le moyen de marier la photo et la vidéo : l'Arche d'images. Un vaisseau spatial vole dans le ciel aquatique. Vision de science-fiction dans les eaux de Fakarava. L'Arche traverse la passe après nous avoir traversé l'esprit. L'idée est devenue réalité en quelques mois. La mise en œuvre a été laborieuse. L'enthousiasme a cédé la place à l'entêtement, et elle a vu le jour. Encore faut-il qu'elle nous offre les images inédites dont nous avons rêvé.*

In order to understand more about these fascinating hunts, we have come up with a way of combining photography and video: the Image Arch. A spaceship flies through the watery sky. A sci-fi vision in the waters of Fakarava. The Ark crosses the channel after having crossed our minds. The idea became reality in a few months. The implementation was laborious. Enthusiasm gave way to stubbornness, and it was born. It still has to offer us the unseen images we dreamed of.



L'Arche *d'images fait 4 m de diamètre et porte 32 petites caméras réparties à intervalles réguliers. Jusque-là, cette technique était réservée à la fiction cinématographique, ou à l'analyse d'un geste sportif spectaculaire. Le concept est futé: faire un arrêt sur image puis faire le tour de la scène ainsi figée. L'action doit s'exécuter au centre exact de l'Arche, là où rayonnent les 32 caméras. Reste à espérer que nous parviendrons à nous en servir avec des animaux sauvages en pleine chasse.*

The Image Arch is 4 m in diameter and carries 32 small cameras distributed at regular intervals. Until now, this technique was reserved for cinematographic fiction or the analysis of a spectacular sporting event. The concept is clever: freeze frame and then walk around the frozen scene. The action must take place in the exact centre of the Arch, where the 32 cameras are shining. Let's hope we can use it with wild animals on the hunt.

After ten days of hardship, Antonin and Tybo pilot the Ark with virtuosity and the sequences follow one another. It's like in a fantasy film: the magician stops the clock, so things and people come to a standstill, and then he walks around as he pleases in this suspended space. This is exactly what we want to do, but in the middle of sharks. I can hear the divers screaming underwater when a searing chase scene is captured. I see it as the reconciliation of photography and cinema: stopping time but leaving movement free.

Après *dix jours de galère, Antonin et Tybo pilotent l'Arche avec virtuosité et les séquences s'enchaînent. C'est comme dans un film fantastique: le magicien stoppe l'horloge, alors les choses et les gens s'immobilisent, puis il se promène à sa guise dans cet espace en suspens. C'est précisément ce que nous voulons réaliser, mais au milieu des requins. J'entends les plongeurs crier sous l'eau quand une scène de chasse fulgurante est saisie. Moi, j'y vois la réconciliation de la photo et du cinéma: arrêter le temps mais laisser libre le mouvement.*

The scientific team is analysing the frame-by-frame videos that we have been filming since the first expedition. They allow us to understand the different phases of an attack: first of all, it is undoubtedly the noise that attracts the shark, sight and movement are also important, but in the dark, the shark has an additional advantage: it detects the electromagnetic fields produced by the fish thanks to the sensitive cells that it has all along its mouth - the Ampullae of Lorenzini.

L'équipe *scientifique analyse les vidéos à images/seconde que nous tournons depuis la première expédition. Elles permettent de comprendre les différentes phases d'une attaque : d'abord c'est sans doute le bruit qui attire le requin, la vue et le mouvement comptent aussi beaucoup, mais dans la pénombre, le requin a un atout supplémentaire : il détecte les champs électromagnétiques que produisent les poissons grâce à des cellules sensibles qu'il a tout le long de la gueule - les ampoules de Lorenzini.*

Cette *année, nous espérons suivre 40 requins pour estimer entre autres leur activité, leur vitesse de déplacement, et confirmer les chasses en binômes. Ce suivit à long terme va permettre d'enregistrer tous leurs déplacements pendant une année. Au début de la mission, l'équipe a installé 25 récepteurs acoustiques dans la passe, en vue du marquage. Seule point à résoudre: la capture des requins. Pour l'avoir déjà expérimentée, je trouve la pêche à l'hameçon extrêmement violente. J'ai donc décidé te tenter une nouvelle méthode: saisir le squale à la base de la queue et de le retourner. La technique est connue: le requin tombe alors en catalepsie et devient manipulable. Une seconde avant, le requin, surexcité, était en pleine chasse. La seconde d'après, il est totalement immobilisé. C'est ainsi que nous allons délicatement remonter les 40 requins gris près la surface. Les chercheurs Johann, Charlie et Yannis vont les opérer et leur insérer un petit émetteur dans la cavité abdominale, une opération insignifiante pour le requin qui cicatrise incroyablement vite.*

This year, we hope to track 40 sharks to estimate their activity, speed of movement, and confirm pair hunts, among other things. This long-term monitoring will allow us to record all their movements for a year. At the beginning of the mission, the team installed 25 acoustic receivers in the channel, in preparation for tagging. The only issue to be resolved is the capture of the sharks. Having already experienced it, I find fishing with hooks extremely violent. So I decided to try a new method: grab the shark at the base of its tail and turn it over. The technique is well known: the shark then falls into tonic immobility and becomes manageable. One second before, the shark was excited and hunting. The next second, it is completely immobilised. This is how we will carefully bring the 40 grey sharks to the surface. Researchers Johann, Charlie and Yannis will operate on them and insert a small transmitter into their abdominal cavity, an operation that is insignificant for the shark, which heals incredibly quickly.

Tactics of encircling prey by sharks, amorous fluttering of groupers. We are proud of all these images and yet they are only a small glimpse into the great Secrets of the Oceans. Can it be otherwise? What can we know about these liquid expanses that occupy 2/3 of the globe? Worse: if we think in terms of volume where life is possible, then the oceans represent about 95% of this planet that we have so poorly named Earth. This Planet Seas, vast and deep, how can we believe we know it, we, poor primates without gills?

Tactiques *d'encerclement des proies par les requins, voltiges amoureuses des mérous. Nous sommes fiers de toutes ces images et pourtant elles ne sont qu'un petit éclairage sur les grands Secrets d'Océans. Peut-il en être autrement ? Que pouvons-nous savoir de ces étendues liquides qui occupent les 2/3 du globe ? Pire : si l'on résonne en volume où la vie est possible, alors les océans représentent environ 95% de cette planète que l'on a si mal nommé Terre. Cette Planète Mers, vaste et profonde, comment peut-on croire la connaître, nous autres, pauvres primates dépourvus de branchies ?*

Pendant *21 semaines cumulées sur quatre années, nous avons plongé tous les jours et toutes les nuits. A nous tous, c'est environ 3000 heures sous la surface, toujours au même endroit. J'ai aimé cette agréable discipline de la répétition, mes camarades aussi, je crois. Recréer ailleurs de nouvelles routines, c'est peut-être cela l'aventure.*

For 21 weeks over four years, we dived every day and night. Between us, that's about 3000 hours under the surface, always in the same place. I liked this pleasant discipline of repetition, and I think my comrades did too. Recreating new routines elsewhere is perhaps the adventure.

Observer *c'est chercher à expliquer la réalité, photographier c'est tendre à la sublimer. Les scènes de chasse et de ponte vont si vite qu'elles échappent au regard. Alors, bien qu'instinctive, seule reste la prise de vue pour répondre aux deux désirs: comprendre et contempler. 85 000 déclenchements en quatre voyages sur quatre années. Depuis la préhistoire, les hommes fascinés par le monde sauvage qui les entoure ont éprouvé cet impérieux besoin de l'illustrer. Autrefois, l'homme des cavernes et ses peintures rupestres, aujourd'hui des plongeurs et leurs clichés en haute définition. Ne serait-ce pas la continuité d'une même tradition picturale? A travers les âges, c'est peut-être le même hommage, dérisoire mais rassurant, à l'inexplicable beauté de la nature. Sous la mer la curiosité ne s'émousse pas, elle s'aiguise au fil de l'eau. Quand les temps de plongée s'allongent, le besoin de contempler grandit. Paradoxe de ces milliers d'heures en immersion pour ne saisir que de furtives tranches de vie sauvage, des instincts de requins, des pulsions de poissons... d'inoubliables instants d'océans. Envie encore de les saisir. Il faudra revenir.*

To observe is to try to explain reality, to photograph is to try to sublimate it. Hunting and egg-laying scenes move so fast that they escape the eye. So, although instinctive, the only thing left to do is to take pictures in order to respond to the two desires: to understand and to contemplate. 85,000 shots in four trips over four years.
Since prehistoric times, people have been fascinated by the wild world around them and have felt the pressing need to illustrate it. In the past, cavemen and their cave paintings, today divers and their high-definition photographs. Is this not the continuity of the same pictorial tradition? Through the ages, it is perhaps the same tribute, derisory but reassuring, to the inexplicable beauty of nature.
Under the sea, curiosity does not wane, it is sharpened by the water. When the diving time gets longer, the need to contemplate grows. The paradox of thousands of hours of immersion to capture only furtive slices of wild life, shark instincts, fish impulses... unforgettable moments of the ocean. I still want to capture them. We will have to come back.

L'archipel *des Tuamotu est formé de 76 atolls éparpillés sur 1600 km. Sur la carte du Pacifique, leurs traits n'apparaissent même pas. Ces fantômes d'anciens volcans sont pourtant bien vivants. A mes yeux, ils sont une chaîne de montagnes dont on ne connaitrait que les sommets. La plongée profonde devient de l'alpinisme à l'envers. En 2017, notre bateau a couru de sommet en sommet avec, à chaque relais, l'espoir de quelques ascensions négatives.*

On peut voir l'atoll comme un simple disque de corail, tout plat, affleurant à la surface, ou bien comme une couronne vivante posée sur une aiguille rocheuse de 2000 mètres de hauteur. Selon que le regard est terrien ou sous-marin, l'atoll corallien est une île qui porte du végétal ou un animal qui porte une île. Il y a deux visions possibles.

D'un coté la noble entreprise des minuscules polypes de corail qui construisent le récif, de l'autre, les forces de l'océan qui le détruisent. Mais si les coraux bâtisseurs n'avaient nulle contrainte, le récif serait monolithique, lisse, privé de relief, de fractures, pauvre en diversité. Il faut croire qu'à bâtir sans obstacles, on s'élève sans éclat.

À 120 m de profondeur, les parois que nous parcourons sont vertigineuses. On s'étonnerait presque que la quiétude des grands fonds abrite des reliefs si tourmentés. Ce serait oublier qu'il y a 20 000 ans, la mer était 120 m plus bas. Ce que nous voyons là, sont les vestiges d'un ancien littoral battu par les vagues et la houle d'une autre époque. Descendre dans les profondeurs, c'est remonter dans le temps.

Le long des parois obscures brillent d'intrigants couloirs blancs. L'érosion du récif près de la surface engendre, 100 m plus bas, ces chutes de sable. Les cascades suivent au ralenti de profondes entailles verticales. A croire que les coraux torturés pleurent sur les joues de l'atoll et que vers les abysses coulent des larmes de sable.

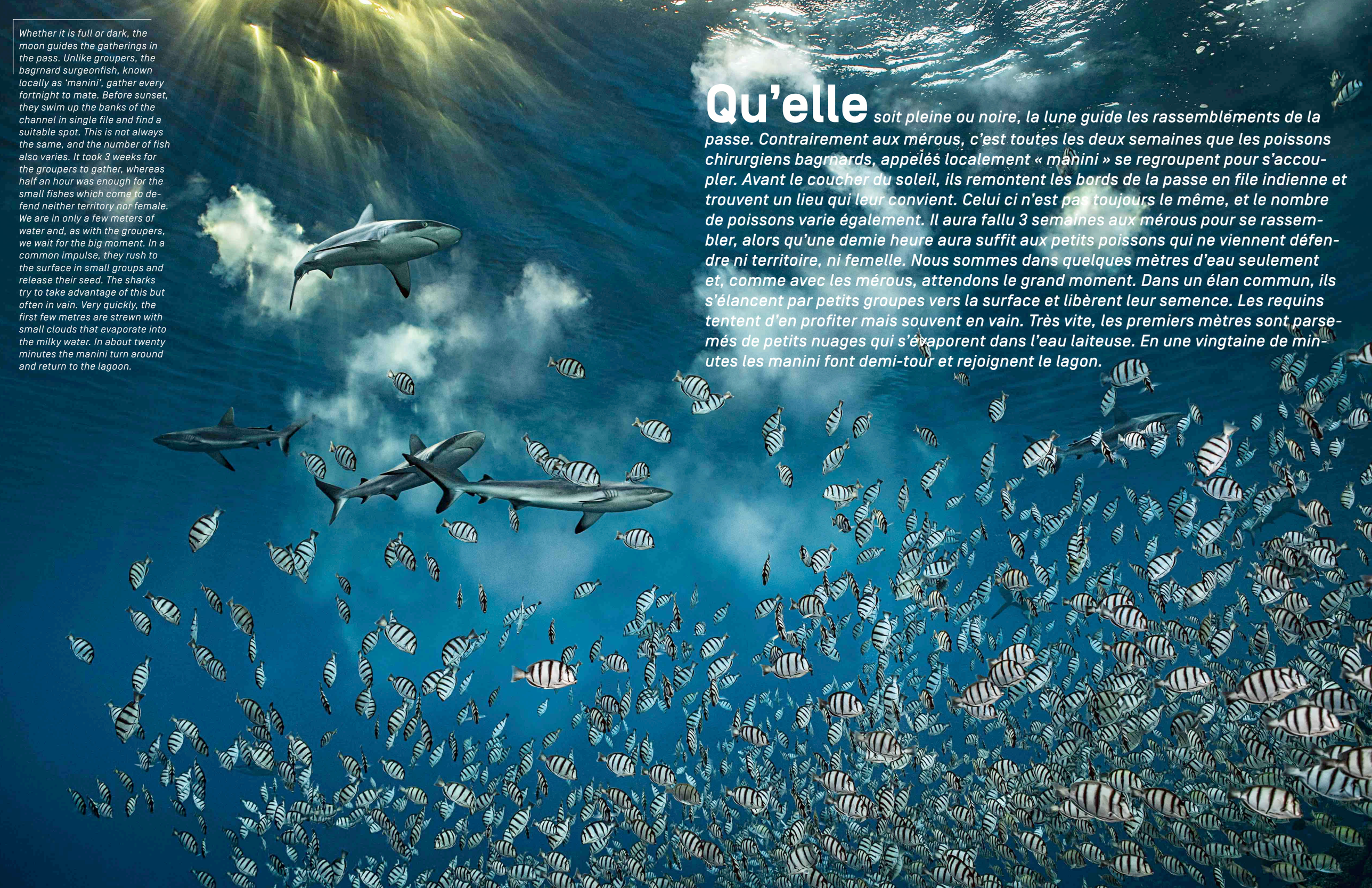
The Tuamotu archipelago is made up of 76 atolls scattered over 1600 km. On the Pacific map, their features do not even appear. Yet these ghosts of ancient volcanoes are very much alive. In my eyes, they are a mountain range of which only the summits are known. Deep diving becomes mountaineering in reverse. In 2017, our boat raced from peak to peak with the hope of a few negative climbs at each stop.

The atoll can be seen as a simple, flat coral disc, just touching the surface, or as a living crown on a 2 000-metre-high rocky spike. Depending on whether one looks at it from the land or from the sea, the coral atoll is an island that bears plants or an animal that bears an island. There are two possible visions.

On the one hand, the noble enterprise of the tiny coral polyps that build the reef, on the other, the forces of the ocean that destroy it. But if the coral builders had no constraints, the reef would be monolithic, smooth, devoid of relief and fractures, poor in diversity. It seems that if you build without obstacles, you rise without a sparkle.

At a depth of 120 m, the walls we walk along are vertiginous. One would almost be surprised that the quietness of the deep sea shelters such tormented reliefs. This would be to forget that 20,000 years ago, the sea was 120 m lower. What we see here are the remains of an ancient coastline beaten by the waves and swell of another era. To go down into the depths is to go back in time.

Intriguing white corridors shine along the dark walls. The erosion of the reef near the surface creates these sand falls 100 metres below. The waterfalls follow deep vertical cuts in slow motion. It is as if the tortured corals are crying on the cheeks of the atoll and tears of sand are flowing towards the abyss.



Whether it is full or dark, the moon guides the gatherings in the pass. Unlike groupers, the bagrnard surgeonfish, known locally as 'manini', gather every fortnight to mate. Before sunset, they swim up the banks of the channel in single file and find a suitable spot. This is not always the same, and the number of fish also varies. It took 3 weeks for the groupers to gather, whereas half an hour was enough for the small fishes which come to defend neither territory nor female. We are in only a few meters of water and, as with the groupers, we wait for the big moment. In a common impulse, they rush to the surface in small groups and release their seed. The sharks try to take advantage of this but often in vain. Very quickly, the first few metres are strewn with small clouds that evaporate into the milky water. In about twenty minutes the manini turn around and return to the lagoon.

***Qu'elle** soit pleine ou noire, la lune guide les rassemblements de la passe. Contrairement aux mérous, c'est toutes les deux semaines que les poissons chirurgiens bagrnards, appelés localement « manini » se regroupent pour s'accoupler. Avant le coucher du soleil, ils remontent les bords de la passe en file indienne et trouvent un lieu qui leur convient. Celui ci n'est pas toujours le même, et le nombre de poissons varie également. Il aura fallu 3 semaines aux mérous pour se rassembler, alors qu'une demie heure aura suffit aux petits poissons qui ne viennent défendre ni territoire, ni femelle. Nous sommes dans quelques mètres d'eau seulement et, comme avec les mérous, attendons le grand moment. Dans un élan commun, ils s'élancent par petits groupes vers la surface et libèrent leur semence. Les requins tentent d'en profiter mais souvent en vain. Très vite, les premiers mètres sont parsemés de petits nuages qui s'évaporent dans l'eau laiteuse. En une vingtaine de minutes les manini font demi-tour et rejoignent le lagon.*

No Fin, No Future | Tanpa Sirip Hiu, Tidak Ada Masa Depan
Nusa Penida, Indonesia | September 2018
Cinzah Merkens | @mrcinzah | cinzah.com

A Drop of Paint Can Create an Ocean of Change

Celebrating a Decade of Art and Activism

Written by Akira Biondo
Director of Operations at PangeaSeed Foundation
Co-founder of the Sea Walls: Artists for Oceans program

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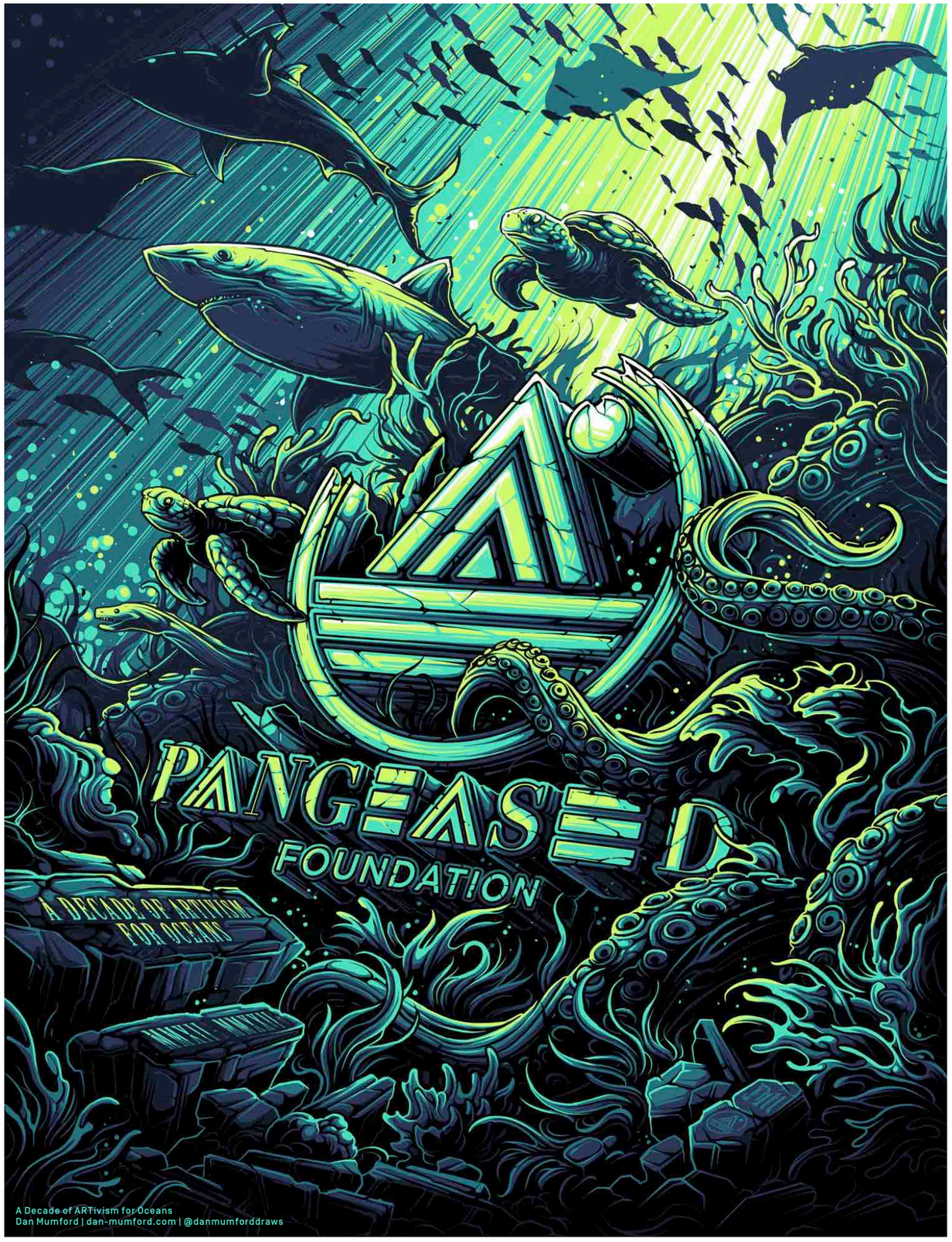
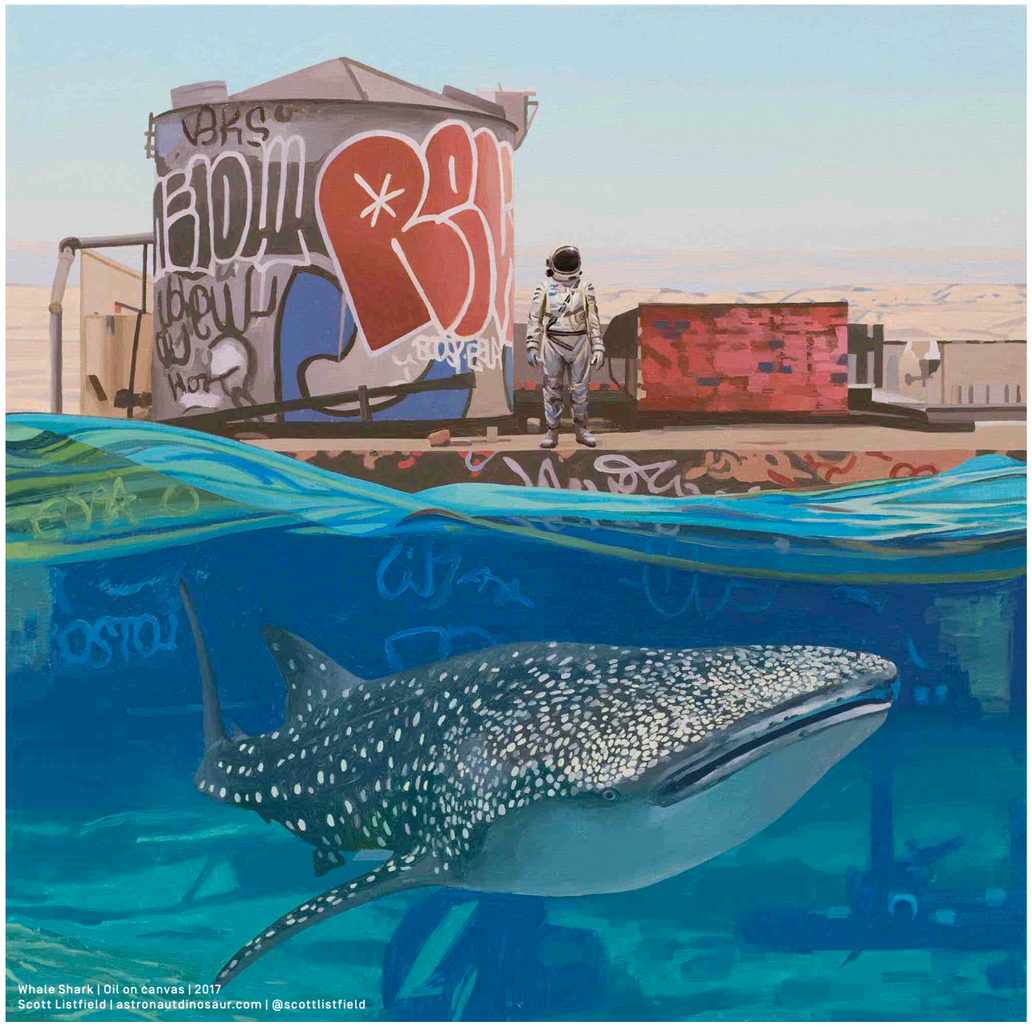
100 Million | San Diego, California, USA | September 2016
Cinzah Merkens | @mrcinzah | cinzah.com



A Decade of ARTivism for Oceans
Dan Mumford | dan-mumford.com | @danmumforddraws



Whale Shark | Oil on canvas | 2017
Scott Listfield | astronautdinosaur.com | @scottlistfield

Once a budding, grassroots shark conservation group in Tokyo, Japan, PangeaSeed Foundation has evolved to become the foremost international organization acting at the intersection of culture and environmentalism to further the conservation of our oceans.

Over the past ten years, their focus has expanded from sharks to broader marine conservation topics they address through their various ARTivism-driven programs.

Established in 2014, Sea Walls: Artists for Oceans is a globe-spanning public art initiative that brings the ocean into streets across the globe. Collaborating with an ever-growing network of 400+ artists, PangeaSeed Foundation has curated and produced over 500 murals in 19 countries worldwide, each shining a spotlight on locally relevant marine environmental matters.

Working hand in hand with community organizers, activists, researchers, and governments, their flagship projects each feature the creation of 10-15 murals alongside a suite of community outreach events to foster long-term community involvement in localized conservation efforts.

In addition to these large-scale street art installations, the Printed Oceans program is a vehicle that PangeaSeed Foundation has utilized to drive engagement through the regular release of limited-edition fine art prints. Highlighting endangered marine species, habitats, and pressing ocean issues, Printed Oceans has allowed them to bring ARTivism into the homes, offices, and classrooms of people across the globe, where these works of art continue to spark critical conversations about everyone's role in protecting our oceans for future generations.

Throughout their work, the power and relevance of (public) art are undeniable with its ability to evoke emotion and revitalize and beautify once-decaying streetscapes with messages of hope and urgency. By harnessing this incredible medium, PangeaSeed Foundation is (re)connecting and educating coastal and landlocked communities with the planet's most important ecosystem: our ocean.

Now, having celebrated a decade of dedication to giving our oceans a creative voice, they plan on continuing their mission to inspire ocean stewardship and action through science, education, and ARTivism in new and exciting ways.

The following is a small selection of Sea Walls murals and artworks created for the Printed Oceans program that showcase sharks and rays.

Learn more about PangeaSeed Foundation and Sea Walls: Artists for Oceans at pangeaseed.org and seawalls.org.

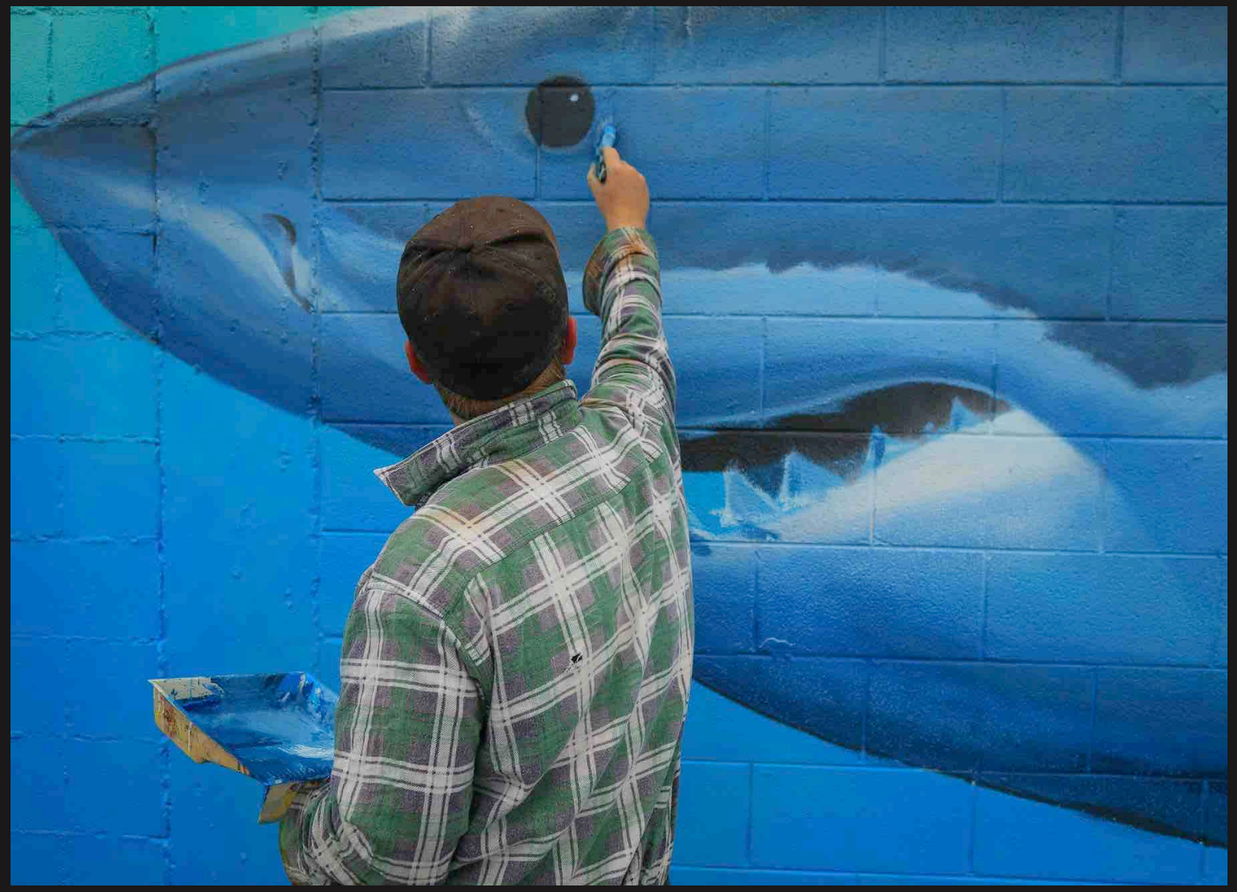
Su Vida Es Nuestra Vida | Cozumel, Mexico | May 2019
Alegria Del Prado | @alegriadelprado

Rob Stewart (@TeamSharkwater)
Tribute Mural | Toronto, Canada |
GETSO (@getsofacto) & bird0 (@JerryRugg)

Translucent Whale Shark |
Cancun, México | July 2017 | Nychos |
@nychos | rabbiteyemovement.at

Beyond Boundaries | Santa Cruz, California, USA | September 2021
David Rice | @d_j_rice | xplrstudios.com

Sharkwater | Napier, New Zealand | March 2017
Freeman White | @freemanwhiteart | freemanwhite.art



In Our Hands | St. Croix, U.S. Virgin Islands | December 2019
Sabek | @sabekns

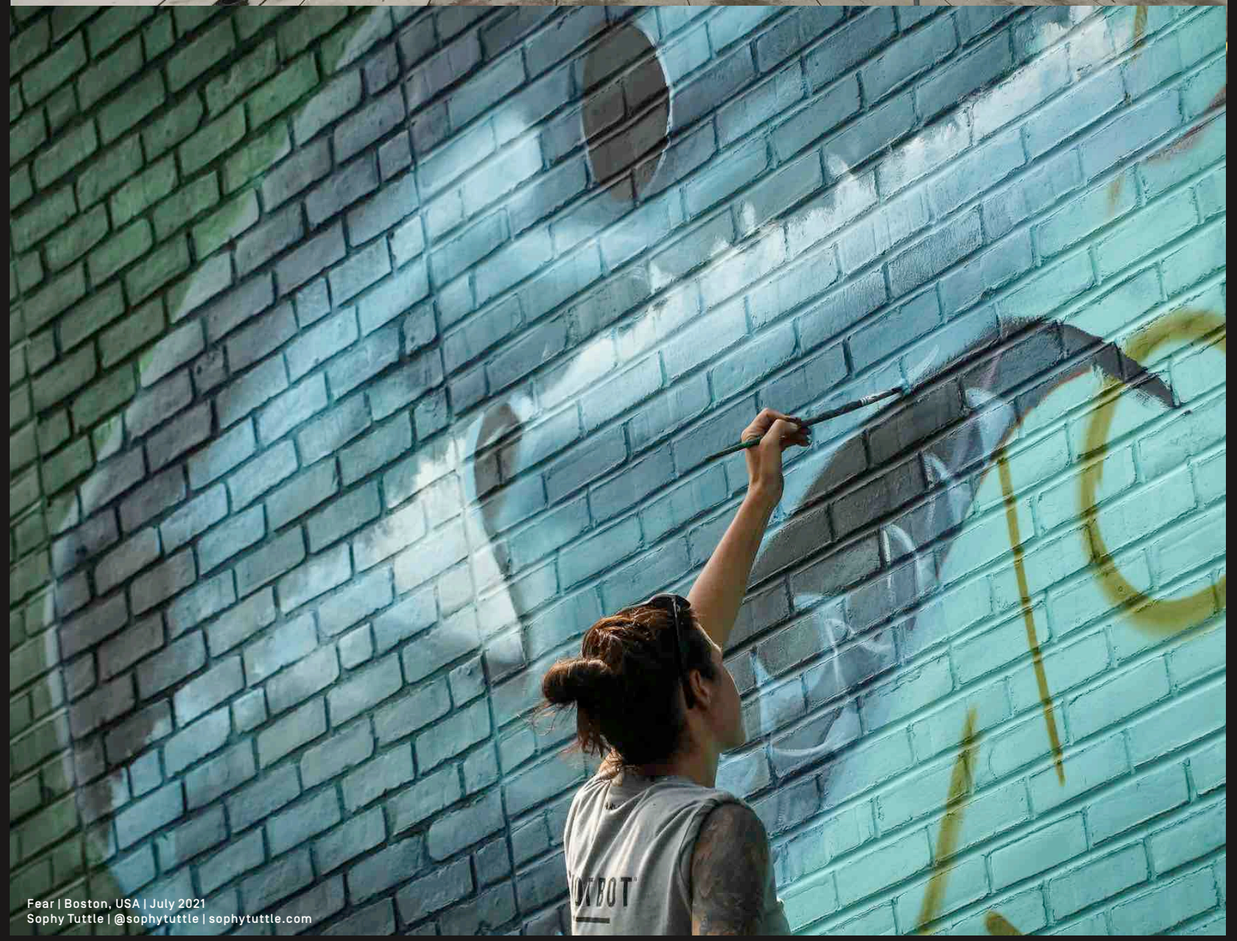
Convenience = Consequence | Cairns, Australia | May 2018
Fuzeillear | @fuzeillear | fuzeillear.com

Light Workers: The Hues of the Hiu
Nusa Penida, Indonesia | September 2018
Marissa Quinn | @marissaquinn | marissaquinn-art.com

Moriría Por Ti | Isla Mujeres, Mexico | July 2014
Tristan Eaton | @tristaneaton | tristaneaton.com

Untitled | Isla Mujeres, Mexico | July 2014
David 'Meggs' Hooke | @houseofmeggs |
davidmeggshooke.com

Change the Cycle | St. Croix, U.S. Virgin Islands | December 2019
Taj Francis | @tajfrancis | tajtenfold.com



Fear | Boston, USA | July 2021
Sophy Tuttle | @sophytuttle | sophytuttle.com

Sea Capsule | Bimini, Bahamas | October 2021
Tratos | @11tratos | 11tratos.com

Photo by Brooke Pyke | Ningaloo Reef Photos

Funding Opportunities

PADI Foundation

padifoundation.org

Deadline for application: January 15, 2023

The PADI Foundation encourages and supports research and education related to aquatic environments. The Foundation will fund and assist worthwhile projects that either:
- Enrich mankind's understanding of aquatic environments and encourage sensitivity to and protection of ecosystems.
- Increase understanding of sport diving physics and physiology that will benefit the general diving public and add to the scientific understanding of man's relationship and ability to survive in the underwater environment.
- Improve understanding of, and response to, hazards to humans and ecosystems related to climate change in coastal and ocean environments.

Mohamed bin Zayed Species Conservation Fund

speciesconservation.org/grants/

Deadline for application: February 28, 2023

The Fund has been established to provide targeted grants to individual species conservation initiatives, recognize leaders in the field and elevate the importance of species in the broader conservation debate. Its focus is global and eligibility for grants will extend to all plant, animal, and fungi species conservation efforts, without discrimination on the basis of region or selected species.
The Fund was established to support species conservation work, so if your project is not about an endangered species it is probably not worth your while submitting an application.
The Fund will use the IUCN Red List as the primary guide to the conservation status of a given species, although documented variations for sub-species, distinct populations, and sub-populations will be taken into account.
Grants will be awarded based on their ability to meet criteria pre-determined by the Species Fund, and are for a maximum of $25'000 for each project.

National Geographic Explorers

nationalgeographic.org/society/grants-and-investments/

Deadline for application: April 12, 2023 @ 11:59 PM EDT

The National Geographic Society funds individuals working on science, conservation, storytelling, education, and technology projects that align with one or more of our focus areas.
And we don't just support their incredible work. We actively seek to help them network, connect, and learn with National Geographic and each other, empower them with cutting-edge tools, technology, and training, and further their impact and recognition through our storytelling.
Level I Grants are designed for individuals who may be earlier in their career, those looking to establish themselves better in their field, those seeking mentorship from others in their field and beyond, or those who want to grow their network and enhance their impact by joining a global community of National Geographic Explorers. Funding requests at this level can be up to USD $20,000. Projects can be up to one year in length, although projects with "Technology" as the primary focus can be up to two years.
If you are more established in your field, have previously received a National Geographic Society grant, or are seeking a higher level of funding, you may apply for a Level II Grant. You are not required to have previously received a National Geographic Society grant to apply for this opportunity. These grants are highly competitive and reserved for select projects that push boundaries to achieve significant and tangible impact in your field. Projects can be up to two years long. Level II Grant recipients receive funding up to $100,000. Smaller

Upcoming Meetings

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.

IMPAC 5

5th International Marine ProtectedAreas Congress (IMPAC5)
February 3 - 9, 2023
Vancouver, Canada
impac5.ca

International Marine Protected Areas Congresses (IMPAC) are an opportunity for the global community of marine conservation managers and practitioners to exchange knowledge, experience and best practices to strengthen the conservation of marine biodiversity and to protect the natural and cultural heritage of the ocean.

IMPAC5 will be jointly hosted by the Host First Nations — Musqueam Indian Band, Squamish Nation, and Tsleil-waututh Nation — together with the Province of British Columbia, the Government of Canada, the Canadian Parks and Wilderness Society (CPAWS) and the International Union for the Conservation of Nature (IUCN).

IMPAC5 is an opportunity to bring together Indigenous peoples and cultures from around the world to embrace a collaborative approach and learn from Indigenous leadership in ocean conservation.

Join thousands of marine protected area professionals from around the world to chart a course towards protecting 30% of the ocean by 2030. Learn about traditional marine protection practices and innovative sustainability initiatives from local and international indige

4th Meeting of the Signatories to the Memorandum of Understanding on the Conservation of Migratory Sharks

February 28 – March 2, 2023
CMS Secretariat, United Nations Campus, Platz der Vereinten Nationen 1, 53113 Bonn, Germany
cms.int/en/SharksMOS4

The 4th Meeting of Signatories (MOS4) to the Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MOU) will be open for Signatories. As per the Rules of Procedure, non-Signatory Range States, Cooperating Partners, the United Nations, its Specialized Agencies, non-Signatory States, or any relevant scientific, environmental, cultural, fisheries, or technical body, including governmental or non-governmental organizations, concerned with the conservation and management of sharks may participate as observers.

5th Asia-Pacific Coral Reef Symposium (APCRS)
June 19 – 23, 2023
National University of Singapore (NUS)
apcrs2023.org

The Asia-Pacific is a region of global significance. Most of its nations are undergoing rapid economic growth, but importantly it also cradles more than half of the world's marine species, with coral reefs being among the most crucial ecosystems distributed within the biodiversity hotspots that encompass Southeast Asia and northern Australia. Despite their importance, coral reefs here are threatened by a variety of stressors, including coastal modification and rapid climate change, giving rise not only to ecological implications but also to socio-economic impacts.

To draw attention to these threats and to work together towards practical solutions, the 1st Asia-Pacific Coral Reef Symposium was organised in 2006 to provide a platform for scientists, educators, managers, environmentalists, and other stakeholders in the region to share their knowledge and expertise on the fields of coral reef biology, ecology, management, and conservation, with the intention of forging greater cooperation and effective programs for collaboration to preserve our common marine natural heritage.

Held every four years and hosted by different institutions in the region, the number of participants has increased steadily from 250 in the first Symposium to more than 500 in the fourth Symposium. The expanding networks of people involved in the event illustrate the ever-growing interest and urgency in conserving coral reefs and marine resources in the region.

With the theme 'Coral reef science and management in a rapidly changing world', the 5th APCRS will continue to be a forum for reef scientists and managers to present, discuss and integrate the science and conservation of Asia-Pacific coral reef ecosystems. Ultimately, we hope the region's scientific community can come together to create new paradigms to meet the key challenges to the region's reefs in the future.

11th Indo-Pacific Fish Conference (IPFC) and the Annual Conference of the Australian Society for Fish Biology (ASFB)
November 20 – 24, 2023
The University of Auckland, Auckland, New Zealand
ipfc11-asfb.ac.nz

The Indo-Pacific Fish Conference (IPFC), held every four years, is undoubtedly one of the world's premier ichthyological conferences and is eagerly anticipated by marine, estuarine and freshwater fish enthusiasts alike.

The Australian Society for Fish Biology (ASFB), founded in 1971, aims to promote research, education, and management of fish and fisheries across the Indo-Pacific.

We are excited to bring these two conferences together in a joint meeting that will reflect the extraordinary biological, environmental and cultural diversity of the vast Indo-Pacific region.

IUCN SSG Sponsors & Supporters

The IUCN SSC Shark Specialist Group is fiscally sponsored by Re:wild, a 501(c)(3) non-profit organization with headquarters in Austin, TX, USA (tax ID: 26-2887967).

Sharks and rays need you.
Please donate and help us make a difference.

Sharks and rays are some of the most threatened species in the world, more so than land animals. Populations are declining at alarming rates and 37% of species are already threatened with extinction. With your support we can find solutions and take actions to conserve these incredible animals before it is too late.

The IUCN SSC Shark Specialist Group achievements over the last 30 years have been possible due to the generous support of funders, members, and other volunteers from countless organizations. Our members volunteer their time, effort and expertise to advance our mission and vision.

We would like to express our most sincere gratitude for the generous grants, collaborations, and support to our group, our teams, our projects, and our efforts. We appreciate the support that has been provided over the years and look forward to continuing our journey and endeavors together into the future.

ATLANTIS DUBAI

Shark Conservation Fund

WHITE SHARK

save our seas foundation

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

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