saveourseas

THE SAVE OUR SEAS FOUNDATION MAGAZINE

OCEAN OPTIMISM | 20 YEARS | LEGACY | N° 12

NOTE ON THE COVERS

Front cover: Endemic pyjama catsharks are found in kelp forests and on rocky reefs in South Africa, and nowhere else in the world.

Photo by Mac Stone | © Save our Seas Foundation

Back cover: The SOSF Founder trails a respectful distance from a manta ray in an awe-filled encounter.

Photo © Christopher Vaughn Jones

Twenty years of research has broadened the diversity of species under investigation, expanding from a focus on large, charismatic sharks to include smaller mesopredators and important rays and skates. The education around sharks now promotes their functional diversity and ecosystem importance. Finally, we're learning more about critical shark habitats and how to protect them best.

EDITOR'S LETTER

Twenty years of shark conservation, research and education required some kind of celebration. And we hope that this 12th issue of *Save our Seas*, the magazine of the Save our Seas Foundation (SOSF), is an uplifting and insightful tribute to two decades of work by passionate people across the planet.

We are delighted to share for the first time in this magazine the personal story and insights from the Founder of SOSF, His Excellency Abdulmohsen Abdulmalik Al-Sheikh. He sat down with Oscar-winning filmmaker Pippa Ehrlich to talk about falling in love with sharks, shifting perceptions, and what our contribution can mean if we know what we have to thank our planet for.

In his photographic portfolio, *National Geographic* photographer and storyteller Thomas Peschak takes us into *Wild Seas*. We celebrate sharks, and the other marine animals that share their ocean home, confront some of the challenges they still face, and reflect on our place alongside the other lives on this planet.

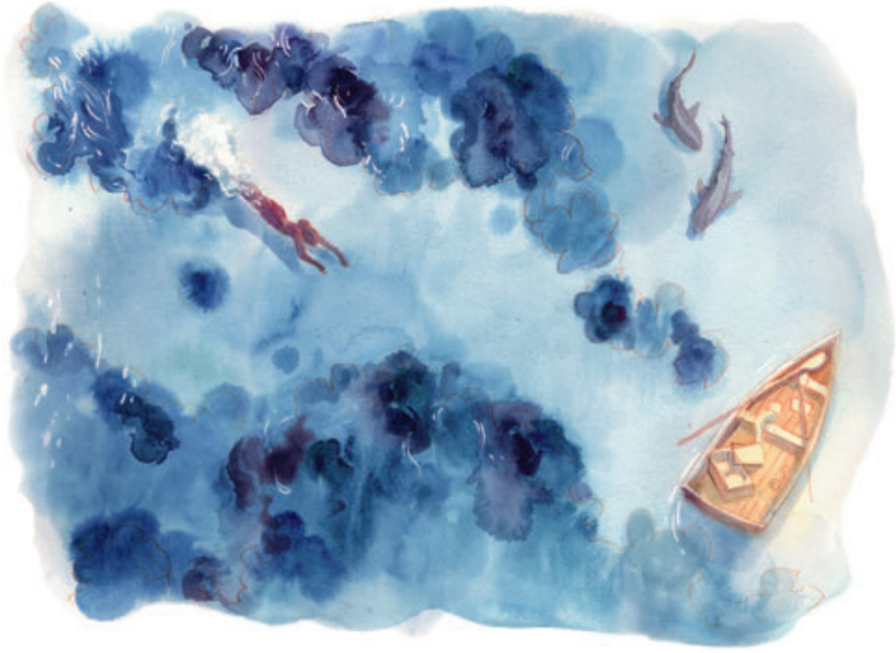
We are particularly excited to present the stories from our Scientific Advisors, and the Directors of our Centres from around the world, in an entirely new light. Dr Dean Grubbs, Dr Andrew Chin and Sarah Fowler (OBE) sit down to discuss well over 30 years of shark conservation: what has been achieved, where are the gaps – and where are we heading? Dr Helen Scales, author of *Spirals in Time*, *The Brilliant Abyss* and *What A Shell Can Tell*, opens our eyes to the work of Professor Mahmood Shivji and the SOSF Shark Research Center in a way that helps us see what the relevance of conservation genetics is to our lives in *DNA: Why it Matters*. Dr Isla Hodgson poses the important question of how we introduce children to the sheer awe of nature, in a world increasingly burdened by environmental issues and responsibilities. Her writing is beautifully accompanied by the whimsical visuals of illustrator Rebecca Traunig, who recalls what wonder the world can bring to a child if they are only guided to experience its joys. And Lois Flounders journeys to the Western Indian Ocean to explore the biodiversity lifeboat that is D'Arros Island and St Joseph Atoll.

We hope you have fun exploring the Ocean Fun section and close the final pages of this edition feeling energised by a new idea of the future. If the vision of the team who made this magazine happen, and the passion of all whose work is reflected in its pages is anything to go by, we have much hope to hold onto.

Dr Lauren De Vos
Editor-in-chief

2023 dawns differently in shark science, conservation and education. Twenty years has seen us battling familiar issues and presented new challenges, but has brought about exciting changes and significant growth (page 38).

Photo © Matthew During



Fostering a sense of wonder and curiosity for our oceans in a world increasingly burdened by environmental issues is the challenge we face when introducing children to the sea (page 88).

Illustration by Rebecca Traunig

D'Arros Island and St Joseph Atoll may be a lifeboat for biodiversity in the Western Indian Ocean, and they are a bright gem in the Seychelles' ocean crown (page 72).

Photo © Christopher Vaughn Jones

Pippa Ehrlich
FILMMAKER AND CONSERVATION STORYTELLER

Pippa specialises in stories about conservation, science and the relationship between people and the natural world. She co-directed *My Octopus Teacher*, a film that garnered attention worldwide and won more than 20 awards. For the past seven years she has been a part of the Sea Change Project, documenting and exploring the underwater forests of Cape Town to capture stories to assist its long-term protection. Pippa previously worked for the Save Our Seas Foundation as an environmental journalist, collaborating with some of the world's top marine researchers and underwater photographers.

See page 06

Lois Flounders
MARINE BIOLOGIST AND SCIENCE COMMUNICATOR

Whilst on land (a rare occurrence), Lois works as a fisheries and elasmobranch specialist, which takes her to far-flung corners of the world to engage with fisheries communities and industries from the Maldives to Micronesia. The goal? To make global fishing efforts more sustainable! When it comes to writing, Lois is on a mission to make marine science and conservation mainstream, scrapping the scientific jargon to ensure that science goes beyond the journals and is accessible to all. Lois is a frequent contributor to the Save Our Seas Foundation's website Ocean News.

See page 72

Thomas Peschak
NATIONAL GEOGRAPHIC PHOTOGRAPHER,
EXPLORER AND STORYTELLING FELLOW

Thomas specialises in documenting the beauty and fragility of the world's oceans, islands and coastlines. Originally trained as a marine biologist, he embraced photojournalism 20 years ago after realising that his photographs could have greater conservation impact than scientific data. Thomas is the Director of Storytelling for the Save Our Seas Foundation, an organisation he has been an integral part of for more than 15 years. *Wild Seas* is a collection of his remarkable images from wild ocean locales around the globe.

See page 16

Lauren De Vos
MARINE BIOLOGIST AND SCIENCE WRITER

Reading and the natural world are two of Lauren's enduring loves. For her whole life, Lauren has cherished the words of natural history and travel writers that could transport her across this planet, and the wildness of her South African home. A career in marine biology prompted a passion for sharing her findings and the challenges facing our planet. As the full-time science writer for the Save Our Seas Foundation, she now turns the science of project leaders into stories, hoping to inspire and challenge readers, and galvanise action for our oceans.

See page 30, 38 and 102

Helen Scales
MARINE BIOLOGIST, WRITER AND BROADCASTER

Helen is a marine biologist, writer and broadcaster based in Cambridge, UK and the west coast of France. Her books include *The Brilliant Abyss*, the *Guardian* bestseller *Spirals in Time*, and titles for young readers including *What a Shell Can Tell* and the *Scientists in the Wild* series. Her writing regularly appears in the *Guardian*, *New Scientist* and *National Geographic*. She collaborates on ocean projects with artists, musicians, game designers, photographers and filmmakers, and is a Save Our Seas Foundation storytelling ambassador.

See page 58

Isla Hodgson
MARINE SOCIAL SCIENTIST AND SCIENCE COMMUNICATOR

Based on the west coast of Scotland, Isla's love for sharks grew from one of the most iconic Scottish species – the basking shark. She soon realised how little her friends and family knew about these incredible animals, and this drove her to start communicating science as well as conducting it. She now works for the Save Our Seas Foundation, producing its official podcast World of Sharks, while at the same time carrying out her own research in ocean governance, marine policy and MPA management.

See page 14 and 88

SAVE OUR SEAS FOUNDATION FOUNDER

His Excellency Abdulmohsen Abdulmalik Al-Sheikh

IN CONVERSATION WITH PIPPA EHRLICH

HIS EXCELLENCY ABDULMOHSEN ABDULMALIK AL-SHEIKH FORMALLY STARTED THE SAVE OUR SEAS FOUNDATION (SOSF) IN 2003 BUT HAD BEEN EXPLORING OUR OCEANS AND SUPPORTING MARINE CONSERVATION PROJECTS LONG BEFORE THAT. HERE, IN CONVERSATION WITH PIPPA EHRLICH, HIS EXCELLENCY TALKS ABOUT HOW HE FELL IN LOVE WITH SHARKS AND THEN SET ABOUT HELPING THE RECOVERY OF SHARK POPULATIONS AROUND THE WORLD.

What are your earliest memories of the natural world?

I remember being fascinated by nature, even when I was very young. I was born in a village in the Arabian Desert, which was dry and arid, but still found the landscape to be dynamic and interesting. When I was about 12 years old, I saw the Red Sea coastline for the first time. I remember looking at the water in awe. There were many colourful fish swimming in the shallow clear waters, and I could see the deeper dark blue water beyond the coral reef's edge.

How did you feel the first time you entered the ocean?

I was mesmerised by the ocean: the clarity of the water, the vivid colours and the diversity of fish. I was about 13 years old when I first started snorkelling. I immediately loved being underwater – it felt more natural for me to be submerged in water than to be on land. The Red Sea was vibrant and teeming with life. You can't begin to imagine the dramatic transition from vast sand dunes to clear blue water filled with a multitude of life – it was like being in an entirely different world!

What was your impression of sharks before you saw one for the first time?

When I was younger, little was known about shark behaviour. People weren't really diving or snorkelling with sharks. Popular media unfortunately sensationalised shark attacks and created a lot of unnecessary fear and anxiety. I'll always remember the first time I saw a grey reef shark whilst diving in the Red Sea. I was exhilarated by the experience but at the same time a little nervous. I recall hiding behind a coral head waiting for the shark to swim past, hoping it wouldn't come near me. It goes to show how misconceptions play on one's mind because, in reality, the grey reef shark was probably more concerned about me.

When did your perceptions shift?

After spending a lot of time in the ocean and many hours diving with sharks, I could tell that they didn't see me as food. Sharks want to eat fish, marine mammals and other sharks. The more I watched them, the more I realised how intelligent and highly specialised they are.

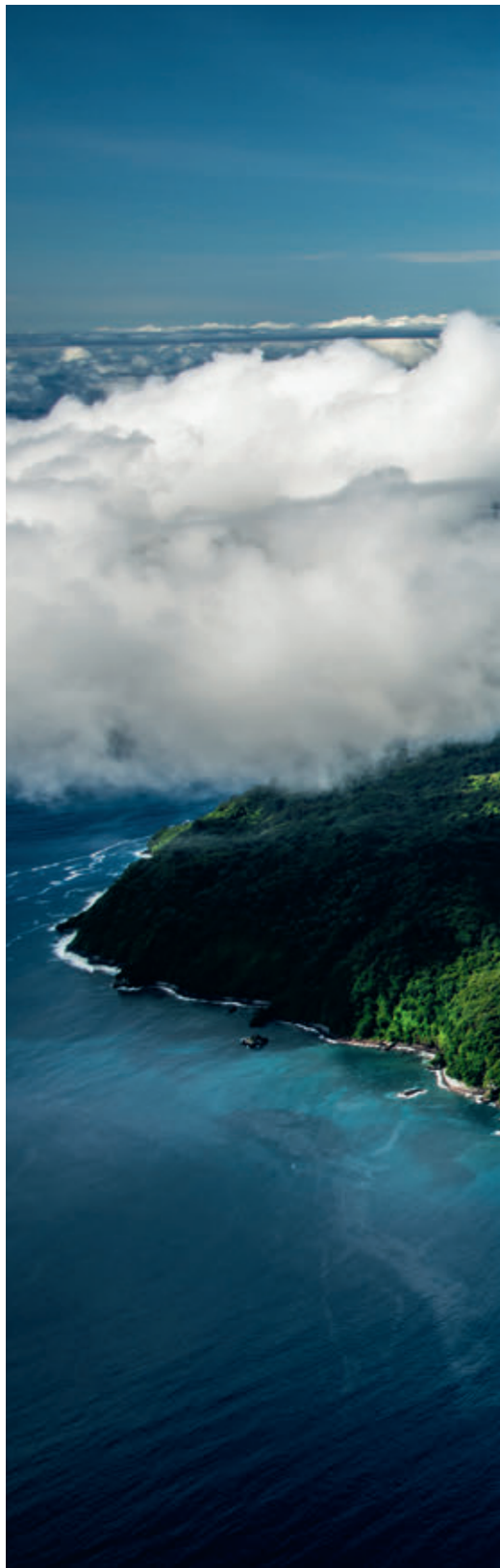
When did your understanding transform into a love for sharks?

I spent many hours in the Red Sea, diving with the same silky sharks over several years. I thought about nothing else whilst with them, and every dive was different, every encounter truly exhilarating. It may seem surreal to anyone unfamiliar with sharks but I gained an understanding and formed a relationship with these sharks. Over time they revealed their different personalities, each one behaving slightly differently from the next, and I fell in love with them, not only as a species, but as individuals too.

Was there some specific event that made you realise, 'Wow, these animals need help'?

In 1998, I returned to the remote Revillagigedo islands situated 300 miles off the West Coast of Mexico on a diving expedition. Whilst descending to a rocky pinnacle off the island of San Benedicto, we came across a discarded drift net snagged on the rocks. Numerous sharks and rays had already been entangled in the netting and a young bottlenose dolphin had drowned. An illegal fishing boat had abandoned the fishing net the day before. We did our very best to remove all the netting from the rocks so that no more animals would become entangled. We didn't see any living sharks for the two days we were diving there. It was a very sad and sombre experience to witness such a dramatic decline from the abundant life we had encountered at the same location only a year before.

The local scientists who joined us during that expedition explained how critical these islands were for the sharks' recovery, and the immense fishing pressure the marine park was under. The entire experience was a real turning point for me.



Previous page, left: The Founder gazes at a reef manta as it soars over colourful reefs in Maldives.
Photo © Sebastian Staines

Previous page, right: The Founder's encounter with sperm whales in Dominican Republic makes for a surreal meeting.
Photo © Sebastian Staines

Left: The Cocos patrol boat has helped to play a role in safeguarding the island's rich marine heritage.
Photo © Matthew During

Below: Ocean currents make Cocos Island vital for Eastern Pacific Ocean connectivity, and its wildness makes it magical.
Photo © Matthew During

Left: Silky sharks, each with their unique personality, were early characters in the Founder's ocean journey.

Photo © Simon Hilbourne

Next page: A budding freediver, newly minted from the D'Arros Experience, reaches for a reef at D'Arros Island.

Photo by Dillys Pouponeau | © Save our Seas Foundation

I gained an understanding and formed a relationship with these sharks.

I believe this is your first interview for the SOSF magazine, why is that?

The Save Our Seas Foundation is all about providing the marine environment with a voice and giving support to the people who are working to protect it. While I'm deeply passionate about the Foundation and its mission, I prefer to facilitate that work and enable our project leaders and their work to take centre stage.

Over the past 20 years, what do you consider to be the best achievements for the Foundation?

Once when diving around Cocos Island in 2000, situated far off the coast of Costa Rica, I spent time with the local park rangers. They explained that fishing boats were illegally setting long lines within the marine protected area. They felt helpless as they didn't have a boat to be able to stop these illegal fishing practices. The Save Our Seas Foundation supplied a fast patrol boat later that year, allowing the park rangers to patrol and protect the marine park.

In 2020 I returned to Cocos Island. The park rangers I met 20 years earlier were still there, using the same boat to patrol the marine reserve. They explained how invaluable the boat had been in protecting the island's marine life. This highlighted that with the right tools and motivation, the Save Our Seas Foundation can make a huge difference. Cocos Island is a magical place – the marine life there is extraordinary. To be able to do something simple, yet so effective, was both touching and empowering for me.

On a larger scale, the Save Our Seas Foundation has now built a global network of project leaders, supporting almost 500 projects in about 90 countries. We're all working together for a brighter future for sharks and rays. With the most recent CITES [Convention on International Trade in Endangered Species] meeting, 90 per cent of the shark species targeted by the fin trade are now protected from international trade. I feel so proud that the Save Our Seas Foundation and the scientists we support played an important role in this achievement.

Another valuable success has been advances in marine education. The majority of people no longer think of sharks as terrifying creatures. There's now far more understanding, appreciation and compassion for them than before. Sharks play a vital role in the world's oceans and, increasingly, people are realising how threatened they are and in need of protection.

You place a lot of emphasis on nurturing young people through education, but also on working with young scientists. What was your thinking behind that?

It's very important to me to nurture the next generation of leaders in shark conservation. Over the past 20 years, helping young marine scientists to achieve their goals has allowed them to develop and become pioneers in marine conservation today. Many have made huge differences for sharks around the world. A good example of this is Alison Kock, one of our first grantees and at the time a PhD student from South Africa. We supported her research on white shark behaviour in False Bay. She now works for the South

It's very important to me to nurture the next generation of leaders in shark conservation.

African Government as a lead marine biologist for the National Parks Department, helping to manage and monitor the effectiveness of Marine Protected Areas along the South African coastline.

What is your vision for D'Arros and St Joseph and why is that place special to you?

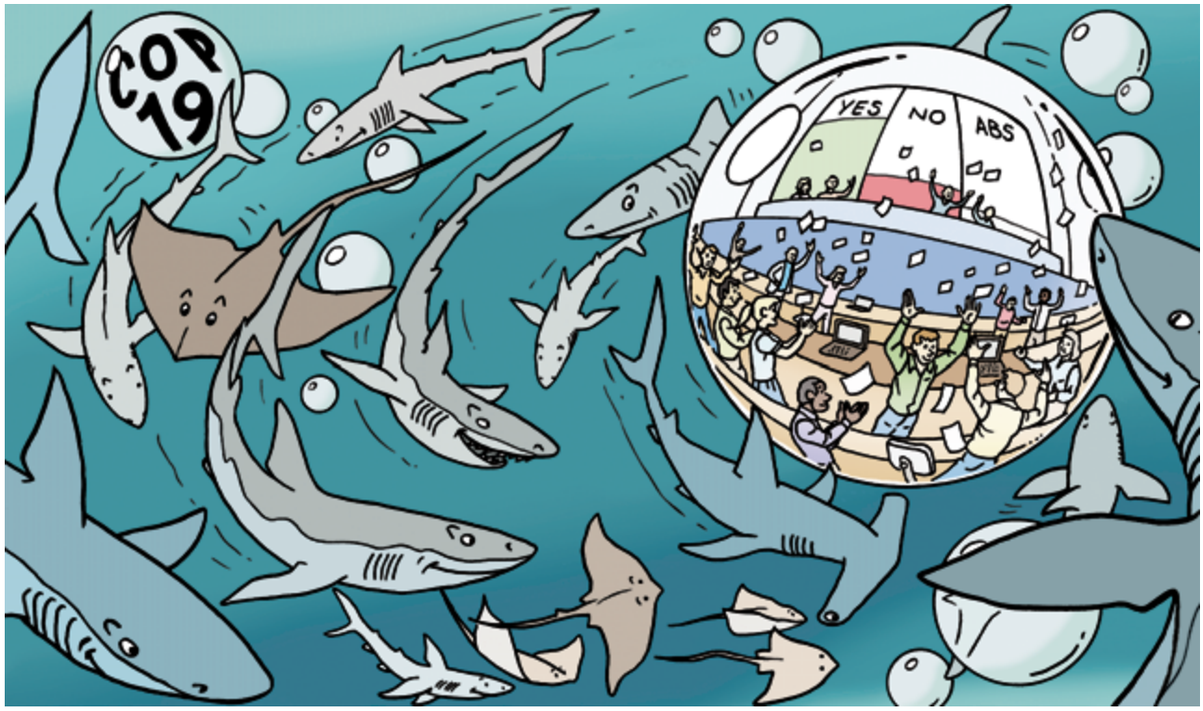
That place is one of the last jewels left in this world, because of all the marine life there. My vision is to create a world-class field station both for children's education and shark and ray research. It's important to me that we continue to protect the marine reserve that has finally been declared there.

More importantly, we want it to be a place for sharing the magic of the wilderness and ocean. We're often so completely disconnected from nature and I think that as humans there's a part of us that's still very wild, and will always yearn to be in those places. We're already running educational field camps for young Seychellois. The students work alongside our scientists collecting data in the field. They learn about the marine environment and experience nature for themselves. They then leave the camps understanding the true value and benefit of creating marine reserves. This is what the whole planet should look like and it's something that could be done in other parts of the world too. Even with a small marine reserve, you can make a huge difference for a local community.

And what about your vision for the Foundation in general?

My vision for the Foundation is to make a difference where I can and to have a positive influence on protecting the ocean and the future of human beings. This planet has given us so much in our lifetime, and this is how I can give back in my own small and humble way.

It's my way of saying 'thank you Planet Earth for all the joy you've given me.'



THE ROAD TO CITES

WORDS: ISLA HODGSON | ILLUSTRATION: RÉGRIC

CITES COP19 WAS A LANDMARK MOMENT FOR SHARK AND RAY CONSERVATION. BUT BRINGING 90% OF THE FIN TRADE UNDER REGULATION WAS NEVER GOING TO BE EASY. BEHIND THESE HISTORIC CITES LISTINGS IS A STORY OF PERSEVERANCE, COLLABORATION AND HOPE.

It was a moment of unity. Scientists, conservationists, policy-makers, NGOs, practitioners and activists, scattered across time zones and continents, all watching a large conference room in Panama City. There, parties to the Convention on International Trade in Endangered Species (CITES) were deciding by anonymous vote on one of the most ambitious proposals for sharks and rays to date – one that, if passed, would regulate almost all of the shark-fin trade. Some, like me, had stayed up late to watch the livestream, bent over phone and laptop screens. Others were in the room itself, shrouded in a heavy silence. One attendee sent round a picture of their smartwatch displaying an impressive heart rate of 146 beats per minute.

To say this was a significant moment for shark conservation would be an understatement. For years, numerous individuals, organisations and governments had worked tirelessly to overcome opposition, scepticism, and many political, cultural and economic barriers to protect some of the most traded shark species in the world. More than a decade of hard work, condensed into a nail-biting few minutes.

Suddenly the blank screen we had all been watching glitched and, collectively, the entire shark conservation community held its breath. Then, the result: 88 yes, 29 no, 17 abstain. An overwhelming majority in favour of bringing the fin trade under regulation – the half-billion-dollar industry that has been instrumental in bringing many species to the brink of extinction. Instantly the room erupted in a not-so-successful attempt at silent celebration, cuddly toy sharks proudly held aloft. And messages of joy and pride rippled across social media as the news reached those of us at home.

'It was a huge relief!' says Luke Warwick, director of the Sharks and Rays Program for the Wildlife Conservation Society (WCS), an organisation that had been a driving force behind the ambitious proposals. 'With so many years of work culminating in Panama, the adoption of the proposals was exciting, but also a moment to reflect on the dedication of so many shark and ray conservation leaders who made the landmark listings possible.'

The journey to this moment started a long time before the 2,500 delegates gathered in Panama for the 19th 'World Wildlife Conference'. CITES – an international agreement between governments to regulate trade in endangered species – had officially come into force in July of 1975, but it wasn't until 40 years later that sharks and rays began to trickle into the Appendices. At that time, scientists lacked the data to sufficiently support proposals to include many commercially traded species. The political environment was also unfavourable. International trade in shark products was, and still is, highly lucrative. Many parties to CITES had a vested interest in seeing trade continue without oversight and did not yet face the public pressure to protect sharks that we see today. 'The general consensus 10 to 15 years ago was that few, if any, sharks and rays could be CITES-listed,' Luke recalls. 'Full regulation of the around 100 species that comprise the shark-fin trade seemed all but impossible.' Securing such protections for sharks would require significant resources, dedication and, above all, the enduring belief that one day the tide would turn.

It was a big win, to achieve the impossible.

THE JOURNEY BEGINS

A glimmer of hope came in 2013, when the first commercially traded shark species were listed on Appendix II. This included the oceanic whitetip shark, formerly one of the world's most abundant species before demand for their fins drove populations into freefall. This, Luke feels, set the wheels into motion. 'Following those first listings, a wide range of governments, groups and individuals worked together to ensure they were effectively implemented, while pushing to build on them.' Momentum continued to grow, and at CITES COP18 in Geneva, Switzerland in 2019, the addition of shortfin and longfin mako sharks, wedgefishes and giant guitarfishes, brought almost a quarter of the fin trade under regulation. It was significant progress, at least from a political standpoint. But, with new science indicating global shark and ray populations were still plummeting, there was little time for pause. Even stronger and more comprehensive regulations were needed.

Looking three years ahead to CITES COP19, several ocean-minded governments, working together with the WCS, Shark Conservation Fund (SCF) and leading shark scientists, began to circulate a bold plan to regulate the remainder of the shark-fin trade. They were met with considerable scepticism. It was ambitious: a proposal to list the entire family of 56 requiem shark species, one of the largest and most traded families of sharks in the world. Additionally, all six small hammerhead species and the remainder of the guitarfish family would be included. This would require substantial work and resources. Each proposal would need to demonstrate, using robust scientific evidence, that trade sufficiently threatened the very survival of the species in question.

Luckily, science had advanced rapidly since the first shark listings. 'The proposals that moved us from 25% to more than 90% of the shark-fin trade being regulated were made possible by focused scientific research,' says Luke. 'The wealth of information provided by the updates to all shark and ray IUCN Red List assessments was crucial, along with innovative studies that used underwater cameras to survey reef shark populations, and genetic techniques used to uncover the composition of the shark-fin trade at its hub in Hong Kong.' But collating all the scientific evidence was only part of the battle. This was a political arena. Those who made the final decisions were not shark scientists and conservationists; they were world leaders, representing countries and regions with vastly different interests and socio-economic backgrounds. Getting the proposals over the line would also require a sophisticated global campaign to persuade those in power that protecting sharks was not only in their best interests, but essential for our future.

A TEAM EFFORT

Despite the initial push-back, SCF and WCS forged ahead, and along with the Paul G. Allen Family Foundation, Oceans 5 and the Flotilla Foundation, worked to provide resources for a global campaign to drum up political and logistical support for more comprehensive global trade regulations for sharks and rays. A significant part of this involved developing tools to demonstrate how these listings could be implemented.

Equal effort went into public communications. Although the public do not vote for species to be CITES-listed, their voice matters for those that do. Governments will inevitably want to stay on the right side of their constituents, and so getting the public behind protections for sharks could influence political support for the proposal. As part of the SCF, the Save Our Seas Foundation (SOSF), along with the International Fund for Animal Welfare (IFAW), Blue Resources Trust, Humane Society International and WCS, worked hard on an ambitious communications strategy for the lead-up to COP19. This included infographics that broke down the four biggest research papers of the last decade, showing how international trade had impacted sharks worldwide and why this mattered. They also explained the case for adding the entire family of requiem sharks, linking them to the shark-fin trade.

As COP19 drew closer, there was cause for cautious optimism. Conference hosts – the Government of Panama – championed the proposal for requiem sharks, which was then co-sponsored by 40 other countries. They also co-sponsored the proposal for small hammerheads, which was championed by the European Union. On the day itself several desks proudly sported plush sharks and some delegates had even arrived in shark attire. All promising signs – but they still had to get past the other governments in attendance, some of whom directly opposed the proposals. But against the odds, parties voted in favour of adopting both proposals and at a plenary session the following week, they were formally adopted. It was a big win for those who had fought determinedly, against all the odds, to achieve the impossible.

WHAT HAPPENS NEXT?

It was a long road to CITES COP19 – but the work doesn't stop there. 'The listings represent the end of the first phase of shark conservation, which was to establish strong drivers for domestic shark conservation,' Luke explains, 'but without follow-up, they won't help save species from extinction. Work will now focus on implementation.' Customs and border officials will now require training in the use of genetic and visual tools to identify illegally traded products, and in the preparation of new procedures and documentation to ensure that catch and trade is sustainable. In respect of the challenges ahead, CITES has already amended its allotted time for countries to get everything in order. All countries must be ready to implement the new trade regulations in 12 months – 2023 will be a very busy year for some!

But for now, Luke – and the many others who worked so hard to bring this to fruition – can pause to reflect, and celebrate. 'The fact that transformative action was possible within a decade is incredible,' smiles Luke. 'And that is the level of ambition we need to take into the next phase of shark conservation if we are to save these ancient predators from extinction.'

THOMAS PESCHAK

From gregarious gray whales plying the tourist-filled waters of Baja California to acrobatic manta rays in Maldives and parading penguins in Antarctica, *National Geographic* photographer Thomas Peschak has spent a lifetime documenting the beauty and fragility of underwater life and the majesty of wild coastlines.

This awe-inspiring collection of photography charts his transformation from marine biologist to full-time conservation advocate, armed with little more than a mask, fins and a camera. For our 20th anniversary, we celebrate this life journey alongside Peschak, who started with the Save Our Seas Foundation more than 15 years ago as the expedition photographer, and is now Director of Storytelling. In the vivid pages that follow, Peschak photographs shark behaviours in extraordinary habitats and swims among silhouetted seals to reveal the splendour of pristine seas, and contrast the challenges that contact with human beings can bring.

Filled with magnificent images from South Africa, Seychelles, Mexico and more, this illuminating collection offers an impassioned case for revering – and preserving – the world's oceans.

PORTFOLIO

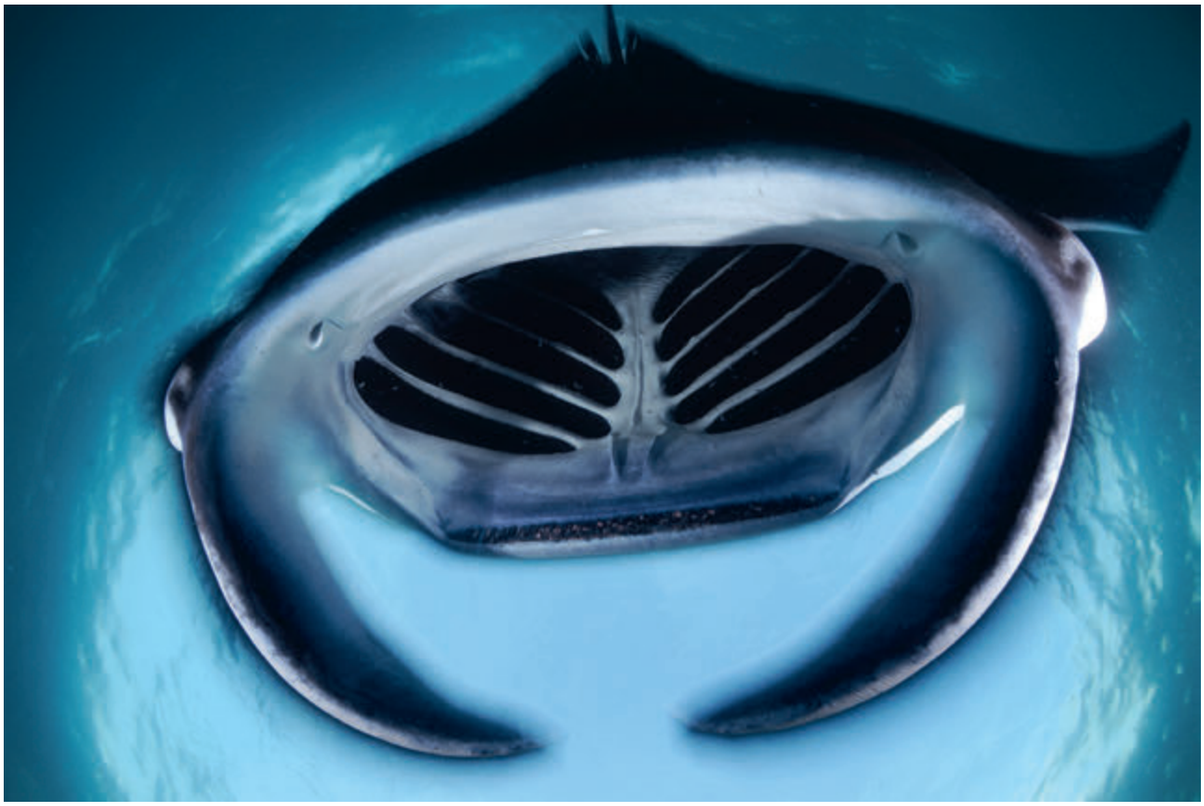
BLACKTIP FLOTILLA
Swimming in inches of warm water off Aldabra, blacktip reef sharks wait for the tide to refill the lagoon. With their bellies touching the sand, they point their snouts into the current to keep water flowing over their gills.
Seychelles, 2008.

Previous spread:
WHITE SHARK KAYAK
I originally set out to create a photograph of the researcher in the kayak following the great white. Instead, a bold female shark came up from behind. In those days I was using slide film and was down to the last few frames. As the dorsal fin broke the surface, the scientist looked back, and I pressed the shutter.
South Africa, 2003.

Left: NIGHT SCHOOL
Light shines into the lagoon of Bassas da India, a remote atoll west of Madagascar, revealing a gathering of juvenile Galápagos sharks.
Mozambique Channel, 2010.

Right: SCALING UP
At six feet long, these silky sharks are larger than most humans. A filter-feeding whale shark – the largest fish in the world – dwarfs them as they rub against it to scrape parasites off their skin.
Galápagos, 2016.

OPEN FOR BUSINESS
A gaping blacktip shark shows off rows of narrow slender teeth, perfectly adapted for a diet of fish. Abundant in the Indian Ocean off KwaZulu-Natal, this species is a mainstay of shark diving operators at Aliwal Shoal.
South Africa, 2007.



OPEN WIDE
A reef manta gorges itself on tiny prey as it somersaults backwards through the water. The cephalic fins held in front of the lower jaw funnel plankton-rich water into the mouth.
Maldives, 2008.

FINNED
Shark fins dry in the sun before being packed and shipped to buyers abroad. Most are destined for Hong Kong, which is the largest shark importer in the world.
Oman, 2012.

BAD MEDICINE
Manta ray gill plates have only recently entered into Asian folk medicinal lores, but are not featured in any official Traditional Chinese Medicine manuals. Their popularity appears to stem from media attention and marketing by retailers.
Sri Lanka, 2009.

TESTING THE WATERS
A surfer tests a prototype electromagnetic shark-deterring surfboard at Aliwal Shoal near Durban.
South Africa, 2005.

Next page: SHARING SPACE
Cape fur seals dive amongst a swarm of box jellyfish in the kelp-lined shallows of the Table Mountain Marine Protected Area. This African variety of jellyfish is nowhere near as venomous as its infamous Australian relative.
South Africa, 2012.

Last page: CLOSE CONTACT
A tourist on a boat reaches into the water in the hope of touching a grey whale. Baja California's San Ignacio Lagoon is one of the few places in the world where whales seek out physical contact with people. This unique culture has been passed down from mother to offspring for more than 40 years.
Mexico, 2015.

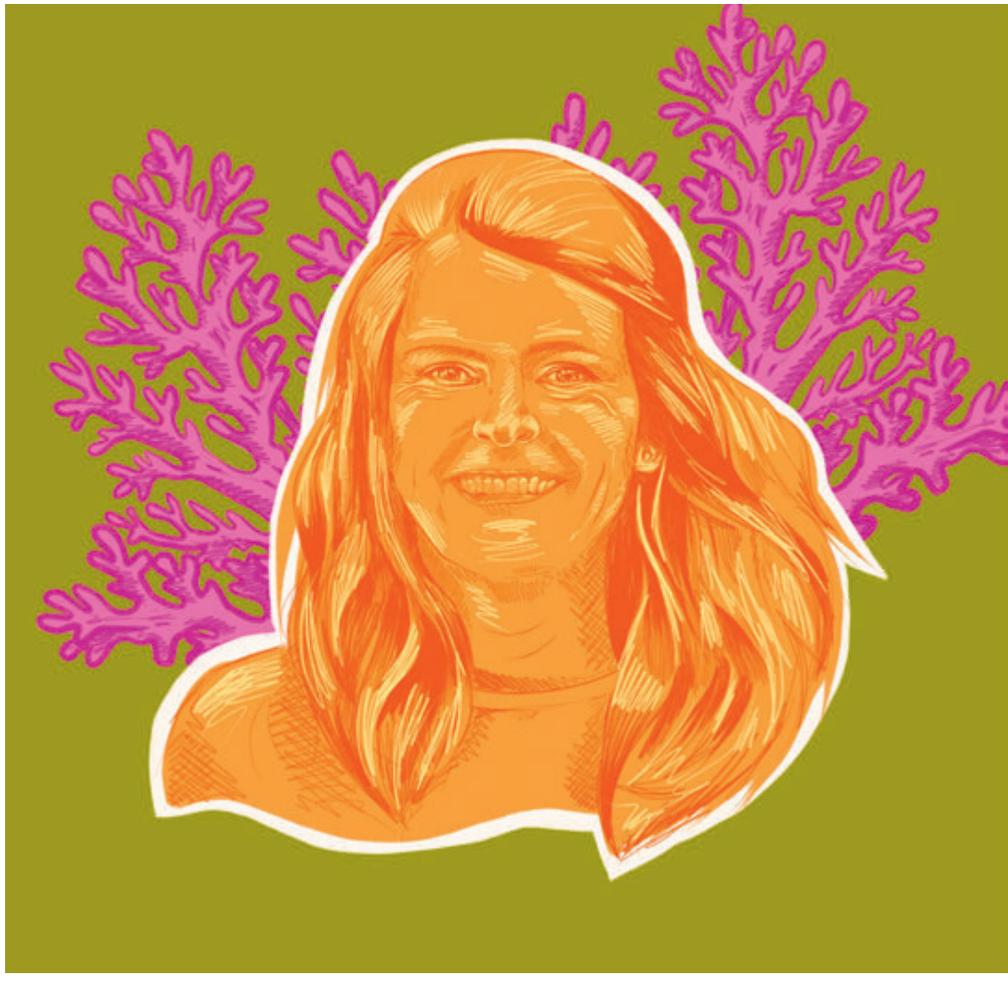
AROUND THE TABLE

WORDS: LAUREN DE VOS
ILLUSTRATIONS: XEE SUMMER

THE SAVE OUR SEAS FOUNDATION SCIENTIFIC ADVISORS HAVE POOLED THEIR EXPERTISE OVER THE YEARS TO SUPPORT THE FOUNDATION IN REACHING ITS ACHIEVEMENTS. AS WE CELEBRATE 20 YEARS OF SHARK SCIENCE AND CONSERVATION WITH THE SOSF, LAUREN DE VOS CHATTED TO TO SARAH FOWLER, DEAN GRUBBS AND ANDREW CHIN ABOUT THEIR REFLECTIONS: THEIR RESPECTIVE JOURNEYS, THE OPPORTUNITIES AHEAD – AND WHAT THEY'VE DEEMED SUCCESSES.

'Are we ready for a world with sharks?' Dr Dean Grubbs gives a wry grin as we conclude his interview. His question catches me off-guard: are we prepared to deal with our own success? Generally, we're knee-deep in tackling dwindling shark and ray populations, vanishing critical habitats and the looming undercurrent of climate change. Imagining what we might do if we succeed seems – foolhardy? Idealistic? It's almost tempting fate.

But Dean's question is one posed separately by both Sarah Fowler (OBE), a founding member of the International Union for the Conservation of Nature's (IUCN) Shark Specialist Group (SSG), and Dr Andrew Chin, a coastal fisheries scientist based in Queensland, Australia. 'What is clear after 20 years is that we're starting to see some successes. But we have a problem coming down the line – and that problem *is* success.' Sarah's optimism has carried her through a significant career in shark conservation. But her pragmatism keeps her looking at the horizon: 'We're focused on saving the last endangered shark, but what we're *not* looking at are the issues that arise with success.' Andrew's direct research experience means he shares both Dean and Sarah's views: 'As shark populations rebuild in parts of the world, we're encountering conflicts that we didn't have 20 years ago. Depredation (fishers losing their catch to sharks) is an emerging issue. But looking to a future with sharks, we have technologies we didn't previously. As many challenges as there are, there are equally many opportunities.'



A LIFE AQUATIC

An ecologist with a fisheries-bent, Dean is the current associate director of research at Florida State University Coastal and Marine Laboratory. 'I was more interested in biology,' says Dean of his introduction to shark and ray research. But he was steered towards shark fisheries management, and with scant life history information available at the time on coastal sharks, Dean started his graduate research exploring the movement patterns and habitat use of species like sandbar and dusky sharks. His focus on shark fisheries management has expanded to include understanding the life histories, habitat use and movement patterns of endangered species such as sawfishes, and poorly understood estuarine, coastal and deep-water sharks.

Sarah chaired the IUCN SSG for 14 years and led the first global chondrichthyan fishes Red List assessment. 'I started in shark conservation 40 years ago.' She reflects on how little information there was at the time: 'The basic stuff: where are the animals? What's out there? Do they even have names?' Her focus lies in seeing scientific research feed into the implementation of management needs: 'This is where things are important and where we have huge opportunities.'

'And what's keeping you here?' A slight provocation. Andrew's head sinks into his hands, and he glances up briefly to give a dry chuckle: 'Am I staying here?' he quips. 'Sorry, it's been a day …' he gestures to the computer. 'Budgets,' he shrugs: 'Mental jiu-jitsu.' Stay in shark science long enough and your average day will end up lightyears from those early days of sunburnt seafaring. Funding applications, student administration: a myriad of bureaucratic bugbears crowd your time. 'When I entered this field, it was all about sharks and diving. As my career has progressed, what drives me has changed. I value this career now because it allows me to be creative and selective. I'm always being challenged, pushed to the edge of my comfort zone. All this means that I'm never bored. As someone who has neurodivergent traits, that fits well with me. There is a joy in bringing together talented, enthusiastic people and devising ideas to solve real-world problems. In doing so, making the world a better place.' In essence? Service and stewardship: 'That's important to me. I don't work with sharks as much anymore as I do with fishers. This still allows me to work at a net benefit to shark conservation.'

> "It's now that we're seeing real traction."
>
> SARAH FOWLER

Sarah quips self-deprecatingly: 'I've been working on this for 40 years, and it's beginning to happen … so I must be incredibly ineffective!' And yet inefficient she is not. The challenge of conservation lies in its long-term nature: something at odds with the timeline of politics. 'Countries understand that to implement their international obligations like the Convention on International Trade in Endangered Species (CITES) and Convention on Migratory Species (CMS), they must do so on a regional level. They need advice from regional fisheries bodies, and they need networks of a nature like those being set up under the CMS memorandum of understanding (the Memorandum of Understanding on the Conservation of Migratory Sharks or CMS Sharks MOU) to conduct joint projects.' She pauses: 'And that's what's keeping me in shark conservation. This is new. The potential has been there for years, but it's now that we're seeing real traction.'

MIND THE GAP

Dean highlights that some of our current gaps in shark conservation remain unchanged. 'We still need fisheries scientists and applied biologists who are willing to get their hands dirty to find out basic life history information. How many pups does this species have, and how often? How long does it take for them to reach maturity? We can't manage their populations if we don't know the answers to these questions.' Andrew adds: 'We undervalue taxonomy, and we need capacity in that space.'

'Many species are migratory, and many are shared stocks. One country cannot in isolation manage a threatened species; they must cooperate with their neighbours.' Sarah is excited to see countries increasingly adopting this regional approach. 'I would also like to see more implementation of the Regional Seas Conventions and Action Plans. These are not fisheries plans, they are environmental conventions. The challenge of starting to do the work of connecting the environment and fisheries at a regional level excites me.'

'But we have a real problem with siloes,' she reflects. 'The environment silo that deals with CITES, CMS and protected species, and the fisheries silo which understandably deals with commercially important species. Everyone has limited capacity and resources. And each 'side' doesn't know much about the other; we need to break down siloes and get people talking to one another to understand that they have separate tools that are complementary and can achieve a common goal of sustainability.'

'The recent CITES listings are a success at a global scale,' offers Andrew. 'Whether that translates into effective implementation is hard to quantify. At certain scales, it surely does. But – and here's the philosophical point that highlights what remains a challenge in shark conservation: a policy win now can indicate a previous conservation and management failure. The fact that we need policies to protect species indicates problems in other areas. Ultimately, the real "wins" would be species being downlisted on the IUCN Red List and removed from CITES and CMS.'

"We still need fisheries scientists and applied biologists who are willing to get their hands dirty to find out basic life history information."

DEAN GRUBBS

'We need infrastructure and education in many countries to support shark management. The United States of America (US), Australia and others appear as "bright spots" with sustainable shark fisheries.' Dean has seen the course of change in his lifetime, but he's cautious before suggesting that this is easy to achieve globally without real support: 'The infrastructure for shark management is lacking across most of the world. And to succeed, diversity of income and livelihoods is also necessary, as well as other sources of protein.' He continues: 'We also need more long-term surveys. If you scrutinise the places where we've had successes, they're usually places where long-term datasets are available. We can then monitor what's happening: track declines, monitor recoveries.' Andrew expands on the same point: 'We have new policies and regulations being promulgated, but is their effectiveness and are those potential recoveries being monitored at the correct scale? Once conservation policy is passed, how does our adaptive management cycle continue? How is it being implemented, monitored, reviewed and improved?'

Andrew takes a long pause and draws a breath: 'We need to rebalance the conservation spend to fund capacity. As a society, we undervalue conservation. We consider those working in conservation as being invested in "passion projects" and therefore they don't deserve to be paid like someone working in a commercial entity. Ecosystem services are undervalued, and the cohort of people working to maintain the very fabric of our existence are not valued or funded. People are very willing to fund projects, but unless we can give the people responsible for executing those projects an opportunity to earn a decent living, we can't truly succeed.'

Andrew's thoughts speak directly to the need to support mental health and career longevity among scientists: 'One of our challenges is that we operate in an environment of scarcity. The hardships and uncertainty generate anxiety.' A key challenge that we need to remedy, he suggests, is what we are pushed to prioritise in the sector. 'Grant comparisons, publication metrics: what's really important? When I reflect on my career, what strikes me as the most meaningful wins are the connections I've made with people, not the publication of a paper. It's the tangible changes in the way people operate on the water, and the way people think about sharks and conservation. That's what matters.'

"As a society, we undervalue conservation."

ANDREW CHIN

A WORLD OF SUCCESS

'Twenty years on, we're seeing shark data being applied in conservation management,' concludes Sarah. 'The shark conservation framework is much stronger, and we have national legislation to protect species – but we also have far more activity on a regional basis, and internationally.'

'We've seen the emergence of a third cohort of shark and ray researchers, with many of them situated in Africa, Asia and South America. This is fantastic! They're responsible for a large increase in innovative work being done,' says Andrew celebratorily.

'I'm optimistic that we'll be able to move sawfish from endangered status to a lower threat status, in the US, at least before I retire!' says Dean with a smile. 'I think that we also have lessons to learn from the places where we've had some successes. We need to use what we've learnt to engage with the public and prepare them for what success looks like: prepare them for a recovered shark population.' He casts his mind ahead to the possibility of more shark recoveries across the ocean. 'In the areas where sharks are recovering, we have a shifting baselines issue. Where shark depredation is happening, fishers sometimes complain that sharks are now getting out of hand! They call for culls, or removal of protected areas. But if you've been fishing like I have in Florida over a longer period, you'll know that what we're seeing now is similar to what we saw 45 years ago, when the ecosystem functioned better. If you've only been fishing since the early 1990s, when shark populations were in crisis, of course it appears that the population has exploded!'

Dean and Sarah are calling for us to prioritise the headspace (and resources) to envision a world where we can all be better at participating in living with sharks, whether we need to continue to fight for their protection, or whether we need to learn to live alongside them. Twenty years have brought us far from the *Jaws* phenomenon. To move towards this world requires breaking down barriers and recognising that we all have the same objective: a sustainable future with sharks. Andrew's final reflections push us even further, urging us to create a conservation community that rejects our current culture of sleep deprivation, publish-or-perish competition, and chronic stress. 'There's a lot of enthusiasm out there; perhaps what we need is guidance and training in conservation leadership. Something to have us think broadly about our conservation effort, our people, our community, ourselves. And how to build a sustainable, effective conservation effort.'

FEATURE STORY

TWENTY YEARS OF SHARK AND RAY CONSERVATION

38 – 55

Twenty years requires reflection: has what we think about sharks shifted? Do we conduct research differently? And what are some of the emerging ways we're managing and conserving sharks?

Left: A planktivorous whale shark dwarfs a diver; so much of what we think about sharks has required a perspective shift in the course of 20 years.

Photo © Sebastian Staines

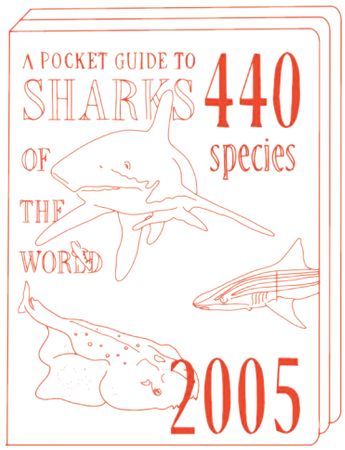
Celebrating sharks

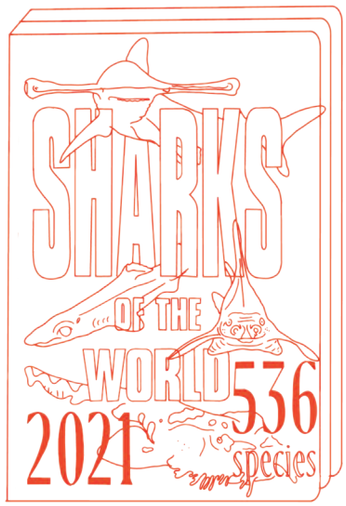
the sea & community

WORDS BY

Lauren De Vos

Twenty years ago, the US had just invaded Iraq, space shuttle Columbia disintegrated on re-entry into our atmosphere, and Finding Nemo *launched a trio of repentant sharks intent on revoking fish as food onto the silver screen. In that same year, a fledgling Save our Seas Foundation (SOSF) embedded itself in the shark research and conservation community. Since then, science has upped our count of sharks to 536 species, skates have been tracked laying eggs in deep-sea volcanic vents, and researchers discovered that Greenland sharks could live up to 400 years. Charting changes and challenges, we look at some highlights of what has been navigated in two decades of shark conservation.*





SHARKS OF THE WORLD

What we know about sharks – their diversity, their habits and their habitats – has grown enormously over two decades.

Illustrations: Thom Design Studio

A few quick taps of the keyboard, and the term 'shark conservation' blinks back in the Google Scholar search bar. With the search filter toggled for results between 2003 and 2004, Julia Baum sounds the alarm for the *'Collapse and conservation of shark populations in the Northwest Atlantic'*. Sonja Fordham proposes the spiny dogfish as her case study to explore if the Convention on Trade in Endangered Species (CITES) could complement shark conservation efforts. In 2003, we knew very well that a crisis was on hand: a rudimentary scan for scientific papers reflects concern for shark populations globally. The 1980s and 1990s had seen a broader societal shift in thinking about sharks. But filter the search to highlight papers released just from 2022, and titles transport you from southern Florida to southeast Asia, the Caribbean to Colombia and across the African continent's coast. Acronyms abound: we're using ROVs, AUVs, BRUVs. Concern for sharks remains high – probably at the highest it's ever been, but is there any obvious shift? Yes, we see a broadening in the diversity of where shark science is being done, the species under investigation, the technologies we're using, and who is doing the research.

'The amount of shark research has really increased since the early 2000s. And the more we've learnt, the more we've found that we don't know.' Dr Andrew Chin, a SOSF scientific advisor, says there is truth in what sounds otherwise like a scientific cliché. 'We've found that species we thought were one, are not – they're subspecies or a complex, or totally new species.' The first incarnation of the field guide *Sharks of the World* was published by Leonard Compagno with Sarah Fowler and Marc Dando in 2005 and detailed 440 species. The latest edition of this tome, now led by Dave Ebert and published in 2021, details 536 species. 'And as we've found more, the challenges have multiplied. In some respects, we've come out of ignorance into more understanding, and now we're truly coming to grips with the problems,' continues Chin. In the space of two decades, more amorphous issues have crept onto our horizons to join overfishing and habitat loss as concerns. Caroline Wheeler, for instance, has been looking at how rising sea temperatures will affect epaulette shark reproduction. Whether the work of Sue-Ann Watson on giant clams, Andrew Chin on porcupine rays, the SOSF D'Arros Research Centre (SOSF-DRC) on coral reefs, or Eloise Cave on shark genetics, increasing numbers of project leaders have been deciphering what changing temperatures and ocean chemistry will mean for marine life. 'But it doesn't mean that all we have is problems,' reminds Andrew.

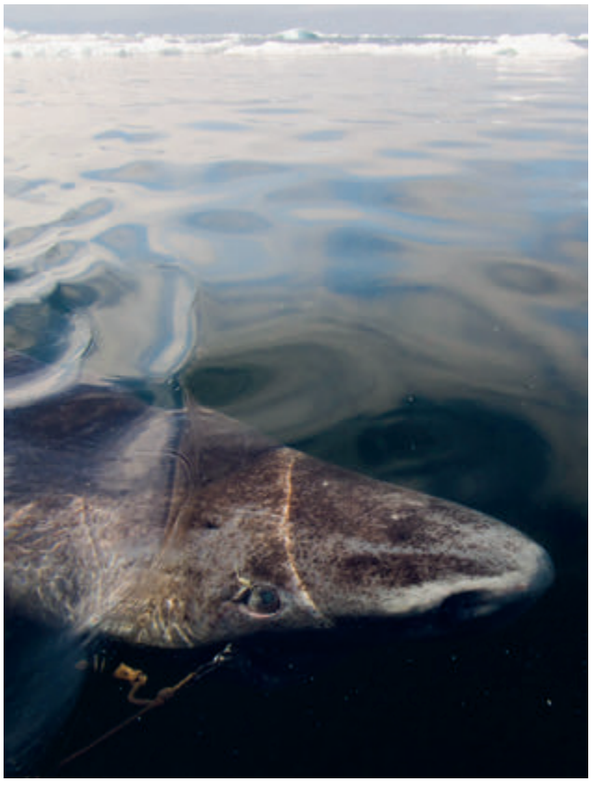
Right: Protecting sharks means understanding how they use their environment. This baby lemon shark uses the mangroves of Bimini, Bahamas, as a nursery.

Photo by Shin Arunrugstichai | © Save Our Seas Foundation

Peter Bushnell and Julius Nielsen took SOSF research to polar reaches, tagging 'old and cold' Greenland sharks in icy climes.

Photo © Julius Nielsen

Researchers discovered that Greenland sharks could live up to 400 years.



HAVE WE CHANGED WHAT WE THINK ABOUT SHARKS?

'For us divers, sharks are mortal enemies.' It's a surprising voiceover to hear intoned by Jacques Cousteau. One of the longest-standing issues for sharks has always been our perception of them. And we most often lay the blame for the PR plight of sharks squarely at the feet of Steven Spielberg and Peter Benchley, the duo who released a rogue shark in 1975 onto movie screens, and into the imaginations of children in land-locked swimming pools everywhere. Ironically, CITES came into force mere days after *Jaws* was released. It would take a further 40 years before the white shark was listed on CITES Appendix II. But as Jacques Cousteau narrates a particularly bloody scene from his 1956 *The Silent World*, we realise that sharks have been demonised in popular culture long before that cello theme sawed its way into popular culture. In garish technicolour, the French oceanographer's crew gaffs scores of oceanic whitetip and blue sharks from the sea and hauls their thrashing bodies onboard the famous *Calypso*, only to be bludgeoned to death. Today, the oceanic whitetip is listed as critically endangered by the International Union for the Conservation of Nature (IUCN) on its Red List of Threatened Species. Both oceanic whitetip and blue sharks are listed on CITES Appendix II.

But we're not in the same place as we were. In perhaps one of the best examples of a large-scale shift in how people think about sharing the sea with sharks, the SOSF began co-funding a pioneering South African shark safety programme and its white shark research in 2009. The Sharks Spotters programme fundamentally shifted the approach to beach-goer safety, finding solutions that incorporated people (and managing their behaviour and information sources) rather than focusing solely on sharks as the issue. The effort to centre people in the solutions to shark PR problems brought political and social sciences to the fore generally. Christopher Neff was supported by SOSF in 2013 to collect data on public perceptions of sharks. It seemed that real progress was being made to shift peoples' misconceptions. But at the same time, 2011 saw five shark hunts and the deliberation of shark net deployment across parts of Réunion Island and Australia. Says Neff in an interview with SOSF in 2019: 'Ironically, the worst case that I have come across is also the best case. It happened in Western Australia in 2014 where they had set out drum lines (baited hooks, buoyed to the surface) to cull white sharks. This was part of a state-wide effort to kill great white sharks. Following this, there was the largest pro-shark rally in history with thousands of people coming out to protect sharks. This was followed by a challenge to the Government by activists.'

So, while we may have moved away from glorifying Cousteau's 1950s gore, and much work has been done to mitigate the *Jaws* image, our perceptions of sharks remain complex and nuanced. In their 2019 scientific paper, John Carlson and co-authors ask: '*Are we ready for shark conservation success?*' They identify three potential avenues where shark-human conflict may once again arise: increased shark bite incidents, shark depredation in fisheries, and management conflicts involving threatened species pose potential avenues of misunderstanding and dispute. How we manage these conflicts depends on the resources we invest now, and how we value thinking ahead to shark conservation success.

> "Are we ready for shark conservation success?"
>
> John Carlson

Left: Meeting sharks with fascination rather than fear is a hallmark of shifting views, and huge efforts in shark education.

Photo by Shin Arunrugstichai | © Save Our Seas Foundation

Right: Cape Town's Shark Spotters programme is a success story; one that centres people as the solution in the human-wildlife conflict crisis.

Photo by Mac Stone | © Save Our Seas Foundation

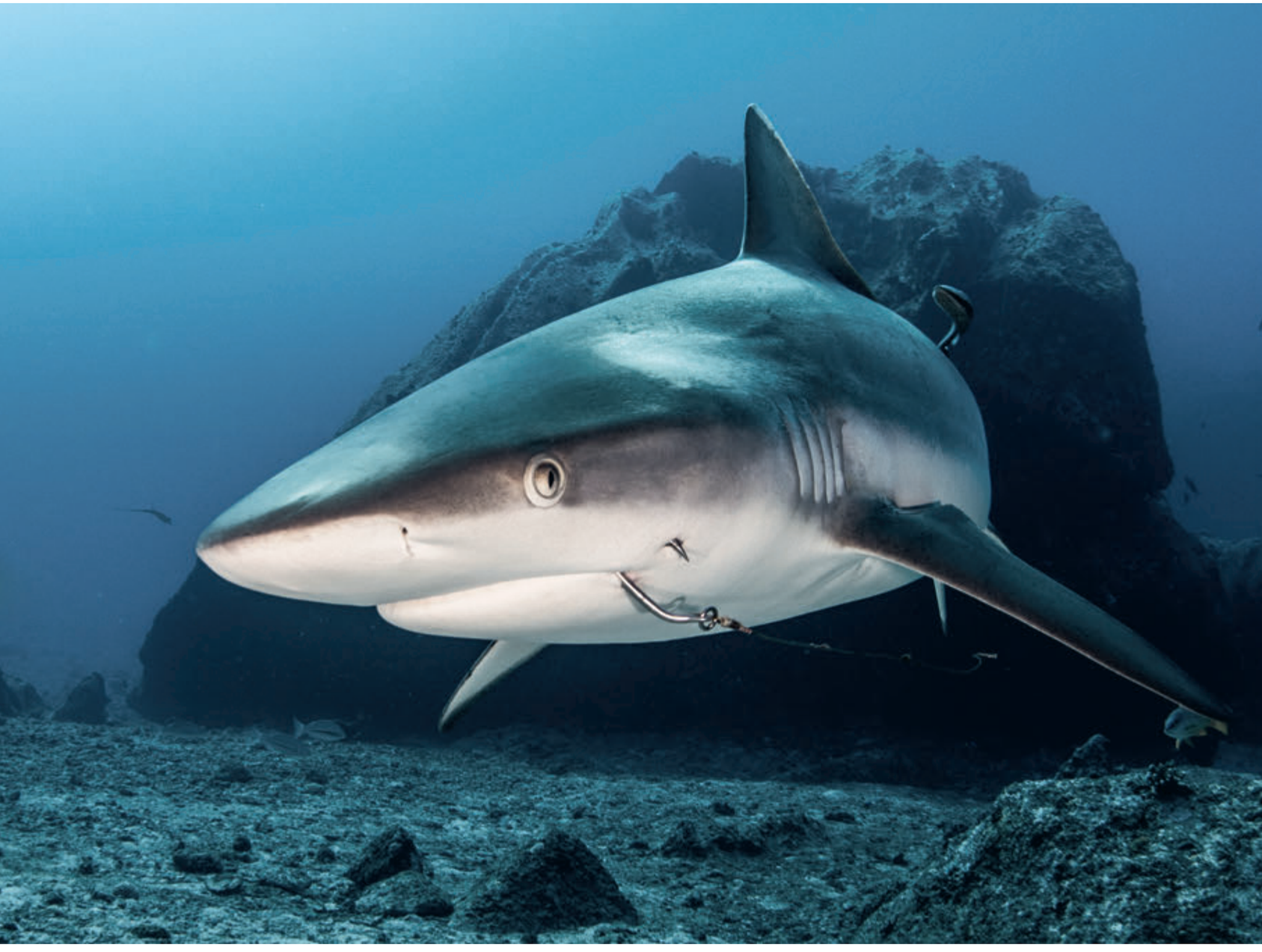
Below: A world where loathsome shark imagery is passé and holds no interest for a younger generation; this is an exciting future.

Photo by Shin Arunrugstichai | © Save Our Seas Foundation

HAVE WE CHANGED HOW WE RESEARCH AND MANAGE SHARKS?

'Our understanding of the status of marine biodiversity remains incredibly limited.' Nick Dulvy, professor at Simon Fraser University, was a keynote speaker at Sharks International in 2022. His speech was sobering, but unsurprising given the recent publication of the updated IUCN Red List of Threatened Species. The review evaluated 1199 species of chondrichthyans (sharks, rays, skates and chimaeras) and the results showed that more than one-third (37.5%) of these species are threatened with extinction. The Red Sea torpedo ray, Java stingaree and Lost shark were highlighted as possibly extinct (each seen last in 1898, 1868 and 1934, respectively). Nick continues: 'We know where the threat is: half of all coastal species are threatened, and that threat is highest in the tropics and subtropics.' And we also know what the threats are. 'Of all the threatened species listed on the IUCN Red List, every single one is threatened by overfishing.'

When we chat after Sharks International, Nick continues: "Now that we know what has happened over the past twenty years, it can be hard to find the motivation to move forward. But we have also learned that what gets monitored, get managed. Now that we know what is threatened, and where they are threatened, we can monitor and manage populations - and recoveries will follow". In their paper[1] published in Current Biology in 2017, Colin Simpfendorfer and Nick Dulvy review 'Bright spots of sustainable shark fishing'. Yes, many shark populations are overfished (in another ironic twist of time, global catches peaked 20 years ago in 2003). But where well-developed fisheries management systems exist, populations meet all or some of the 'sustainability' criteria; notably, in Australia, the United States, New Zealand and Canada. The question remains: if tens of millions of sharks are being caught each year, and we're still deep in crisis, why not forgo sustainable fishing and implement outright bans? Simpfendorfer and Dulvy give a measured answer in



Below: Shark populations remain in crisis: the latest IUCN Red Listings herald a grave future if we don't act swiftly and decisively.

Photo © Matthew During

1. Simpfendorfer, C.A. and Dulvy, N.K., 2017. Bright spots of sustainable shark fishing. *Current Biology*, 27(3), R97-R98.

2. Dulvy, N.K., Simpfendorfer, C.A., Davidson, L.N.K., Fordham, S.V., Bräutigam, A., Sant, G. and Welch, D.J. 2017 Challenges and priorities in shark and ray conservation. *Current Biology*, 27(11), R565-R572.

Above: A landmark 90% of the shark-fin trade was brought under regulation in 2022 with new CITES listings. The remaining guitarfish species, like this one, were among the groups included.

Photo © Taryn Murray

Below: We know that the overwhelming cause of shark and ray collapses is overfishing.

Photo © Annie Guttridge

> "Of all the threatened species listed on the IUCN Red List, every single one is threatened by overfishing."
>
> NICK DULVY

this paper (and elsewhere)[2]: these may be solutions in some cases, but where sharks are caught and retained as bycatch or are important as food security, we'll need to learn from these 'bright spots' to move to sustainable fisheries.

We also know that the drive to improve our knowledge has never been higher. There is hope where once it was lost. 'Species like the clown wedgefish in Indonesia and speartooth sharks in Papua New Guinea that we thought had been lost, have been rediscovered,' says Andrew Chin. Unlikely places are emerging as something of a 'lifeboat' for sharks and rays: the Gulf of Papua, for instance, harbours all four endangered Indo-Pacific sawfish species (narrow, dwarf, green and largetooth) and two river shark species (northern and speartooth). Project leaders Michael Grant and William White have been working in the region, and over the course of four years, White has gone on to record a total of 138 chondrichthyans in both historic and contemporary records, with 12 new species described.

Finally, we also know that policy makers can listen when they're given accessible information. In 2003, the first sharks (whale sharks and basking sharks) were listed on CITES Appendix II. In 2022, CITES parties voted to bring 90% of the shark-fin trade under surveillance and regulation. Among their five recommended lessons learnt that can help move us towards sustainable shark fisheries, Simpfendorfer and Dulvy point out that international treaties like CITES can help drive improved shark management.

Left: A celebration of sharks: fish spill like confetti from a cave where nurse sharks nestle. We're seeing more diverse species and habitats featured in media, research and education.

Photo by Shin Arunrugstichai | © Save Our Seas Foundation

WHAT IS OUR FUTURE WITH SHARKS?

In moments of intense overwhelm, a quick glance out of the salt-stained windows of the SOSF Shark Education Centre in Kalk Bay, South Africa gives pause. Scuttling over the rocky shores of the no-take Dalebrook marine protected area (MPA), school children peer into shallow pools and huddle around exciting discoveries. They're not yet marvelling at the agility of a blue shark that is found further offshore, or puzzling through the kelp forest looking for sevengill sharks. Most of them will never see one of these charismatic sharks alive in its habitat. No, they are utterly absorbed in the micro-dramas playing out in the intertidal zone: they are rooting for the tiny camouflaged fish that duck into crevices, and hearing tales of farming limpets that tend their algal food gardens. They shriek when red bait ascidians (sea squirts) shoot sea water from their siphons, and they might well cheer if a more unusual visitor: an octopus, perhaps, or a tiny endemic shyshark is swept from the sanctity of the kelp into the ebb and flow of the tidal pools where they can finally be more closely observed. Their curiosity, their sense of connection: it's the lifeline upon which we depend, and the precious gift we must protect.

And their total immersion in the world that is the rocky shores; its interconnectedness with the ocean that rolls away to the horizon and visits their feet in foaming white wavelets, sparks a thought. Sharks have so long occupied a particular place in our collective consciousness: they seem, for so long, to have been a group apart. In many respects, this distinction is justified. Long-lived, slow-growing denizens that have ruled the oceans for more than 450 million years, with their skeletons made of cartilage, they are defined by the air of fascination that has seen them both maligned and the focus of an intense conservation crisis. But there may be something to be said for sharks to be settled in their ecosystem context: in our understanding of the roles they play, in the management of their populations, and in their protection. Exactly 30 years ago, 168 nations signed the Convention on Biological Diversity into being. The ratification of this treaty, which recognised the importance of conserving the fabric of all life for the benefit of future generations, spawned a host of other ambitious goals. And so, we find ourselves in 2023 scrambling towards the deadlines to protect 30% of the ocean by 2030, to meet the Aichi Targets, to uphold the United Nations Sustainable Development Goal (SDG) 14. In the midst of this lies a siloed approach that many scientists, foremost among them SOSF scientific advisor Sarah Fowler, are trying to connect: our management of sharks as resources, and our management of them as part of the ecosystem.

Left and right: The kelp forests of Cape Town harbour a unique array of endemic sharks (found nowhere else on the planet).
Photo © Danel Wentzel

The IUCN Shark Specialist Group's (SSG) Important Shark and Ray Areas (ISRAs) process supports the identification of essential habitats for sharks. Whilst some countries have pledged 30% ocean protection in marine protected area (MPA) networks, many have at a minimum agreed to meet the Aichi Targets of 10%. The question is: which percentage gets protection? Until now, the jury has been out on the value of MPA protection for sharks; however, the ISRAs process hopes to amalgamate information that can inform the management and protection of critical habitats that sharks use. Their nurseries and feeding grounds are the last strongholds for highly endangered species and the only lifeboats for endemic species found nowhere else in the world. Equipped with the best information on which areas are most crucial for sharks' survival, the ISRAs give us a global-scale strategy for sharks – and ensure that they are no longer left off the spatial planning map. The ISRAs will ultimately overlap in time and space with other parallel processes: the Important Marine Mammal Areas (IMMAs), Turtle Areas (IMTAs) and Bird Areas (IBAs). In this way, sharks are both the focus of their own intense research prioritisation process, and integrated as part of a more holistic whole by finally making it onto the same maps as other marine life.

We will, hopefully, be able to see sharks at different scales: defined as the focus for policy prioritisation and integrated into our planning for the ocean's entire tapestry of life. And what a win that would be as we move into a future with sharks: each of us able to tap into what comes so naturally to those children on the rocky shores. A sense of connection. At ease with interconnectedness. One wonders what the response from a child on the seashore would be about sharks and the sea today, versus 20 years ago. And perhaps this would be something to ponder when making sense of our place on this planet: could we celebrate sharks as part of the sea, and a greater community?

Below: Sharks, yes, but rays too need to be the focus of improved research, management and protection measures.
Photo © Pelayo Salinas

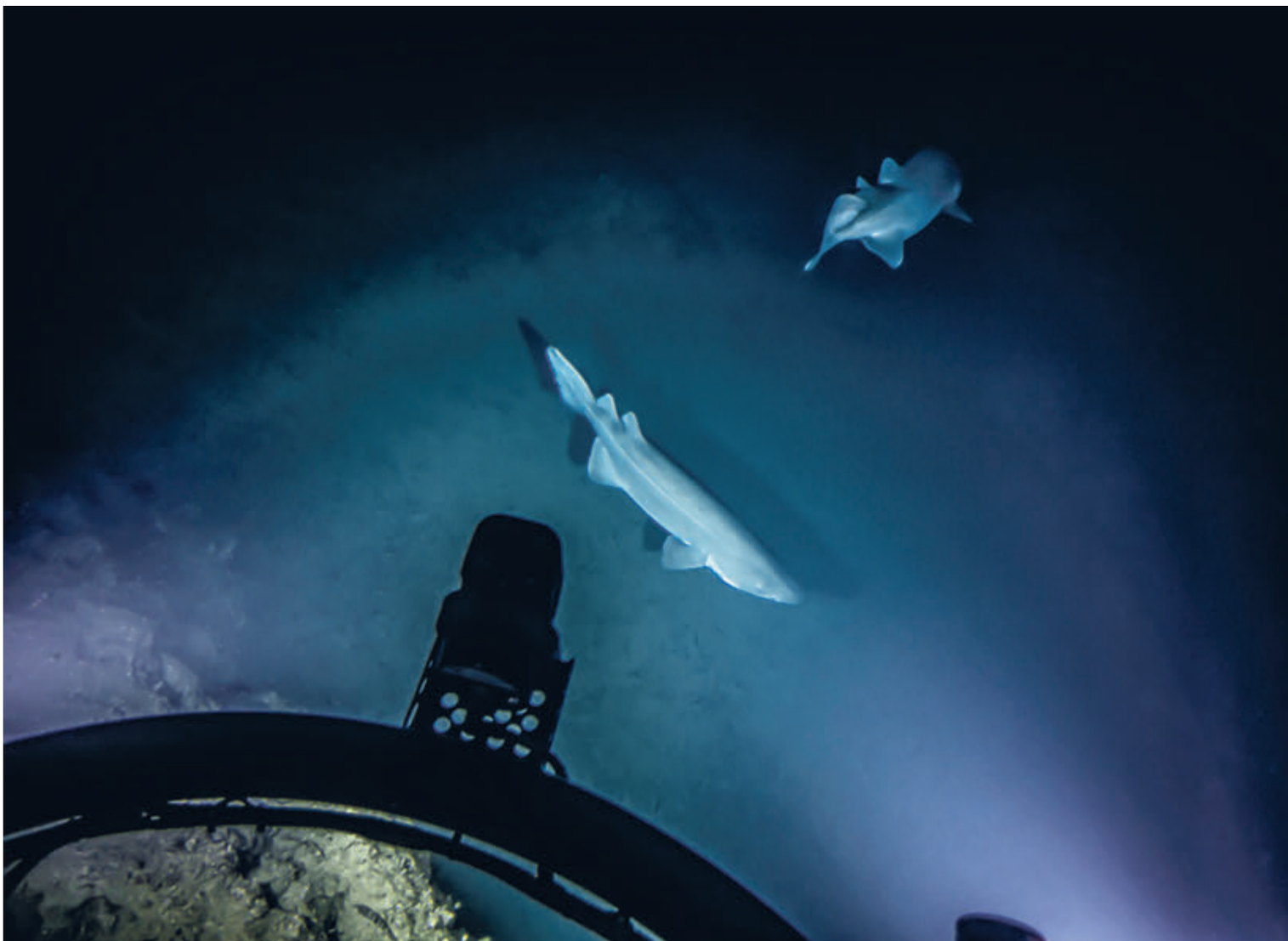
Right: The overview effect: what happens when we look at protecting sharks as a holistic part of the ocean ecosystems they support? Can we scale that approach to a global reach?
Photo © James Lea

Left: With so much left to discover, the investment in shark research that draws on what we have learnt heralds an exciting future with tangible strides towards conservation success.
Photo © Matthew During

Below: Finding our place on this planet, and looking at living with sharks, means re-examining our connection to our oceans.
Photo © Sandra Bessudo

"And the more we've learnt, the more we've found that we don't know."

ANDREW CHIN



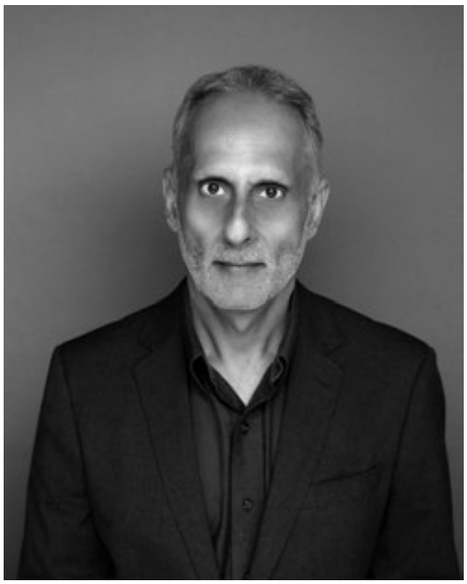
INSIDE STORIES

DNA

why it matters

WORDS BY

Helen Scales



Professor Mahmood Shivji is director of the Save our Seas Foundation Shark Research Center, housed at Nova Southeastern University, Florida.

Above: Photo © Nova Southeastern University

Right: Photo by Justin Gilligan | © Save Our Seas Foundation

In the past few years, most of us have had up-close encounters with genetic tests as the COVID-19 swab poked just a bit too far up our noses. The field of genetics is pushing into many parts of our daily lives, from genetically modified (GM) foods to the companies that offer to tell us how many Neanderthal genes we have, and it's also revolutionising the way scientists study species in the wild – including sharks. A mako shark racing across the Atlantic or a sevengill shark nosing its way through a shadowy kelp forest may seem a long way from the lab-based scientists who decipher DNA. And yet many sharks are telling their stories of how the ocean is changing and what we need to do to help conserve them, all from the genetic codes hidden inside their cells.

For Professor Mahmood Shivji, director of the (SOSF-SRC) which is housed at Nova Southeastern University in Florida, it all began in the 1990s when he read a local newspaper article about shark fishing. Originally an ecologist by training, he had switched to genetics for his PhD but hadn't yet worked with sharks. 'Fisheries managers were saying that they had a really difficult time identifying the shark body parts that were coming in from fishermen,' says Shivji. The practice back then was for fishers to catch sharks and cut off their head, fins and tail leaving just the torsos, which are known as logs. 'I read that article and I thought DNA can figure this out.'

So, Shivji got in touch with a team of shark biologists and asked if they could send him samples of tissue they'd collected from known species of sharks. He used these to identify genetic markers, short sequences of DNA code that are unique to each species and can tell them apart. To test out these markers, Shivji asked the biologists to send him more samples, but not tell him which shark species they came from. 'It worked,' he says. This was the first time anyone had developed a genetic test for identifying shark species.

Jump forward to today and shark researchers have a huge genetic toolbox which they're using to answer all sorts of questions. They can zoom in on intricate details or pan out and investigate sharks over huge swathes of space and time.

From a bucket of seawater, it's now possible to sift tiny fragments of DNA which sharks leave behind in sloughed off skin cells and mucus. This environmental DNA or eDNA only lasts for a few days and can reveal which species recently swam by. Conservationists in Europe are using eDNA to identify important areas where critically endangered angel sharks still live, even if nobody sees them.

Shivji now uses DNA to gain a global view of sharks. He continues to work closely with fisheries managers and biologists who send him snippets of tissue from sharks they work with in the field. 'Over the years, we've accumulated a really large collection of shark samples of different species from different parts of the world,' he says. This catalogue is helping Shivji and colleagues draw genetic boundaries around shark populations and redefine our view of the otherwise borderless global ocean. They found, for instance, that tiger sharks are not all mingling and interbreeding with each other, even though they can migrate huge distances. Tiger sharks in the Atlantic don't mix with those in the Indian and Pacific oceans. Tiger sharks that hang around Hawai'i are also genetically distinct from others. Likewise, broadnose sevengill sharks are genetically separate in the South Atlantic Ocean, the Eastern Pacific and Oceania. Night sharks prowl the deep waters of the twilight zone in at least two distinct groups in the Atlantic. The more species are studied, the more their genetics are showing just how divided and structured shark populations truly are.

This has major implications for shark conservation. Those regional populations need looking after separately rather than as global, cosmopolitan collectives. If, say, tiger sharks become overfished and depleted in the Atlantic, others from elsewhere are not going to come and help replenish their numbers.

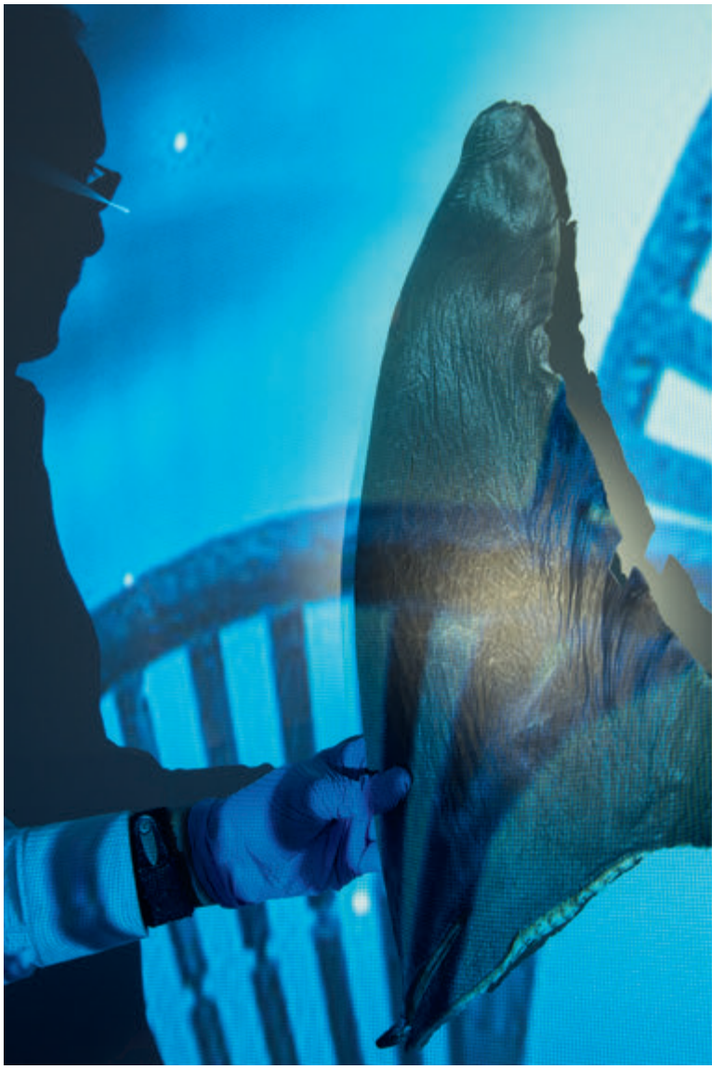
With DNA sequencing now much cheaper and more accurate than ever, scientists have begun decoding the entire genetic makeup, or genomes, of sharks. Recently, Shivji and colleagues sequenced for the first time the genomes of shortfin mako and great hammerhead sharks. Diving deep into the DNA of these animals has turned the scientists into time travellers. Based on variation in the genetic codes from just two individual sharks, they retraced the history of the species and inferred that the numbers of makos and hammerheads both drastically declined over the past quarter of a million years.

Left: Researchers at the SOSF-DRC at Nova Southeastern University might tackle issues at the molecular scale, but their application has real-world implications for shark conservation.

Photo © Nova Southeastern University

Right: Conservation genetics is opening avenues for refined shark fisheries management, giving new insights into population structuring in 'borderless' oceans.

Photos right and below by Justin Gilligan | © Save Our Seas Foundation



Populations that lack diversity can be more prone to going extinct.

More worryingly, the great hammerhead genome showed very low levels of genetic diversity, a likely indication that the species is in big trouble and not well equipped to cope with climate change. 'The more genetic diversity there is, the better,' says Shivji. 'That's a fundamental principle in conservation.' Variation within populations was the basis for Charles Darwin's theory of evolution, allowing species to adapt to their surroundings. On the flip side, populations that lack diversity can be more prone to going extinct, especially when their environment is swiftly changing as the ocean is today.

The great hammerhead's DNA also revealed it was highly inbred, likely because its population was very small – another sign of a species that's not in great shape. 'Great hammerheads need extremely urgent measures for their conservation,' says Shivji. 'Genetically they're on their way out.'

The genome of the shortfin mako shark delivered more positive news. Its genetic variation was much higher than the great hammerhead's. It seems there was a large enough population of shortfin makos in the past to help protect them from inbreeding and loss of diversity when humans came along and started hunting them. 'This species is endangered,' says Shivji, 'but I think with proper management it has the potential to come back and restore its genetic diversity.'

Above: Tracking the genetic traces of sharks using their fins has allowed researchers to confirm the most common species in trade.

Photo © Travel Pix | Alamy Stock Photo

Right: Hong Kong is the bustling hub of shark trade and traffic, as the largest importer of shark fins in the world.

Photo © Leungchopan | Shutterstock

TRACKING TRADE

Having begun his work with shark DNA identifying species from their dismembered torsos, Shivji also followed the genetic trail of their fins. For decades, the global trade in fins to make into soup has been a huge but poorly understood threat to shark populations. In the early 2000s, Shivji began collaborating with Shelley Clarke, then a PhD student at Imperial College London, to apply genetic tools to the puzzle of which species were involved in the shark-fin trade.

By the time shark-fins have been cut off, dried and bleached to an old-fingernail yellow, a lot of them are hard to tell apart by eye. Clarke was working in Hong Kong, the world's largest shark-fin market, visiting wholesalers and gathering samples of fins from huge shipments as they were being sorted for sale in auction houses. Back in the lab, Clarke and Shivji used genetics to match up the Chinese names given to fins sold in the marketplace with specific shark species. 'I ended up developing a very rapid test that didn't require DNA sequencing,' says Shivji. Instead he used a much faster, streamlined method, similar to PCR tests for COVID-19. These tests showed that blue sharks were the most common species being traded, followed by shortfin mako, silky, dusky, sandbar and tiger sharks.

Twenty years later, Diego Cardeñosa from Florida International University continues to monitor the global fin trade via the marketplace in Hong Kong. Instead of buying whole fins, members of his team visit the market once a month, randomly select 10 dried seafood vendors out of around 300, and buy from each of them a cheap bag of trimmings that are snipped off fins to neaten the edges.

Two thirds of the species showing up in their genetic tests of fin trimmings were threatened with extinction.

Cardeñosa picks out 10 pieces from each bag and runs genetic tests to identify the species. 'It gives us a unique perspective on shark-fin trade dynamics,' says Cardeñosa. 'If something happens in trade and one species starts being traded more, or disappears from trade, we will quickly notice that change.'

So far, the Hong Kong surveys show that not a lot has been changing in the fin trade, despite better protection for sharks. In 2003, whale sharks and basking sharks were the first chondrichthyan species added to CITES, a convention that oversees the international trade in endangered species. By 2017, the CITES list included another dozen endangered sharks that are prominent in the fin trade, including silky, hammerhead and thresher sharks. The trade in these species hasn't been banned, but it's regulated. Nations signed up to CITES must provide paperwork certifying the animals were caught without depleting wild populations. The Hong Kong surveys suggest that CITES-listed shark species are still being traded illegally without the necessary permits. 'We found that CITES-listed species were an order of magnitude more common than they should be,' says Cardeñosa.

Then in 2022, his team released a shocking study. They had found that two thirds of the species showing up in their genetic tests of fin trimmings were threatened with extinction. Most of these were on the same list of oceanic, wide-ranging species that Clarke and Shivji had identified, which have the biggest most valuable fins. Cardeñosa also detected a smaller but still significant proportion of fins from endangered species that live along coastlines and have a more restricted range, species like blacknose sharks, pig-eye sharks and sicklefin lemon sharks. As Cardeñosa pointed out, there was a big gap in the way sharks were being managed and in many places these coastal species were flying under the radar with no regulations in place to protect them.

A few months after that study came out, the latest round of CITES negotiations took place in Panama. Up for discussion was the most ambitious list of sharks to date. Dozens more species were put forward for trade regulations: guitarfish, several hammerhead sharks and the entire family of requiem sharks including many of the coastal species Cardeñosa's team had identified as needing protection.

Previous spread and above: Shark conservation genetic research has a role to play in fisheries management and informing trade regulations. The real world implications? Long-term livelihoods are protected, and we move towards sustainability.

Photo previous page © Toby Mathews | The Ocean Agency
Photo above © Nicolas Job | The Ocean Agency

Right: The votes at CITES COP19 in 2022 brought about much-needed change in shark policy, with 90% of the fin trade brought under regulation by the new listing of species.

Photo © Toby Matthews | The Ocean Agency

The vote went ahead and all the shark proposals were adopted. ‘We think [the study] really helped to make the decision in favour of the listing of those species,’ he says.

The decision marks what Cardeñosa hopes will be a turning point in the shark-fin trade. Now almost 90 per cent of traded fins are from CITES-listed species, which should make enforcement more straightforward. Customs officers can now assume that every container coming into Hong Kong holds some CITES species and needs to be accompanied by a permit. Shipments without permits are probably illegal. They still need to be checked, which is where another part of Cardeñosa’s work comes in. His team has developed a mobile shark DNA lab that can be taken to a container of fins and used on site to identify the species inside.

The mobile lab requires a small investment in equipment up front, then it costs only a dollar to run a sample. Critically, the entire process is fast. Depending on the country, customs officers may only have a 24 or 36-hour window to provide evidence of an illegal shipment of protected wildlife. Previously, it could take a week or more to send tissue samples off to a lab for analysis. Now Cardeñosa is training customs officers to do the forensic analyses themselves and get results within a few hours. ‘It’s just like making a little cocktail,’ he says. ‘You don’t need to be a lab technician, and you don’t need to have a degree in biology or genetics to do it.’

Other endangered species besides sharks can be identified in a mobile lab. Cardeñosa was involved in the first conviction of eel smugglers in Hong Kong after he helped identify the strictly protected European species in a consignment of wriggling juvenile eels. ‘You can make as many laws as you want, but if you cannot enforce them, then they’re just paper laws,’ he says.

Many countries are already using mobile DNA labs to monitor the shark-fin trade, including Belize, Panama, Brazil, Peru, Ecuador and Spain. Cardeñosa is confident more will join them as CITES regulations come into force. ‘I think countries now are going to really need these kinds of tools to get all the evidence they need,’ he says.

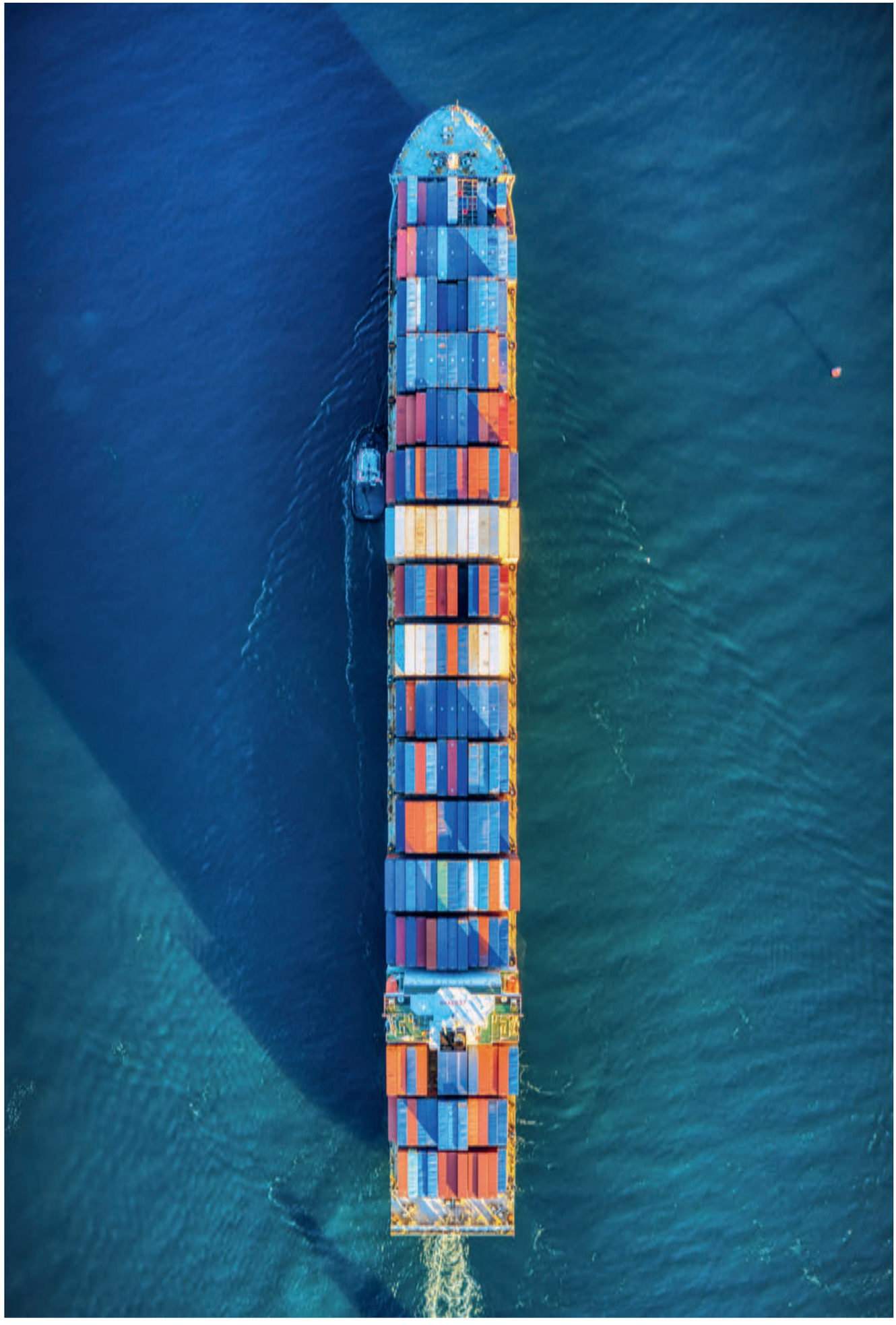
In the meantime, Cardeñosa’s team will continue their surveys of the trade in Hong Kong. ‘The long-term data set that we’re collecting is really valuable for setting new policies and assessing the compliance of previous ones,’ he says. He also plans to track where illegally traded shark fins are coming from. Based on genetic variations from place to place within a species, it’s now possible to work out where sharks were caught and to pinpoint areas of the world where more help is needed to monitor and control the trade. ‘The good thing with genetics is that every time you find something it leads you to more answers,’ he says.

Above: The workload burdened by the shark-fin trade on border officials was enormous; hopefully genetic solutions can act in tandem now with new CITES listings to reduce this load.

Photo © South China Morning Post / Alamy

Right: Our oceans serve as a trade highway, shuttling shark products across borders in astounding volumes. Genetic solutions add tools to our management and regulation arsenal.

Photo © Cameron Venti / The Ocean Agency



Banking on the future

WORDS BY
Lois Flounders

Previous page: In an ocean where predators disappear first and fast, the electric colours of a coral grouper (or hind) secreted on a reef are cause for celebration.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Left: One of the farthest-flung islands in the Amirantes, D'Arros is near-pristine, having been somewhat sheltered from human access.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Above: From manta rays to the most minute reef inhabitants, life at D'Arros flourishes in technicolour detail.

Photo by Henriette Grimmel | © Save Our Seas Foundation

Roughly 1,600 kilometres east of mainland Africa, 115 islands rise from the azure waters of the Western Indian Ocean (WIO). Together, they form the Seychelles archipelago. The mountainous capital island of Mahé, home to more than 90% of the country's 100,0000-strong population, seems a bustling metropolis. Granitic boulders border the busy beaches. In contrast, the Outer Islands comprise coralline islands forming remote atolls merely a few feet above sea level. Calm waters lap at the white sands of the shoreline or meet mangroves – critical habitats home to juvenile species of sharks and migratory seabirds. Below the surface you'll find highly productive marine ecosystems that are rich sources of food and livelihoods, supporting jobs for a quarter of a million people in the WIO region. As diverse as the land (and sea) are the people who inhabit it. Seychellois Creole culture is a harmonious blend of different nationalities and cultures. For those who live here, life maintains an element of consistency. The sun rises and sets at the same time year-round, and routine can be found even amongst the capital's chaos.

Seychelles is only one of 32 countries whose territorial waters fall under the western boundary of the Indo-Pacific Ocean, but it's one of the region's greatest contributors to the high endemism (biodiversity found here and nowhere else on the planet) for which the WIO is renowned. In fact, the WIO is one of the regions richest in marine life on our planet, with almost 15% of its biodiversity considered endemic. The richness of biodiversity (the sheer number of different species of corals, fish, sharks, plants and other life) is highest in the WIO along the east coast of Africa and its islands, placing Seychelles at the epicentre of an extraordinary ocean bounty. On land, rapid population growth, densification and urbanisation are the hallmarks of many countries in this region, and while the life-giving waters of the WIO provide vital resources for these human communities, their stability is being eroded by overfishing, habitat degradation from coastal developments and pollution, and climate change.

Off the coast of Somalia and Tanzania, for instance, trawlers – a type of fishing vessel that pulls nets along the ocean floor or in midwater – are blamed for wiping out entire schools of tuna, including the young ones, causing dramatic population collapses. Often, these vessels are operating illegally (something called illegal, unreported and unregulated, or IUU, fishing). And from Seychelles to the coast of Mozambique and South Africa, coral reefs are on

the brink of collapse – some predict within the next 50 years. Sustained, heightened temperatures across the WIO have already led to radical declines in coral cover across the region. As the waters warm, the corals expel symbiotic algae which live in their tissue, causing them to turn white (a phenomenon known as bleaching). These events are becoming more common, with reefs across the WIO classified as critically endangered at risk of becoming functionally extinct in the near future. With 43% of sharks and rays also threatened with extinction in the WIO region, things are getting serious. Scientists predict widespread starvation in the WIO by 2035.

Here in Seychelles, it's clear that the hustle and bustle of daily life doesn't distract from the steady decline of the surrounding reefs. A deep understanding and concern is felt among the Seychellois, who pride themselves on the nation's natural beauty. Travel 225 kilometres southwest of Mahé and you'll discover the far-flung Amirantes Island group. Within lie D'Arros Island and its sister atoll, St Joseph. Those arriving on these islands for the first time are amazed by their tranquillity, but moreover, the near-pristine nature that exists in every nook and niche – a striking contrast to the bleak outlook across the WIO more generally. It's precisely this geographical isolation that makes this such a special place, a serene stronghold where life can continue mostly undisturbed and unharmed by humans. For scientists, it's a paradise. It's that final frontier, a place of unbelievable biodiversity that gives a unique opportunity to study a system that remains as it should. D'Arros Island and St Joseph Atoll act as a template for which goals for ecosystem restoration can be set. They're a protected place where the ocean can recover and replenish, a source of rejuvenation for the life they host.

Recognising this, in 2004, a research station was founded on D'Arros, which has been run by the Save Our Seas Foundation since 2012. A core team of four passionate scientists inhabit the island year-round with a clear mission – to preserve and showcase the ecological integrity of D'Arros Island and St Joseph Atoll through research, monitoring, restoration and education. Programme director Henriette Grimmel explains that they've learnt to always be on the lookout and to expect the unexpected, exemplified by the team's recent encounter with a nesting giant tortoise – a rare opportunity to observe the laying process of an endemic and endangered species. For research director Dr Robert Bullock, D'Arros

Below: All five species of turtle found in the Western Indian Ocean are considered threatened on the IUCN Red List.

Photo © James Lea

Right: A long-term monitoring project initiated by Dr Jeanne Mortimer has tracked hawksbill and green turtles on D'Arros Island since 2004.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Left: Gorgonian sea fans branch into the filtered light like intricate lacework waving on the washing line.

Photo © Christopher Leon

Above: Healthy reef fish populations might do more than act as a source for populations elsewhere; they may help bleached coral communities at D'Arros recover.

Photo by Christopher Boyes | © Save Our Seas Foundation

and St Joseph have become his favourite places in the world. Completing the core team are research officers, Ellie Moulinie and Dillys Pouponeau. Born and raised in Seychelles, these accomplished ocean-loving women completed their degrees in Environmental Science at the University of Seychelles and have since clocked up quite the conservation CV, working on numerous projects throughout the nation. Ellie and Dillys understand better than anyone just how extraordinary life and work on D'Arros is.

'You wake up every day and look up, and are completely surrounded by biodiversity – endemic birds, seabirds, tortoises, native flora and fauna,' Ellie's eyes light up as she continues, 'I still cannot quite comprehend it, but D'Arros just gives this feeling of being so lucky to be a single person in a massive forest, undisturbed, with only the sounds of nature around you.' It's a spectacular place to do science. For Ellie, much of her day consists of swabbing the genital region (called the cloaca) of juvenile blacktip reef sharks and sicklefin lemon sharks in St Joseph Atoll. As Ellie explains, 'obtaining faecal DNA from shark cloacal swabs is a more accurate way (than traditional techniques, such as stable isotopes) to find out about an individual shark's diet,' she continues, 'we're basically investigating shark poop to see what it's been eating.' Ellie is then able to answer critical questions: How does diet change with life stages? And how do these two shark species share the space? We already know that these baby sharks fare better in the protected, prey-rich waters of D'Arros and St Joseph than other similar coastal habitats across the world. And years of dedicated tracking data on sharks from the Save our Seas Foundation D'Arros Research Centre (SOSF-DRC) has helped to shape the marine protected area (MPA) that now legally formalises the sanctity of this ocean ecosystem.

Dillys dedicates her time to studying the rather different diet of the planktivorous reef manta rays. 'We take plankton samples in different locations when we do, and we don't, see the mantas,' describes Dillys. 'We can then investigate the biomass, abundance, and species of plankton present. Is there a threshold for them starting to feed?' Gaining a deeper understanding of the foraging habits of manta rays helps scientists in Seychelles and further afield to understand how the species might be affected by climate change, which affects the distribution of their planktivorous prey. In fact, understanding manta rays here is

Below: Tracking data have shown how critical D'Arros Island is for reef manta rays, which show a strong attachment to, and preference for, the marine protected area (MPA) that protects them here.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Right: With three of the world's most active mobula fisheries located in the Indian Ocean, and growing fisheries in East Africa and Pakistan, protecting manta rays where they aggregate is critical.

Photo © Christopher Leon

Left: The word sanctuary denotes a protected reserve, a refuge or a holy place. We need more places where life is sacred.

Photo © Dan Beecham

Right: Research – and reflection – can help us set references for what ecosystem recovery should look like.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Next page: With 43% of sharks and rays considered threatened in the Western Indian Ocean, nursery sites and safe waters for shark populations are critical for recovery and replenishment.

Photo © Christopher Vaughn Jones

also critical for ensuring sustainable tourism in Seychelles. With 89% of tagged reef mantas detected a mere 2.5 kilometres from the shoreline at D'Arros and St Joseph between 2013 and 2017, the SOSF-DRC has shown that this remote blip on the map might not be visited by tourists themselves, but it's a vital stronghold that's relied upon by the reef mantas that swoop across to other tourist hotspots across the Amirantes for the rest of the year.

It's hard to link the relevance of remote islands flung far from any mainland to the lives and livelihoods of Seychellois and WIO citizens. But delve into the research findings of the SOSF-DRC in the past decade, and it becomes clear that D'Arros and St Joseph shine as a lifeboat for biodiversity in the region. The shoreline here is the only location in Seychelles that supports nesting and foraging populations of both endangered green and critically endangered hawksbill turtles. In fact, it may represent the most important location for hawksbills in the entire WIO. Turtles tracked from D'Arros swim as far as mainland Africa, and the sharks that are monitored through a vast network of 'listening' stations have travelled even further afield. The endangered humphead wrasse hunkers down to find some of its only known viable refuge habitat here. D'Arros and St Joseph Atoll are a sanctuary for replenishment that ocean nomads rely on, a haven that shelters the last viable populations of some species and a place of incredible discovery where new species can shape our understanding of Seychelles' natural heritage. It's also possibly a site of investment, where healthy populations can seed and sustain surrounding areas. Here, corals appear to have fared better in recovering from the devastating global coral bleaching episode of 2015/2016, and the results of a rapid biodiversity survey in 2017 recorded a stupefying 514 fish species, which represents 60% of Seychelles' 889 known reef-fish species. D'Arros and St Joseph Atoll might just show us that when important coral habitats are protected, fish can grow to maturity, and when the aggregation sites of charismatic megafauna are conserved, we have a chance to bolster fisheries and tourism, securing jobs and food security. If biodiversity continues to thrive here, the impact of D'Arros and St Joseph Atoll could far outweigh its relatively minute size in a vast ocean and represent a stronghold for Seychelles and an ailing WIO.

As remote, but not entirely untouchable ecosystems, the SOSF-DRC team now also have to look toward the trends of the future. How might, what they've learnt about the biology and ecology of these islands, change? Take the juvenile sharks which use the nursery sites of St Joseph Atoll. These areas are critical for their health and survival, but climate change is causing them to become ecological traps – the waters are getting warmer, yet the sharks have nowhere to go. It's a multi-generational problem that requires longer-term thinking to solve, something which the current custodians of these extraordinary islands are acutely aware of.

Left: Life explodes in pyrotechnic profusion; a reference for what protection and recovery of our oceans can mean.

Photo by Rainer von Brandis | © Save Our Seas Foundation

Above: Access to wild places where children can find sanctuary in nature are just as important as ensuring they learn how to take care of the planet.

Photo by Dillys Pouponeau | © Save Our Seas Foundation

Future success here is inherently reliant on nurturing the next generation in Seychellois-led conservation, a fundamental responsibility of the SOSF-DRC. In 2022, the team re-launched the D'Arros Experience, an annual two-week-long camp event that aims to engage young Seychellois on the importance of the ecosystems that form part of their national heritage. The intent: to get them excited about this stuff! Each year 16 competition-winning kids travel to the islands, where they're provided with practical, hands-on field experience and the opportunity to experience what they have in their backyard.

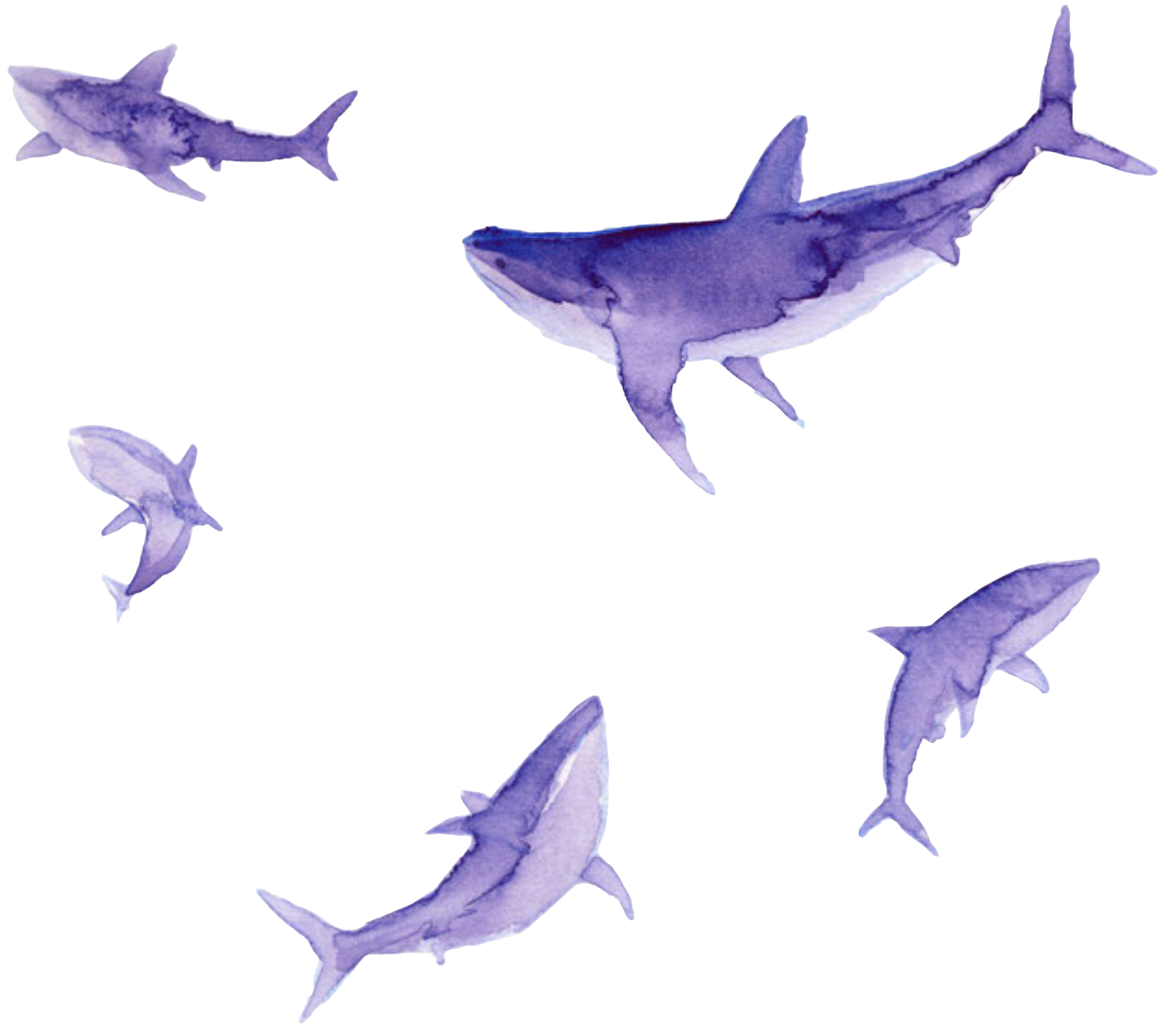
In the end, as much as the wildlife, it's the people that make this place. Though it can be tough living in a small team on a remote and isolated island, the SOSF-DRC scientists feel privileged to live and work here. And in a strange way, it's each individual's preference to work with animals over humans that unites them as people. As Henriette says, a good wildlife encounter here can feed you for months. Be it the mantas that bring the team into their best mindset, or the adrenalin-filled nightly turtle 'treasure hunts' during nesting season, life on D'Arros is constantly evolving. The team is proud to be driving this change in a positive direction, securing the future of these magnificently biodiverse islands for all. Their work here amounts to something much bigger than their day-to-day tasks: by deepening our understanding of this near-pristine habitat, the SOSF-DRC are providing the knowledge that is critical to protecting livelihoods and tourism in the Western Indian Ocean region for decades to come.

Playing with protection

WORDS BY *Isla Hodgson*

ILLUSTRATIONS BY *Rebecca Traunig*

The joy of nature is something all children should experience. But in today's world, they will also encounter something other than nature: anxiety and a deep sense of responsibility for its future. Save Our Seas Foundation Shark Education Centre (SOSF-SEC) has a challenging but important role to play in raising awareness of the threats to our oceans, while instilling a sense of hope and wonder in young hearts and minds.



At a plenary session during the United Nations Climate Change Conference, COP27, the delegation of Ghana requests the floor. But the voice that follows is not that of an official. It is 10-year-old poet and activist Nakeeyat Dramani Sam. Alone in a sea of business attire and faces much older than her own, she addresses those in attendance with an incredible composure that belies her tender age. She speaks softly but powerfully, her words direct. 'There's less than 86 months before we hit 1.5 [degrees Celsius]. And I'm already much older than that. So dear people at this COP – I appeal to you. Have a heart and do the math. It's an emergency.'

Watching this play out through a screen on the other side of the world, I feel a complex mixture of emotions. I am in awe of Nakeeyat and others like her who, before they have even finished school, are fighting to be heard on an international stage. Following in the footsteps of Vanessa Nakate and Greta Thunberg, youth across the world are taking the baton early; tired and frustrated by political inaction, they are stepping up to the plate to safeguard nature and their own futures. This brings me hope, but also great sadness. I can't help thinking of my younger self, at the turn of the millennium, when my relationship with nature was one of sheer joy and exploration. Terms like 'climate change' and 'ecological catastrophe' were not part of my vocabulary. Thoughts of losing the species I had come to know and love never crossed my mind, nor did the possibility that extreme weather events would eclipse the seasons. My peers and I would never have dreamed of squaring up to a politician or stepping out of school to strike. But we didn't have to. For the young people of today, the awe and wonder of the natural world is being eclipsed by a much darker reality: we are hurtling towards climate breakdown at alarming speed, and those in power aren't reaching for the emergency brake. It's a dawning realisation that director of the SOSF Shark Education Centre, Dr Clova Mabin, recognises on the faces of their students: 'the look they get…it's just shock. They've seen something so beautiful, and then it might be taken away.'

The term 'eco-anxiety' was coined in 2017 by the American Psychological Association to describe the chronic distress related to worsening environmental conditions. In the five short years since, reports have shown worrying increases in the number of children and young people experiencing eco-anxiety. A 2021 survey of more than 10,000 people aged 16 to 25 showed 75% feared for their future, and just under half reported that negative thoughts related to the environment impacted their ability to function normally. Another survey conducted in 2020, this time with child psychiatrists in England, showed that more than half of their patients were suffering with the condition. For the first time, children are inheriting not only the joy of nature, but also a sense of responsibility for its rescue. So how do we introduce them to the natural world with the appropriate capacity for both play, and protection?

FORGING A CONNECTION TO THE SEA

Nestled among the brightly coloured houses and vibrant coffee shops of South Africa's Kalk Bay, the SOSF Shark Education Centre overlooks the Atlantic Ocean, across the legendary False Bay to the Hottentots Holland mountains beyond. There couldn't be a more perfect location for a centre dedicated to connecting the public with marine life. Right outside the door lies the Dalebrook Marine Protected Area (MPA), a sanctuary zone within the greater Table Mountain National Park MPA. This hugely biodiverse rocky reef forms the setting for many of the centre's activities. Students are taken on 'treasure hunts' to the rock pools at low tide to discover the animals hiding within them. They are taught to snorkel above the reef itself, watching the kelp fronds sway and spotting for sharks, or surf in the sheltered bay, learning about the tides and currents. In nurturing a love and fascination for the underwater world, Clova and her team can then encourage behaviours to protect it.

Fostering this connection is especially important considering that many of the kids enrolled in the centre's programmes do not have access to the ocean, despite living in close proximity. Students who live as little as three kilometres away have often not seen the sea, let alone swum or snorkelled in it. Although Kalk Bay itself is considered an affluent neighbourhood, Cape Town and the surrounding

areas still experience vast socio-economic inequality. Many of the children and young people who come to the centre do not have running water, electricity, or a reliable source of food. ‘Some of them aren’t sure where their next meal is coming from,’ Clova explains. ‘I remember one of the first high schools we worked with…the kids were falling asleep at their desks. We were wondering what was going on. It was the first lesson of the day, surely they couldn’t be tired already? When I spoke to the teacher, she told us that they likely hadn’t eaten anything since the school meal the previous afternoon. It was a big reality check.’

In this way, the centre provides something more than just education: a refuge. For people from all walks of life, the ocean can be a distraction from life’s stresses, a place of peace. Experiences at Dalebrook have helped some of the centre’s students overcome grief, combat fears, and feel joy. Clova smiles as she remembers the beaming face of a young girl who tackled her fear of the water and swam for the first time, donning a mask and snorkel and exclaiming at the beauty beneath her. ‘I think for everyone, there’s something meditative about being in the ocean and controlling your breathing. It’s not something most children are taught at home. The slow controlled breathing, alongside something as magical as ocean immersion allows them to escape from their everyday lives.’

THE POWER OF PLAY

Once that connection has been established, the door is open for learning. We know from the fields of education and human developmental research that play is integral to a child's ability to retain information – and at the SOSF Shark Education Centre, having fun is key, no matter what your age. 'I think the power of play is underestimated, especially as you get older,' says Clova. 'Who doesn't want to learn through play? It's much more fun! And when you're having fun, your mind is more open to new ideas and new concepts.'

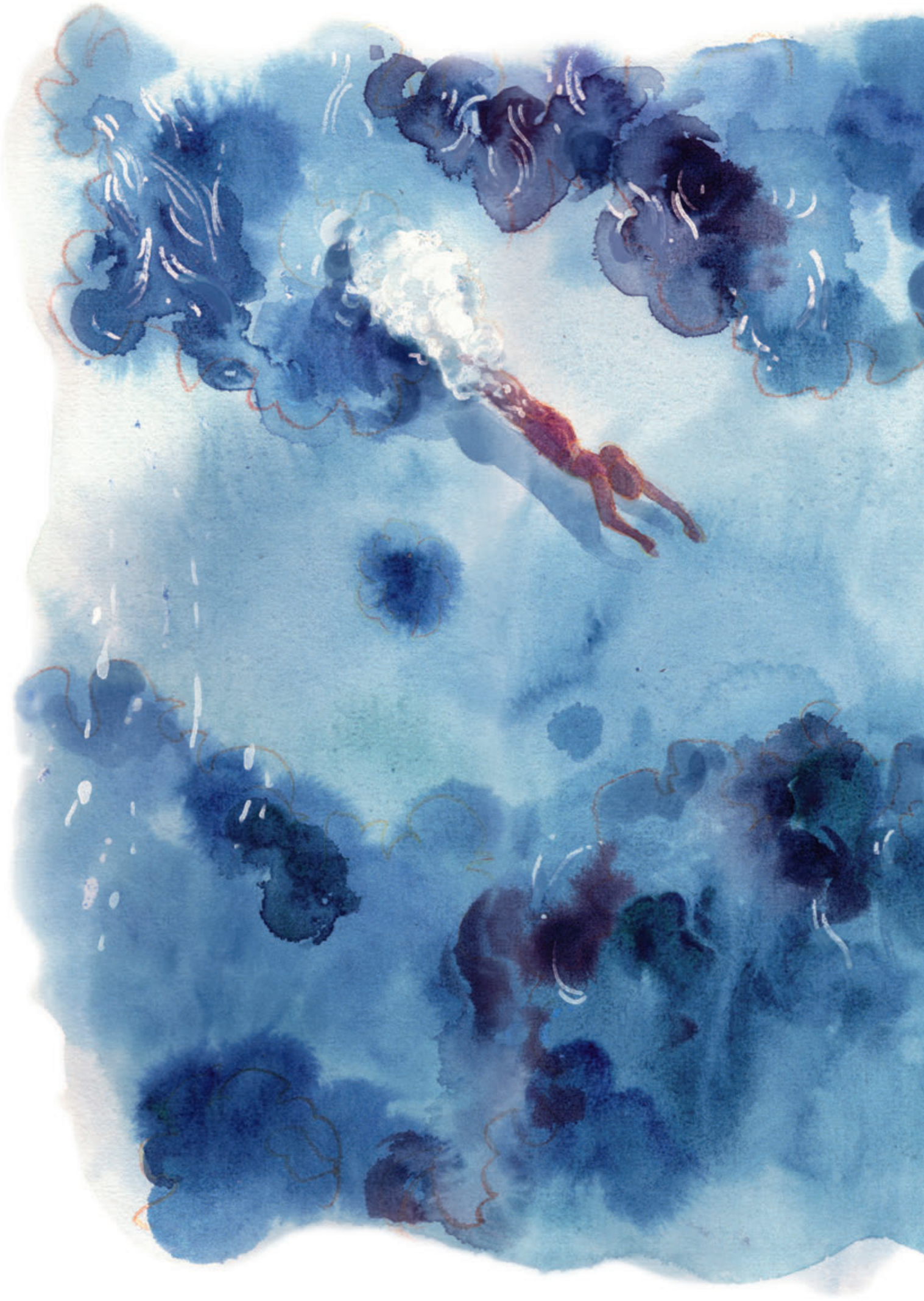
For example, when it comes to teaching schools about the rocky reef at Dalebrook, Clova asks them to role-play. Some students become the animals, adopting their behaviours. Others become the waves and the wind, moving the others about like pawns on a chessboard. And one is always the sun, standing tall and holding aloft a bright light. 'It's putting them into situations where they're really experiencing it, at a level they never have before.' Other games include shark bingo and a marine version of twister (which, personally, I'm dying to play).

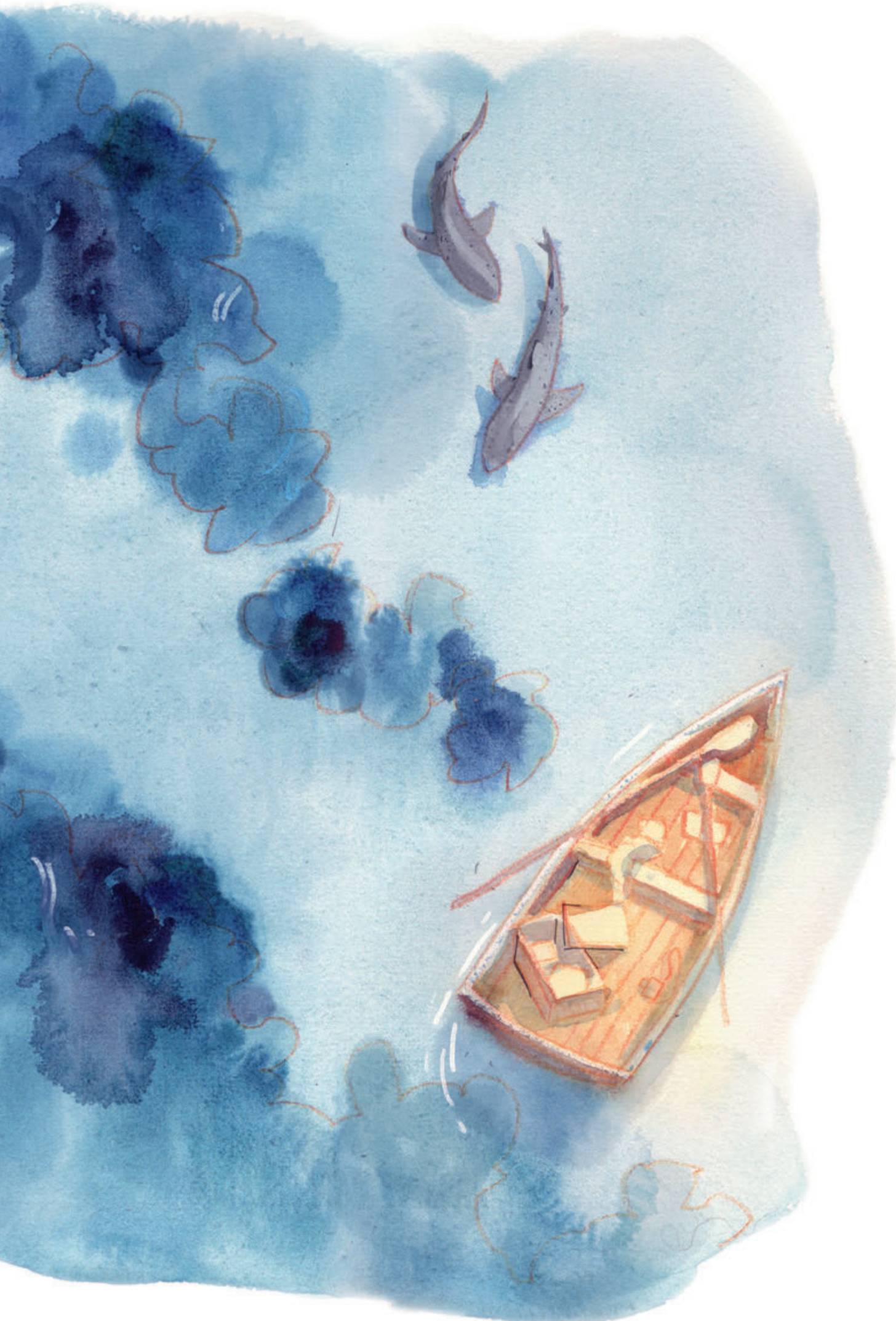
But aside from cool species of shark and ocean processes, students must also inevitably learn about the complex issues facing the very ecosystem they've come to love. Can this be achieved through play, too? Clova tells me about one of her favourite online games, called Survive the Century, created by Sam Beckbessinger, Christopher Trisos and Simon Nicholson. Described as a 'branching narrative game', players are walked through various scenarios representing the political, environmental and social choices humans will have to make within the next 100 years. 'It's a more gentle approach, because there are no real consequences, but they still understand the urgency of the situation,' Clova explains. 'And it allows them to see that their actions can make a real difference.'

BALANCING RESPONSIBILITY WITH HOPE

For the children and young people that Clova works with, eco-anxiety is uncharted territory. With so much else on their plate, the environment doesn't yet feature much in their day-to-day life. But it will become a problem in the near future, especially given the importance of the ocean to their mental health: 'they might feel like the thing that is going to help them is being taken away'.

We can't shy away from the issues facing our oceans, or indeed the threats to the very futures of the next generation. But we can be conscious of how we deliver that message. At the SOSF Shark Education Centre, Clova says, building 'constructive hope' is vital. 'We talk about the positive things that are happening, where there are improvements. And we give clear calls to action – realistic things that they can achieve. That's really important, to make them feel as though they're capable of doing something.' These calls to action must be appropriate to their target audience – for instance, recycling centres are not available where lots of the kids live. But, while at the centre, they can get involved in beach and river cleans. 'That adds the community feel to it as well,' Clova continues, 'which is also important in terms of them feeling they're not alone.'





LOOKING TO THE FUTURE

Up until now, the SOSF Shark Education Centre has focused on its short- and medium-term programmes. These include the 'Marine Explorer's' programme and half-day interactions, where schools could visit the centre and learn of sharks and rocky shores. More recently, a 10-week programme was established to give kids a real foundation in snorkelling, alongside 'Sea School', an after-school club dedicated to marine education. But Clova wants to build on that. Her vision for the centre's future is very much rooted in the long-term. Eventually, she'd like to be able to follow a group through school, nurturing their skills through time and providing career advice at opportune moments. 'I believe that's where we'll see real success. Those kids are going to have bright futures.'

One Shark Education Centre alumni is already on her way to that bright future. Logan, now an intern, began visiting the centre several times through another programme. She is now a trainee educator for the centre, and is applying to university to pursue her dream of becoming a marine scientist. She will be an inspiration for other children, like her, who visit the centre and fall in love with sharks, and the underwater world they call home.

I think back to Nakeeyat's speech at COP27. Her message was one of grave warning, but also hope. She challenged world leaders to 'kindly up [their] game' and protect the futures of those like her. She urged richer countries to support climate-vulnerable nations, suffering disproportionately the effects of climate change, but lacking the resources to recover. The delegates hung on her every syllable. Upon her last word, the room erupted into a standing ovation. Just two days later, a groundbreaking agreement was passed to provide 'loss and damage' funds to more vulnerable countries. I like to think that Nakeeyat's words, and those of many others before her, cut through the dryness and jargon and reminded world leaders of what was at stake: the very futures of the next generation. And, that other young people watched this and felt hopeful. That they saw they had the power to turn the tide, and the responsibility to protect nature was one that was shared between many.

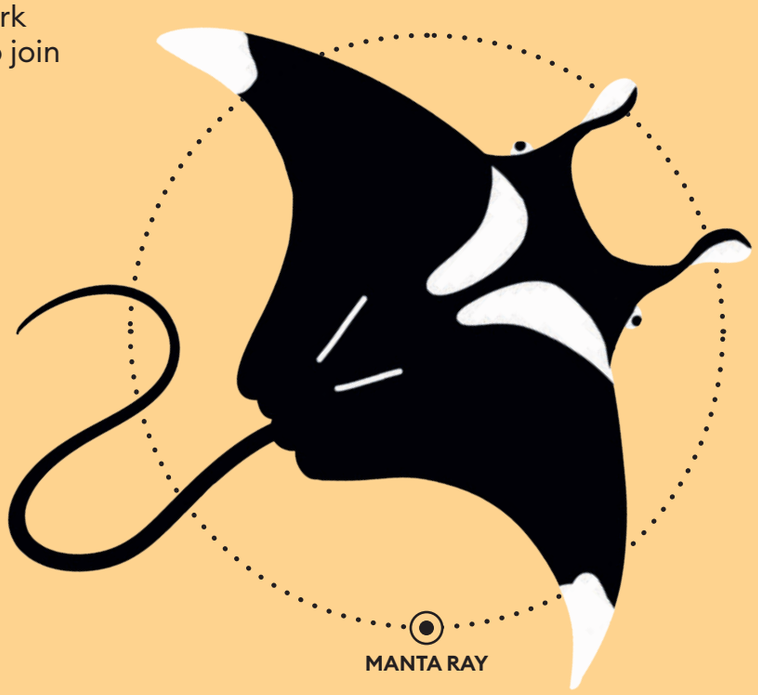
As Clova says: 'Some of them feel that because they're children, they're powerless. But people like Greta and Vanessa show just how powerful children can be. Their voices can be heard around the world. I think when we share the work that other kids are doing, and the impact they are having just by using their voice, then ours see that no matter their background they still have agency. They can still change the world. There is still hope.'

OCEAN FUN

Sharks and rays play many different roles to keep our oceans healthy. Read on to understand why protecting sharks is important for our future!

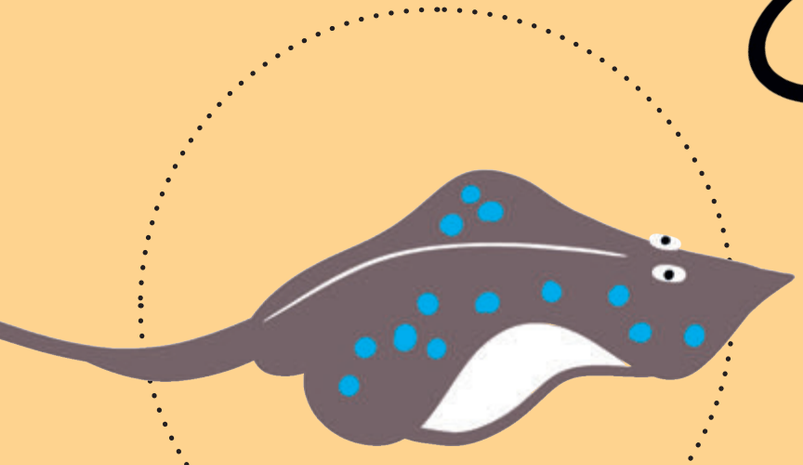
CONNECT THE DOTS

We need sharks in our oceans to do important jobs. The different roles sharks and rays play help to keep our oceans healthy. Read the clues for each shark and ray on the left page, and then draw a line to join the dots to match the animal on the left with its habitat on the right page!



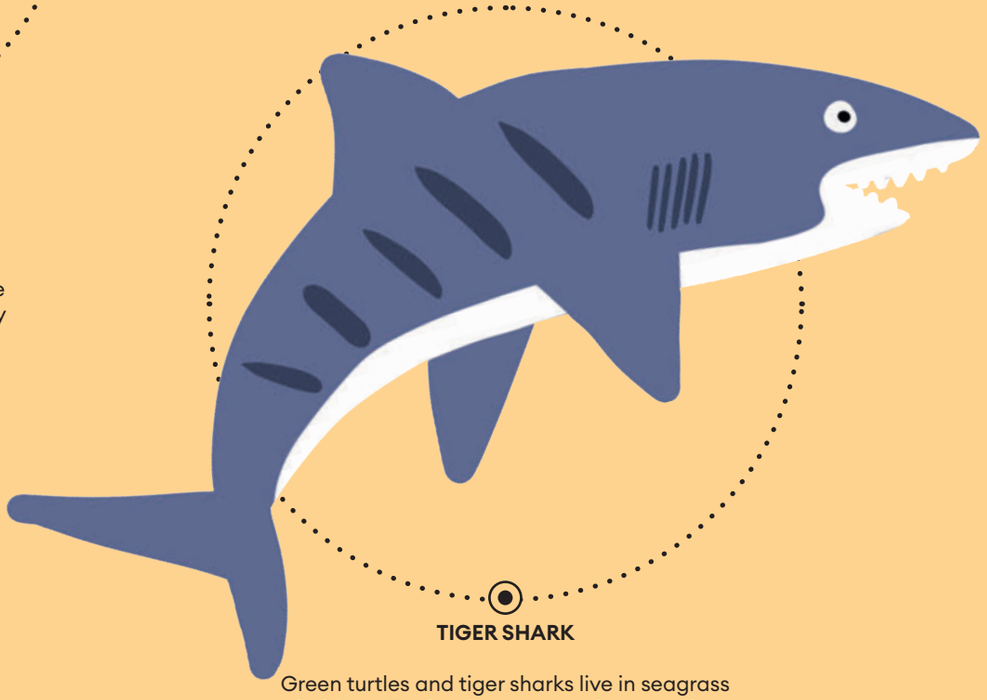
MANTA RAY

Manta rays swim out to the open ocean at night to eat tiny plants and animals called zooplankton. During the day, these manta rays swim back to the shallow coral reef to hang out with their friends – and when they poop there, they help to "fertilise" the coral reef!



STINGRAY

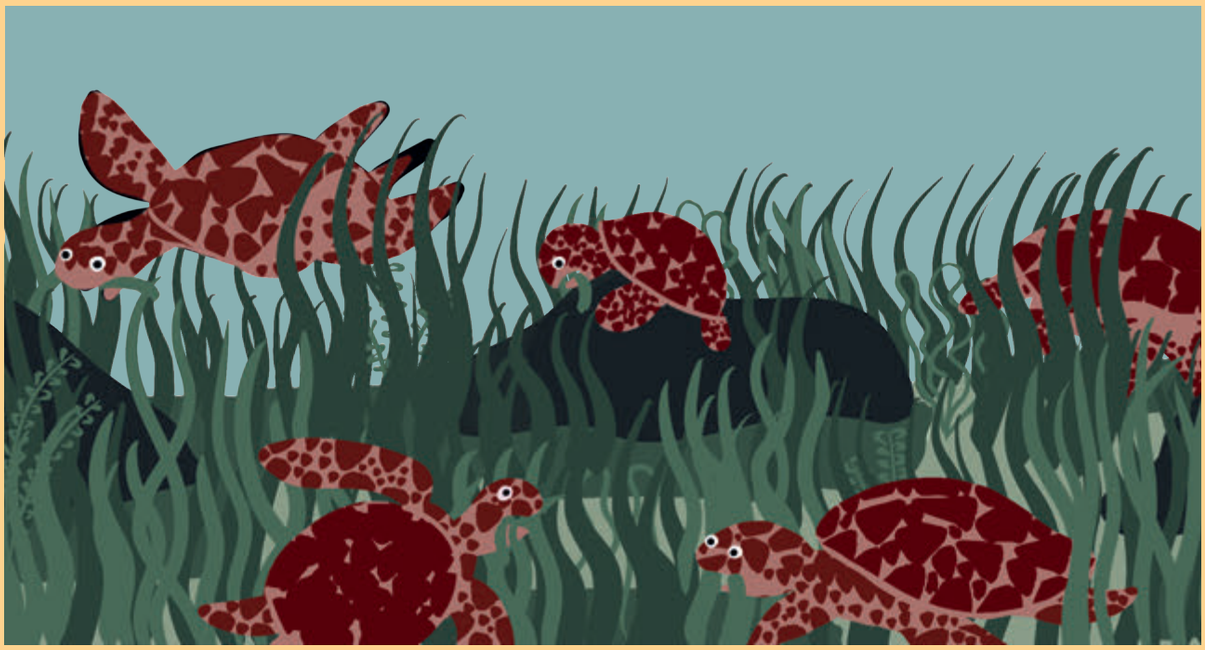
Rays dig around on the sandy seafloor searching for food. They kick up sand and create little holes on the seafloor that become homes for other animals. They also flick up tiny prawns and worms that were hidden in the sand, helping to bring food for other animals.



TIGER SHARK

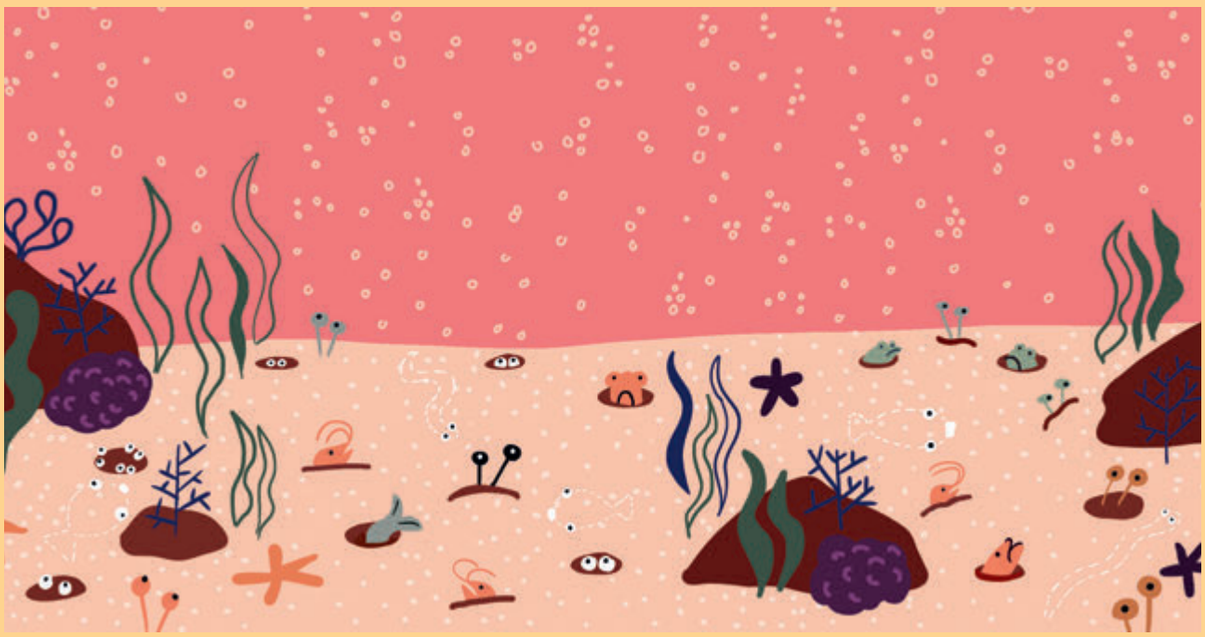
Green turtles and tiger sharks live in seagrass habitats. Turtles don't want to be eaten by sharks, so they move around a lot! This means that turtles don't eat too much seagrass. Tiger sharks help to keep that ecosystem healthy just by patrolling as top predators!

SEAGRASS MEADOWS



CORAL REEFS

SANDY SEAFLOOR



LABYRINTH

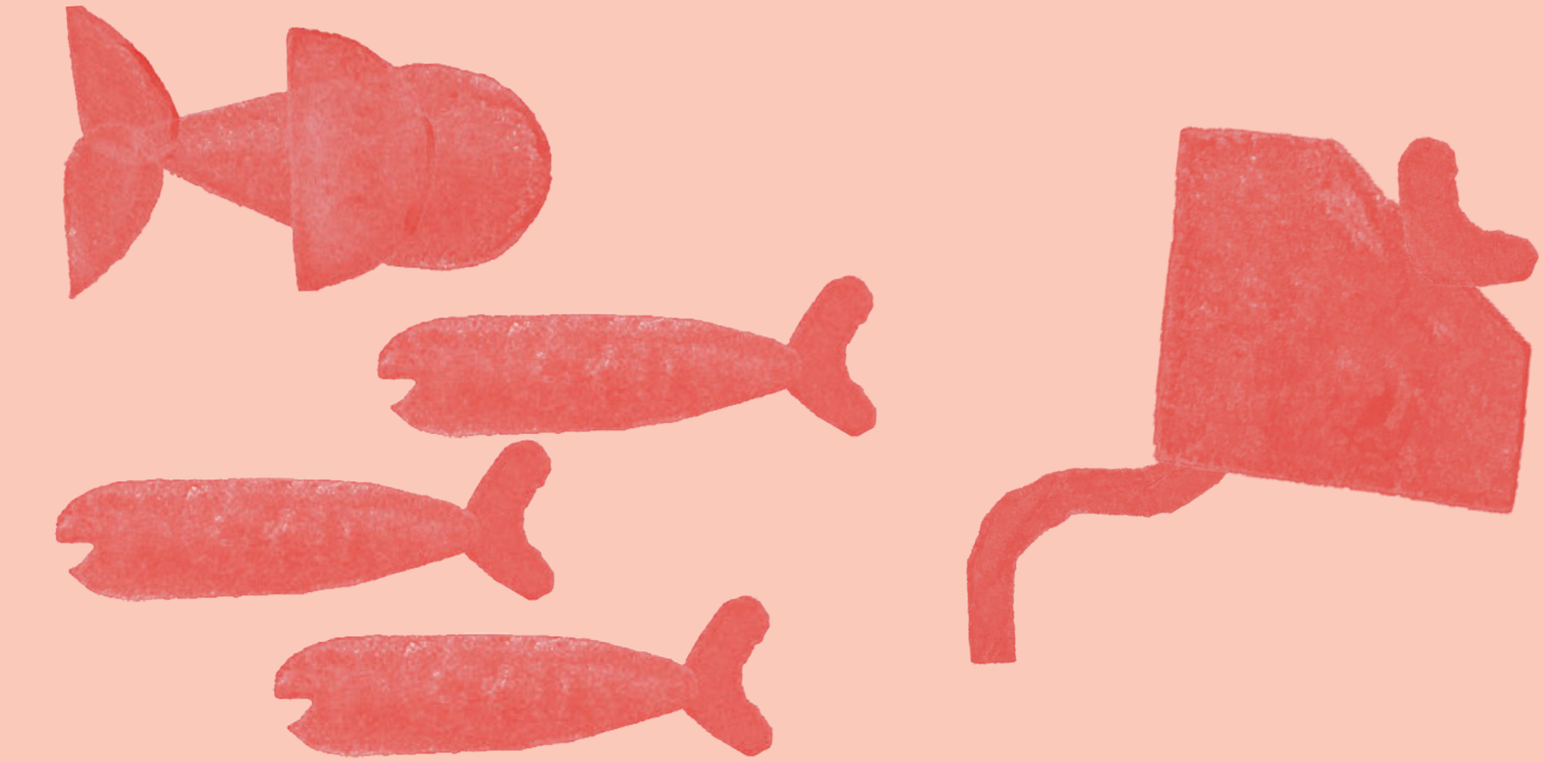
Some sharks move huge distances across our oceans. Others move between different habitats. Help this sawfish move from the river and mangroves where it was born, out into the open ocean where it will live as an adult. Make sure to avoid all the threats along the way!

SPOT THREE SHARKS

ONE-FIN ELECTRIC RAY
These rays can hide from predators and search for prey camouflaged by the sand.

WHITE SHARK
White sharks are ambush predators of seals. Their light underbelly makes them hard to see if you're on the sand below, and their dark top-side makes them tricky to spot if you're swimming above. This is called counter-shading.

PUFFADDER SHYSHARK
Puffadder shysharks are mottled in colour, which makes them quite camouflaged on rocky reefs in kelp forests and able to swim undetected between the anemones, seastars and urchins clinging to the rocks.



CREATE

Get crafty to create your own ecosystem with sharks and rays! Use what you've learnt to shape sharks, and the animals that live with them, in their special habitats.

Make your own

MAKE YOUR OWN DESIGN
Bring this blank page to life: create your own coral reef or mangrove nursery, a kelp forest or a wild open sea!

Step 1
Cut a potato in two

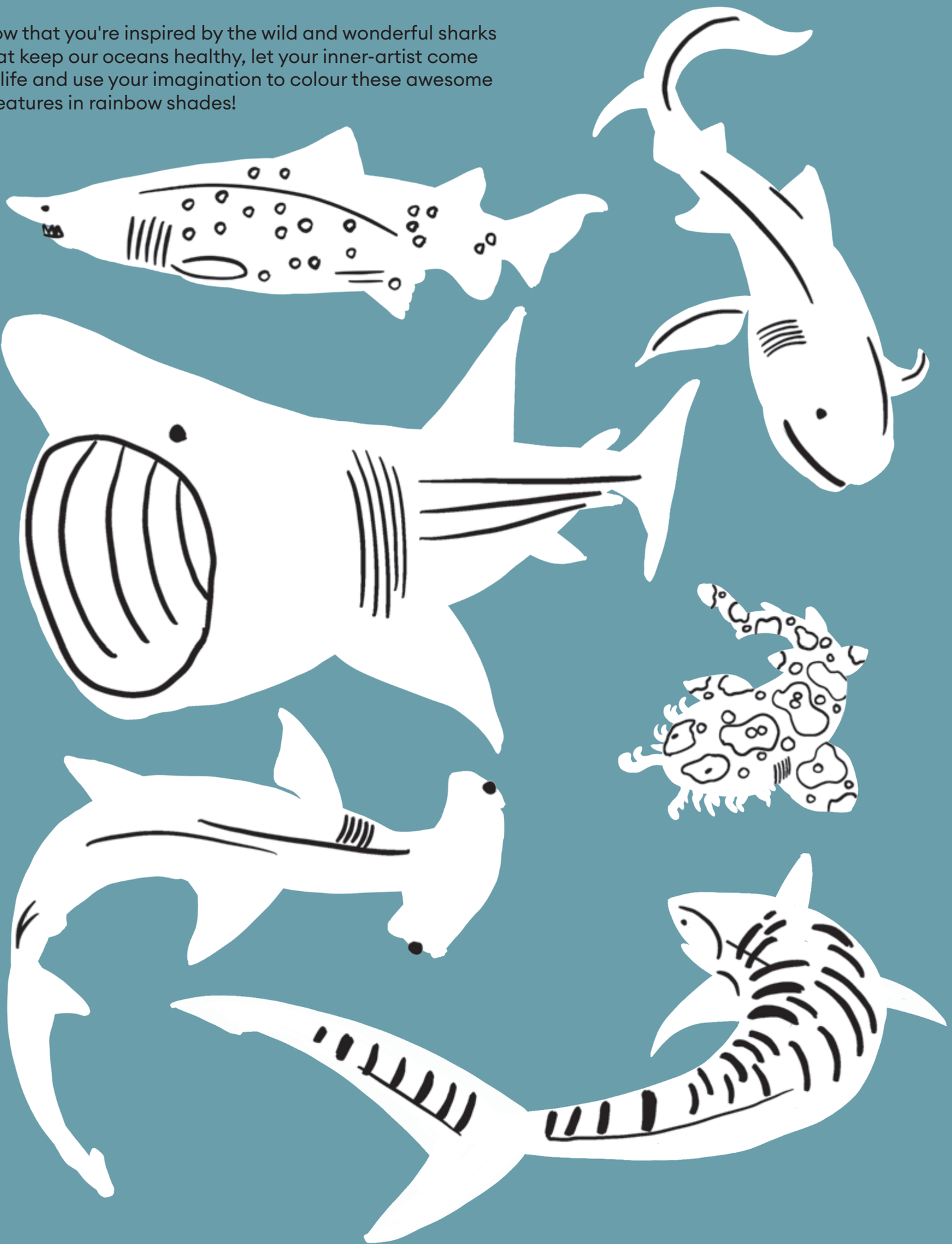
Step 2
Think of a shape

Step 3
Carve with a small knife, 1 cm deep

Step 4
Choose a suitable paint for the surface, e.g. use textile paint to print a cap or t-shirt

COLOUR

Now that you're inspired by the wild and wonderful sharks that keep our oceans healthy, let your inner-artist come to life and use your imagination to colour these awesome creatures in rainbow shades!



ABOUT THE SAVE OUR SEAS FOUNDATION

A commitment to protecting our oceans and their rich biodiversity is at the heart of the Save Our Seas Foundation's (SOSF) work. To achieve this, the Foundation offers funding and support to research, conservation and education projects that focus on threatened marine wildlife and its habitats. From its origins as a small not-for-profit organisation, the SOSF has grown from funding just five projects to supporting over 480 projects in more than 90 countries worldwide. It functions not as a research institute itself, but strives to sustain the many and varied efforts of scientists, conservationists and educators through generous contributions of financial, practical and scientific support. The SOSF funds three permanent centres, works with five long-term partners and now funds an average of 60 projects annually.

To find out more about the Foundation, visit saveourseas.com

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