Front Row Seats for The Third Wave :: Marissa Eckert :: Kim & Kay Vaudin Portfolio

X-Ray Mag

GLOBAL EDITION
Dec 2019 /Jan 2020
Number 95

Japan's
Izu Peninsula

The Philippines'
Wrecks of Coron

Cave Diving
Cerro Rabón

UW Photo
Exposure, Contrast & Curves

Tech
Psych Skills

REVILLAGIGEDO ISLANDS
Socorro

COVER PHOTO BY MATTHEW MEIER

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X-RAY MAG is published by AquaScope Media ApS
Copenhagen, Denmark
www.xray-mag.com

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COVER PHOTO: *Diver Jennifer Black swimming underneath a chevron manta ray—creating an effect known as a "manta sombrero," Socorro Islands, Mexico*
Photo by Matthew Meier (**MatthewMeierPhoto.com**)

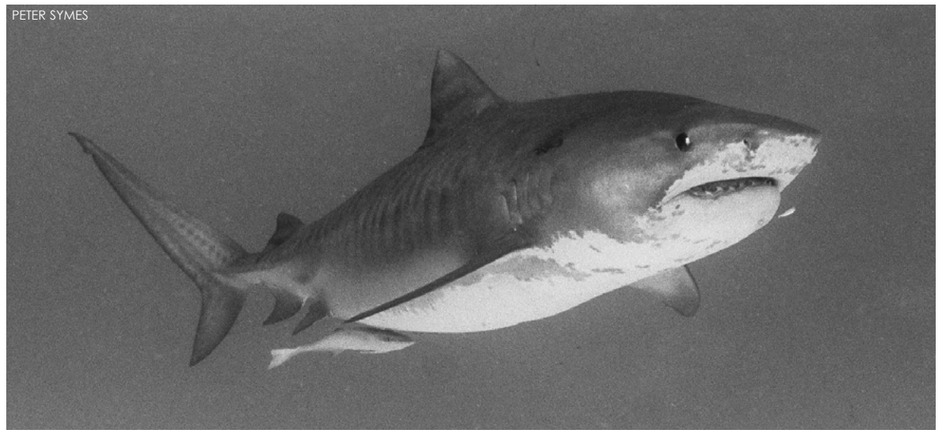
contents

School of razor surgeonfish, Socorro, Mexico. Photo by Matthew Meier

columns...

plus...

Our Own Reality Stars


PETER SYMES

Meet Smiley (pictured), a stately tiger shark, easily recognisable by her crooked jaw, who is well known to those who have been lucky enough to encounter her off Tiger Beach in the Bahamas. Look around at various articles, sites and social media pages and chances are, you will find her framed by other photographers. She is even featured in an image adorning Scubapro's website. Evidently, a lot of people have had encounters and interactions with Smiley.

I still remember clearly the instant I spotted Smiley. She approached our dive group warily and kept her distance for a pensive long while as if she was a bit unsure as to whether or not we were safe to approach. A notion that was a bit absurd given she was much bigger than any of us, very muscular and had a wide mouthful of razor-sharp teeth. Predators tend to be wary. Getting injured in the wild can be a death sentence.

Obviously, she is used to divers; she tends to hover about, and gets in close, once she gets comfortable with the individual group of divers. She is, however, in no way tame but very much a wild animal that roams freely and migrates vast distances. She is just habituated to divers and appears to associate with them, snack on some regular morsels of food and, who knows, perhaps some sort of entertainment.

We are not considered lunch, thankfully. Only, I gladly admit, I did question my sanity before I jumped into the crowd of circling sharks the first time.

But what soon stood out on this dive was that individual sharks had different characteristics too. They were clearly intelligent, observant and cognizant of interacting with groups of divers.

Who knows what goes on in the mind of a dolphin, shark, manta, octopus or turtle we may encounter? How much do we have in common and how much do we innately understand about each other? I cannot help wondering. Octopuses in particular makes me ponder. They are smart, can solve problems and use tools. Yet, they are molluscs with brains and nervous systems that are completely different in structure and wiring than ours. Intelligence comes in many shapes and forms.

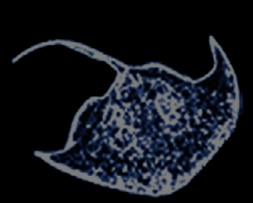
How do these other species see us, and why do some of them seem to actively seek out divers just to interact with them? Mantas seem to do so, and, as they are planktivores, they are surely not coming to us for food.

Most of us appreciate how much individuality and character a dog or a cat can possess. (I am not sure if the term "personality" is applicable to non-persons). After all, they are close companions and a comfort for quite many people.

I count it as one of the most enlightening experiences, to discover and keep rediscovering all over again, how this also seems to be true of many of the marine species we encounter that choose to interact with us when we go for an excursion below the surface.

Just remember never to chase, corner or harass any creature. The stress is harmful. Be gentle and respectful towards marine life—just like you would like to be treated yourself.

— Peter Symes
Publisher & Editor-in-Chief

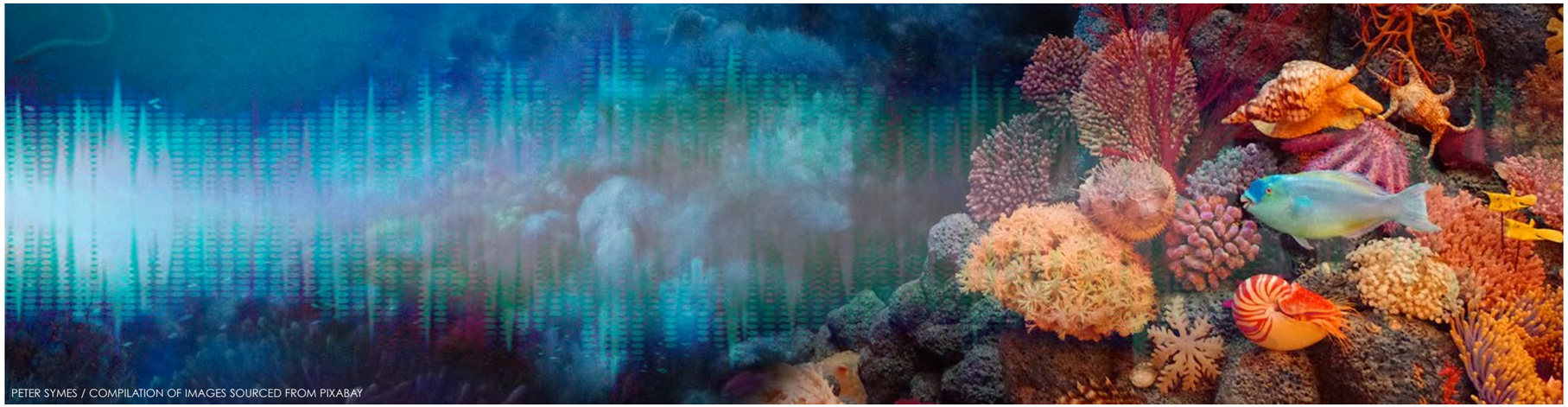


News edited
by Catherine GS Lim

from the deep

NEWS

Acoustic enrichment can enhance fish community development on degraded coral reef habitat.



PETER SYMES / COMPILATION OF IMAGES SOURCED FROM PIXABAY

Using sound to attract fish to reefs

Maintaining healthy fish communities counteracts reef degradation, but degraded reefs smell and sound less attractive to settlement-stage fishes than their healthy states. Playback of healthy reef sound can increase fish settlement and retention to degraded habitat.

Healthy coral reefs are full of sounds of life—with the whistles, pops and grunts of fish, the crackle of snapping shrimp, etc. These sounds travel out through the ocean currents, and "advertise" to young fish to come and settle down at this particular reef ecosystem.

However, when reefs are degraded or dying, the environment falls silent. Literally.

As a result, young fish do not find their way to such reefs, and this exasperates the reef's dire situation.

In a recent study, an international team of researchers have managed to attract young fish to degraded reefs by using loudspeakers to play sounds of healthy reefs. The technique is called acoustic enrichment.

Describing the sounds of a healthy reef as a "dazzling biological soundscape," Professor Steve Simpson from the University of Exeter said that "juvenile fish home in on these sounds when they're looking for a place to settle."

According to the press release, "broadcasting healthy reef sound doubled the total number of fish arriving onto experimental patches of reef habitat, as well as increasing the number of species present by 50 percent."

"Of course, attracting fish to a dead reef won't bring it back to life automatically, but recovery is underpinned by fish that clean the reef and create space for corals to regrow," said Australian Institute of Marine Science fish biologist Dr Mark Meekan.

Describing acoustic enrichment as a promising technique for management on a local basis, co-author Professor Andy Radford from the University of Bristol added: "If combined with habitat restoration and other conservation measures, rebuilding fish communities in this manner might accelerate ecosystem recovery." ■

SOURCE: NATURE COMMUNICATIONS

The underwater museums are open to the public and must be accessed by snorkeling or scuba diving. However, to facilitate access by the non-diving public, many of the shipwrecks researched by Indiana University have conserved artifacts on display in the Museo de las Atarazanas Reales, the Dominican Republic's national maritime museum.

Fifth Living Museum in the Sea opens in Dominican Republic

If you plan to go diving near the southern coast of the Dominican Republic, you should check out the new underwater museum that has just opened in the La Caleta Underwater National Park.

As the fifth Living Museum in the Sea, the 1725 Nuestra Señora de Begoña is the reconstruction of the wreck of a Spanish frigate that sank during a storm in 1725.

Similar to those historic dioramas one finds in a normal museum, these Living Museums in the Sea are the result of a collaboration between the government of the Dominican Republic and Indiana University (IU) Center for Underwater Science. They are essentially maritime archaeological parks featuring both real artefacts and replicas that show how a particular wreck appeared when it was discovered.

Sustainable alternative

Calling it "a sustainable alternative to treasure hunting," Charles Beeker, Director of the Center for Underwater Science, said in a press release that the creation of such structures involve both biological and archaeological protection efforts because scientists combine maritime treasures with their associated underwater biology. "Treasure hunters can only sell it once, but with the living museum model, we can sell history forever," he added.

To date, the Nuestra Señora de Begoña is the fifth Living Museum of the Sea. Some of the previous ones include Guadalupe Underwater Archaeological Preserve (the Dominican Republic's first underwater shipwreck museum), Morales Underwater Archaeological Preserve (artificial shipwreck park on Guarango Reef) and Captain Kidd Underwater Archaeological Preserve (shipwreck park sited at Captain Kidd's 1699 Quedagh Merchant).

In addition, artefacts from shipwrecks are better preserved when they are returned to their original wreck site underwater. In the case of the Nuestra Señora de Begoña, artefacts like its cannons and anchors were brought back and installed at the site.

Better kept in water

"The thing with artefacts in maritime archaeology is that they're underwater, and they've taken in chloride and salt ions from the saltwater," said Tori Galloway, a research associate at UI. "When you pull them out of the water, they disintegrate much more quickly."

Returning the artefacts to the wreck site also solves a problem that is unique to the Dominican Republic. Here, treasure hunting is legal, as long as half of what has been salvaged is returned to the government. As a result, the government is burdened with a large quantity of artefacts that do not tolerate the above-water environment well. Thus, Living Museums in the Sea allow the artefacts to be returned to an environment in which they can be better preserved in situ, without the need for costly preservation methods.

For those keen to visit the Nuestra Señora de Begoña wreck, it is, of course, only accessible to scuba divers or snorkellers. Nonetheless, those who prefer not to get wet can view some artefacts of many of the shipwrecks researched by IU at the Museo de las Atarazanas Reales.

In the weeks to come, the research team will create a 3D photogrammetric rendering of the wreck, which can be used for long-term monitoring and management. ■

SOURCE: INDIANA UNIVERSITY

Indiana University researcher Matt Maus and diving safety officer Sam Haskell position the replica cannons on the site of the new "Living Museum in the Sea."

Edited by
Catherine
GS Lim

The offshore reefs of Fiji's Beqa Lagoon feature a healthy diversity of marine life

Offshore coral reefs are healthier

Coral reefs that are located in remote offshore places are healthier than those that are found near the coastline, as the latter tend to be subject to nutrient runoff and sedimentation.

Researchers from the Woods Hole Oceanographic Institution (WHOI) and the Centro de Investigaciones Marinas—Universidad de La Habana (CIM-UH) have discovered that offshore coral reefs that are also protected tend to be healthier than nearshore ones.

In their study, seawater from 25 reefs in Cuba and the Florida Keys in the United States were tested for nutrients and other parameters that would give researchers a glimpse into the microbial community present. They discovered a marked difference between the reefs that experienced a large amount of human activity compared to those that did not.

Many of the Cuban reefs studied did not experience a lot of nutrient runoff or sedimentation flowing into the sea, since there was not large-scale industrial agriculture or extensive development along most of the Cuban coastline.

For instance, at the Jardines de la Reina, a reef system about 50 miles off Cuba's southern coast, sees minimal human activity due to its remote location. In addition, most of the archipelago lies within a marine natural park, enabling it to enjoy further protection from maritime traffic, fishing and recreational diving.

Here, researchers detected low nutrient concentrations and a high abundance of Prochlorococcus, a photosynthetic bacterium that thrives in low nutrient waters.

In contrast, at the more accessible reefs of Los Canarreos in Cuba (which experiences relatively more human activity in the form of illegal fishing, tourism and recreational diving as a result), there were higher concentrations of nitrogen and organic carbon.

The same was true for the nearshore reefs in the Florida Keys, where the condition of the reefs had been declining as the study progressed.

In addition, the healthier Cuban reefs saw more diverse microbial communities with abundant photosynthetic microbes, compared to those at the reefs in Florida.

Changes to reef structure

According to lead author WHOI graduate student Laura Weber, human impact like overfishing and pollution lead to changes in the reef structure. She added that "removal of algae grazers such as herbivorous fish and sea urchins leads to increases in macroalgae, which then leads to increased organic carbon, contributing to the degradation of coral reefs."

The study concluded that reefs that were offshore and enjoy protection status tended to be healthier, as they were subject to lower nutrient runoff and carbon from industrial activities.

The team hopes that the findings can help resource managers in their decision making to protect and restore coral reefs in the Caribbean in light of habitat and climate-based change. ■

SOURCE: ENVIRONMENTAL MICROBIOLOGY JOURNAL.

Starboard side of the wreck. Could this be the sister ship of *Vasa*?

Two shipwrecks as big as the famed *Vasa* ship discovered inside Stockholm's archipelago

The wrecks of two well-preserved 17th-century warships has been discovered off the coast of Vaxholm, a Swedish island near Stockholm. Marine archaeologists suspect one of the vessels is the sister ship of the famed *Vasa* warship.

Following the discovery in the beginning of November, maritime archaeologists at Vrak—Museum of Wrecks, a new museum that is part of Sweden's National Maritime and Transport Museums, have investigated the site in a depression in the sea bottom, outside of Vaxholm. What they found was astonishing—the maritime archaeologists first discovered a shipwreck as big as the *Vasa* ship. It was a 17th-century warship that was most likely purpose-sunk to make it harder for intruders to take the sea route to Stockholm. The stern is broken, but the bow is better preserved and sticks up roughly five metres from the bottom of the sea. The measurements taken and the design details recorded both tally well with the *Vasa*'s.

"It was like swimming around the *Vasa* ship," said maritime archaeologist Jim Hansson.

The next day, the team found another shipwreck—probably larger than the first—in the lengthened section of the first wreck they had found. The maritime archaeologists hope they may have discovered *Vasa*'s sister ship, Äpplet ("the Apple"), one of several large warships that, according to historical sources, were sunk outside Vaxholm during the second half of the 17th century. *Vasa* was salvaged in 1961 and is currently on display at the Vasa Museum in Stockholm, one of Sweden's most popular tourist spots.

Vasa on display in Stockholm. The ship is one of Sweden's most popular tourist attractions and has been seen by over 35 million visitors since it was salvaged in 1961.

Aside from *Vasa*, three other ships were ordered from the same shipwright: *Äpplet* (the Apple), *Kronan* (the Crown) and the *Scepter* and built in a series together with the *Vasa* during King Gustav Adolf's equipping of the Swedish naval fleet. Unlike *Vasa*, which ignominiously capsized and sank less than a mile into its maiden voyage, they all served in the Swedish navy and participated in naval battles.

"We think that some of them were sunk in the area," said Patrik Höglund, another maritime archaeologist and diver at the newly established Museum of Wrecks.

The ships are believed to have been sunk on purpose after they were decommissioned, serving as underwater spike strips for enemy ships. During the dives, the archaeologists took several samples of the wood in the wrecks. These samples will now be analysed in order to date and hopefully identify the wrecks.

The dives were carried out by the National Maritime and Transport Museums in cooperation with the Swedish Navy. ■

SOURCE: VRAK–MUSEUM OF WRECKS

Marine archaeologists retrieve artifacts for analysis.

IONIAN AQUARIUM

ABOVE: 2,000-year-old Roman vessel heavily laden with amphorae. The number of amphorae lying on the cargo surficial layer was 1,200, based on the detailed counting of the intact amphorae. LEFT: A wreck carrying roof tiles was found in shallow water off Cyprus. The vessel has been dated to the end of the 6th or the 7th century AD.

CYPRUS DEPARTMENT OF ANTIQUITIES

Several ancient wrecks laden with amphorae discovered off Cyprus and Greece

Wrecks with around 800 Roman amphorae, dating to the end of the 6th or the 7th century AD, have been found scattered in shallow waters in Akrotiri-Dreamers Bay in Cyprus. Greek archaeologists also discovered the remains of a massive Roman vessel laden with as many as 6,000 amphorae off Kefalonia off Greece's western coast.

Beside the remains of the ancient breakwater submerged just some 1 to 4m beneath the water in the Akrotiri-Dreamers Bay in Cyprus, archeaologists noticed a dispersed and concreted concentration of largely homogenous ceramics located on an elevated, rocky outcrop to the east of the breakwater. Additional finds, including numerous stone anchors, led to the discovery of what appears to be the remains of a wreck carrying roof tiles, dating back to the end of the 6th or the 7th century AD.

Massive Roman wreck

Believed to have sunk some 2,000 years ago, the remains of a massive 35m Roman vessel—believed to be the largest classical shipwreck found in the eastern Mediterranean—was discovered at a depth of around 60m during a survey off Kefalonia, one of the Ionian islands off Greece's western coast. The site is situated 1.5 miles from the entrance to the harbour of Fiscardo, the island's only village to not be destroyed during World War II.

The finding was made by a 10-member team from Greece's University of Patras during surveys conducted between 2013 and 2014, and is the fourth Roman wreck to be found in the area. Dated to between 100 BCE and 100 CE, it is more than double the length of the average vessel of the time. Especially notable is its cargo of 6,000 terracotta pots known as amphorae, used during the Roman Empire for transporting wine and olive oil. ■

SOURCE: JOURNAL OF ARCHAEOLOGICAL SCIENCE

Truk Lagoon initiative launched

Text by Rosemary E. Lunn

Many returning divers visiting Scapa Flow have found they are getting much more out of their diving because they now have an array of resources at their fingertips, including some very detailed three-dimensional images of the interned fleet.

It now looks as though, apart from the "Operation Hailstone" ships sunk in Truk Lagoon, Micronesia will also benefit from being professionally documented too. Plans are being announced that a baseline is going to be established on these "bucket-list dive" wrecks.

Importance of baseline

Over the past five years, the World War II wrecks of Truk (Chuuk) Lagoon have started to show signs of age, and significant structural collapse has occurred in many wrecks. This has not been overlooked by renowned expedition leader Pete Mesley, owner of Lust4Rust Diving Excursions.

Since 2004, he has been running respected expeditions to this wreck mecca, that are structured in such a way that groups of divers safely get the most out of their trip.

"I have noticed the deterioration of many of these wrecks, especially over the last few years, which is causing a lot of concern," stated Mesley. "There is obvious attention on the environmental front with the thought that there is a lot of potential oil still trapped in these wrecks. If they should fracture and the oil released into the environment, this could cause catastrophic damage to an already fragile ecosystem.

"It's not only that, but also how long can these wrecks still draw people from all over the globe to come and dive? Tourism makes up over 90 percent of Chuuk's revenue, so the lives of most would be dramatically affected if tourism dried up. We have therefore decided to set up this important wreck baseline. This data is vital for many different sectors, and they will be able to use this information to make informed decisions as to the status of these wrecks."

Work has already started

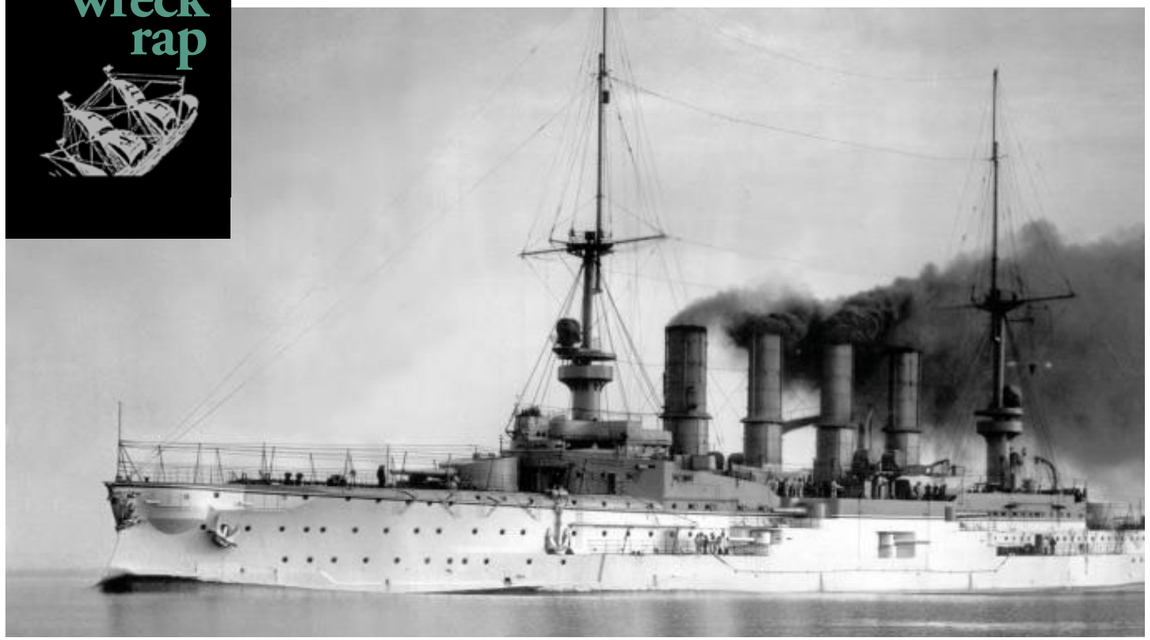
Mesley is also taking steps to help local government futurise Chuuk, so divers and tourism can prosper for the next 75 odd years; hence, Mesley has brought in fellow award-winning underwater photographer Marcus Blatchford in to start this mammoth task.

"I have known Marcus for a number of years now and we have often talked about 3D modelling these wrecks. With his experience in not only the image gathering but also his vast knowledge in collating and processing the data, Marcus was the perfect choice."

This looks to be a fascinating process because Mesley has hundreds of hours of experience photographing and diving the Truk wrecks, whilst Blatchford has been doing a serious amount of work on the photogrammetry front. (In August 2018, we reported that Blatchford—together with Maltaqua and Steve Jakeway—had photographed and produced limited edition prints and a full-colour poster showing 3D images of the SS *Le Polynesien* wreck off Malta).

The data collection process has now started. In November 2019, several thousand images were captured with the hope they will be processed into fourteen 3D models.

You can now follow this journey by "liking" and checking out the Truk Wreck Baseline Project page on Facebook. ■



Admiral Graf von Spee's famous flagship, the battlecruiser SMS *Scharnhorst*.

WWI heavy cruiser SMS *Scharnhorst* discovered off Falklands

Wreckage of German WWI battlecruiser SMS *Scharnhorst* is discovered off the Falkland Islands 105 years after it was sunk by the British warships HMS *Invincible* and HMS *Inflexible* in a crucial battle.

The wreck of the German battlecruiser SMS *Scharnhorst*, sunk by the Royal Navy during the First World War with the loss of all her crew and Admiral Graf von Spee, has been found in the South Atlantic. SMS *Scharnhorst*, the flagship of the East Asia Squadron, which was once the scourge of the Royal Navy, went down with most of the rest of the formation on 8 December 1914, in the Battle of the Falkland Islands. The battlecruiser sank with more than 800 crew members on board.

The *Scharnhorst* had tried to lead a naval attack on the Falklands, but the German squadron was surprised by a larger force of British warships. During the resulting Battle of the Falkland Islands, the British sank the *Scharnhorst* along with eight other German warships.

End of squadron

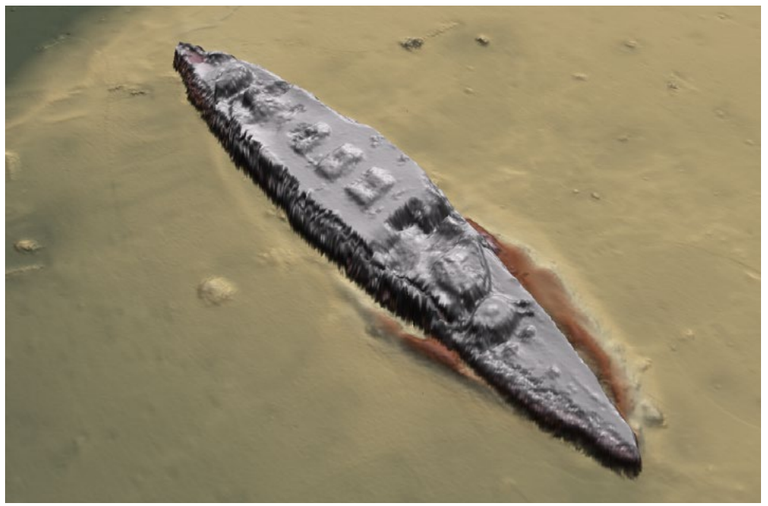
The action was particularly important because as a consequence of the battle, the German East Asia Squadron—Germany's only permanent overseas naval formation—effectively ceased to exist, bringing an end to commerce raiding by German warships.

Found!

Sitting upright on the seabed about 100 miles southeast of Port Stanley, some 1,600m (5,280ft) down, the *Scharnhorst* was discovered by marine archaeologist Mensun Bound, the first success in a search by the Falklands Maritime Heritage Trust to locate the warship.

"The moment of discovery was extraordinary," said Bound. "We are often chasing shadows on the seabed, but when the *Scharnhorst* first appeared in the data flow, there was no doubt that this was one of the German fleet. You could even see the impact crater. We sent down a remotely-operated vehicle to explore, and almost straightaway, we were into a debris field that said 'battle.' Suddenly, she just came out of the gloom with great guns poking in every direction."

The Falkland Maritime Heritage Trust is now seeking to have the site formally protected in law. The wreck was not touched or in any way disturbed during the operation. The team on board Seabed Constructor conducted an act of remembrance at the site, commemorating all who died during the battle. ■



Sidescan sonar image of SMS *Scharnhorst* resting on the seabed

Famous WWII US destroyer deepest wreck ever found

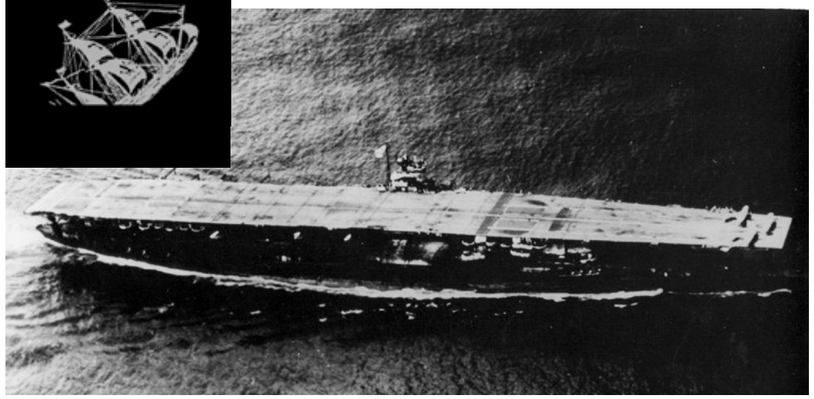
Explorers aboard the RV *Petrel* encountered the shattered remains of *Johnston*, the American Fletcher-class destroyer that fought in the Battle of Leyte Gulf, 6,220m (20,406ft) beneath the Philippine Sea.

The ship was most famous for her bold action in the Battle off Samar. The sacrifices of *Johnston*, and her little escort carrier task unit "Taffy 3," helped stop a massive Japanese fleet from attacking vulnerable US landing forces, and eventually inflicted greater losses to the Japanese attackers than they suffered. After a bruising three-hour fight, in which *Johnston* sank "destroyer after destroyer", according to the US Navy, the vessel succumbed to the onslaught.

Of the crew of 327, only 141 survived. Of the 186 lost, about 50 were killed by enemy action, 45 died on rafts from battle injuries and 92, including the captain, Lieutenant Commander Ernest E. Evans, were alive in the water after *Johnston* sank, but were never heard from again.

For *Johnston's* supreme courage during the Battle off Samar, she was awarded the Presidential Unit Citation. The ship received six battle stars for service in World War II. Her captain, Lieutenant Commander Ernest E. Evans, posthumously received the Medal of Honor.

Explorers aboard the research vessel *Petrel* used an undersea drone to locate and film the twisted remains of the warship. Eerie video footage shows mangled gun emplacements, two funnels and other unrecognisable hunks of twisted metal strewn across the seabed. "There is no hull structure intact that we can find. This wreck is completely decimated—it is just debris," the crew of the *Petrel* stated in a released video. ■



The Japanese aircraft carrier *Akagi* pictured underway in the summer of 1941.

WWII Japanese aircraft carriers *Akagi* and *Kaga* found

Deep-sea explorers aboard the research vessel *Petrel* have found two Japanese aircraft carriers that were sunk in the Battle of Midway during World War II.

The discoveries came after weeks of searching by crew members based on the research vessel *Petrel*. The vessel is owned by Vulcan Inc, a company created by the late Microsoft co-founder Paul Allen.

The carriers *Kaga* and *Akagi* were among seven ships that went down in the Battle of Midway, a major air and sea battle fought between the United States and Japan in 1942, which killed 3,057 Japanese and 307 Americans. Along with *Kaga*, three other Japanese fleet carriers—*Akagi*, *Soryu* and *Hiryu*—were sunk during the battle. The Battle of Midway took place six months after Japan's attack on Pearl Harbor. After the attack, the Imperial Japanese Navy planned to invade and capture Midway Island by luring American aircraft carriers into an ambush. The ruins of *Akagi* were found in the Papahanaumokuakea Marine National Monument, resting more than 17,000ft below the surface of the Central Pacific Ocean about 1,300mi northwest of Pearl Harbor, the press release said. Crew aboard the *Petrel* determined the ruins belonged to *Akagi* by taking sonar images identified by the vessel and matching them with the dimensions and location of the lost warship.

"Every shipwreck we find reminds us all of the ultimate sacrifice made by those who served their countries," said Robert Kraft, Vulcan Inc.'s director of undersea operations, in a press release. "Our team is truly honoured to have discovered the Japanese Flagship Carrier, *Akagi*." ■

SOURCE: VULCAN INC

USS *Grayback*, a US Navy submarine lost in 1944 to enemy air attack, has been found off the coast of Okinawa.

Two more WWII submarines have been found

The wreck of USS *Grayback* was discovered off Japan and HMS *Urge* was found off Malta.

The USS *Grayback*, one of WWII's most successful US submarines, was discovered 1,400ft below sea level off the coast of Okinawa, Japan. The submarine was found by the Lost 52 Project, which locates lost US World War II submarines, and is the first US submarine discovered off the coast of Japan.

Wrong location

The search was conducted by US and Japanese researchers who discovered a flaw in the translation of Japanese military documents that detailed where the *Grayback* had likely sunk. All this time, the Navy's historical records had listed an incorrect longitude for the submarine's location. The team discovered the *Grayback* about 100 miles from the area where it was originally thought to have gone down. Lost 52 Project founder Tim Taylor described the discovery as "absolutely amazing."

Severe bomb damage

The submarine sits upright on the bottom in 1,400ft (430m) of water. The deck gun was found approximately 400ft from the primary wreckage. The wreck has severe damage aft of the conning tower, consistent with reports of a direct bomb hit in that area. Records from Japan indicated that *Grayback* had been hit by an aerial bomb from a Nakajima B5N while on the surface and further damaged by depth charges. The bow is broken off at an angle and a portion near the stern also imploded. Finally, the builder's plate remains attached to the intact bridge.

HMS *Urge*

Part of Britain's 10th Submarine Flotilla, the HMS *Urge* left the Mediterranean island of Malta on 27 April 1942 but never made it to its destination of the Egyptian port of Alexandria. Until its discovery this summer, the reason for both the ship's disappearance and its final resting place were unknown. The discovery of HMS *Urge* suggests it sank after hitting an explosive marine mine placed by an enemy German warship.

A marine archaeology survey team from the University of Malta made the discovery. The wreck had been discovered a few months earlier but no announcement was made until the Ministry confirmed that the remains were of HMS *Urge*. Professor Timmy Gambin said the wreck was "in absolutely fantastic condition".

"It's sitting upright on the seabed, very proud, in the direction it was ordered to take on its way to Alexandria," he told *BBC Breakfast*. ■

SOURCES: LOST 52 PROJECT, BBC

The wreck of the British submarine HMS *Urge* has been found in 130m (430ft) of water two miles off the coast of Malta.

Japan's Izu Peninsula

— Diving the Southern & Western Coasts

Text and photos by Martin Voeller

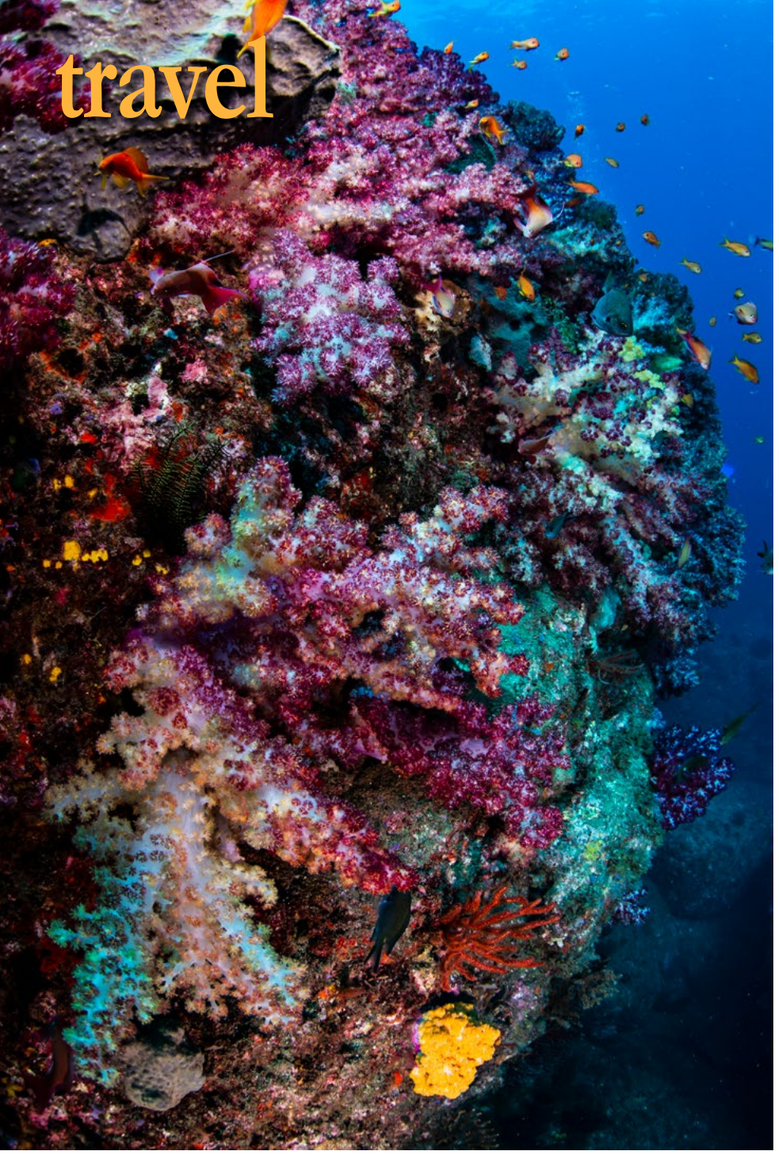
In just five years, Japan has seen its number of tourists grow by 20 million, and most of them visit the country to see the ancient temples, to experience the onsen hot springs, or to walk through the labyrinth of neon skyscrapers in its urban cities. Japan is an island country surrounded by the ocean, and it should be no surprise that the country offers excellent scuba diving opportunities along its vast coastlines—it is an archipelagic country with islands spanning over 3,000km. And not far away from Tokyo lies Izu, which is Tokyo's backyard of diving, accessible by car in just two to three hours from the city.

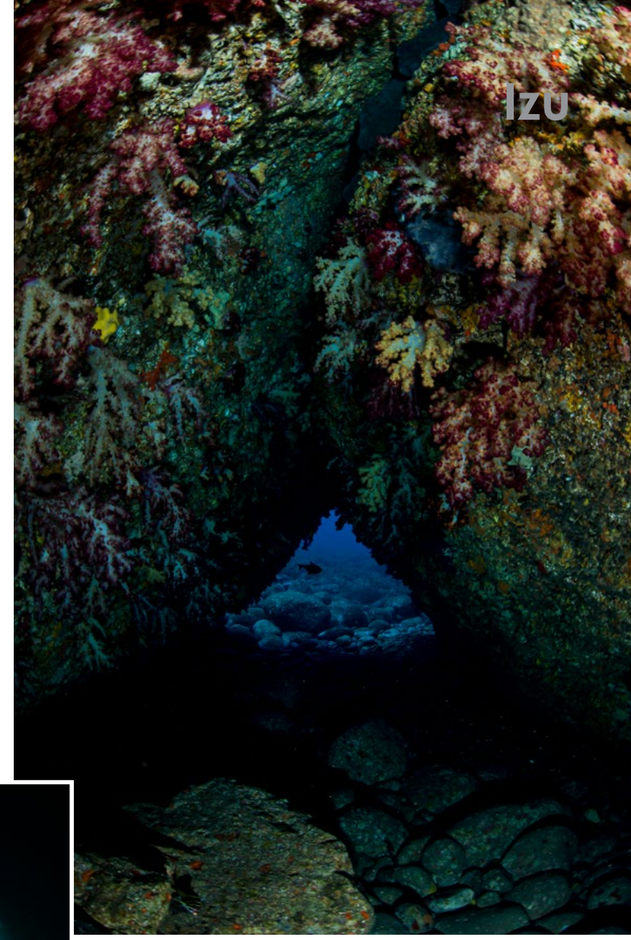
Izu, a large mountainous peninsula, has the largest number of dive sites on the mainland. This peninsula is a result of the Philippine Sea Plate colliding with the Okhotsk Plate at the Nankai Trough. Originally, the peninsula comprised a group of volcanic islands and submarine volcanoes, which drifted north and collided with Honshu Island (the main island of Japan) about 600,000 years ago. Even now, volcanic activities continue underneath the peninsula. Because of this activity, there are abundant hot springs and freshwater springs, as well as scenic landscapes.

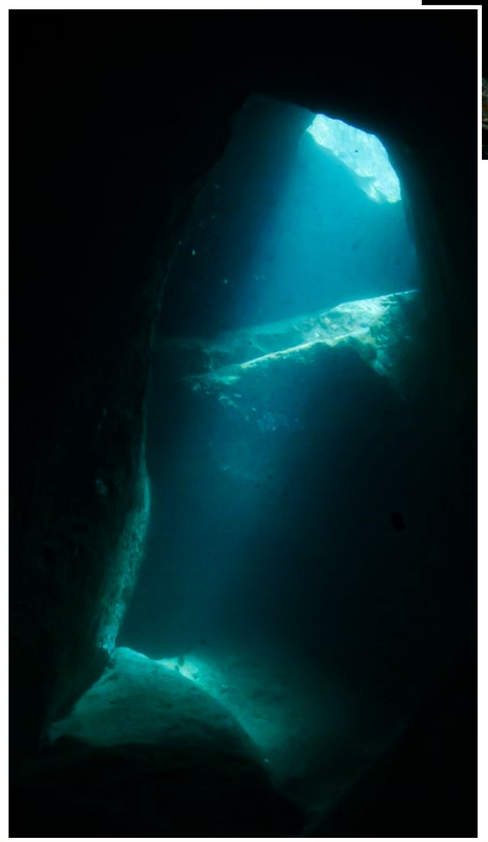
Although diving is popular within Japan among the locals, not much information is conveyed outside to the global diving community. The intent of this article is to change that, covering my experience diving mainly along the western and southern coasts of Izu. To the west lies Suruga Bay, which is the deepest bay in Japan, and high mountains dominate the east. The famous Mount Fuji can also be seen from many

Anemone shrimp on bubble tip coral (above); Arrow crab (top left)

Mount Fuji can be seen from Izu Peninsula (above)
PREVIOUS PAGE: *Dermatobranchus ornatus* nudibranch at Shishihama







THIS PAGE: Underwater caves and caverns at Kumomi attract schools of small fishes, taking cover there to evade predators.

of the dive sites on the western coast, and beautiful sunsets over the rocky, rugged cliffs make the location enjoyable both underwater and on land. Water temperatures of Izu usually range from the upper 20s (Celsius) during the warm summer months to the low teens during the cold winter months.

Underwater cave havens of Kumomi

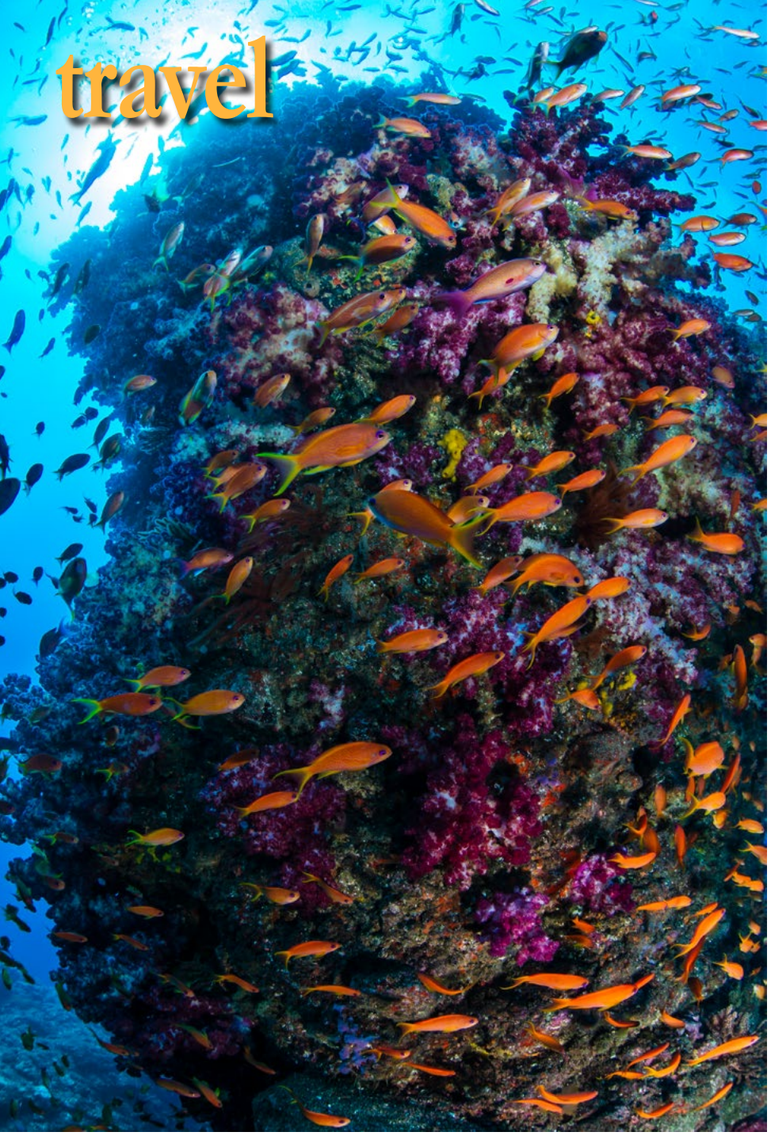
Kumomi lies on the southwestern part of Izu Peninsula. I had dived caverns and tunnels in Japan before in Okinawa (Miyakojima), but I never knew that a dive site similar to the ones of Miyakojima existed on Izu Peninsula.

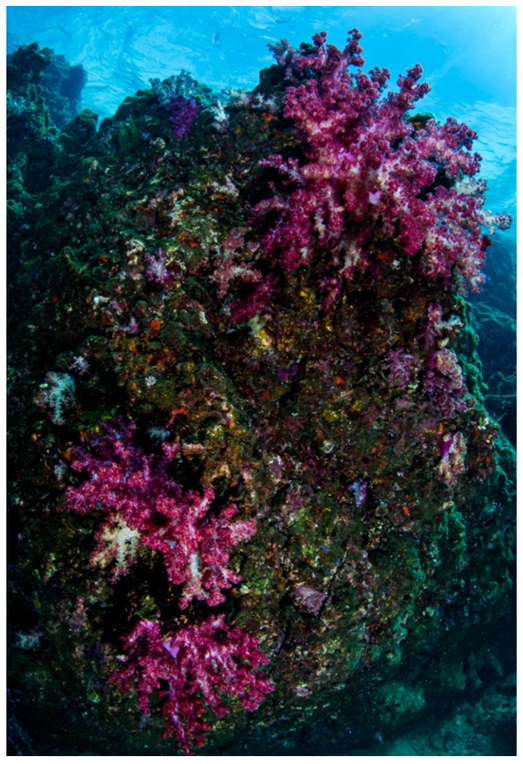
Kumomi is filled with underwater crevasses, tunnels, arches and caverns. Diving here, you may feel as if you are exploring an endless underwater maze, as you are led through one opening after another.

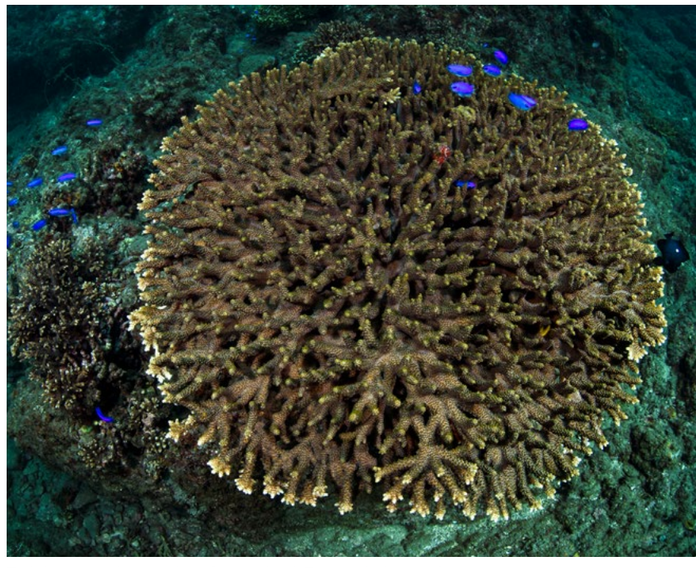
Many of the cavern entrances are embellished with lush, colorful, soft corals ranging in color from orange to red to green. The caverns mesmerize me into thinking that they are entrances into an underwater paradise. And on sunny days when a beam of sunlight illuminates the caverns from narrow openings above, you get the "cathedral" effect—it is like an explosion of light and is a surreal natural phenomenon that must be experienced firsthand.

There is a plethora of fish as well. Kumomi is not just a dive site for experiencing unique underwater terrain and topography. In fact, you will often encounter many schools of fish inside the dark caverns; they seem to be hiding inside the caverns for protection from predators. Yet, it is not so difficult to get close to the schooling fish. However, it is a challenge to capture a photograph with good composition, which shows depth. Like birds in the sky, the schools of fish act in unison, changing direction en masse in an instant. The trick is to position yourself, so that they instantaneously move in the desired direction and then photograph that movement of unison. And with a mixture of the blue ocean and black cavern backgrounds, you can create a pretty nice dramatic photo.

Although this dive site is a must for wide-angle photography lovers, macro photographers will also not be disappointed. Inside the cavern crevices, you will often







Dense schools of anthias can be found at Tago (above and top right); Sunset over Izu Peninsula (top center); School of Japanese butterflyfish (center) and brilliant soft corals on reef at Tago (right)

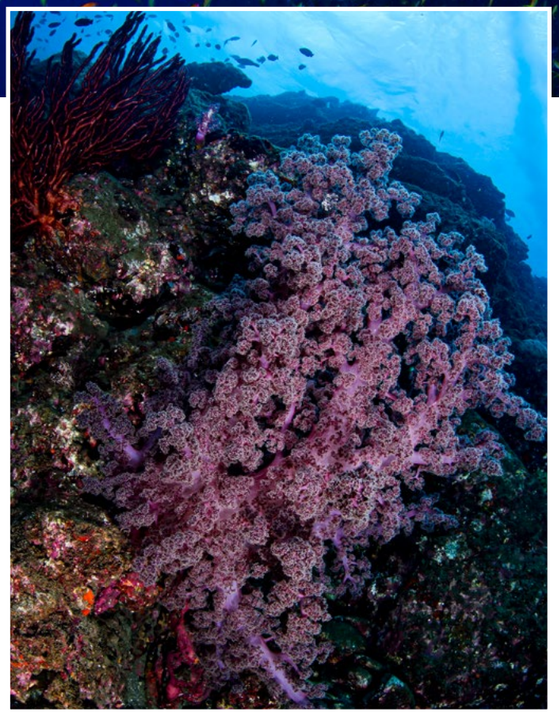
Table coral can be found at Tago (above)

find a myriad of creatures co-existing together, ranging from spiny lobsters and shrimps to moray eels.

Tago: A paradise of anthias

Tago is a dive site well known for its schooling anthias. This site also lies in southwestern Izu and is a neighboring dive site of Kumomi. Scalefin anthias and cherry anthias are commonly seen in immense numbers here, often swimming around the beautiful corals that populate the reefs. Anthias are sequential hermaphrodites—they transform from juveniles into functional females, and after they grow larger, they become males. Photographing this group of anthias can be a bigger challenge as they form shoals, not schools. A group of fish that stay together for social reasons is said to be shoaling, and if the shoal is swimming in the same direction together, it is schooling. Hence, it can be difficult to predict the movement of the anthias, and moreover, they do not necessarily swim in unison.

Another attraction of this site are the endless patches of healthy hard corals. Due to rising sea temperatures, many hard corals are getting bleached and are dying off around the world. Okinawa—the southernmost set of islands of Japan, which is famous for its clear, tropical waters—is no exception. Ishigaki Island of Okinawa, for instance, saw about 70 percent of its beautiful hard corals get bleached and perish back in 2016. Although some are recovering, our generation



Swarms of anthias fill wide-angle shots at Tago (above); Purple soft coral carpets the reef at Tago (left); Electric blue damselfish inhabit large, healthy colonies of bright green hard corals at Tago (right)

will probably never again see the likes of the big table corals that once dominated the area.

Tago, on the other hand, is a different story. Here, one can find an area filled with long patches of hard corals ranging in color from yellow to green, and they are all healthy and thriving. Small table corals can be seen here as well. With the sun's rays hitting down from above, it is relaxing just to float freely above these coral patches, which fill the area at a depth of 10m. The presence of electric blue-colored damselfish inhabiting the corals is also very pleasing to the eyes. It is a sight that is often only seen in tropical ocean beds.

Large school of hammerhead sharks at Mikomoto

Hammerhead rivers of Mikomoto

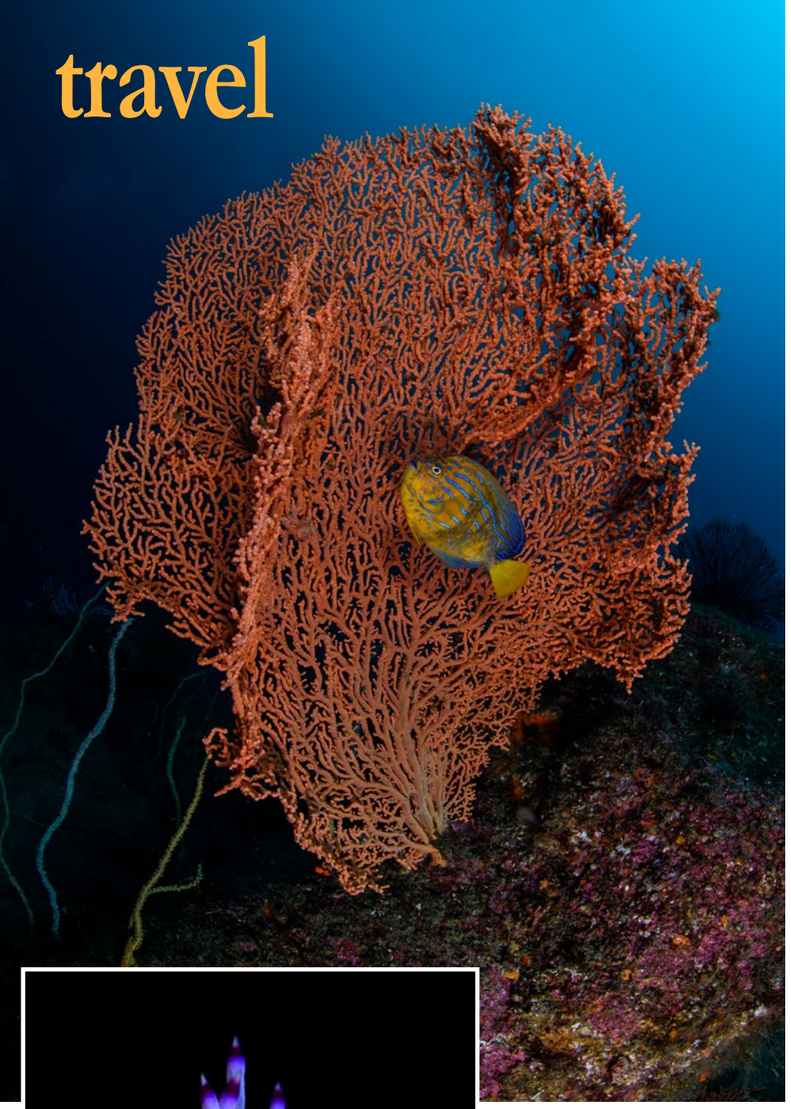
Off the southernmost tip of Izu Peninsula lies a small uninhabited island called Mikomoto. What divers seek here is the Kuroshio Current (Black Tide), which is an ocean current that begins off from the Philippines and flows northeastward past Japan, where it merges with the easterly drift of the North Pacific Current. It is similar to the Gulf Stream in the Atlantic Ocean whereby warm and tropical currents are brought to the polar region. It is this phenomenon that brings warm sea temperatures and interesting sea creatures to southern Izu, as it gets directly hit by the currents. One of the highlights is to see the schooling hammerhead sharks that come via this current during the summer and autumn months every year. There is an unusually large number of sharks here, compared to other dive spots around the world.

This dive site is for advanced divers. It is an adrenaline-packed dive that requires quite a bit of physical agility and endurance. As soon as you enter the water off the boat, you will encounter currents, and therefore, a diver must be able to descend quickly. The Kuroshio Current is in fact the second strongest current in the world. The direction of the currents can change suddenly, including down-currents.

Once you encounter a massive school of hammerhead sharks, which can sometimes number over a hundred individuals, there are two options you can take to observe them. If there are rocky reefs nearby at your depth, you might be able to stabilize yourself with a finger or reef hook gently placed on a rocky spot with no delicate corals (careful not to damage the reef), while you are in the midst of some current. You will then stay stationary and can observe the jaw-dropping scene of the hammerhead sharks swimming by. They look as if they are dancing together in unison, and it is a privilege to see them so up close and personal.

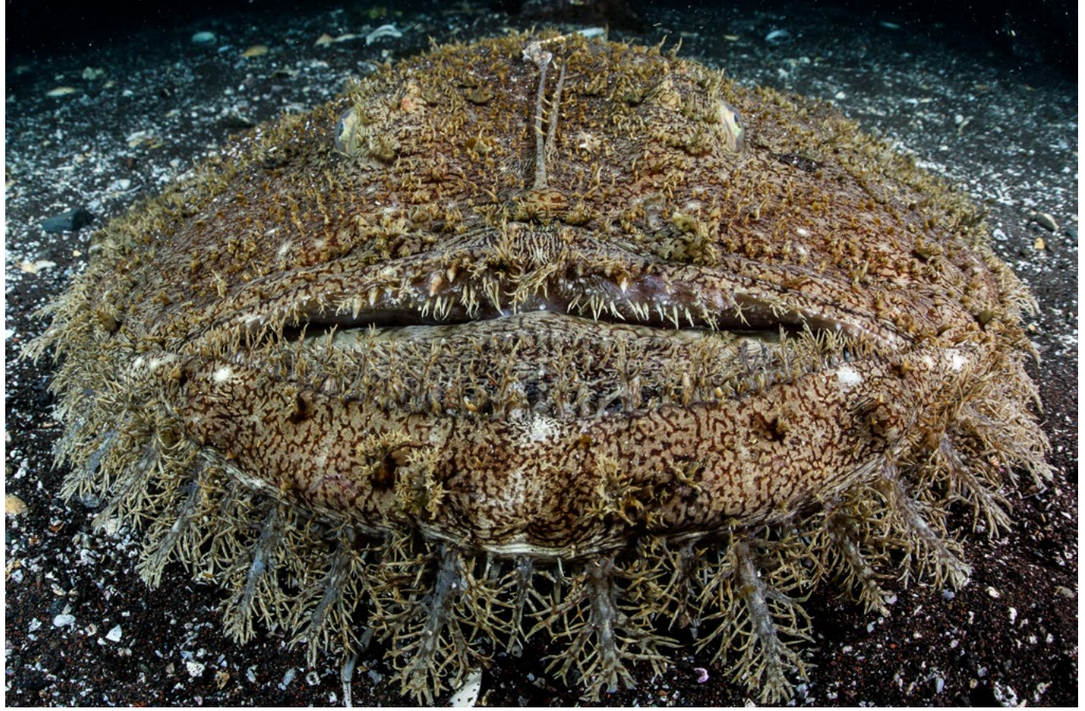
If there is no rocky reef nearby to assist divers in staying stationary, or if the ocean bottom is too deep, divers may then need

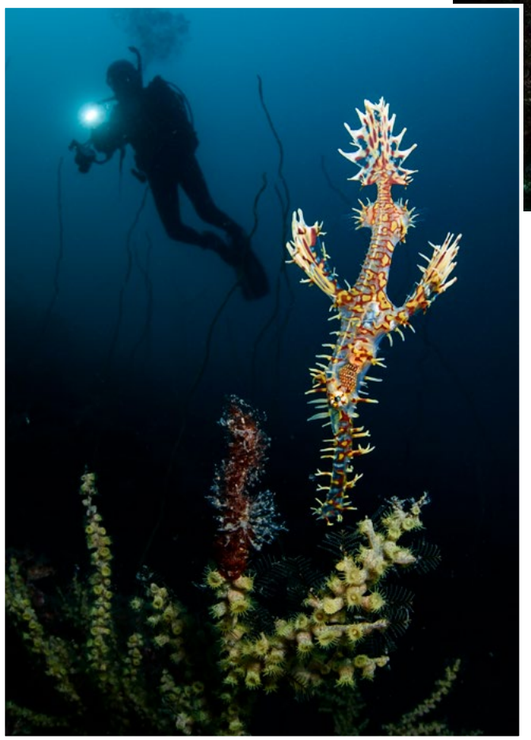
Schooling hammerhead sharks ride the Kuroshio Current (Black Tide) at Mikomoto



Goniobranchus tinctorius nudibranch

Blue-striped anglefish and large gorgonian sea fan (above), monkfish (top center), and zebra crab on fire urchin (right) at Osezaki





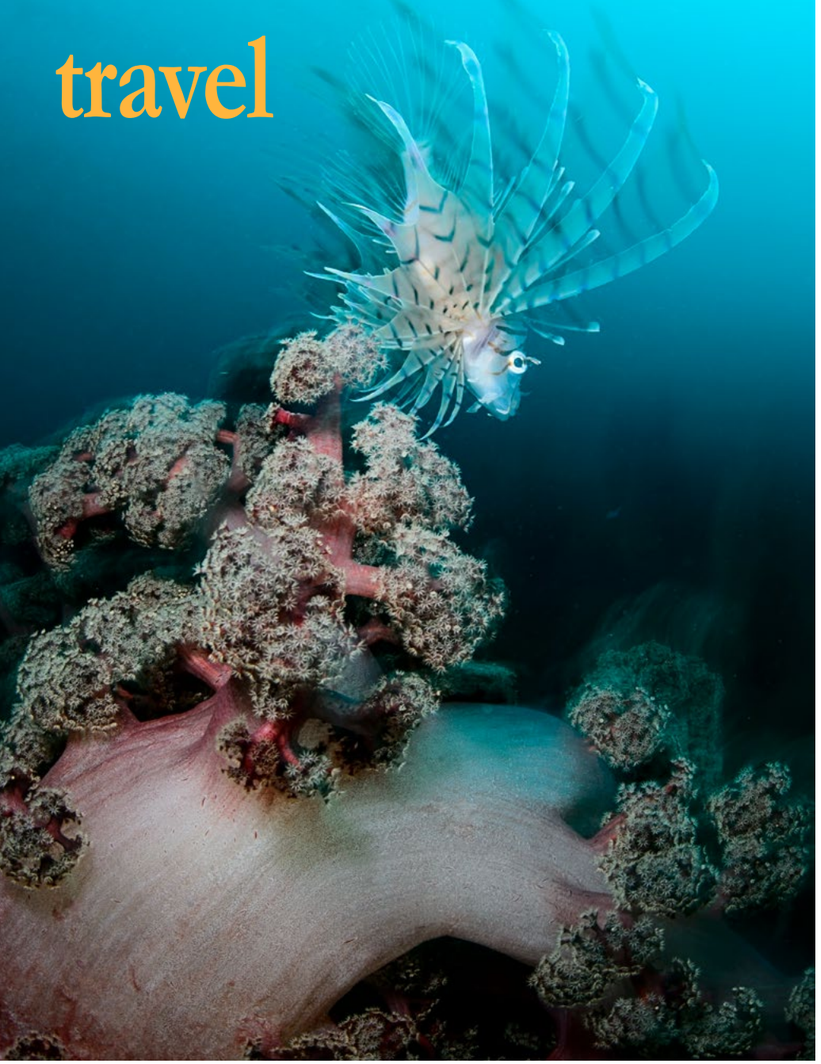
Yellow pygmy goby in bottle (above), soft corals on reef (top right) and diver with ornate ghost pipefish (left) at Osezaki

to swim a bit nearer to the sharks for a closer look, often times finning against strong currents. The sharks, however, are quite timid, especially of bubbles coming from humans, and will swim away quickly. So, approaching the sharks must be done very carefully.

After exiting the water and getting back onto the dive boat, you may feel as if you have run a marathon underwater, searching for the sharks. But it is after all worth the effort and the challenge you went through. It is truly a rare opportunity to observe such large pelagic sharks in their natural habitat.

Osezaki—macro mecca

Osezaki is mostly known as the macro mecca of Honshu, Japan. It is a site that lies on the northwestern coast of Izu, and because of its uniquely shaped bay, it is well protected from bad weather. When the dive sites of Izu are closed due to poor weather, everybody flocks to this site as it is rarely closed. The macro life that can be seen here all year round is



Tiny goby at Shishihama (above); Lionfish on soft corals at Osezaki (top left)

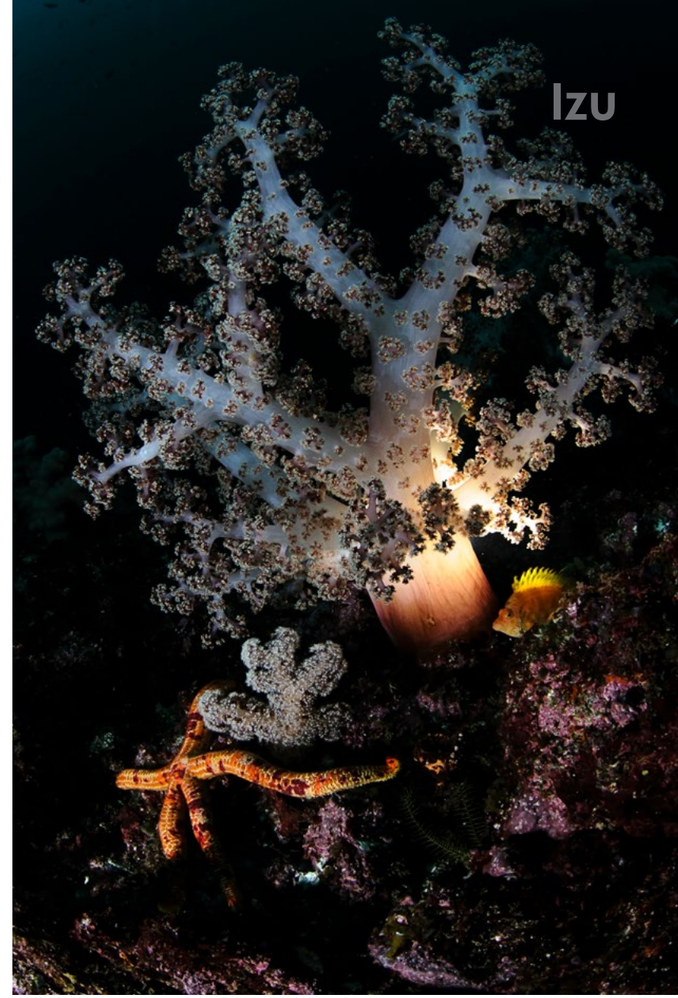
endless: nudibranchs, gobies, seahorses, frogfish, anthias, squids, moray eels and shrimps, to name just a few. If you hire a local dive guide, the guide will usually point and show you where all the underwater sea creatures are located.

To keep things interesting, many man-made artifacts (like a wheelchair, shrine, statues, bathtub and car tires) have been intentionally placed on the ocean floor where one can do muck diving. When I first saw them a decade ago as a certifying open water student, I was awestruck, thinking that people were polluting the ocean. However, looking closely, I soon realized that rich macro life including corals had been proliferating on these items underwater, and this is what makes this seascape great, especially for macro photographers.

Hypselodoris placida nudibranch (above); *Dendrodoris denisoni* nudibranch (left)

Yellow pygmy gobies dwelling inside a glass bottle periodically poke out their faces to greet divers. Moray eels keep their mouths wide open as they patiently wait while various shrimps clean inside their mouths. Monkfish during the cold winter months come up from the deep depths to shallower areas to bury themselves under the sand and ambush their prey. The mystical *Mola molas* visit the site during springtime to allow their two-meter-large circular bodies to be cleaned of parasites by butterflyfish, which are denizens of the area. The list is endless, and every season is different, filled with various marine life.

Not only is Osezaki a macro mecca, but as diving there is quite easy, it is also a site popular for obtaining dive certifications. Deep diving can be done as well, and hence, it is becoming a popular site for many technical divers to carry out their training.

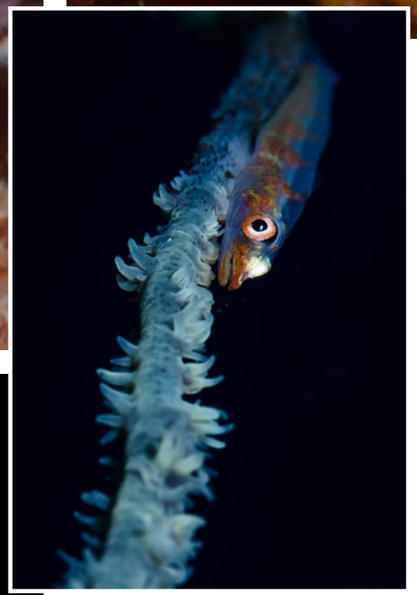


Yellow hawkfish and sea star with large soft coral at Shishihama (above); Anemonefish in bubble tip anemone at Osezaki (top center)

Shishihama

Shishihama is located north of Osezaki and is the dive site that is closest to Mount Fuji. It is another location that is popular for macro diving. As this area is covered with volcanic terrain, the beach and ocean slope are of dark

Frogfish at Shishi-hama (above)



Frogfish (above), whip coral goby on whip coral (left), and *Dendrodoris denisoni* nudibranch (right) at Shishihama

Arrow crab (above) and yellow-edged moray eel (top left) at Shishihama

sand, rocks and boulders. Once you reach the bottom at 40m, it is covered by soft mud where muck diving can be done. Many varieties of nudibranchs and frogfish can be found roaming freely on the ocean floor, while spider crabs and gobies can be found hiding among the colorful soft corals. When not looking for small critters, the beautiful anthias will keep you well entertained as they dance in front of you.

In addition to the various marine life that thrive at Shishihama, the site is also popular among technical divers, as the dive shop there offers various nitrox mixes. The dive site has a gentle slope with a guide rope leading you all the way down to 30m, and some divers go down even farther. Hoops are set up underwater for divers to practice their buoyancy, which is good for training.

Uncover the unknown Japanese waters

People have the perception that scuba diving is a luxury sport for people at expensive ocean resorts. This is not necessarily the case, especially in Japan, where even groups of college students can often be seen diving together as members of a school club on the weekends. Whether you are a diver wanting to enjoy tropical diving or a daredevil ready for more challenges diving in freezing cold water, Japan has it all, and you will be surprised at its natural wonders as you explore the Japanese waters. ■

"Dive in Japan" is a non-profit organization operated by NPO Japan Diving Experience, which assists inbound travelers who wish to dive in Japan. You can choose from a menu of over 170 dive locations in Japan. For more information about diving in Japan via this NPO, please visit: ***dive-in-japan.com****.*

Martin Voeller is an avid diver and underwater photographer based in Tokyo, Japan. Diving since 2011, he is a certified NAUI Divemaster and serves as a dive guide in the Kanto area. Having dived from the southernmost tip of Japan (Okinawa) to the northern tip (Hokkaido) and much in-between, he enjoys the variety of diving that Japan offers, ranging from tropical to cold water. He continues to explore Japan's diverse undersea formations and topography, and his mission is to share this with the rest of the world.

Big Animals at Socorro

Mexico's Revillagigedo Islands

Text and photos by Matthew Meier

_Go, go, go!_ At our skiff driver's urging, we slipped into the water as quickly and quietly as possible, in hopes of snorkeling with the pod of false killer whales that was hunting in the bay. Again and again, we attempted to intersect their path, but our timing or positioning resulted in views of them in the fleeting distance or not at all. Finally, I was fortunate to have a member of the pod swim past just close enough to capture a few photos with my fisheye lens. At the end of our exhausting excursion, everyone on the dive boat had seen the false killer whales and a few lucky guests had the privilege of swimming alongside a mother and her newborn.

This was definitely one of the more exhilarating surface intervals I have ever experienced and an incredible bonus animal sighting on top of all of the manta rays, sharks, dolphins and huge schools of fish we had already encountered while diving. Welcome to big-animal paradise!

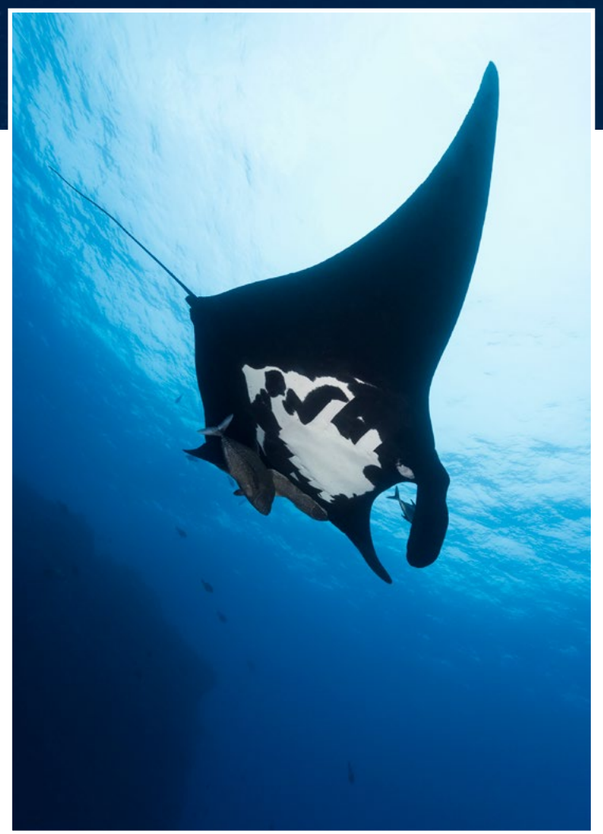
The Revillagigedo Archipelago comprises four volcanic islands named San Benedicto, Clarion, Roca Partida and Socorro, which are situated southwest of Cabo San Lucas, Mexico, in the Pacific Ocean. The latter also lends its namesake to the more commonly referred-to Socorro Islands, for those of us who struggle to pronounce "Revillagigedo." With the exception of a Mexican Navy installation on Socorro, which houses roughly 250 military personnel and their families, the islands are uninhabited.

A liveaboard dive boat is the only way to see this vast frontier due to the islands' isolated nature. Clarion is the most remote and as such is rarely visited, located 125 miles (200km) past the next farthest island of Roca Partida. San Benedicto and Socorro Islands are close to one another and located roughly 240 miles (386km) from Cabo San Lucas.

The area is famous with scuba divers for the giant oceanic manta rays and other large pelagics that frequent the waters. The Revillagigedo Islands were pronounced a UNESCO World Heritage Site in July 2016, and the

Diver with chevron manta ray, swimming overhead, accompanied by remora (above); Solitary false killer whale swimming near the surface (top left); Nazca booby searching for fish (left); A mother humpback whale helps bring her calf to the surface for a breath of air (previous page)

Panoramic aerial view of San Benedicto Island and the cinder cone created in the 1952 volcanic eruption



Black manta ray swimming overhead at Boiler (above); A "manta sombrero" selfie attempt, with a chevron manta ray overhead—my very first selfie underwater (right)

Mexican government created North America's largest marine protected area and also declared it a national park in 2017. The 57,000 sq mi (150,000 sq km) of protected area bans fishing, mining and tourism development within and on the islands themselves.

Manta rays

Giant oceanic manta rays have a wingspan of up to 23ft (7m), and those around the Socorro Islands are some of the largest I have ever seen. They exhibit two different color variations; the black manta is nearly all black on both sides and the chevron manta has a patterned mix of black, white and gray on top and mostly white underneath.

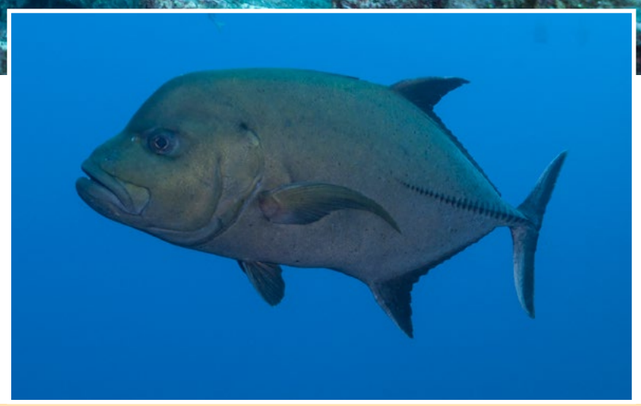
Each individual has distinct spots on their underside and like a human's fingerprints, the markings can be used for identification. Regardless of their coloration, the mantas around Socorro seem to enjoy diver's exhaust bubbles on their bellies and will hover in the water column over each diver in turn, giving guests the privilege of experiencing a "manta sombrero."

San Benedicto Island

San Benedicto Island is closest in proximity to Cabo San Lucas and is typically the first anchorage after an overnight crossing. We arrived in time for a late afternoon checkout dive

Silvertip shark (above) and Galapagos shark (right) swim over the rocky reef at El Canon dive site; Solitary blackjack fish (bottom right)

Socorro chub, yellow variation



at Las Cuevas to knock off the rust and perform buoyancy and gear checks.

Situated in a protected cove on the leeward side of the island, the site made for an easy first dive, swimming amongst large boulders and caverns as we searched for lobsters, white-tipped reef sharks, baby porcupine fish and stingrays buried in the sand. We saw several Socorro chub swimming amongst the rocks, most of which are a lackluster gray in color, but the remaining ten to 15 percent of the population scream for attention with a vibrant yellow.

El Canon. The next morning, we dove at El Canon, located near the anchorage on the backside of the island. The underwater topography consisted of a horseshoe-shaped, downward sloping rock structure, separated by a sand flat. Sitting at 90ft, the main attraction is a cleaning station above a rocky pinnacle near the drop-off to deep water. Here, you can duck behind the rocks and observe Galapagos and silvertip sharks swimming circular patterns around the formation while you wait for manta rays to arrive.

We had at least one manta show up on every dive and were treated to hunting Pacific bottlenose dolphins chasing jacks in the dim early morning light of our first dive. It was here that I also saw my first black manta ray.

I have swum with chevron and reef manta rays on various dives across the globe but had never been graced by the presence of a black manta ray. This beautiful creature snuck

Aerial view of the cinder cone and lava flow into the Pacific Ocean, from the 1952 volcanic eruption on San Benedicto Island (above); Octopus tucked into a rocky crevice (top left); Blue spiny lobster walking across the rocky reef (left); Black manta ray swimming over the rocky reef at Boiler (below); Sunset silhouette of Sleeping Lady rock formation at the southern end of San Benedicto Island (right)

up on us as we were working our way down the rocky reef to the cleaning station. One minute, I was seemingly alone with my thoughts, and the next, I had a massive shadow gliding off my left shoulder. The camera came up out of reflex, and I did my best to stay close. But keeping up with a manta ray without the aid of external propulsion is pure fantasy and it easily disappeared into the distance. Happily, we were able to see several more black manta rays over the course of our trip, and I had numerous opportunities to improve on my first photo attempts.

Returning to the boat after each dive, we witnessed several silky sharks near the surface and discovered hundreds of fish hiding below, using the overhead structure as a refuge. There were several schools of jacks of differing species, all staying in close-knit groups for protection against the silky sharks, who were keen for a meal but equally curious to inspect the divers in their midst as well.

Volcanic origins

The distinct cinder cone shape of San Benedicto Island was created from a supposedly dormant volcano that last erupted in 1952. On the eastern side of the cinder cone, a massive lava flow exploded out of its base, creating new land as it spread out into the ocean. The black lava rock stands out in sharp contrast to the ash-colored cone and is an impressive sight. However, to reveal the truly remarkable scope of the lava flow, the elevated perspective of a drone is required. I captured several multi-stitch panoramic shots of the island and was as excited about those aerial photos as I was with any of the spectacular underwater wildlife shots.

At the southern end of the anchorage is a rock structure known as the Sleeping Lady, which is formed by the outline of the island. She was pointed out to me while in silhouette at sunset, and since then, I have been unable to gaze at the scene without seeing a lady in repose.

Boiler. On our second full day of diving, we transferred to the world-famous Boiler dive site on the other side of San Benedicto. This enormous underwater rock pinnacle reaches nearly to the surface depending on the tides and drops off sharply into the inky darkness below.

Large schools of fish use the rock as a safe haven against

Polarized school of blackjack fish with silky sharks (above); Yellowfin surgeonfish (left)

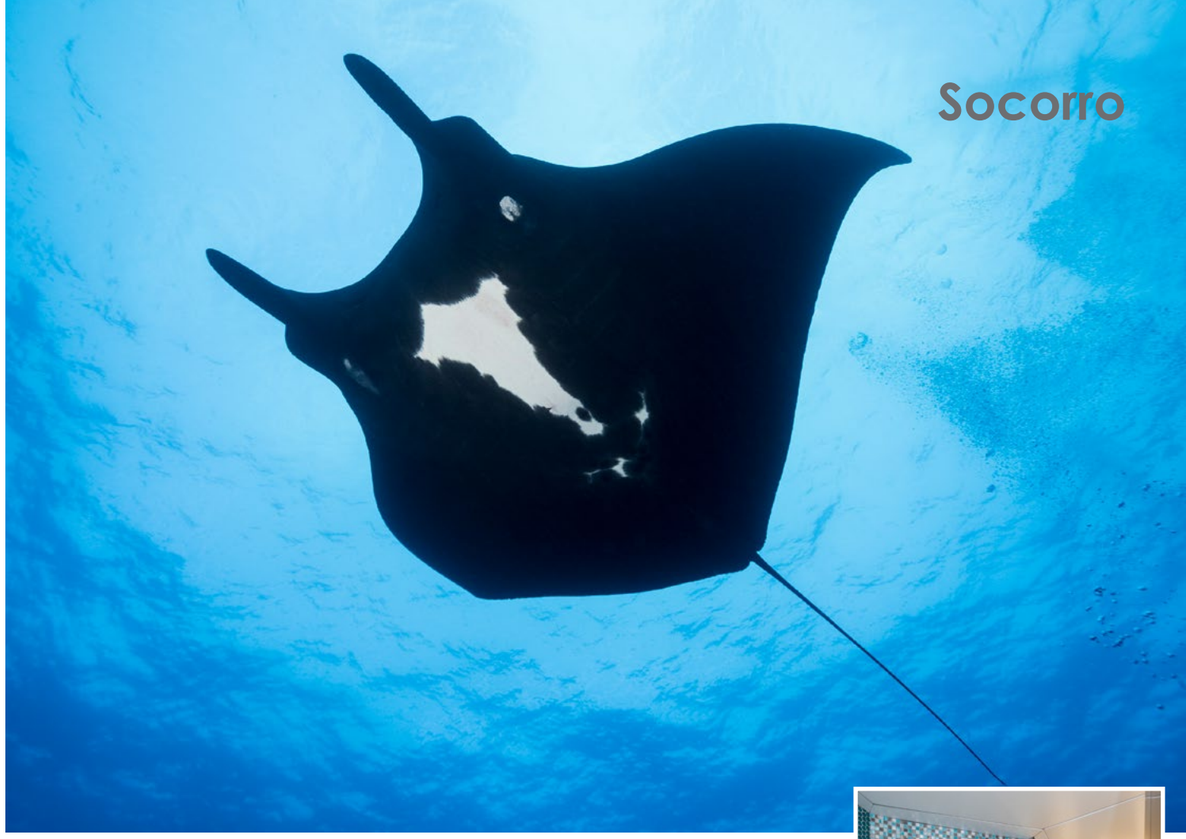
predators and are often found at the northern or southern ends depending on the current. We saw aggregations of bigeye jacks, blackjacks, bluefin trevally, razor surgeonfish and Pacific creolefish. White-tipped reef sharks rest on rock ledges during the day, conserving energy to pack hunt at night, often with huge blue spiny lobster standing guard nearby.

The real stars however are the large pelagic critters that can show up at any time. Manta rays are a near constant inhabitant, and the Pacific bottlenose dolphins here can be very friendly, often stalling in front of a diver as if asking for a belly rub. Several dolphins swam by on our first dive but kept their distance since they were escorting a new baby.

Whale sharks have been known to materialize out of the blue, and in the springtime, humpback whales frequent the area, though it is rare to actually see them in the water here. More often, you can hear and sometimes feel their calls resonate through the water, as they stay just far enough away to tempt you to chase their vocalizations into the void.

I did just that on my first trip to Socorro, spending an entire dive swimming into the blue, chasing the

Polarized school of bigeye jacks (above); Silky shark (top center)



CLOCKWISE FROM ABOVE: The *Socorro Vortex* liveaboard at anchor in the Pacific Ocean; Pair of Pacific bottlenose dolphins; Black manta ray; The Clarion Deluxe Suite bathroom, the Roca Master Suite and the lounge on the *Socorro Vortex* liveaboard; Adult humpback whale exhales on the surface.

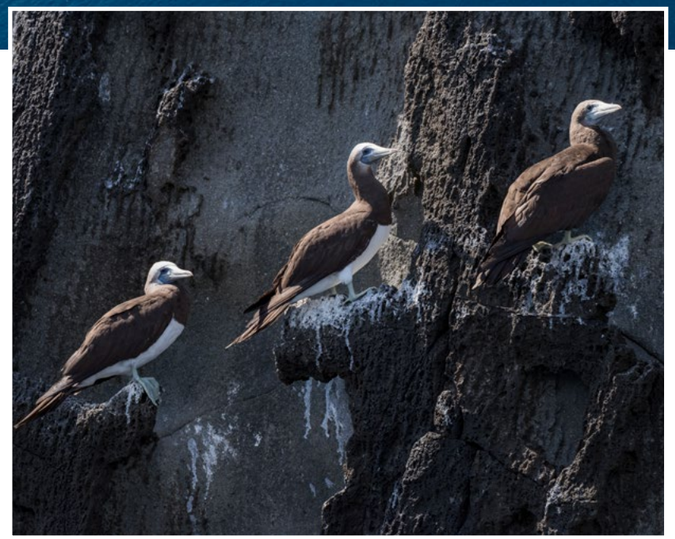
sound of the singing whales but never saw a thing. This is also where we spent one of our surface intervals in search of the false killer whales. The pod was hunting around the island for several weeks, and we had interactions with them on two separate days.

The liveaboard

The latest liveaboard to operate in the Revillagigedo Islands is the luxurious new *Socorro Vortex*. She is a former Canadian Coast Guard vessel that has been completely redesigned with seven spacious staterooms, extensive lounge areas, expansive camera tables and a hot tub on the top sun deck.

Each guest room has an en suite bath, individual air conditioning, unique artwork, abundant storage and either two twin beds or a king-size bed. The unique tile design and color scheme of each bathroom is also an elegant and fun touch.

At 140ft (43m) in length and with a top speed of 18 to 20 knots, she is capable of making the transits between islands faster than any other liveaboard in action. The *Vortex* is an exclusive treat for her max of only 14 guests.



Aerial view of Socorro Island, the *Socorro Vortex* liveaboard dive boat and the Cabo Pearce dive site (above); Three brown booby birds resting on a rocky ledge at the Cabo Pearce dive site (left)

Diving

Diving at the Socorro Islands is meant for advanced divers with reliable buoyancy control, who are comfortable in blue water and an often bottomless environment. When sea conditions allow, divers may make a giant stride directly down to the dive site, but more frequently they are transported from their anchored liveaboard by an inflatable RHIB called a *panga*, before back-rolling into the water.

A normal day consists of three to four dives, depending on location, each of which is limited by Mexican regulations to 45 minutes in length. Night dives are not permitted. Dive guides are responsible for three to five divers each, and everyone is required to carry a surface marker, whistle and GPS positioning device in case they get lost from the group and drift out to sea. For an added level of safety, the *Socorro Vortex* is a nitrox-only boat, and we dived with a mixture of 30 to 32 percent, depending on the depth of the dive site. Every tank was filled and analyzed by the crew, before being confirmed by each diver prior to a dive.

Socorro Island

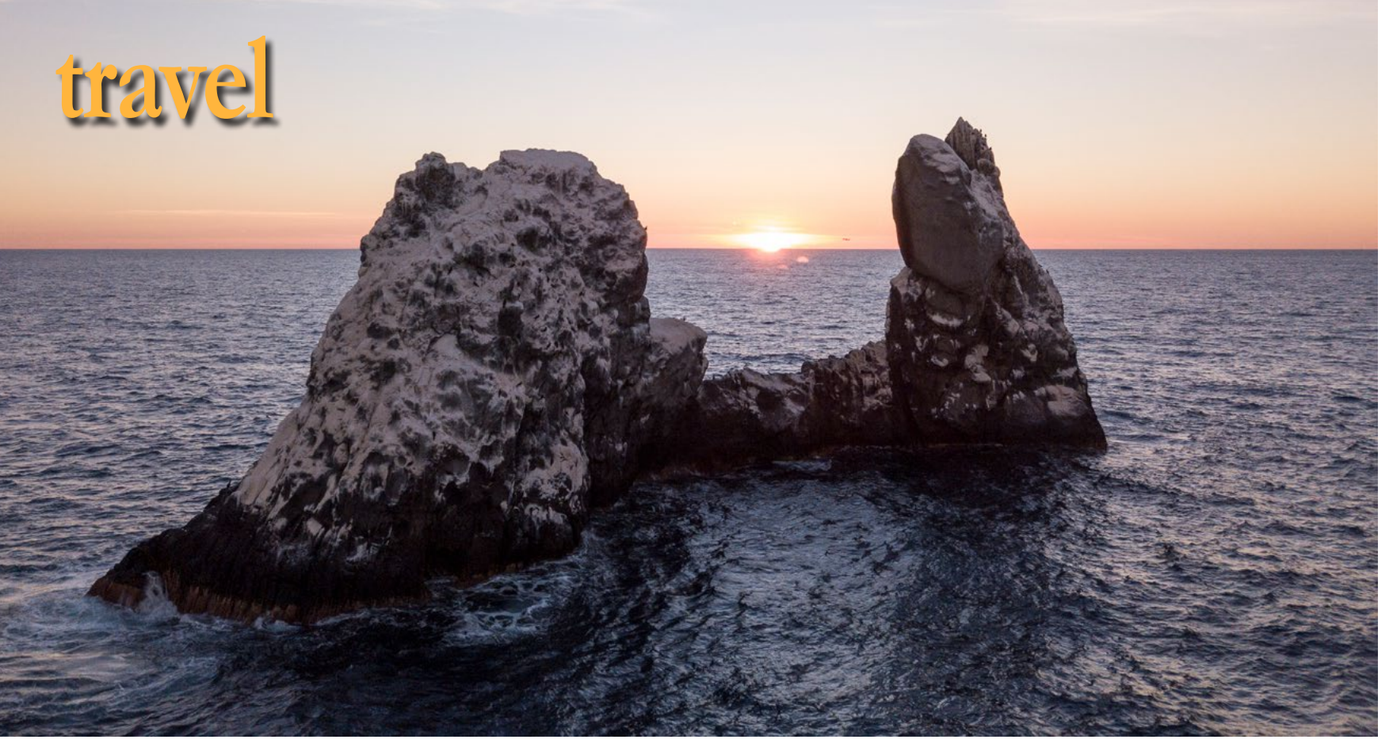
Every trip to the Revillagigedo Islands requires a stop at Socorro Island, a short 30-mile (48km) passage from San Benedicto, to register with the Mexican Navy and verify passports. This is typically done in the late afternoon—in our case, following three dives at the Cabo Pearce dive site.

Located at the end of a long lava flow peninsula extending out into the ocean, the area comprises large boulders, valleys and channels—as one might expect from boiling lava exploding into the cool water. The peninsula climbs several stories above the water's surface, with sheer walls and a small cave spanning the entire width near its base at the water's edge.

Dozens of brown booby birds roost on the small ledges along the volcanic walls, providing sanctuary from potential predators and easy access to the prolific feeding grounds in the waters below. Cemented on a rock ledge, around 40ft underwater, is a plaque commemorating the area's UNESCO World Heritage Site status: "inscribed for its outstanding universal value which deserve protection for the benefit of all humanity." A large green sea turtle nearly guided us to the plaque on our first dive before continuing on its path as we stopped to take photos.

From there, we moved across the rocky terrain to a submerged buoy that marked a cleaning station for mantas and other pelagic visitors. Dozens of yellow barberfish

Underwater concrete UNESCO World Heritage Site plaque, Cabo Pearce dive site, Socorro Island (above); Diver swims in open water with a large school of dark-colored cotton-mouth jacks (top right)



Aerial view of the sun setting in between the rock pinnacles at Roca Partida (above); Hammerhead shark in open water (left)

congregated around the rocky outcropping, waiting for an easy meal. After lingering unsuccessfully to see the cleaners in action, we drifted with the current into blue water and found a large school of striped bonito being chased by silky and silvertip sharks, along with several small yellowfin tuna. A few dozen scalloped hammerhead sharks were also gathering in the hazy distance, but attempts to capture images in the murky visibility were futile.

After our dives, while anchored in the harbor of the navy base awaiting our inspection, we were treated to mating loggerhead turtles at the water's surface. The action went on for well over an hour before abruptly ending near sunset with a loud splash, as the turtles dived underwater, not to be seen again.

Roca Partida

Departing the navy base, we motored for roughly 7.5 hours overnight to Roca Partida. This north-south-oriented, field-goal-shaped seamount, whose name literally translates to "split rock," rises 100ft (30m) above sea level and measures only 300ft (90m) long by 26ft (8m) wide. It is the lone sliver of land for nearly a hundred miles in any direction. As such, it attracts a spectacular variety of life. Massive schools of cottonmouth jacks, bigeye jacks, blackjacks, striped bonito, yellowfin tuna and Pacific creolefish were present on nearly every dive. As were the Galapagos, silky and occasional scalloped hammerhead sharks, which were pursuing the fish around the rock.

We saw a few manta rays as well, but nothing compared to the numbers we encountered at San Benedicto. Whitetipped reef sharks lay on top of one another, consistently stacked onto ledges 40-50ft (12-15m) down, along with the biggest blue spiny lobsters I had ever faced. Immense wahoo circled during safety stops, along with

Polarized school of silver-colored cottonmouth jacks (left); A loggerhead turtle takes a breath of air at the surface during mating at Socorro Island (below)

Socorro

Large school of dark-colored cottonmouth jacks swimming along the vertical rock wall at Roca Partida

Three small juvenile whitetip reef sharks resting on a colorful rock ledge during the day, saving energy to pack hunt at night (above); Longtail stingray flings sand while raising up to swim away (left)

Several silky sharks swimming among a large, polarized school of striped bonito (above); Bluefin trevally (right)

the curious silky sharks, which seemed keen to sneak up on divers from behind.

Though we were not lucky enough to see them on our trip, tiger sharks have made appearances here, as have whale sharks, orca, large bait balls and schools of Galapagos and hammerhead sharks. In the springtime, typically during the months of February and March, a mother humpback whale and her calf have been seen here in years past. The divemasters speculate that the mother may have been introduced to divers at Roca with her mother and is comfortable bringing her offspring back to this location.

Due to the potential for deep dives and the extreme remoteness of Roca Partida, the Mexican government limits operators to three dives per day. We were blessed with relatively calm seas during our visit and anchored overnight, affording us two full days of diving.

On our second morning, we awoke to find another boat nearby. Our crew communicated with them over the radio to establish staggered dive times, so we were not all in the water at the same time. As the first boat on location, the protocol stated that they had to dive around our schedule.

This meant that our dive times remained the same as the previous day, and their divers jumped in the water as we were finishing our safety stop. This was easy to accomplish with just two boats in full cooperation and only three dives per day, but it is considerably more challenging on a site allowing four dives and the potential for additional boats.

The large schools of fish tend to congregate at either the northern or southern ends of the rock, depending on the current. Dropping in on either the eastern or western side, divers can choose to fight the current and stay with the schools of fish or ride the current to explore the rest of the pinnacle. These decisions are typically made as a group before splashing down but can, and often are, modified by the divemaster after assessing conditions underwater.

At the end of each dive, the group swims away from the rock for extraction and on occasion floats with the current out into the blue during the safety stop, before being picked up by the skiff. Divers can travel great distances during those few minutes and a surface marker is imperative to designate their location for the skiff drivers.

Back on the liveaboard between dives, there was ample time to relax, rehydrate, refuel, reload memory cards and change batteries before the next dive. The salon offered several comfortable couches and a large screen TV for those wanting creature comforts, and the entire top deck was filled with lounge chairs for sun worshippers. I took the opportunity to make a twilight flight with my drone the first night and captured the sun setting between the spires of the rocky pinnacle.

Several silky sharks swimming through a school of blackjack fish (above); Silhouette of the Arch of Cabo San Lucas against a sunset sky—these rocks at the southern-most end of the Baja Peninsula separate the Sea of Cortez from the Pacific Ocean (right).

San Benedicto

After two mesmerizing days at Roca Partida, we picked up anchor and steamed overnight back to San Benedicto for our last two days of diving. We awoke at El Canon alongside our sister ship the *Solmar V* and proceeded to alternate dive times with them throughout the day.

El Canon. The early morning visibility at depth on our first dive was a bit hazy compared to our previous stopover, and we elected to spend the majority of the dive under the liveaboard, swimming amongst the jacks and silky sharks.

During breakfast after the first dive, we noticed birds gathering over the water nearby and realized that the false killer whales were hunting again and had driven a school of fish to the surface. Frantically grabbing snorkel gear and cameras, we jumped into the inflatables and sped to the scene. Unfortunately, we arrived too late to catch the whales in action but were able to observe dozens of silky sharks cleaning up the scraps, as well as several dolphins in search of an easy meal.

Climbing back into the skiff, we stayed out for another hour shadowing the whales around the bay, while making several attempts to engage them in the water. Exhausted but grateful for the interactions, we eventually headed back to the boat to get ready for our next dive.

The remainder of the day was somewhat tame by comparison, though we did see several Galapagos and silky sharks at the cleaning station, with both chevron and black manta rays and a small school of scalloped hammerhead sharks off in the distance. Puffy white clouds materialized in the afternoon sky, and I took advantage of the nice backdrop to capture a few more aerial shots of the cinder cone and lava flow.

Boiler. For our final day of diving, we moved back to the Boiler and were treated to a plethora of manta ray interactions. A large black manta swam amongst us for a large portion of the first dive, and I was thrilled to capture photos of my dive buddy swimming alongside, with the Boiler in the background.

During our safety stop, six to eight bottlenose dolphins swam past, including what appeared to be the same youngster we saw days earlier. Two chevron manta rays stayed with us for most of the second dive, and a lone

Diver with school of Pacific creolefish and the large rock formation at Boiler dive site (above)

scalloped hammerhead shark came in close for an inspection but was still too far away for my fisheye lens.

We briefly saw a couple of manta rays on the third dive, but it was otherwise uneventful, and there was a feeling that we might end the trip on a low note. An incredibly playful chevron manta ray made sure that did not happen, as it was on us as soon as we entered the water for dive number four.

I barely had time to extend my strobes, as I clambered to get in position to photograph the manta as it swam over my head within seconds of hitting the water. Once everyone was able to get

Several scuba divers swimming with two chevron manta rays in front of the massive rock formation at the Boiler dive site

Chevron manta ray, with remora, swimming overhead

Socorro

the islands.

Sitting on the upper deck at sunrise, I watched a trio of Nazca booby birds fishing in the shadow of the boat, targeting the fish below by exploiting the lack of glare on the water's surface to hunt for their morning meal. It was an impressive display of ingenuity, technique and skillful flying.

Cabo San Lucas

If you have the opportunity to extend your trip a few days on either side of your journey to the Socorro Islands, there are many other big-animal encounters available in the waters off Cabo San Lucas. Pelagic Safaris, a member of the Pelagic Fleet, offers full- and half-day snorkeling trips in pursuit of marlin, orcas, schooling mobula rays, turtles, sharks, dolphins and whales. The species vary with the season, and there are often multiple possibilities on any given day. I was fortunate to swim with a mother humpback whale and her calf during a visit to Cabo in February.

The first time I jumped into the water, the whales passed between myself and the other snorkelers, as the mother brought the baby up to the surface for a breath of air. It was a spectacular moment that I will not soon forget and well worth the hours on the water to allow the whales time to accept and get comfortable with our presence.

Be sure to stop at Land's End and the Arch of Cabo San Lucas on your way back into the harbor to witness the last bit of dry land at the southernmost end of the Baja Peninsula. These massive rocks separate the Sea of Cortez from the Pacific Ocean and the confluence of those two bodies of water create some challenging currents beneath the surface.

Aerial view of Lands End and the Arch of Cabo San Lucas in early morning sunlight

Afterthoughts

The big-animal diving at the Revillagigedo Islands definitely ranks near the top of my list of favorite places. There are few spots on earth with the possibility for so many diverse pelagic interactions. I will continue to dream about swimming with the humpback whales at Roca Partida and look forward to my next chance to connect with the manta rays. One day, I hope you get to experience your own manta sombrero and potentially join me on a future adventure. ■

*The author would like to thank the Pelagic Fleet (**pelagicfleet.com**) and the crew of the* Socorro Vortex *(**vortexliveaboard.com**) for hosting this expedition. Thanks also go to Scubapro (**scubapro.com**) and Blue Abyss Photo (**blueabyssphoto.com**) for their assistance with underwater dive and photo gear.*

*Matthew Meier is a professional underwater photographer and travel writer based in San Diego, California. To see more of his work and to order photo prints, please visit: **matthewmeierphoto.com**.*

settled, we dispersed in the water column and spent the next 45 minutes savoring the manta ray as it danced from diver to diver, enjoying our bubbles. I even attempted my first underwater selfie while sporting a manta sombrero.

The ray stayed with us throughout our safety stop and even came to the surface after we finally had to get out of the water, as if to say "don't go" or simply bid to us farewell. It was a beautiful experience and a fitting end to our amazing big-animal adventure.

After dinner, we pulled up anchor and started our trek for home. Sea conditions were a bit rough on either end of the journey but calmed down slightly overnight, and we made good time, arriving late in the afternoon back in Cabo, several hours faster than any of my previous transits to

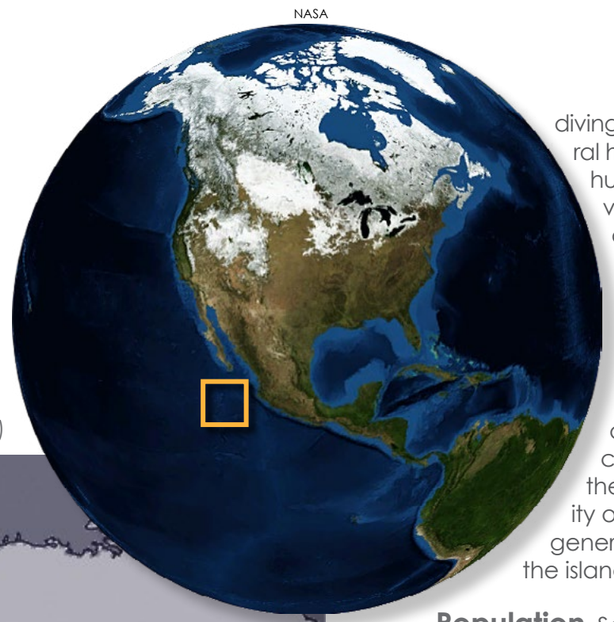
fact file

Socorro, Mexico

SOURCES: US CIA WORLD FACTBOOK, US CDC. GOV, STATE.TRAVEL.US, VORTEXLIVEABOARD.COM, WIKIPEDIA.ORG, XE.COM

History The islands of Socorro and San Benedicto were first discovered by Spanish explorers in December of 1533 and given the names Santo Tomas and Isla do los Inocentes respectively. Roca Partida was given its present-day name when it was first sighted in 1542 by a different Spanish explorer named Villalobos. Jose Camacho was credited with the discovery of the final island in the archipelago, Clarion, in 1779. President Benito Juarez awarded control of the four-island territory to the Mexican state of Colima in 1861, with plans to construct an offshore penitentiary on Socorro Island that never materialized. The Mexican Navy did establish a base on Socorro Island in 1957 and maintains a permanent outpost to this day. Ornithologist Andrew Jackson Grayson discovered the Socorro dove, mockingbird and elf owl on an expedition in 1865 and these species were eventually given scientific names in his honor. Dr Barton Warren Evermann conducted the most comprehensive scientific exploration of the islands at the beginning of 20th century and the volcano on Socorro Island was later renamed in his honor. Mexico's President Enrique Pena Nieto created North America's largest marine protected area and national park around the Revillagigedo Islands on 24 November 2017. This safeguard bans fishing, mining and tourism development within the 57,000 sq mi (150,000 sq km) of protected area and on the islands themselves. The Revillagigedo Archipelago was also declared a UNESCO World Heritage Site in July 2016.. Government: federal presidential republic . Capital: Mexico City.

NASA



Location of Socorro Island on global map (right); Location of Socorro Island on map of Mexico (below); Chevron manta ray at Boiler dive site (bottom left)

US CIA WORLD FACTBOOK / PUBLIC DOMAIN

Geography The Revillagigedo (Socorro) Islands consists of four separate volcanic islands, with San Benedicto Island being the closest to Cabo San Lucas, Mexico, roughly 240 miles to the southwest into the Pacific Ocean. Socorro Island is the largest of the four islands and is located another 30 miles south of San Benedicto, while Roca Partida is another 70 to 80 miles farther west. Clarion Island is 125 miles west from Roca Partida and rarely visited due to its remote location. Socorro and San Benedicto islands have visible cinder cones rising to heights of approximately 3,700 and 1,000ft respectively. Roca Partida, which translates to "split rock," is a field-goal-shaped seamount whose visible structure rises only 100ft above sea level and measures approximately 300ft long by 26ft wide.

Climate Ocean temperatures at the Socorro Islands usually range from 78-82°F in November, 70-74°F in February and March, and then 76–80°F from April to June. A 5mm or 7mm wetsuit is recommended depending on the season, as is a hooded vest. Air temperatures are typically in the 70s and 80s during the day with cooler evenings. A jacket or sweater and long pants are suggested to keep warm after diving. Natural hazards: hurricanes, volcanic activity.

Economy Tourism dollars from scuba diving accounts for the majority of income generated at the islands.

Population Socorro Island has a population of about 250 people, comprising mostly Mexican Navy personnel and their families. Roca Partida and San Benedicto Islands are uninhabited.

Currency The Mexican Pesos (MXN) is the official currency in Mexico, but US dollars are widely accepted. Credit cards are also accepted onboard with the exception of the crew tip, which is cash only. Exchanges rates: 1USD=19.11MXN, 1EUR=21.35MXN, 1GBP=24.72MXN, 1AUD=13.20MXN, 1SGD=14.08MXN.

Language The official language of Mexico is Spanish, though nearly everyone working on the dive boats speaks English.

Cuisine The food on board is a mixture of traditional Mexican fare and American cuisine, which can be tailored to meet any dietary constraints. The meals are frequent, delicious and the portions plentiful.

Tipping Tipping is expected on liveaboard dive boats, and each establishment will have their own guidelines and suggestions. Though a tip of 10 to 15 percent of the value of your trip is generally recommended.

Voltage The voltage on the Socorro Vortex dive boat is 110, and the outlets have a universal prong configuration. There are also a few 220 outlets available. The rest of Mexico has 110 outlets with a US prong configuration.

Travel/Visa A valid passport with an expiration date of at least six months past your departure date is required to enter Mexico.

Health Check with your doctor and health department for updates on required vaccinations or health warnings. In Mexico, there is an intermediate degree of risk for food or waterborne diseases such as bacterial diarrhea, hepatitis and typhoid; and vectorborne diseases such as dengue fever (2016) and malaria in some parts of the country. Active local transmission of Zika virus by Aedes species mosquitoes has been found in Mexico (2016).

Security Check with your state department for travel advisories and updates. Increased caution in Mexico is advised due to violent crime and kidnapping in certain areas.

Phone/Internet The Socorro Vortex has complimentary boat-wide satellite Wifi that is capable of retrieving email and text messages. There is no cell service onboard, though the boat does have a satellite phone in case of emergencies.

Hyperbaric Chamber
The nearest chamber to the Socorro Islands is in Cabo San Lucas, Mexico. ■

Post-reproductive grandmother orcas have a significant beneficial impact on their grandoffspring's survival chances.

Orca grandmothers improve the survival of their grandoffspring

In orcas, researchers have observed the first non-human example of the "grandmother effect" in a menopausal species. That is, when post-reproductive grandmothers assist other members of the species with their offspring, thereby improving the young ones' chances of survival.

Post-reproductive orcas have a large beneficial impact on their grandoffspring's survival chances. The findings of a study involving 378 orcas showed that calves whose maternal grandmother died within the last two years, had a mortality rate that was 4.5 times higher than those with a living grandmother, in the two years following the death.

Interestingly, this effect was especially true whenever the population of Chinook salmon (their food source) was low. In years when the fish population flourished, this effect diminished. Previous research showed that the reason for this was the post-reproductive grandmothers' knowledge and experience when foraging for food.

"We have previously shown that post-reproductive grandmothers lead the group around foraging grounds, and that they are important in doing that in times of need, when the salmon are scarce," explained senior author Dan Franks from the University of York.

With the progressive decrease of salmon populations, the grandmothers' role in this capacity will become even more important in orca populations. In addition, the grandmothers have been known to directly share food with their younger relatives, prompting the researchers to suspect that some babysitting was involved as well.

Such "abilities" may explain why the phenomenon of menopause may have evolved in some species and not others. ■

SOURCE: NATIONAL ACADEMY OF SCIENCES

More companies cut ties with attractions housing captive cetaceans

Marine-animal attractions such as SeaWorld, featuring captive cetaceans trained to perform for public entertainment, see airlines and travel portals halt ticket sales.

Earlier this year, Canada passed a ban on the keeping of dolphins, whales and porpoises for entertainment. Similar bans have been passed in countries like Brazil, Bolivia, Chile, Costa Rica, India, Luxembourg, Norway, Switzerland and the United Kingdom. Airlines and travel providers like British Airways, Delta, JetBlue, United Airlines, Virgin Holidays and Thomas Cook have cut ties with and stopped selling tickets to SeaWorld.

"Our customers tell us they have concerns about wild animals being kept in captivity, and increasingly see animal performances in particular as outdated," said Claire Bentley, Managing Director of British Airways Holidays.

But wait...

However, the path to change is not so cut and dry. Qantas announced at the end of August 2019 that it would continue to sell tickets to SeaWorld. This is contrary to its announcement earlier the same month that it would cut ties with venues that housed captive cetaceans.

This turnabout prompted Ben Pearson, Head of Campaigns at World Animal Protection, to comment: "Their original commitment would have moved us closer to a future where the only place that people could see dolphins is in the wild, where they belong."

"Mixed views"

On its part, Qantas acknowledged the "mixed views" on the issue, but said they would continue to sell hotel rooms and entry tickets to theme parks on the Gold Coast (including SeaWorld) as many customers wanted to visit SeaWorld while holidaying on the Gold Coast.

For travel portal TripAdvisor (and its subsidiary brand Viator), its October 2019 decision to halt the sale of tickets and the generation of revenue from attractions that contribute to the captivity of future generations of cetaceans was in line with its animal welfare policy. This move is being implemented progressively and is expected to be in full force by the end of 2019. However, it acknowledges that for cetaceans currently in captivity, being released into the wild is not a realistic option.

Hence, it will continue to sell tickets for facilities that house their cetacean charges in seaside sanctuaries (or are developing such sanctuaries), which would confine the animals in a coastal body of water that is as natural as possible.

At time of printing, SeaWorld's US websites indicate that their current population of cetaceans would be the last generation to be housed there, despite the fact that their cetacean shows are still on-going. ■

Wrecks of Coron

— *Sunken WWII History in the Philippines*

Text and photos by Brandi Mueller

Lionfish in the coral (above) and *Nembrotha lineolata* nudibranch (right) on the Lusong gunboat wreck

Being an avid wreck diver, Coron has been on my bucket list for ages. Having followed the underwater remains of the Pacific Theater World War II battles, I have found myself in some of the most beautiful places on earth, from the Solomon Islands to Truk Lagoon and many others. Coron is no exception.

Arriving on the island of Busuanga after a short, one-hour flight from the Philippines' capital city of Manila, I was picked up and escorted by van and boat to Sangat Island. As we departed the dock, there were dense mangroves on either side, green foliage encroaching on the small waterway, hardly big enough for two boats to pass in some areas.

Admiring my surroundings, I lost my breath for a moment when the walls of mangroves on either side seemed to open like a curtain to reveal a wide-open expanse of blue water and many green islands rising up from the water at different heights as far as I could see. "Beautiful" seemed like an understatement.

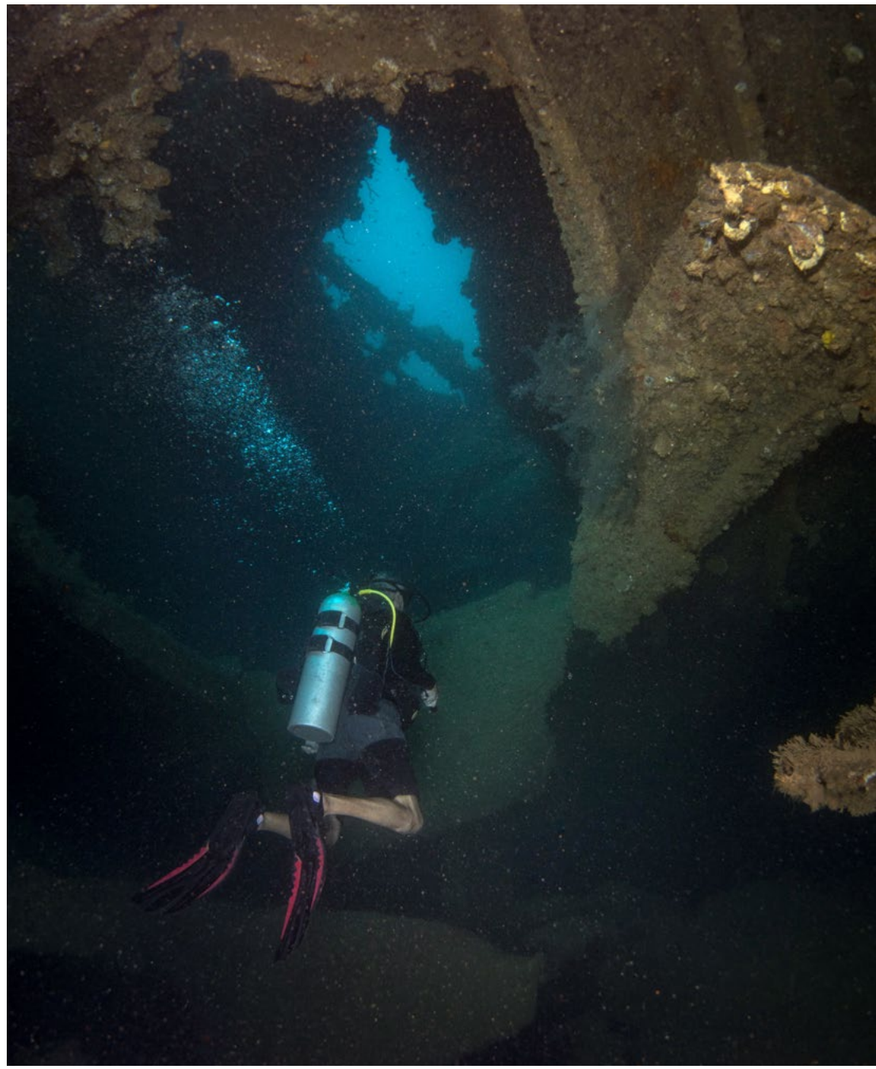
The boat driver picked up speed as we made our way closer to the dive resort, the only property on the island, where I would be staying to dive the wrecks for the next week. Sheer limestone cliffs got closer and the boat turned a corner past a rock face revealing a white sandy beach and several thatch chalets on stilts. I was soon being shown to one of the chalets with an epic view of palm trees and ocean in front of me, and even macaque monkeys could be seen wandering the grounds.

WWII, Coron, 1944

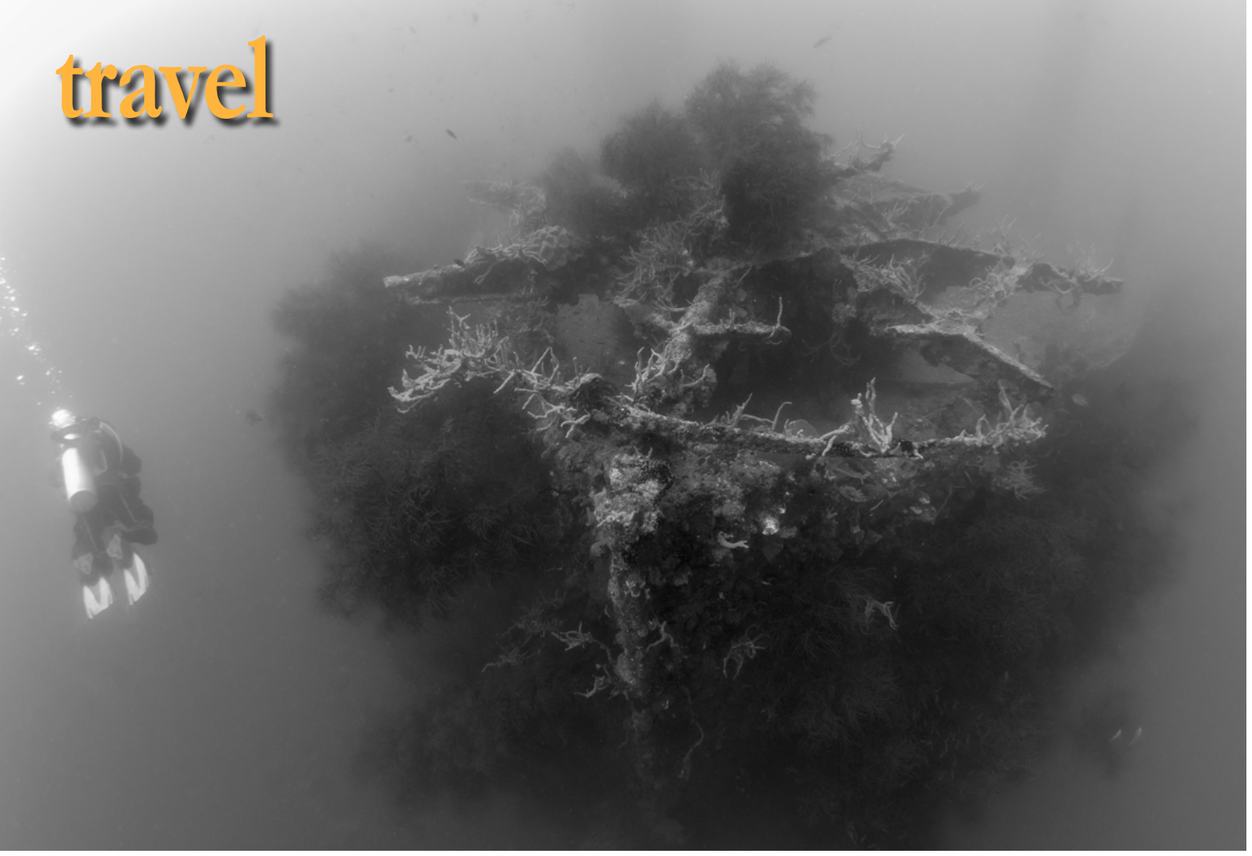
In the summer of 1944, the Americans and Allied forces ramped up action in the Philippines. From September 21 to 24, the United States attacked Manila Bay, sinking 15 ships. In an effort to protect the rest of the fleet, the Japanese sent the remaining ships to locations they had hoped were safe and

out of range. Several ships made their way to Coron Bay to essentially hide out and hopefully not be found by the Americans.

It is unknown if the ships were discovered by aerial photo reconnaissance or if Japanese radio transmissions were intercepted, but their location was no longer a secret. The US carrier group was 340 miles from Coron Bay, but Admiral William F. "Bull" Halsey from the battleship *USS New*



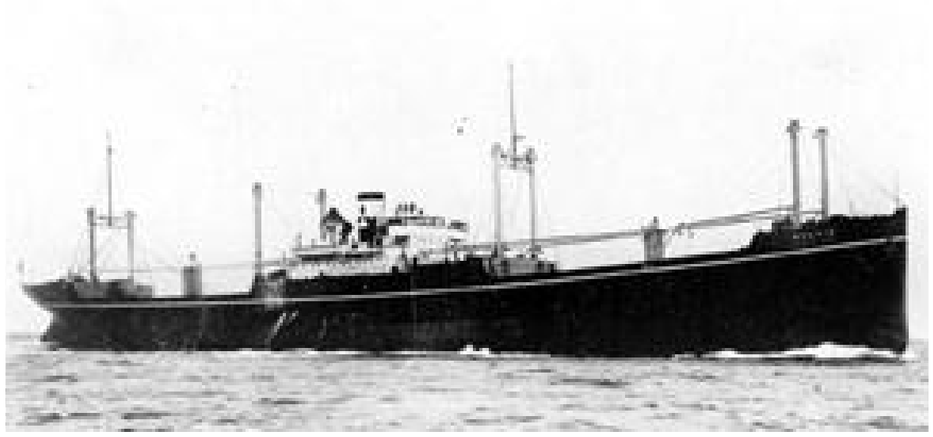
Diver inside *Kogyo Maru* (above); Traditional-styled outriggers on the beach (top right); Cuttlefish under gun turret on bow of *Olympia Maru* (previous page)



Diver on the bow with gun turret of the *Olympia Maru*

Jersey designed a mission that was approved by Vice Admiral Marc A. Mitscher, commander of Task Force 38 on the aircraft carrier *USS Lexington*.

Ninety-six Grumman F6F Hellcat fighters and 24 Curtiss SB2C Helldiver dive bombers took off at 5:50 a.m. on September 24 for what was the longest-range air attack ever launched from aircraft carriers at that time. They arrived at 9:00 a.m, and in just minutes, they took out the fleet and quickly departed so they could make it back safely. As they flew back to the carriers, there were 12 ships sunk or burning in the bay behind them. The planes all returned safely. One ship was reported to have escaped, the *Kamoi*, damaged, but later reported to have made it to port in Hong Kong.



COURTESY OF SANGAT ISLAND DIVE RESORT

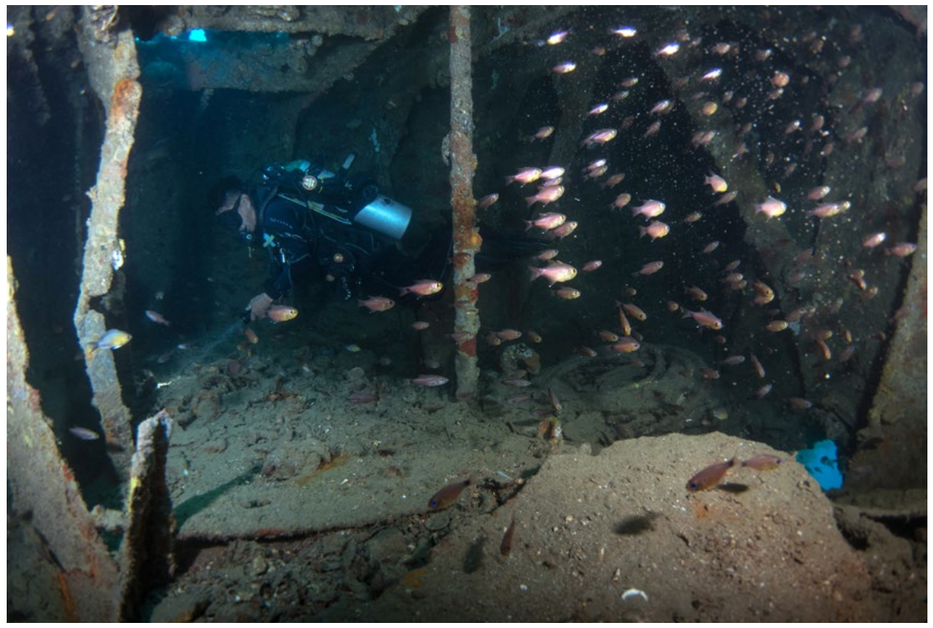
Historical photo of *Olympia Maru*

Underwater for 75 years, these ships now rest below the waves of one of the most beautiful places in the world, both on land and underwater. Topside sheer limestone cliffs and rock faces jut out of the blue waters and are covered in flourishing jungle. Located within the Coral Triangle, the oceanic region with the highest marine biodiversity on Earth, the ships are covered in abundant and colorful marine life. Unfortunately, the ships have been extensively salvaged, with their propellers, engines and artifacts removed, but there is still plenty left to see on the ships.

Olympia Maru

My first dive was on the *Olympia Maru*, a 400ft (122m) freighter sitting upright with the top deck around 60ft (18m). I was visiting during the rainy season when visibility can be a bit murky, and we descended for a few minutes before the shadow of a ship came into view. Starting at the stern, I followed my dive guide straight into the sterncastle of the ship. Coils of lines could be seen, and a stash of beer bottles were on the floor, but what I mostly noticed were several ladders and support beams bending at the weight of the ship. As the years pass, and time and the ocean take their toll on these ships, it is important to remember that they are ever changing. I was told some of the decks were starting to pancake on top of one another, and what I saw concurred with this warning.

We continued swimming through the interior of the ship—in and out of



Diver and fish life inside the *Olympia Maru*

Boiler (left), diver and fuel drums (above) inside the *Olympia Maru*

massive cargo holds with blue ambient light streaming in. A large boiler remained as well as many crushed fuel drums. Even inside the dark and rusty wreck, there were schools of cardinalfish and other small silvery fish, which reflected like glitter in our dive lights.

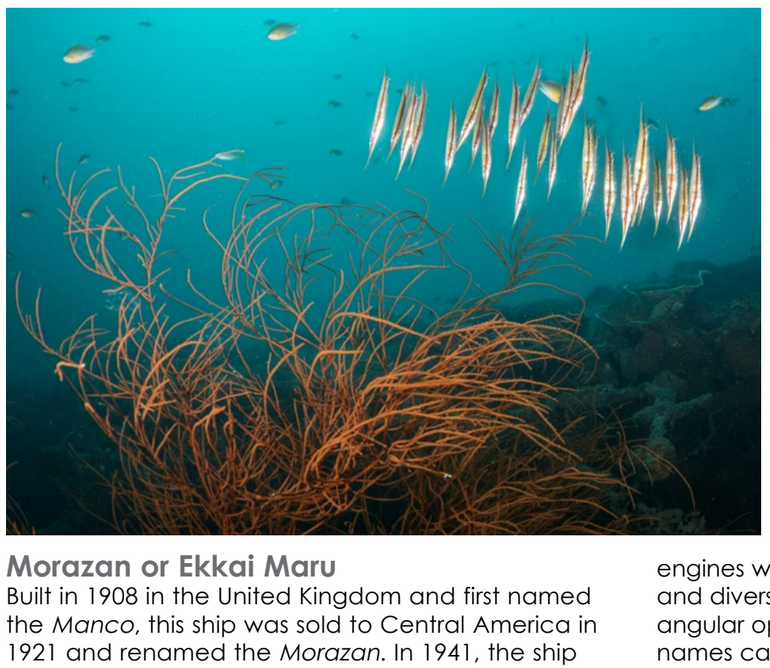
Emerging from within the bowels of the ship, I was greeted at the bow by sunlight and fish everywhere. A huge school of yellow goatfish stretched from one side of the ship to the other and fusiliers darted around feeding in the water column behind them. The gun turret remains but there is no gun. Inspecting the platform, there was a giant cuttlefish doing a poor job of hiding underneath. Its brilliant purple and maroon colors gave it away in an instant and it flashed bright colors for my camera.

Shallow depths allowed for a nice long dive on 32 percent nitrox, and we slowly made our way back to the stern on the outside of the ship, which was teeming with fish. I returned to the surface after the first dive, excited for more.

Pufferfish with remora and juvenile golden trevallies on the mooring line of the *Olympia Maru*

Fire bricks (above) and diver (right) inside and by the boilers (top left) of the *Morazan*

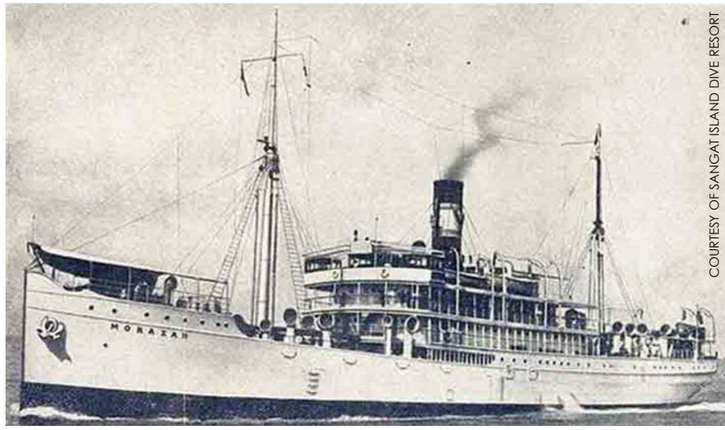
Fish life and coral on the smoke stack of the *Morazan* (above); Razorfish and sea whips on the *Morazan* (right)



Morazan or Ekkai Maru

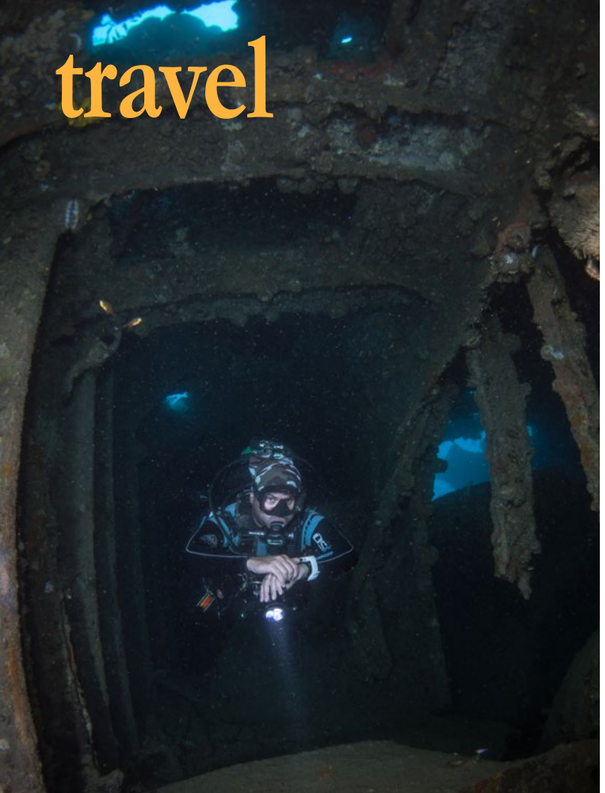
Built in 1908 in the United Kingdom and first named the *Manco*, this ship was sold to Central America in 1921 and renamed the *Morazan*. In 1941, the ship was captured by the Imperial Japanese Navy (IJN) in Shanghai, and in 1942, renamed the *Ekkai Maru*, becoming a cargo vessel for the IJN. On her starboard side sitting at depths of 45 to 85ft (14 to 26m), the estimated 325ft (100m) vessel has a lot of life and some really cool things to see in its interior.

Swimming into the engine room was like swimming into a massive cavern. The engines were salvaged, but two huge boilers remain, and divers can swim in-between them through a triangular opening underneath. Fire bricks with English names can be seen as well as coal in the corners of the ship. There was open space, allowing for light to filter into the wreck while moving through large, easy



COURTESY OF SANGAT ISLAND DIVE RESORT

Historical photo of the *Morazan* or *Ekkai Maru*



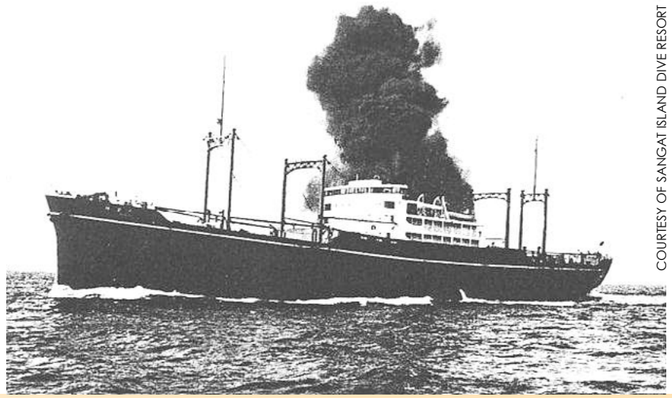
penetrations. It was really fun to twist and turn through the passageways, and it made me feel small moving through this massive ship.

Outside the wreck, there was marine life as if it were a reef and not a ship. The fallen smokestack lay in the sand, and purple sea whip corals seemed to sprout out of it, with fish hiding within. Some of the marine life seen included a school of razorfish swimming over the hull and black coral, a crocodilefish and lionfish.

Kogyo Maru

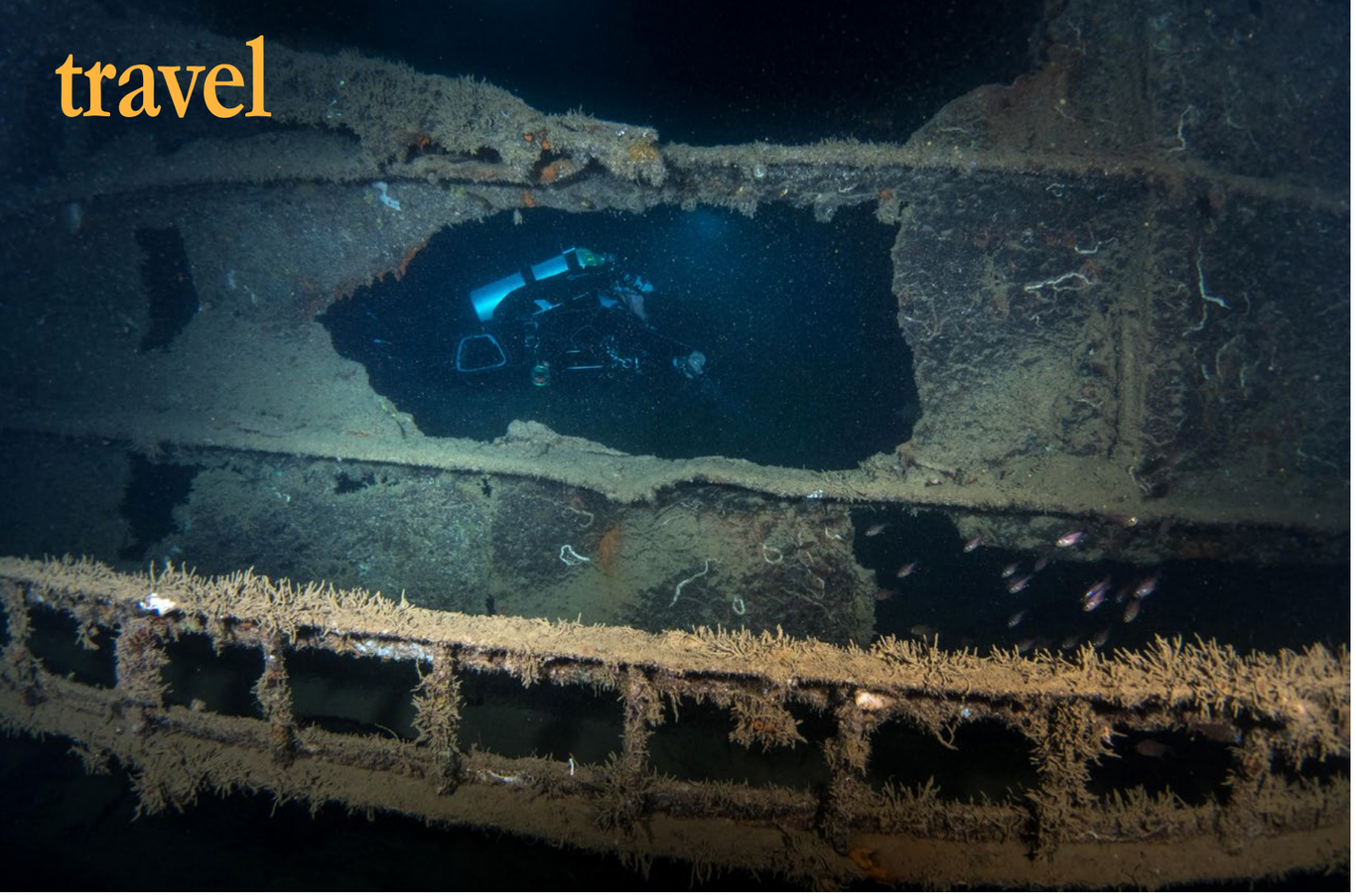
The *Kogyo Maru* is known for some unique objects in the cargo holds including a bulldozer, tractor and many bags of cement. Sitting on its port side, the top deck of the ship is now vertical and almost looks like a wall dive, with enormous cargo-hold openings through which one can swim.

We went into the hold containing the machinery, and one can easily see how everything, including bags of cement, has toppled to the lowest point, which is now the side of the ship. The bulldozer and tractor are mangled on top of the bags of cement. Swimming through a hole in the wall from one cargo hold to the next, there are more bags of cement and many coils of rolled-up wire



COURTESY OF SANGAT ISLAND DIVE RESORT

A hawksbill turtle on the *Kogyo Maru* (above); Historical photo of the *Kogyo Maru* (left); Diver swims over the rudder of the *Morazan* (top center); Diver inside the *Morazan* (top left); Crocodilefish on the *Morazan* (far left)



Diver inside the *Kogyo Maru* (above); Copperband butterflyfish (top right), rice cooker in the galley (right) and tractors wheels and axle (left) on the *Kogyo Maru*

mesh likely used in airport runway construction.

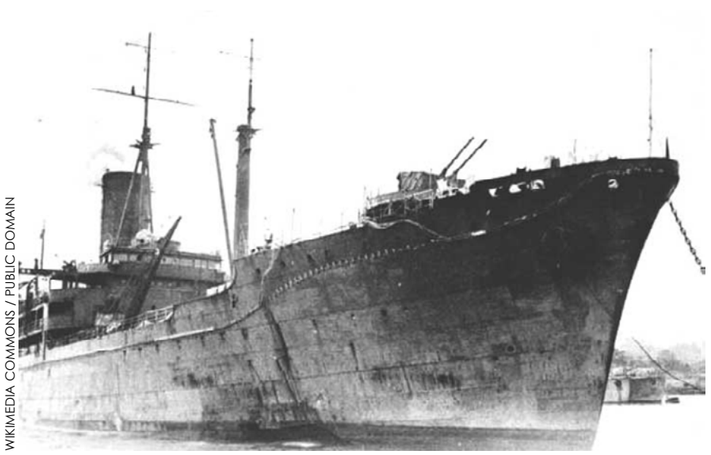
My dive guide took me into two different sections of the galley. Structural damage made it impossible to swim through to both sides, but they both can be accessed by other ways. A huge rice cooker is in one side of the galley, as well as a stove and other cooking equipment. There are many open, easy penetrations through the ship, with plenty of light. Depths range from 78 to 110ft (24 to 34m).

Coming shallow towards the end of this dive, we swam over the hull, now covered with reef life. A hawksbill sea turtle was munching on some coral, completely oblivious to us as it ate its meal and occasionally moved to a different part of the ship before eating more.

Irako Maru

The *Irako Maru* was a refrigerated provisioning ship and could supply food for 25,000 personnel for up to two weeks. Sitting upright, this 482ft (147m) is one of the best ships for more advanced penetrations, although bottom times can be short because it sits at depths from 90 to 140ft (28 to 40m).

Manual ammunition lift to bring ammunition from below up to the gun on deck



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Diver swims near the bow gun turret of the *Irako Maru* (top left); Diver with machinery (above) and catwalk (right) inside *Irako;* Historical photo of *Irako Maru* (left)

We headed to what is likely a large galley with many sinks and machinery. There were also two bicycles in one room and intact catwalks. Towards the bow is a massive wheel used to help bring ammunition from a lower deck up to the gun platform above. I would have loved more time and more dives to explore the interior of this wreck.

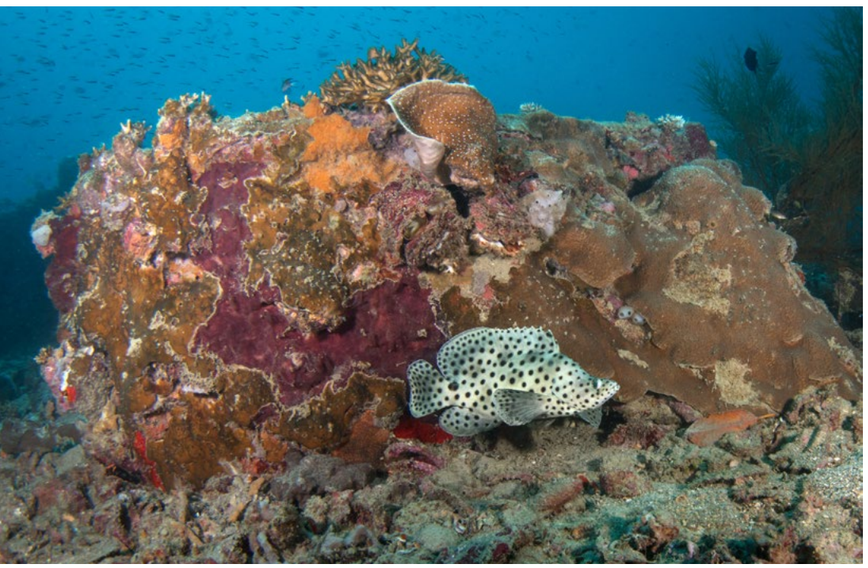
The outside of the ship is also nice. I found the bow particularly photogenic, and a gun turret (with no gun) sits near the bow. Coral and fish were also plentiful on the exterior of the *Irako Maru*.

Okikawa Maru

The *Okikawa Maru* wreck is the farthest from Sangat (just 25 minutes by boat) and well worth the beautiful boat ride which passes pearl farms and several islands. Even though it was the end of the rainy season, I was very lucky, with mostly sunny and calm weather during most of my week of diving.

The *Okikawa Maru* is a massive oil tanker claimed to be over 500ft (170m) long. It sits mostly upright, although the bow is broken from the ship and sits with the nose upward. Shallow depths from 32 to 85ft (10 to 26m) allow for a lot of time to explore, and there is plenty to see both inside and out.

We started at the stern and swam straight to the huge rudder in the sand. The propellers have been removed, but I could picture how large they must have been to propel such a huge ship. Then my



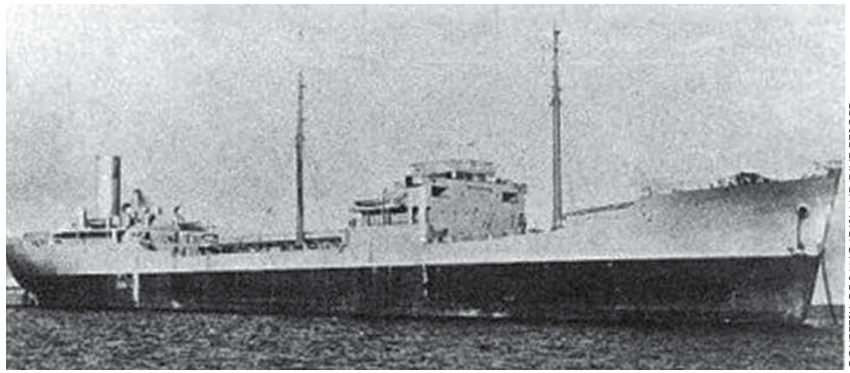
Hawksbill sea turtle in the interior of the wreck of the *Okikawa Maru* (above); Barramundi fish (left) and false clownfish in anemone on the deck (right) of the *Okikawa Maru*; Historical photo of the *Okikawa Maru* (lower right)

dive guide seemed to disappear into thin air. He had gone straight into the ship via the propeller shaft. I, of course, followed.

Slowly swimming through the bowels of this massive ship was incredible and one can swim the entire length inside. Mild to strong currents are common, and because the ship has so many openings, the currents stir up the silt within, making visibility appear dark and spooky. The cavernous holds and oil storage areas were dark but massive. My dive guide, in a very humorous manner, showed me what might be a jail cell or a cage-room by going inside and miming to me he was locked inside and trying to get out.

We continued from hold to hold and into the engine room area (although it was salvaged). We moved through some large openings and some smaller holes in the wall, making it all the way to the bow before emerging into the daylight. Where the bow is broken, there was a group of batfish and other schooling fish.

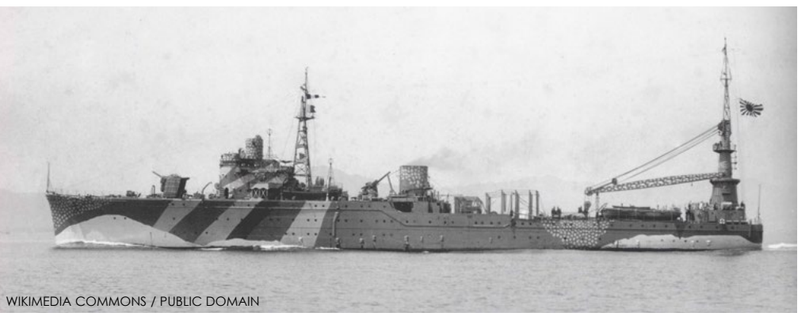
Out in the open and back on deck, we started swimming towards the stern, and I could see the cross hatch of the pipe bridge catwalk used to help move oil in and out of the ship. Covered in marine life, it was hard to make out what it used to be, and many fish were living in and around it. I spotted a barramundi and a little hawksbill sea turtle swimming nearby. I followed the turtle, and it swam right into the wreck, taking me on a little tour of the deck below. Anemones dotted the deck and lots of fish swam by. Overall, this was probably the prettiest wreck, and I really enjoyed the dive.



COURTESY OF SANGAT ISLAND DIVE RESORT

Akitsushima

The *Akisushima* was top on my list to dive and the only warship in Coron. Having spent time diving in Truk Lagoon (Chuuk), this wreck fascinated me because it was there during *Operation Hailstone*, the massive air raid that



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Historical photo of *Akitsushima*

Diver exploring the interior (above) and swimming through the propeller shaft (left) of the *Okikawa Maru*; School of big eyes (right) and remains of a flight helmet (lower right) on the *Akitsushima*

sunk the many ships we dive in Truk today, but the *Akisushima* escaped. The ship was hit twice, but due to its strong construction, it managed to stay afloat and leave via South Pass. It was interesting to consider that if it had not escaped, we might otherwise be diving that ship in Truk.

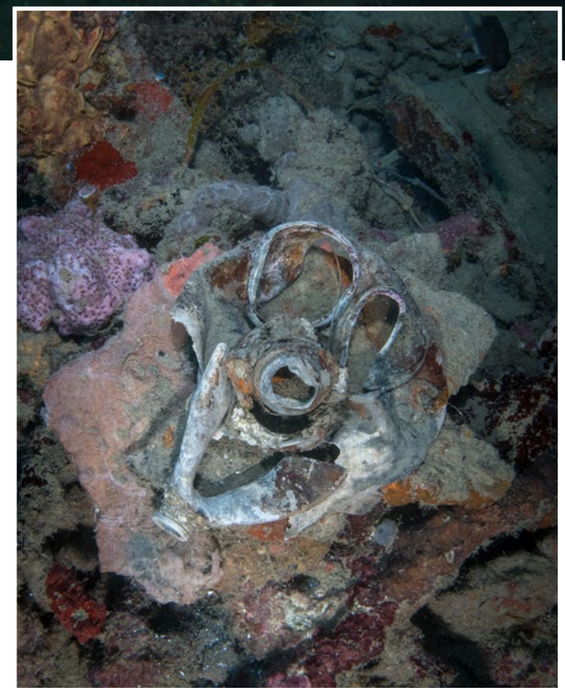
Besides this interesting history, the *Akisushima* was a very unique ship built specifically to be a tender for the Kawanishi H8K "Emily" seaplane. The Emily was a huge plane with a wingspan of almost 125ft (38m) and a gross weight of 54,013lb (24,500kg). To support this, the *Akitsushima* had a massive crane on its stern, which now rests in the sand at 120ft (36m). That was where we started our dive.

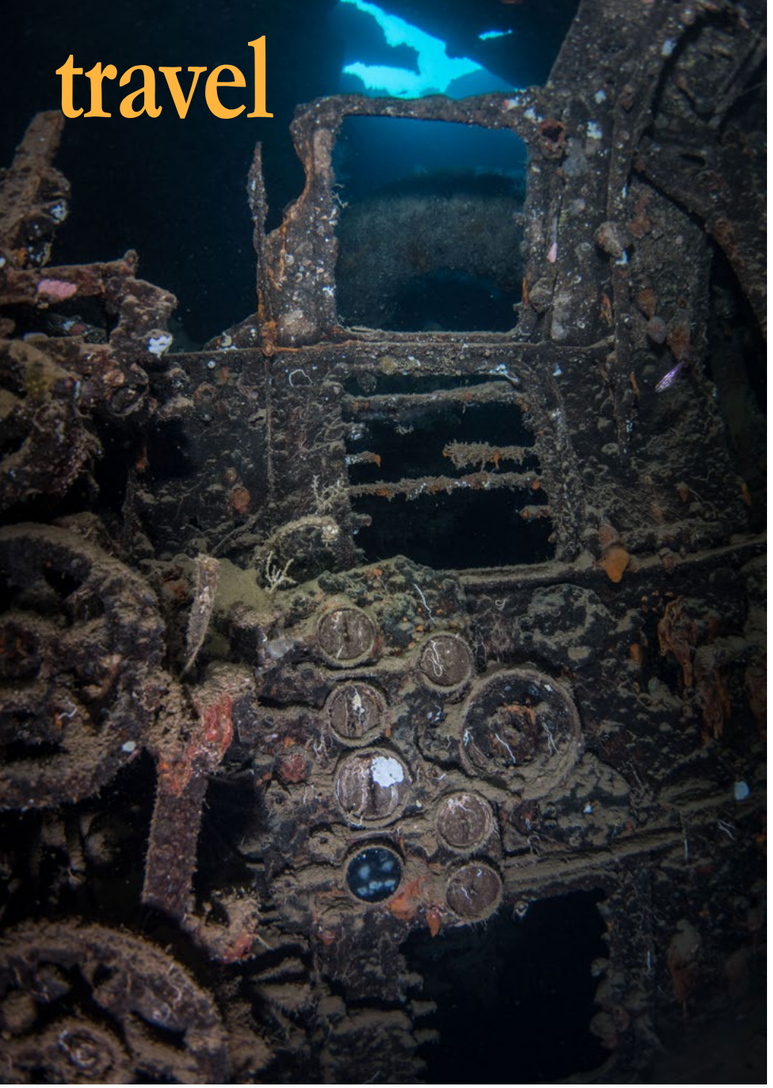
I knew the plan was for my guide to show me the remains of a flight helmet first, but when I saw the crane, I forgot what I was doing and immediately swam out and over the massive structure. Returning back, I saw the flight helmet and the anti-aircraft gun in the sand. After that, we headed inside the ship to see the enormous winch, used to operate the crane, and continued through the engine room, which still had all four engines intact and some interesting gauges.

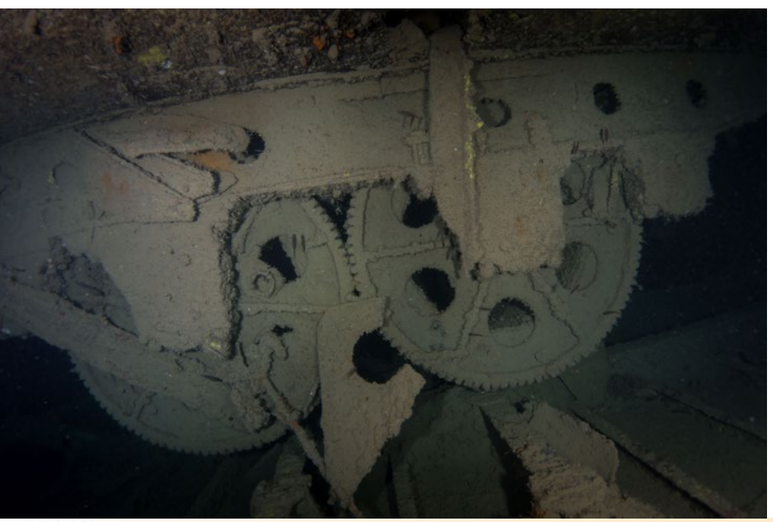
If the *Akisushima* was carrying an Emily when it sank, the plane was never found. Having spent most of the dive at deeper depths, our bottom time was short and ended sooner than I had wanted. We exited the ship and swam slightly shallower along the outside of the wreck. There, we viewed an intact radio tower, before we eventually turned around and headed back to the stern over the hull, which was covered in coral and buzzing with fish.

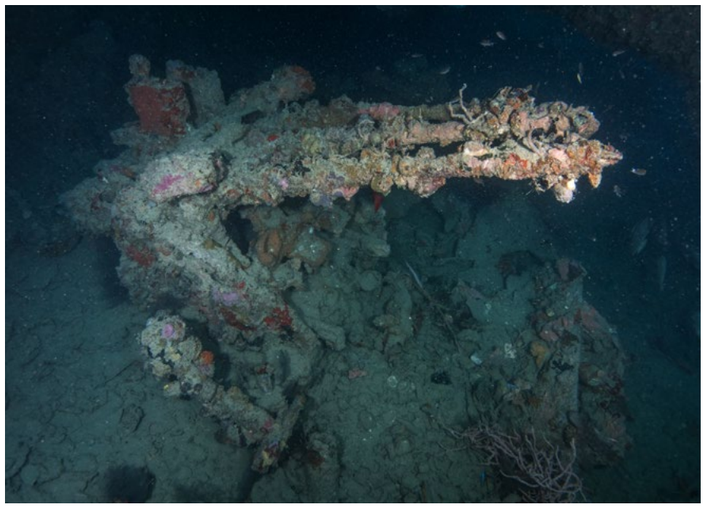
Lusong gunboat

Even though it was a smaller ship and shallower, I really enjoyed the Lusong gunboat. Only 100ft (30m) long, the ship's bow comes up to 15ft (3m). While only the basic structure remains, there were tons of marine life on the wreck and some wide-open







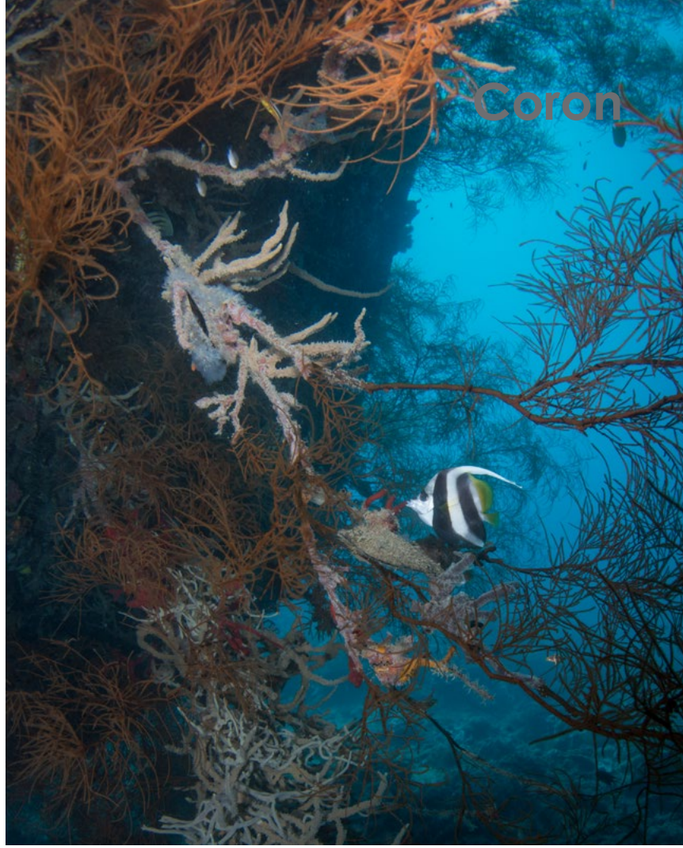


The crane used to move a Kawanishi H8K "Emily" seaplane (above); Antiaircraft gun (left), gauges in the engine room (far left) and winch system (lower left) for the massive crane on the *Akitsushima*

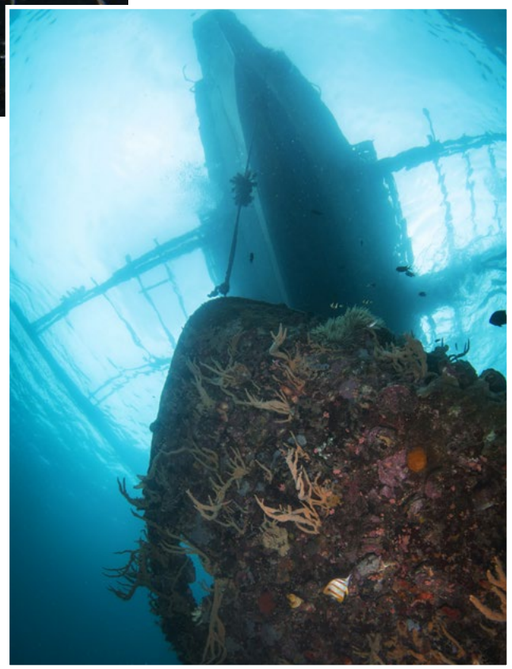
and fun swim-throughs within. My guide found a giant cuttlefish just a few feet off the wreck, which let me take dozens of photos before swimming away. I spent one dive shooting the ship with a wide-angle lens, trying to capture the many lionfish, anemones, and other fish amongst huge bushes of black coral. I also went back for another dive to shoot macro and found nudibranchs, clownfish and porcelain crabs in anemones, jawfish and more. Both were really enjoyable and relaxing dives, and it was neat to see how the ocean has decorated the ship with life.

Sangat sub-chaser

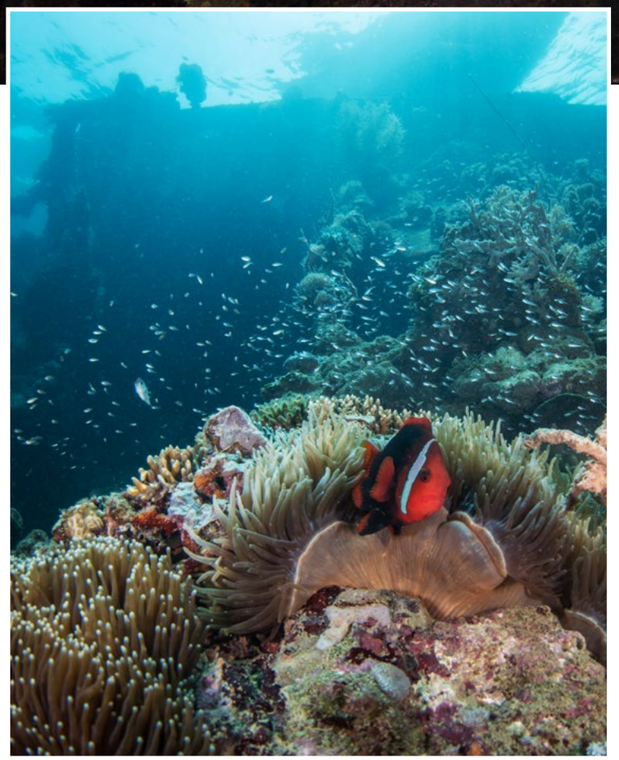
Another smaller wreck, which I found to be a really nice dive, was the sub-chaser located just around the corner from the



A diver explores the interior (above) and a bannerfish among coral (top right) on the Lusong gunboat



School of tiny fish (above) on the Lusong gunboat; Bow of the Sangat sub-chaser with an outrigger dive boat above it (right); Diver (top right), portholes (far right) and Japanese tile bath tub (bottom right) inside the Sangat sub-chaser



Tomato clownfish in anemone on the Lusong gunboat

resort. Situated quite close to land and a vibrant reef, the 115ft (35m) sub-chaser sat mostly upright with a starboard list.

My first dive on the sub-chaser was a twilight dive that turned into a night dive. There was a large population of mandarinfish on the nearby reef, so we checked out the ship first, and as the light started to fade, we headed over to see if any mandarinfish were mating. We saw a few of the vibrant blue-and-red-patterned fish, but none were mating. Continuing the night dive, we saw a teeny, tiny cuttlefish, shrimp, and a sponge crab which was in the process of exchanging its sponge for a purple sea fan.

Returning during the day, I found that I was not the only one who liked diving the sub-chaser. It was a very popular wreck for other dive operators too. Many boats from Coron used the sub-chaser and shallow reef close by for open water students and beginner divers because the ship was as shallow as 15ft (3m) in some areas, with a maximum depth of about 60ft (18m). There was abundant marine life on the ship, including juvenile batfish, lots of coral, and a crocodilefish

Wire coral goby (above); Diver with giant cuttlefish at the Lusong gunboat (left); Jawfish (right); Lion's paw sea cucumber (top right)

Coron

Wire coral shrimp

Crocodilefish inside a stove in the galley of the Sangat sub-chaser (above); The reef near the sub-chaser is home to mandarinfish (center)

sitting in the open hole of a stove in the galley area. It was easy to swim through the ship and see a bathroom with an intact Japanese tile bathtub, through the hull of the ship with open portholes letting in blue light, and the wheelhouse area. We spent the end of the dive checking out the marine life in the reef.

Confusion with names

Which wreck is which seems to have been an endless source of confusion in past years. In this article, I am using the most recent identifications, but in the past, what is now known as the *Olympia Maru* was previously unknown and called the *Tangat*. What is now identified as the *Morazan* was previously incorrectly thought of as the *Olympia*. Finally, what is now known as the *Okikawa* was previously misidentified as the *Taiei Maru*.

Not just wrecks

Not only are the wrecks beautiful artificial reefs covered in life, there are also other reefs to dive around Coron as well. Unfortunately, I ran out of time to do more dives, but there are also two dive sites in geothermal waters called Barracuda Lake and Cathedral Cave. Barracuda Lake requires a 15-minute hike, but once in the water, divers pass through three thermoclines, with the water getting hotter as one gets deeper (until reaching a point where it gets cool again). Cathedral Cave is entered through a limestone cliff face, and divers must pass through a tunnel before reaching stalactite and stalagmite formations and the main cavern. I look forward to returning to see both.

View of the resort side of Sangat Island (above); Scenic wooden walkway on the island (left); Crab for lunch (bottom left)

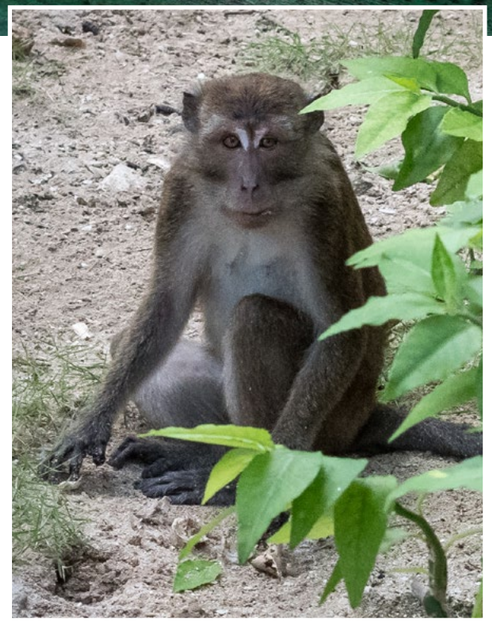
Sangat Island

Not only was the diving incredible, but Sangat Island Dive Resort was the perfect place from which to dive, and I spent the week being surrounded by beauty both above and below. Sangat is a limestone island, which is part of the Calamines Island group in the northern sector of Palawan Province. Busuanga, Coron and Sangat are all a part of the Calamines and boast limestone rock formations, land-locked geothermal lakes, and plenty of birds and wildlife. Sangat is home to various tropical birds, including the endangered tabon scrubfowl , Palawan hornbill, mynahs, Palawan peacock pheasant and Philippine cockatoo. It is also home to macaque monkeys, which, at times, I felt were the true bosses of the resort.

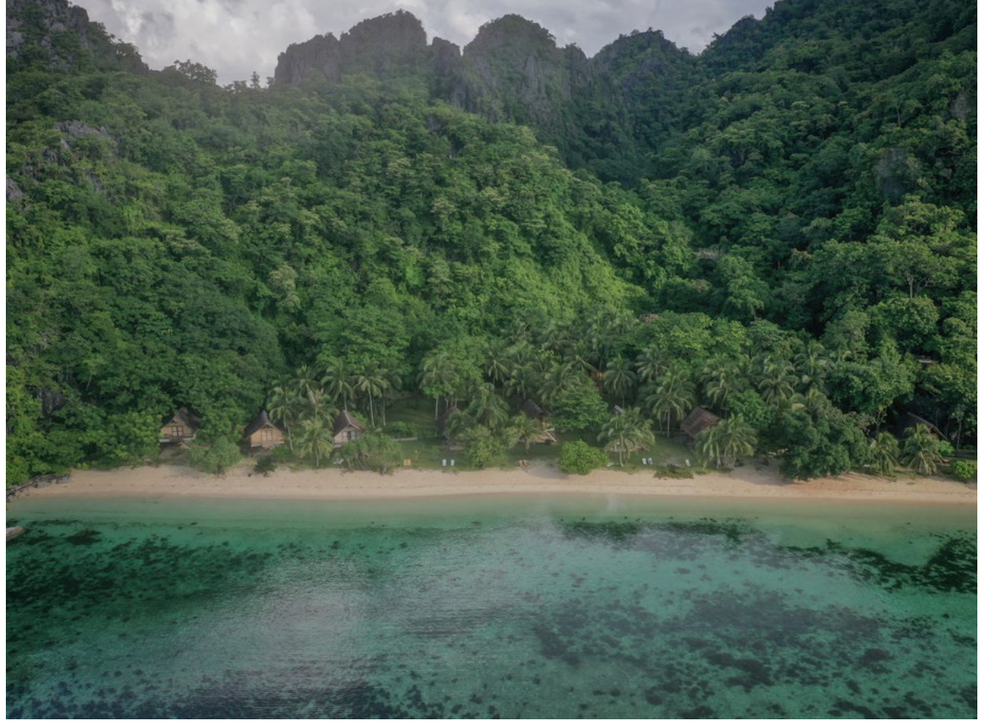
One morning, I was on my way to get coffee, and several monkeys were on the walkway. I could not remember if one is supposed to make eye contact and establish dominance or avoid eye contact. I chose direct eye contact and quickly realized that either I did not thoroughly establish dominance, or I was not supposed to make eye contact. Either way, the alpha male bared his teeth, growled at me and chased me down the path. I thought to myself, "I will not make eye contact again." For the most part, the monkeys just wandered around the resort like they owned the place (I suppose they did), and a few mothers carrying babies would pass in front of my chalet or they would just be eating in the trees.

Accommodations at the resort consist of beachfront chalets, hillside chalets and a two-bedroom villa with a private beach. No one was staying in the villa, so I wandered down the wooden walkway around and over a rock cliff before arriving at the private beach and lovely villa tucked back into another cliffside. The outdoor shower built inside a little rock opening was my favorite part, and it looked like the villa would be a great place to spend some secluded time.

Meals were served at an open-air restaurant and bar area with pool table, bookshelf and plenty of seating. Another bar, the Rock Bar, was just a short walk down a pier over the water onto a rock sitting off the main island. Both were great places to grab a cocktail or a fresh coconut with metal straw (no plastic straws or even single-use plastic water bottles are used on the island).



Macaque monkey on the path



Macaques playing in the trees (above); A few of the beach-side chalets (left); I cannot imagine a prettier view to enjoy some French press coffee (far left); View from chalet (center)

Daily routine

Most mornings, I got up with the sun. The ocean breeze flowing through the screens of my open-air cottage kept it cool and also let in the light. I would slowly get up and head to the dining room area to get a French-press pot of coffee and bring it back to my porch. I would then sip coffee while watching the water in front of me, the occasional monkey go by, or catch up on my reading and emails. The resort only had Wi-Fi in the dining room area, but I had a local cell SIM card that got me 3G all around the resort.

I would then head to breakfast where there were eggs to order, bacon and ham, cheese, fresh fruit juice and other breakfast items, but all I wanted were the mangos—delicious, amazing, perfectly ripe, Filipino mangos. Okay, I ate some other things too, but the mangos were the best. I could have eaten them all day and all night.

After breakfast, I would head to the dive shop and analyze tanks, get my camera ready and head out to the first dive. After each dive, we would come back and do the surface interval at the resort because dive sites were so close. I would grab a coffee or some tea and relax in one of the hammocks under my chalet. After the second dive, lunch was usually buffet style, and there was time for a quick nap or more hammock time (or a nap in the hammock) before the third dive. The dive operator also offered mandarinfish dives and night dives. Dinner was often buffet style or shared plates for big groups.

Overall, I could not shake the feeling of being completely relaxed. There were no noisy cars rushing past, no honking horns. In fact, the only thing I heard was a non-stop nature soundtrack of waves rushing up against the shore, birds, crickets, the occasional snarling from monkeys fighting (how dare they interrupt the peace!)—nothing was rushed (although the dive boat left at the time stated). Otherwise, everything was super relaxing and peaceful.

Other activities included kayaking, and I had planned to use a kayak to go see a geothermal area just on the other side of the island, but diving (and the hammock) took up all of my time. There were also stand-up paddleboards, trekking tours around the island, snorkeling, jet ski tours, sailing, island-hopping day trips and massage service (I did partake in that once, as if I was not relaxed enough already).

I woke up one morning as the sunlight lit up my room and could hear the gentle waves breaking on the sand in front of

Gearing up on the dive boat

Covered in stony corals, the hull of the *Kogyo Maru* looks more like a reef than a ship (above); Porcelain crab (left) and false clownfish (lower left) on Lusong gunboat; In scenic surroundings, a diver on the diveboat, gets ready for a dive (far left)

my chalet. Looking through the mosquito netting and out of the screened window, I could see two monkeys in the tree just outside, reaching for leaves for their breakfast. The whole scene was so peaceful and calming, I was completely relaxed, and it was incredible to be so close to nature.

Environmental aspects

Sangat Island Dive Resort takes ecotourism seriously, and if you look closely, you can see signs of this around the resort. The pier leading to the dive boats has a roof full of solar panels (there are more in other areas too) and the resort is entirely off the public electricity grid. Currently, they are nearly 100 percent solar-powered, right down to powering the compressors filling the tanks. Occasionally on rainy days and at night, they have to start up the generators, but I heard about plans for a larger battery system to avoid using the generator at all.

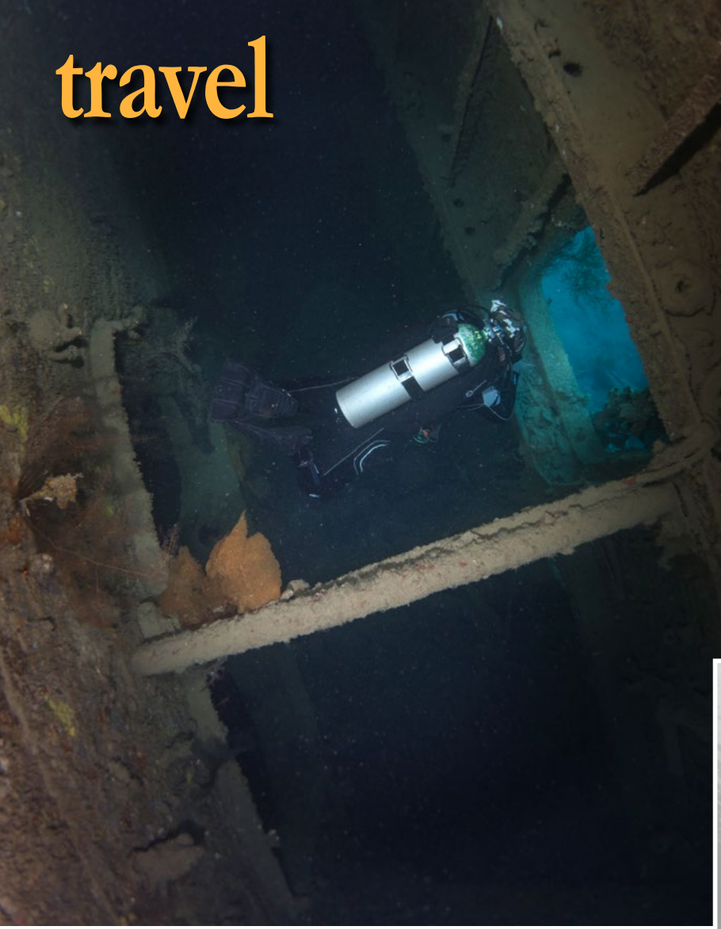
The island makes its own water, and because of this, conserving it is vital. This probably explains my only (very first-world) complaint about the resort—that they do not have hot water in the rooms. I would venture this is partly to keep tourists from taking hour-long hot showers when water is such a precious resource on the island. Days were hot, so generally not having hot water was not much of an issue, but one night after a night dive, it felt particularly chilly.

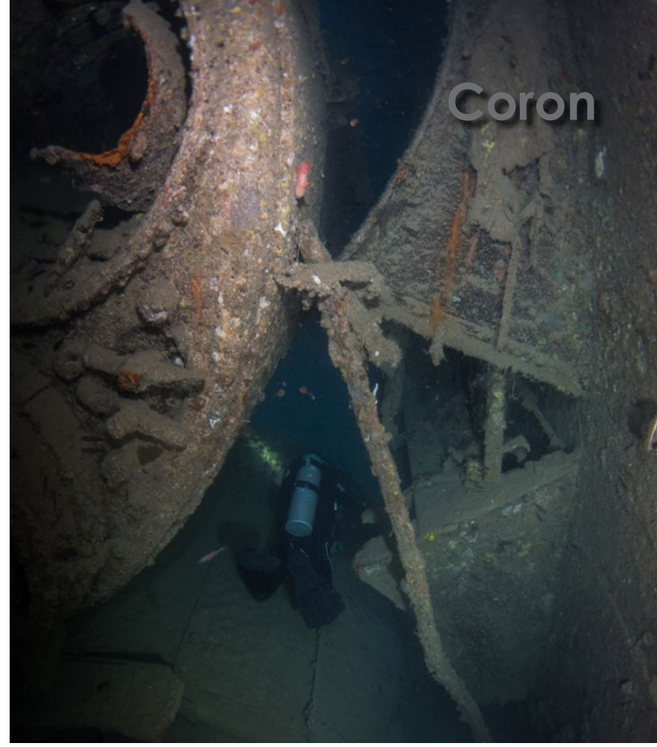
The resort is built with "low impact" materials using traditional methods such as hand-woven bamboo wall panels and cogon grass or nipa palm roofing. There is also a tropical fruit and nut plantation. The Sangat Island Marine Park and Sanctuary includes the waters and reefs surrounding the island, and it hosts reef health studies, coral planting, crown-of-thorns starfish removal projects and more. And you will not find a plastic straw or a plastic bottle on the property. For guests not having their own refillable water bottles, they can borrow or buy one from the reception.

The dive center

The dive center was fully equipped to support recreational and technical divers. The shop has nitrox, single and double tanks, stage tanks, gas blending capabilities and can support closed circuit rebreathers (CCR). The staff teaches classes for beginners to divemasters, and there are speed boats of different sizes to support different dive groups.

There are numerous dive operators in Coron, but Sangat Island Dive Resort has several key advantages, the main being that the wrecks are very close





Bicycle on the *Irako Maru* (above); Lusong gunboat, with dive boat above it (left); Diver inside the *Akitsushima* (top left)

to Sangat Island. Dive shops in Coron mostly use slow, traditional style outrigger boats to take divers to the wrecks, taking 90 minutes to two hours to make the journey. However, from Sangat, boat travel distances to the wrecks take from two minutes to 25 minutes for the longest trek. Not to mention, timing was everything. Being so much closer, we could arrive for the morning dive before the Coron boats and be the first divers of the day on the wrecks (before all the silt got stirred up from other divers). Usually, when we were surfacing from the first dive, the others were just jumping in.

Safety notice

The wrecks of Coron are mostly at recreational depths, but there are a variety of different dive profiles for different levels of divers. For beginners, there are shallower wrecks with lots to see on the outside. For advanced divers, there are great penetrations and the potential to stay deeper for longer. Never dive beyond your training or personal limits, and do only what you are comfortable with. If diving inside the wrecks, always be aware of your fin kicks and buoyancy as it is very easy to silt out a room to zero visibility.

Unfortunately, the wrecks of Coron were heavily salvaged after the war, and things like propellers, engines and anything that could be used for scrap metal were removed a long time ago. Many of the ships' unique artifacts have been removed, but we still found the occasional piece of history. Do not take anything from the wrecks, so that other divers can enjoy them too.

Of course, there is always something to go back for. There is one other wreck near Coron that I did not get to, the *Kyokuzan Maru*. Sangat Island Dive Resort is quite close to the rest of the wrecks, but this one is much farther north. The freighter is 180m long, with the deck at 22m and the sand at 40m. I was told its highlights include several Japanese staff cars and trucks, which can be seen inside. It is on my list for next time.

Between my peaceful, relaxing time at Sangat Island Dive Resort and the epic excitement of diving the WWII wrecks, I had a fantastic time in Coron. There is definitely plenty to see underwater to keep any diver happy while the topside beauty is nothing short of amazing. ■

*Special thanks go to Sangat Island Dive Resort (**sangat.com.ph**).*

*American underwater photographer, dive writer and regular contributor Brandi Mueller is a PADI IDC Staff Instructor and boat captain living in Micronesia. When she's not teaching scuba or driving boats, she's most happy traveling and being underwater with a camera. For more information, visit: **Brandiunderwater.com**.*

SOURCES: CORONWRECKS.COM, SANGAT.COM.PH, TOURISM.GOV.PH

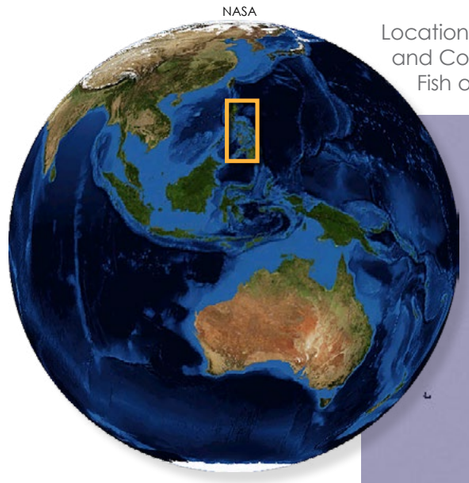
Lionfish on the *Morazan* (above); Diver swims between the boilers of the *Morazan* (top right)

fact file

Philippines

SOURCES: CIA.GOV, CDC.GOV, CORONWRECKS.COM, GOV, STATE.TRAVEL.US, SANGAT.COM.PH, TOURISM.GOV.PH, WIKIPEDIA.ORG, XE.COM

NASA



Location of the Philippines on global map (left) and Coron on map of the Philippines (below); Fish on the *Olympia Maru* (lower left)

US CIA WORLD FACTBOOK

History The Philippines was a United States colony prior to entering WWII. An act was underway at the time for independence to be given to the Philippines by 1943 but allowing US military and naval bases until independence. The Philippines was initially attacked by the Japanese on 8 December 1941, just hours after the attack on Pearl Harbor. Japan believed that all of Asia belonged to the Imperial Japanese Government and was going after the Asian colonies under western rule. The Japanese occupied parts of the Philippines but did not have a stronghold due to the extensive number of islands, guerrilla resistance and support for the Americans. The Allied forces began to take back the Philippines in 1944, and between the Battle of the Philippine Sea (June 19-20) and the Battle of Leyte Gulf (Oct 23-26), Task Force 38 sank 12 ships in Coron Bay. On September 21-24, the Americans were conducting naval air strikes over Manila Bay, which caused 15 ships to sink, and the Japanese moved the remaining ships out of Manila Bay to a secret location. Several ships were sent to Coron Bay, arriving on Sept 23. It is unknown if the fleet was spotted by aerial photos or if radio transmissions were intercepted, but the Americans knew there were ships at Coron Bay, and they attacked on September 24. On what was the longest distance carrier-based air strike up until that time, 96 Grumman F6F Hellcat fighters and 24 Curtiss SB2C Helldiver bombers set off at 5:50 a.m. to cover a distance of 340 miles, arriving at Busuanga Island at 9:00 a.m. Within 15 minutes, all 12 ships were under attack and were either sunk or burning. Government: presidential republic. Capital: Manila

Geography Coron, Sangat and Busuanga Islands are part of Palawan Province, which is the largest province in the Philippines and is over 1,780 islands and islets. Located 170 miles (310km) southwest of Manila, the islands are between the South China Sea and the Sulu Sea. Most are limestone islands with sheer cliffs and also white sand beaches, mangroves and some have lakes within that are connected to the sea underground. Coastline: 36,289km. Natural hazards include typhoons, landslides, volcanoes, earthquakes and tsunamis.

Climate Diving occurs year-round, but better visibility occurs during the dry season from December to June. The wet season is July to November. Water temperatures are 80-85°F (27-30°C), with cooler waters during the dry season. Air temperatures are usually 88°F (31°C) year-round.

Environmental issues The Philippines faces many environmental issues, including water pollution, contaminated groundwater and lack of sewage treatment. Increases in urbanization and agricultural land have led to deforestation, including legal and illegal logging. Air pollution is an issue particularly in Manila. The waters surrounding the Philippines are threatened by overfishing, dynamite fishing, plastic and other pollution (including agricultural) going into the sea and coral bleaching.

Economy Specifically in Palawan Province, agriculture is the main export, along with logging, fishing, oil, pearls and tourism. In the Philippines, overall major exports include electronic products, coconut oil, copper and petroleum products, agriculture and tourism. The Philippines has the 34th largest economy in the world.

Currency Philippine Pesos (PHP). The US dollar, Euro and British Pounds are sometimes accepted at tourist establishments. ATMs are common throughout the Philippines in cities, but there are none on Sangat. Credit cards are accepted at Sangat without fees, and commonly accepted around the Philippines, but sometimes with fees. Exchange rates: 1USD=50.67PHP; 1EUR =56.32PHP; 1GBP=66.23PHP; 1AUD=34.70PHP; 1SGD=37.36PHP

Population 105,893,381 (July 2018 est), with over 12 million living in the capital city of Manila. In Palawan Province 850,000. Ethnic groups: Tagalog 28.1%, Bisaya/Binisaya 11.4%, Cebuano 9.9%, Ilocano 8.8%, Hiligaynon/Ilonggo 8.4%, Bikol/Bicol 6.8%, Waray 4% (2010 est.). Religions: Roman Catholic 80.6%, Protestant 8.2% (includes Philippine Council of Evangelical Churches 2.7%, National Council of Churches in the Philippines 1.2%, other Protestant 4.3%), Muslim 5.6%, tribal religions 0.2% (2010 est.). Internet users: 56,956,436, or 55.5% (July 2016 est.)

Language Filipino and English are the official languages and there are 19 recognized regional languages.

Phone/Internet Sangat Island has local cellphone service and 3G. The resort offers free Wi-Fi in the bar and dining areas. Most of the Philippines has reliable cell and data services.

Voltage 220 volts AC 60 Hz; the Philippines has both type A and type C sockets.

Cuisine The only dining option on Sangat is at the resort and they offer three meals a day plus snacks and all-day coffee and tea. Breakfast includes eggs to order, fruit, bread and breakfast meats. Lunch and dinner are global fusion with lots of options and dietary needs can be accommodated.

Transportation Many major airlines fly into Manila. From Manila, there are daily domestic flights to Busuanga (Coron) Airport (USU). From Coron, the resort can arrange van and boat transfer to the island. There is also an overnight ferry from Manila to Coron that takes around 16 hours.

Travel/Visa Citizens from most countries can enter with a free tourist visa good for 21 days. Passports must be valid for six months after arrival. Proof of yellow fever vaccine may be required if coming from countries with yellow fever. See: immigration.gov.ph.

Health & Security The resort makes safe drinking water, which is available in the rooms and at the dining areas. Tap water is not drinkable. Throughout the Philippines, it is not advisable to drink tap water. Sangat Resort states it does not have malaria or dengue, however the mosquitoes that carry dengue virus are present and the Philippines has reoccurring dengue outbreaks, so avoid mosquito bites. Malaria also occurs in certain parts of the Philippines, so check if prophylaxis is necessary. Routine vaccinations are suggested, including measles and typhoid. Although not a problem at Sangat, rabies is common in the Philippines, so be careful of stray dogs and cats. Crime is not an issue at Sangat. In the rest of the Philippines, like anywhere, take sensible precautions. Secure valuables in safes; do not leave valuables in view inside cars or on beaches; be aware of your surroundings. Eat food that is cooked thoroughly. Check with your state department for current travel advisories before your trip.

Decompression chambers Chambers can be found on various islands across the country, in cities such as Manila, Cebu, Batangas City, Cavite, Makati City, Quezon City and Subic.

Websites
Philippines Tourism
experiencephilippines.org

Front Row Seats for

The Third Wave

Text by Simon Pridmore

The Scuba Confidential column in this issue is taken from Simon's book Scuba Exceptional: Become the Best Diver You Can Be.

In his book *Sapiens: A Brief History of Humankind*, historian Yuval Noah Harari traces the path left by *Homo sapiens* as our species spread over the world, causing the extinction of other human species and sub-species, and half of the planet's big beasts. He describes the extinctions as happening in three waves.

The first and most critical wave took place as *Homo sapiens* foragers spread across the continents—causing a mass extinction as they went. Long before the wheel or writing was invented, half of the animal species on earth that weighed over 50kg were gone.

The second wave occurred later, as *Homo sapiens* farmers conquered the rest of the habitable world. The archaeological record of island after island tells the same three-act tragedy. In Act 1, there is a rich population of large animals that has evolved over millions of years. In Act 2, *Homo sapiens* appears in the form of a potshard or a spear point. Act 3 quickly follows, in which all trace of most of the large animals, and many smaller ones, disappear.

The third wave of *Homo sapiens*-induced extinctions is happening now. Large sea animals escaped the first two waves, but they are the main victims of the third. Many are on the brink of extinction, due to the combined consequences of what we *Homo sapiens* are taking out of the oceans and what we are putting into them. This time, the scene is being played out before our very eyes and, as scuba divers, we have front-row seats.

What we are taking out of the oceans

"Where are the big fish?" "Why are there no sharks?" "It's not as good as it used to be." These are common laments aboard dive boats all over the world. Dive sites called Sharks Pit, Barracuda Rock or Jack Point are now completely bereft of the fish after which they were originally

named. Similar complaints abound in the world of sport fishing too. The reason is simple. Advanced commercial fishing technology and the insatiable demand for seafood have led to harvests of fish in quantities that cannot be sustained. We are taking fish out of the ocean at a faster rate than they can reproduce.

Around coral reefs, divers see far fewer animals at the high end of the food chain, such as sharks, tuna and barracuda, or schooling fish like snappers. There are hardly any of the large slow-moving animals like bumphead parrotfish, groupers and Napoleon wrasse left. What do these fish all have in common? People like to eat them.

As divers, we see things that most people do not. We are witnesses to the emptiness of the reefs. To most people, tuna is pink shredded meat that comes out of a can. To us, a tuna is a sleek, mean, silver killing machine. Our vantage point makes it easier for us to understand the seriousness of the situation. You can argue that this also gives us certain responsibilities. Here is a story that illustrates the point perfectly.

Martina was sitting in a seafood restaurant on a beach in Bali. She had just completed a dive trip in the Komodo National Marine Park in Central Indonesia. During the trip, a member of the crew on her vessel had taken an underwater video of a long-line fishing boat operating in park waters. The whole park is designated as a no-fishing zone, but the regulations are poorly enforced, and endemic corruption enables fishing boats to operate in the park with impunity. The video showed sharks, tuna, trevally, barracuda and other large fish struggling or hanging limp on the line, which was several kilometres long, with thousands of hooks on it.

Martina looked at the menu in the restaurant and noticed how many tuna and barracuda options there were. The video was still very fresh in her mind and she remembered how frustrated and powerless she had felt watching it.

"Surely someone can do something about this," she exclaimed at the time, and was horrified to learn that nobody would or could do anything to stop the illegal carnage. She wracked her brains to think of something that she could do about it herself, but all she could come up with was to share the video on Facebook and vent her anger in the comments, even though she knew this would achieve nothing.

It was the menu that gave her the idea of something useful she could do. It occurred to her that the main reason the fishermen caught the fish was to satisfy the huge market for seafood, of which the restaurant she was sitting in was just a small part. "If I eat fish," she thought, "I am part of the problem. If I stop eating fish, then maybe I contribute in some small way to the solution."

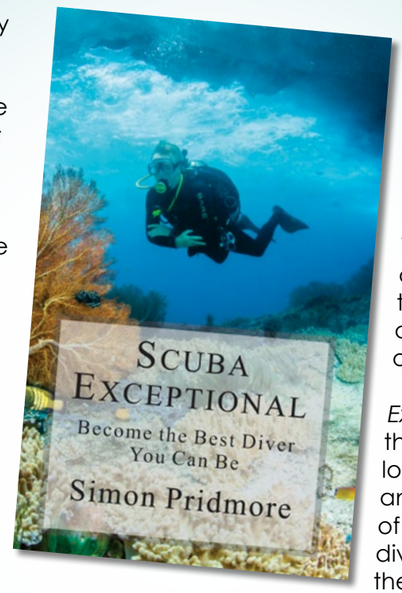
She ordered chicken fried rice.


PIXABAY

A New Book for Scuba Divers!

Scuba Exceptional may be the fifth in Simon Pridmore's *Scuba* series, but it is actually the true follow-up to his first book, the best-selling *Scuba Confidential*.

The philosophy of safer diving through the acquisition of knowledge and skills is the same, although this time the themes are different. As before, Pridmore provides us with a whole host of extremely useful advice and techniques, illustrated by real-life experiences and cautionary tales. The focus this time, though, is more on issues that experienced divers face. There is more technical diving content, and Pridmore covers some relatively complex issues in his usual clear and easy-to-read style. In many cases, the issues that concern technical divers reflect those that affect scuba divers at every level. After all, as Pridmore writes, technical diving is on the same spectrum as conventional sport diving:



It is just a different frequency.

Scuba Exceptional also deals in more detail with the psychological approach to scuba diving, broaching familiar topics from new angles and borrowing techniques and procedures from other areas of human activity.

While most of *Scuba Exceptional* focuses on the diver, it also takes a look at the wider picture and highlights a number of areas where scuba diving professionals and the "industry" as a whole are letting divers down. As always, Pridmore is realistic in his assessments. He may shine a little light on the dark side of the scuba diving world, but he does this in order to illuminate bad practices and encourage change, while offering solutions.

Scuba Exceptional: Become the Best Diver You Can Be by Simon Pridmore is available on: **Amazon.com**.

What we are putting into the oceans

It is not only our hunger for seafood that is destroying life in the oceans. What we put in the oceans has an equally disastrous effect as what we take out of them. Coastal construction releases soil into the water, which smothers coral reefs. Elsewhere, runoff from cultivated land, carried into the ocean by rain or rivers and streams, is an enormous unseen polluter.

The most visible pollution, something that divers see with increasing frequency, is plastic trash, on the surface, in mid-water, stuck on coral outcrops or lying on the seabed. At some dive sites, the trash is ever-present. At others, it is there only at certain times of the year when tides and winds take it from mid-ocean, where it usually circulates unnoticed, and bring it closer to the coast.

Manufacturers produce products and sell them in plastic packaging. Fresh food is presented in supermarkets wrapped in plastic, supposedly on hygiene grounds. The packaging is discarded after purchase. Hardly any of it is recycled, anywhere in the world, no matter which bin we put it in. In some countries that are organised enough, most trash goes into landfills, where it is eventually covered over—out of sight, out of mind. The rest is put on ships and sent away to become someone else's problem.

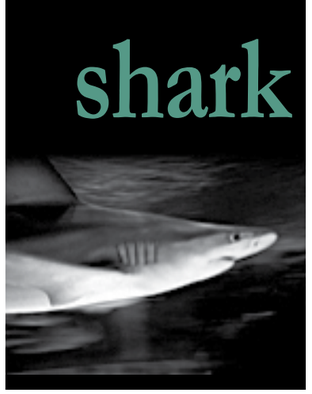
In other countries which are not so organised, trash is dumped in ravines or unsealed dumping grounds and, when it rains, much of it is carried away and eventually arrives in the sea—also out of sight and out of mind for most people, but not for us divers. We see it all too clearly. Our reaction is often one of disgust. "How can they be so irresponsible?" (Note that it is always "they" who are the problem.)

If only it were so straightforward. The plastic water bottle floating on the surface when you came up from your dive just now could be the one you were given in your hotel room the previous week and that you had carefully put in the waste bin. The plastic bag you saw wrapped around the sea fan could be the one that you had put in the recycling bin in your home country several months earlier. The bag subsequently became part of a massive trash shipment, that your country paid to have taken away to another country, but which was instead dumped into the ocean by the carrier vessel en route.

This is appalling, I hear you say. What can we do? The answer is similar to the solution Martina came up with, when she wanted to play a role in reducing the demand for seafood. Wherever we are in the world, at home or away, every plastic bottle, plastic straw, takeaway coffee cup, plastic bag or polystyrene container we use will probably end up in a landfill at best. At worst, it will end up in the sea. So, we can make a difference by not using that bottle, straw, cup, bag or box in the first place. Choose packaging-free and reusable alternatives instead.

After all, if we divers, sitting in our front-row seats, do not do everything in our power to help save the oceans, then what hope is there? ■

Simon Pridmore is the author of the international bestsellers Scuba Confidential: An Insider's Guide to Becoming a Better Diver, Scuba Professional: Insights into Sport Diver Training & Operations *and* Scuba Fundamental: Start Diving the Right Way. *He is also the co-author of* Diving & Snorkeling Guide to Bali *and* Diving & Snorkeling Guide to Raja Ampat & Northeast Indonesia, *and a new adventure travelogue called* Under the Flight Path. *His recently published books include* Scuba Exceptional: Become the Best Diver You Can Be, Scuba Physiological: Think You Know All About Scuba Medicine? Think Again! *and* Dining with Divers: Tales from the Kitchen Table. *For more information, see his website at:* ***SimonPridmore.com***.



Can Commercial Shark Fishing Be Sustainable?

PIXABAY

Text by Ila France Porcher

With the loss of at least 90 percent of sharks worldwide, it would seem to be urgent to protect the ones that remain. Every global study of their status has reported a more dire situation than the last, and that the targeted hunt for the shark fin trade is responsible for their catastrophic depletion. Only one-third of shark species are considered safe, and the most threatened are those accessible to fishing—those within about 1,000m of the surface, or, for seafloor dwellers, 3,000m in depth.

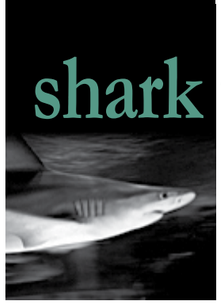
Shark fins are among the most expensive seafood products. The total declared value of the world trade in shark products is close to US$1 billion per year and it is associated with much illegal activity, including murder. To supply the trade, intense shark fishing spans all oceans. Yet, as top predators, sharks have incalculable ecological importance and their removal has grave effects on the ecosystems where they once lived, as the consequences of their absence cascade down through the inter-tangled networks.Yet, those who profit from the shark fin trade continue to promote shark fishing, claiming that it is already widely sustainable, and will be more so. But is this true, or just political promotion by industrial interests?

The fisheries' arguments

Whenever shark fishermen are threatened with the loss of their shark fin profits, they protest. Usually, this involves claiming that if they do not continue to kill the sharks, the animals will soon be out by the beaches, eating people's babies, and this is currently the case in the United States. The strong movement to put an end to the shark fin trade in the United States has resulted in the Shark Fin SalesElimination Act of 2019, which has just been passed by Congress, and is now before the Senate.

But shark fisheries are fighting back, arguing that the shark fin trade should continue for the profit of American fishermen, even claiming that it is good for sharks. Led by coalitions such as the Sustainable Shark Alliance (SSA), which represents shark fishermen, dealers and processors, and those who advocate their views (shark fisheries scientists, lawyers and lobbyists), they promote H.R. 788, the Sustainable Shark Fisheries and Trade Act of 2019, and actually admit that without the profit from shark fins, shark fisheries in the United States will be shut down.

They reason that American shark fishermen fish sustainably, so they should be able to sell their shark fins on the lucrative shark fin market. They promote the idea that if only shark fins from sustain-



Shark Fishing

A large catch of sharks with their fins removed (right); Shark fins, which are the prized ingredient in shark fin soup, considered a delicacy in parts of the Asian community, are shown in a shark conservation display at the Monterey Bay Aquarium (below)

SANDRO LACARBONA / FLICKR / CC BY-NC-ND 2.0

able fisheries are used for shark fin soup, this will put an end to shark finning worldwide, and those countries who continue to practise it will suffer.

However, the numbers reveal that the large market for shark fins in the United States could never be filled by fins from sustainable shark fisheries, for only a few of them temporarily exist.

Fisheries advocates claim that:

- If the shark fin trade is banned, more sharks will be killed, because fishermen will have to catch more sharks to make the same amount of money.
- The fins should be used because of the general principle that the whole shark should be used.
- Sharks are really being killed for meat, not for their fins.
- If American fishermen do not kill the sharks and supply the shark fin trade, "bad actors" will kill them.

But these arguments are not based on science, facts or logic, and rely on political bias and rhetoric. While it sounds like a good idea to import, export and sell products that only come from "sustainable" fisheries, the Sustainable Shark Fisheries and Trade Act of 2019 is completely unrealistic to put into practice.

JASON ROBERTSHAW / WIKIMEDIA COMMONS/ CC BY 2.0

Problems with the Act

The problems of who would set the standard, who would lobby other countries to accept the US evaluation of what is sustainable, and who would monitor the programme, research and pay for it, are all unaddressed. Whether the American public would be willing to finance it through their tax dollars has not been mentioned.

Fisheries governance regimes are very expensive to set up and operate, and the cost varies depending on the type of measures implemented, ranging from scientific advice and management to monitoring, control, surveillance and enforcement. Every country in the world with a shark fishery would need to be lobbied to pass sustainable shark fisheries management legislation. When laws are in place and enough data has been collected to determine what the sustainable catch rates might be for each species caught in every shark fishery, development and funding of management plans would need to be put in place, including staffing, training, purchase of equipment and so on. Then, enforcement plans would need to be developed, implemented and funded. These costs tend to fall on the public sector while the benefits are enjoyed by fishermen.

All that is involved in the Sustainable Shark Fisheries and Trade Act—putting American practices into play on a global scale—would need to be maintained long-term, while somehow requiring every country to keep politics, financial self-interest and corruption (to say nothing of criminality) out of the process.

There is no international body that can force sovereign countries to do anything on this scale. Some countries, especially those with large fisheries, have consistently been resistant to controls on fishing based on scientific data.

Europol reported in 2018 that illegal fishing of tuna was twice that of legal fishing in the Atlantic. If it is not possible to effectively manage a species for which there is probably more data than any other, the idea that the United States will create sustainably managed fisheries for all 500 shark species (and all fish species) throughout the entire world is absurd.

Conflict with WTO agreements

Furthermore, World Trade Organization (WTO) agreements require that no country can favour the imports of one nation over another, nor ban imports of a product while still locally producing and exporting the product. The Sustainable Shark Fisheries and Trade Act would appear to be in direct violation of those agreements, and fisheries advocates have not stated how the United States will get around this.

Misleading US shark fin records

To complicate matters, the United States itself obfuscates its records of its involvement with the shark fin trade. It records trade in dried shark fins only, under just one commodity code, while its exports of raw, frozen shark fins are classified as meat. Thus its official records are very misleading, so that fisheries advocates can easily make the case that the country scarcely contributes to the shark fin trade.

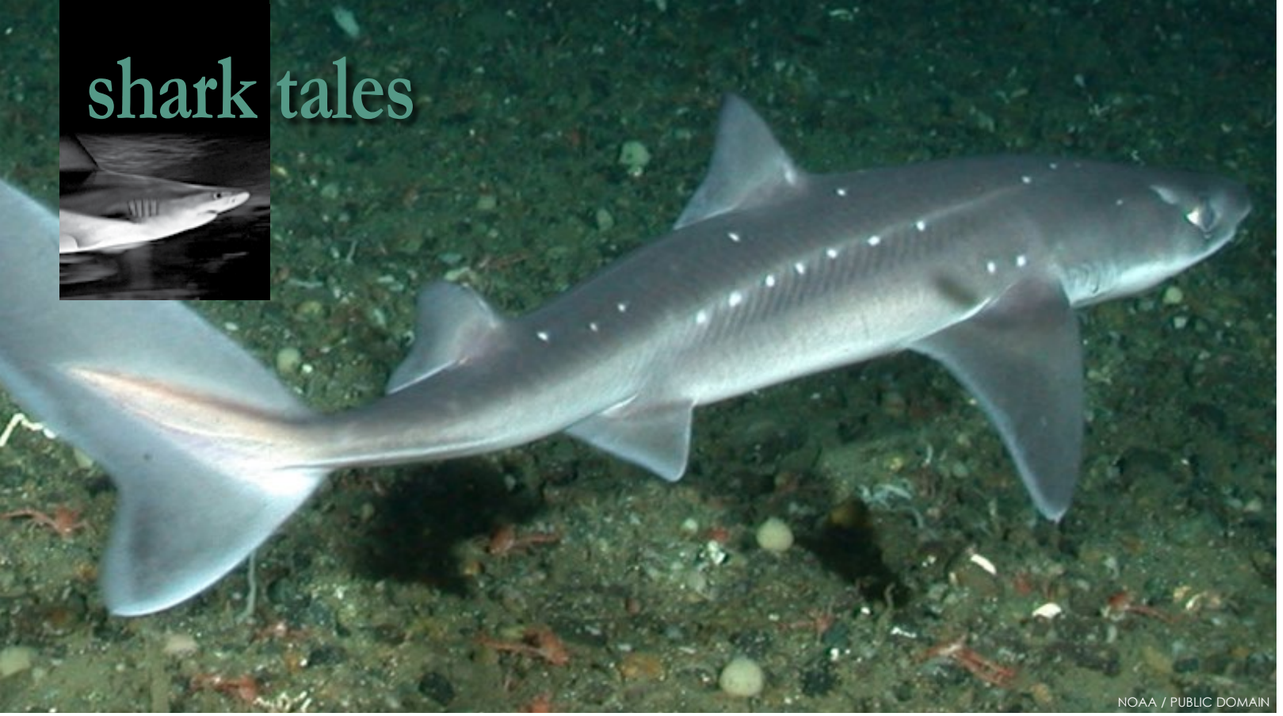
However, other countries have reported exporting large amounts of shark fins to the country. In 2007, for example, other countries reported exporting 1,012 metric tons of shark fins to the United States, 35 times the figure of 28.8 metric tons reported by National Oceanic and Atmospheric Administration (NOAA).

At least several hundred tons of shark fins are consumed annually in the United States, and imports have been rising each year, in spite of the bans in such major centres as California and New York. Ninety-three percent of imports enter through the Los Angeles customs district, and in 2017, one-third of species traded in the Hong Kong shark fin market (the central Asian market for fins) was found to be threatened with extinction.

Replacing fish with sharks

An examination of the best global scien-

shark tales



Spiny dogfish produce fewer young per pregnancy and live longer than other sharks.

tific studies reveals that no shark fishery serving the shark fin market is sustainable. The markets for shark fins and shark meat have always been separate, and involve different species. Those currently considered sustainable are only a few that have targeted sharks for meat, in Australia and the United States. However, they are now being propped up by the value of the sharks' fins and their long-term viability is questionable.

Sharks have become so valuable that they are now sought only for the money for their fins, producing a surplus of meat on the market.

For example, the spiny dogfish fishery, on the US Atlantic coast, is currently considered one of the most notable sustainable shark fisheries. The meat is sent to Europe and the fins to Asia. This fishery markets shark meat as a replacement for cod, the once plentiful fish from that region which is now gone. Since there is little market for shark meat in the country, the meat is sold under different names, such as "rock salmon."

But the stock of spiny dogfish in the western Atlantic Ocean shows wide fluctuations. It collapsed in the 1990s, and NOAA and the US Department of Commerce declared it to be rebuilt in 2010. However, globally, the species is listed by the International Union for Conservation of Nature (IUCN) as being vulnerable to overfishing, and the spiny dogfish is critically endangered just across the Atlantic Ocean. Therefore, the population off the US East Coast is unlikely to be stable, either.

Dogfishes, like other species in the deep, cold waters of the northern continental slopes, have relatively low productivity. They produce fewer young per pregnancy and are longer lived than many other shark species. The bio-accumulation of mercury in their body tissues is greater too, making this shark highly questionable as a choice to offer on the market as food.

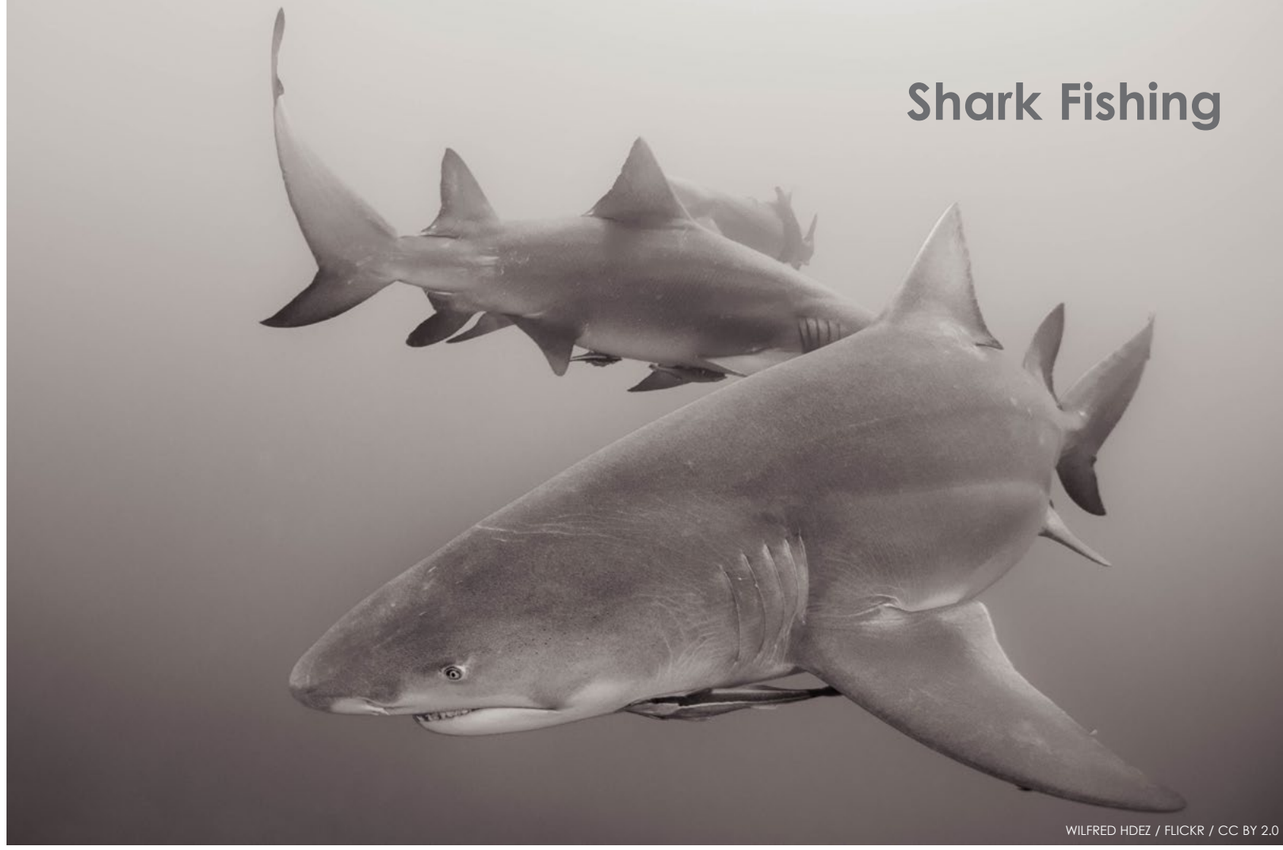
Fisheries' failures

Global analyses have shown that the level of threat to sharks through overfishing is usually greater than what is predicted by the fisheries' assessments. Such local assessments can underestimate the risk of collapse of global stocks of any given species, and have often caused such a collapse.

For example, sharks are already extinct at St. Paul's Rocks, where no carcharhinid reef sharks have been seen in past decades, though they were formerly plentiful. Such local extinctions are the warning signs of fisheries management failure and are the first steps on the road to global extinction.

What becomes evident in the current political situation in the United States, in which shark fishing advocates are lobbying hard for the perpetuation of the shark fin trade, is that American fisheries are focusing on sharks with the intention of profiting from their fins, while the over-abundance of shark meat in the market is being

Lemon sharks (right and below)



Shark Fishing

WILFRED HDEZ / FLICKR / CC BY 2.0

used in everything possible from makeup to dog food.

American fisheries' current policy of taking the top predators, now that they have depleted the fish, is ecological folly. Shark production is much lower than fish production, and if these industrial interests have their way, sharks will soon go the way of cod and many other species that they have fished out.

Fishing effort must lessen

Two World Bank studies, *The Sunken Billions* (2009) and *The Sunken Billions Revisited* (2017), have found that unsustainable fisheries management practices have led to globally depleted fish stocks that produce US$83 billion less in annual net benefits than would otherwise be the case. Ninety percent of fisheries are overexploited. To address this global crisis, the main requirement is that the fishing effort is diminished, while at the same time, fish stocks must be rebuilt, and coastal ecosystems returned to a state of health.

These studies specify that little is known about the actual carrying capacity of most fish stocks that are subject to commercial exploitation, and that fisheries' data are often highly uncertain.

The Sunken Billions predicts that social unrest will result from the necessary reduction of fishing effort that must come, because some fishermen will have to turn to other occupations. So, the current outcry from the shark fishing industry has been predicted, and is understandable, but indefensible. The World Bank recommends that the fishing subsidies that have facilitated overfishing in the past be used to ease this social transition.

Only their fins are wanted

When only the fins of the shark are valuable, and you apply the wise adage to use the whole animal, the question becomes not "what do you do with the fins," but "what do you do with the rest of the shark?"

Texas recently passed a law that required that all dead sharks shipped through the state have their fins naturally attached, so that the fishermen lost the profit from the sale of the fins. This income loss effectively closed down the Western Gulf of Mexico shark fishery in 2019, revealing the degree to which the shark fin market drives shark fisheries.

VGM8383 / FLICKR / CC BY-NC 2.0

In Costa Rica and other South and Central American countries, sharks were considered undesirable and were not used for food prior to the 1980s. Then, the inflated price of shark fin resulted in sharks from a wide variety of habitats being targeted for their fins alone. The "fins attached" policies obligated fishermen to land fins attached to the bodies. So, the shark fin industry's surplus meat was put on the market for domestic consumption, resulting in merchants pushing the meat on local consumers and relying on the use of various other names to sell it. Now, Costa Ricans alone are consuming about 2,000 tons of shark meat a year and the situation is similar in many other countries.

This is a problem with mandating a "fins attached" policy: it does not properly address overfishing. Worldwide, the tendency now is less discarding of the body of the shark, but without a lessening of mortality.

Toxic meat

The problem with loading shark meat into the local markets is that it is poisonous. For example, the Florida Fish and Wildlife Conservation Commission's fishing rules specify a minimum size limit of 54 inches for about half of the shark species caught. At the same time, Florida's Fish Consumption Advisories recommend that no species of coastal shark longer than 43 inches should ever be eaten by anyone. Thus, fishermen are specifically advised to catch large sharks, which are breeding females, and are too toxic to eat.

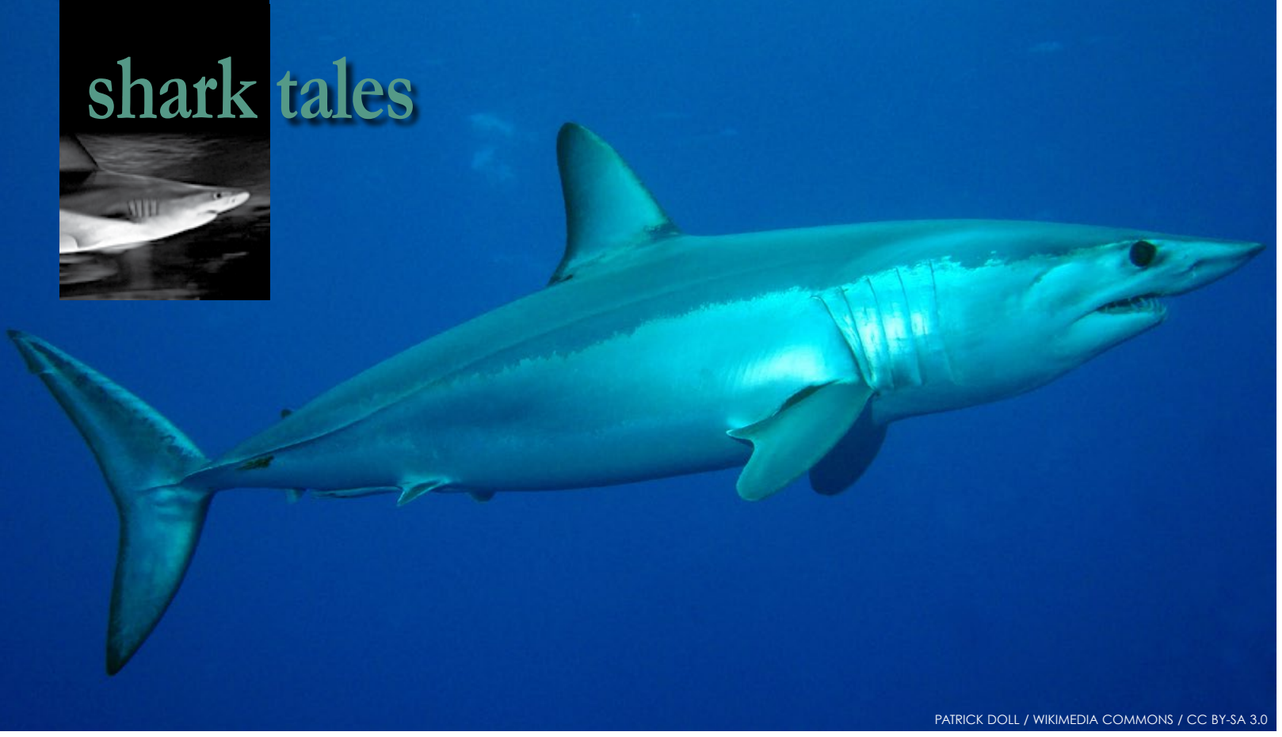
This makes it clear that large species such as lemon and tiger sharks are being killed only for the value of their fins. Thus, fisheries interests lobbying for the perpetuation of the shark fin trade are targeting an animal that is too toxic to eat, and is globally threatened, for the benefit of relatively few industry employees.

Problems with sustainability

While the idea of sustainability sounds good, the facts as found by the best science simply do not support the notion that sustainable shark fishing is possible to put into practice long-term. The scientific studies done to research the matter have revealed how few such fisheries are.

To begin with, pirate fishing takes one-fifth of the total fishing revenue. Twenty-six million tons of catch are thought to be taken illegally each year by pirate industrial-scale fishing, and there is no effective authority to police international waters.

Secondly, the documented shark fin trade shows that fisheries' assessments have underestimated the numbers of sharks being killed by at least 400 percent, another



PATRICK DOLL / WIKIMEDIA COMMONS / CC BY-SA 3.0

The shortfin mako shark (left and below), which was once considered sustainably fished, is now listed as "Endangered" by the IUCN.

Shark Fishing

illustration of the unreliability of fisheries' data.

Furthermore, only a small fraction of the shark fin trade is documented. Most fins are imported from Asia where they have been sourced from many shark-hunting nations, most of which do not keep species-specific catch statistics, so are impossible to trace.

Then, there is the problem of by-catch. The quantities of most shark species taken as by-catch are not recorded, so some species can be at high risk of depletion without this being recognised.

The inherent uncertainties

For a fishery to be sustainable, shark fishing mortality must be equal to, or lower than, the number of dead sharks that make up the "maximum sustainable yield." But in the case of sharks, those reference points are often not known or are very uncertain. The global studies done on shark depletion have emphasised the problems inherent in assessing the true situation, providing detailed descriptions of the difficulties at every level.

For example, in 2015, the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean analysed shortfin mako stocks using the most complete data available but it found that due to missing information, untested indicators and conflicts in the available data, the assessment was impossible to make at all.

The shortfin mako was assessed on the IUCN Red List in 2000 as being "Lower Risk/Near Threatened," and in 2009, it was reclassified as "Vulnerable."

Yet in 2017, the shortfin mako fishery in the North Atlantic Ocean was reported in a scientific journal to be a “bright spot” of sustainable shark fishing and was used by fisheries’ advocates to promote the idea that sustainable shark fisheries exist “all over the world” and that most other shark fisheries can be made sustainable too, with the United States in the lead. But in that same year, the stock assessment on the NOAA Fisheries website showed that this shark was overfished and that overfishing was occurring.

The IUCN then re-classified the shortfin mako from "Vulnerable" to "Endangered" worldwide, with a decreasing population trend. But it was not until 2019 that US fisheries began working on a management plan and urged fishermen to reduce catches voluntarily in the meantime.

Thus, fisheries management in the United States, which claims to be the best in the world, allowed this species to go from "Lower Risk" to "Vulnerable" to "Endangered" in less than 20 years, with no conservation action. It became clear that the "sustainable shark fishery" management approach was not working to maintain shark populations.

Then, at the annual meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT), the United States, along with the European Union, blocked protections for the North Atlantic shortfin mako shark put forth by ten other countries, effectively demonstrating the hollowness of American claims about how it is making shark fishing sustainable.

It is thought by ICCAT scientists that the population of shortfin makos in the North Atlantic could take 50 years to recover, even if fishing is stopped completely. Like other cold-water sharks, shortfin makos are slow-growing and so are especially vulnerable to overfishing. They are killed for sport as well as for their meat and fins, and though they are fished by many nations worldwide, they are not subject to international fishing quotas.

Using them as an example of "sustainable shark fishing" has been highly misleading.

CITES protection

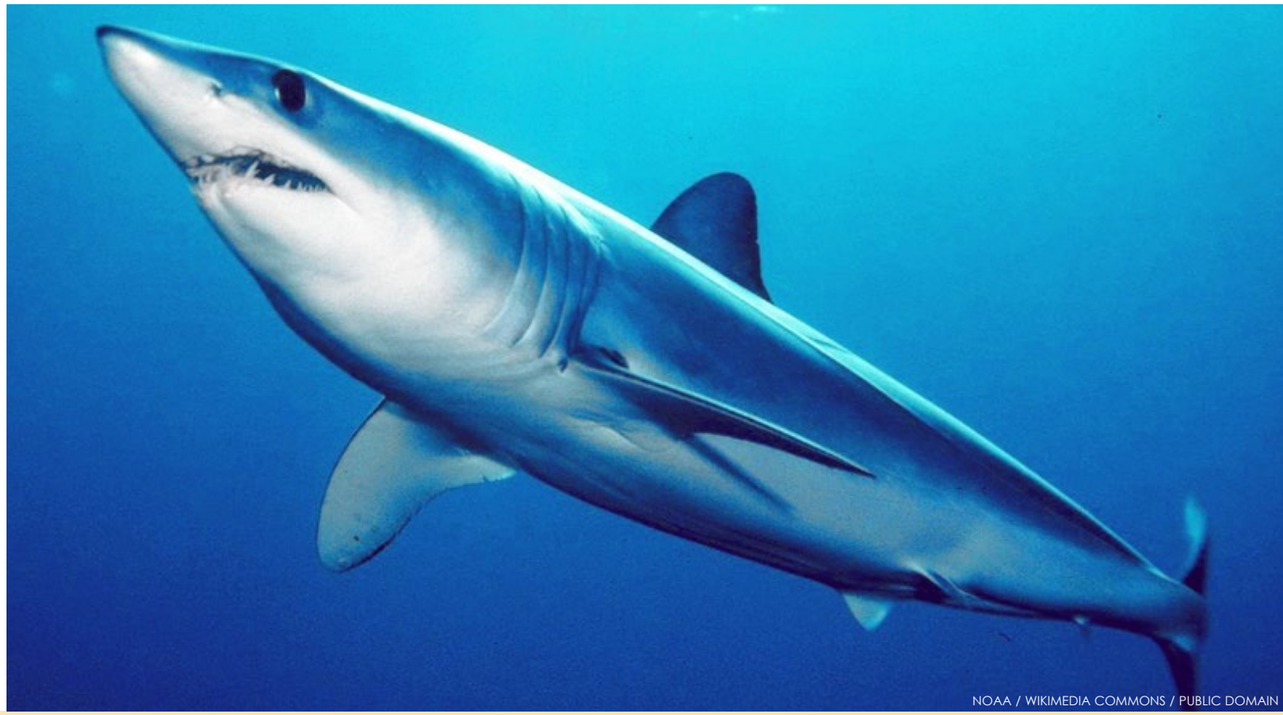
Listings by the Convention on International Trade in Endangered Species (CITES) are currently the only protection available for sharks. But in practice, such a listing only protects the animal from exportation, not from being fished in the first place. Protecting an animal with high market value is extremely difficult and such listings are opposed by shark hunting nations due to the high commercial value of the fins, so increasing effort is required to obtain them. Protection must be gained one species at a time, and only a few species are currently listed, while the shark fin market demands fins from all species.

Once separated from the shark, it is difficult to determine from which species any given fin has been taken, so enforcement is weak. Furthermore, the only protection granted by a CITES listing is the need for a "Non-detrimental" finding before the fins can be exported. This often undermines the protection originally intended for the species by the CITES listing.

Conclusions

Given that sharks have already been depleted by at least 90 percent, the question arises as to how anyone can talk about continuing their slaughter and calling it sustainable. How low do their numbers have to fall before it will become self-evident that we have already lost far too many?

Sharks reproduce much more slowly than fish. While fish lay thousands of eggs, sharks are more like mammals. Female sharks take many years to reach reproductive age, then give birth to just a small number of offspring every one or two years. When fish stocks are commercially exploited, the most valuable stocks and larger individuals are targeted



NOAA / WIKIMEDIA COMMONS / PUBLIC DOMAIN

PIXABAY / PUBLIC DOMAIN

first. With this pattern applied over decades, global marine catches over time have comprised an increasing proportion of juvenile sharks, while the breeding adults are vanishing.

Sharks have high importance ecologically due to radial evolution into new vacant niches in the aftermath of several planet-wide extinctions. As a result, they are interwoven throughout the world's aquatic ecosystems. As large animals at the top of the food chain, their removal is causing whole ecosystems to collapse. Furthermore, due to the continuously increasing human population, the pressure upon them is likely to grow more intense as the years pass.

A variety of indicators show an accumulation of extinction risk throughout the oceans as a result of many decades of overfishing. These are complicated by the effects of climate change—the melting icecaps, the changes in major oceanic current systems, ocean acidification, coral death, warming waters and rising sea levels. Along with industrial and plastic pollution, these changes pose serious threats to marine life, including sharks. The World Bank's recommendation that fishing effort be reduced to a point that allows the healthy recovery of coastal ecosystems, including their top predators, should be adopted until, with careful management and the allocation of many more Marine Protected Areas, the oceans regain a state of ecological stability.

Priority should be given to local fishers who depend on the sea for their protein. Western consumers, who are already eating too much protein, would just choose something else if fish was not on the menu. These are wild animals, and with the human population already so bloated, and growing fast, no wild animal should be expected to support us.

For these reasons, no large-scale shark fishery is going to prove sustainable in the long-term. If history has taught us anything, it is that no species can stand up to sustained, targeted, commercial killing—not whales, not turtles, not fish, and not sharks. At the very least, sharks should be given the same protection now granted to sea turtles—complete protection from international trade. ■

Ila France Porcher, author of The Shark Sessions *and* The True Nature of Sharks, *is an ethologist who focused on the study of reef sharks after she moved to Tahiti in 1995. Her observations, which are the first of their kind, have yielded valuable details about their lives, including their reproductive cycle, social biology, population structure, daily behaviour patterns, roaming tendencies and cognitive abilities. See:* ***ilafranceporcher.wixsite.com/author.***

Blacktip reef sharks

Shark Fishing

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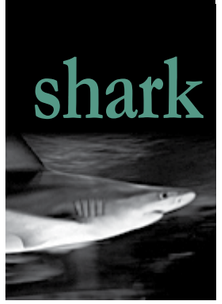
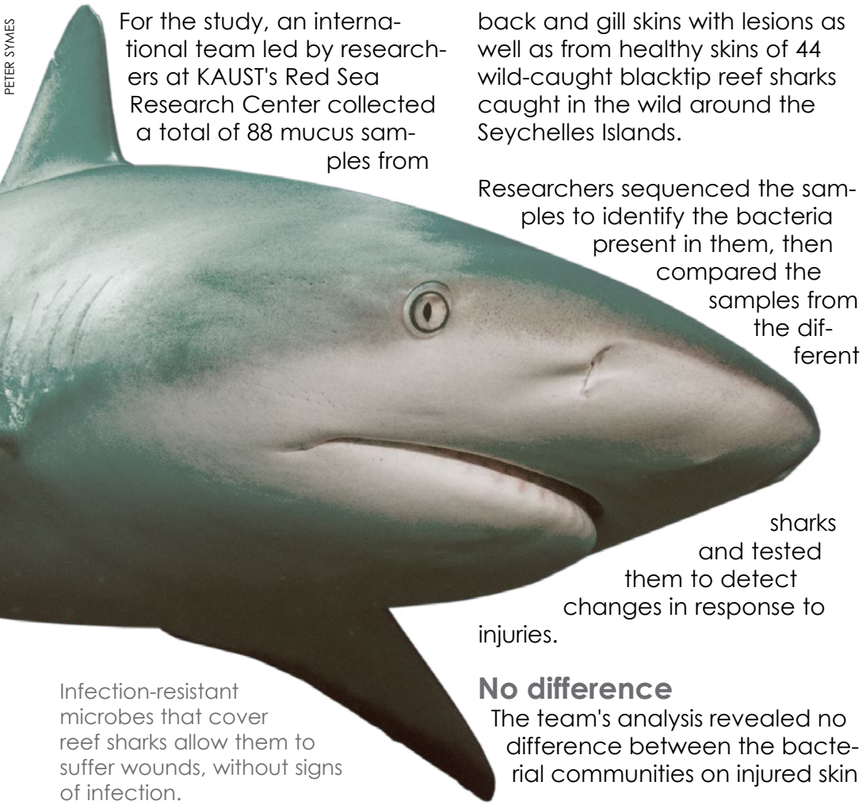


Blacktip reef sharks are often observed with deep open skin injuries.

CLAUDIA POGOREUTZ, ET AL

Bacteria behind the remarkable resilience of shark wounds to infection

While sharks can often be seen with open wounds in the wild, it is quite rare to see obvious signs of infection on them. Clearly, shark skin harbours properties that prevent infection, so shark researchers set out to investigate the possible contribution of the sharks' skin bacterial community to the ability to heal fast.



PETER SYMES

Infection-resistant microbes that cover reef sharks allow them to suffer wounds, without signs of infection.

For the study, an international team led by researchers at KAUST's Red Sea Research Center collected a total of 88 mucus samples from back and gill skins with lesions as well as from healthy skins of 44 wild-caught blacktip reef sharks caught in the wild around the Seychelles Islands.

Researchers sequenced the samples to identify the bacteria present in them, then compared the samples from the different sharks and tested them to detect changes in response to injuries.

No difference

The team's analysis revealed no difference between the bacterial communities on injured skin on gills and uninjured gills or backs. In other words, there was no evidence of infection around the wounds. "We were surprised not to find any substantial change in the skin bacterial communities," said Claudia Pogoreutz, the postdoctoral fellow who led the study.

There were differences discovered in sharks in different locations, Pogoreutz continued, noting it could be from any number of factors.

"The differences in shark skin microbial communities may reflect differences in the ambient environment, such as temperature, population density, nutrient availability or pollution, but we cannot rule out the possibility that the changes could provide an adaptive benefit to the sharks," Pogoreutz said. "There's still so much to learn with respect to shark skin-associated bacteria." ■

SOURCE: ANIMAL MICROBIOME

Shark-proof wetsuit in the making

Scientists have developed a wetsuit that could protect swimmers from fatal shark attacks. The suit, is designed to reduce blood loss—the main cause of death in shark attacks.

Researchers at Flinders University in Adelaide have has been developing and testing a new type of neoprene—the synthetic rubber commonly used in wetsuits—against the force of a bite from several species, including the great white shark. The new material aims to reduce cuts and punctures from a shark attack, thus lessening blood loss for victims. The suits are also made from fabric that is thicker than a typical wetsuit.

"We are cognisant that it will not prevent all injuries as it will not prevent fractures or crushing injuries," associate professor Charlie Huveneers told AFP.

"When a shark bite occurs, it can have severe physical, mental, social and economic consequences. It is therefore important to keep developing new means of reducing shark bite risks and ensure the efficacy of such new products."

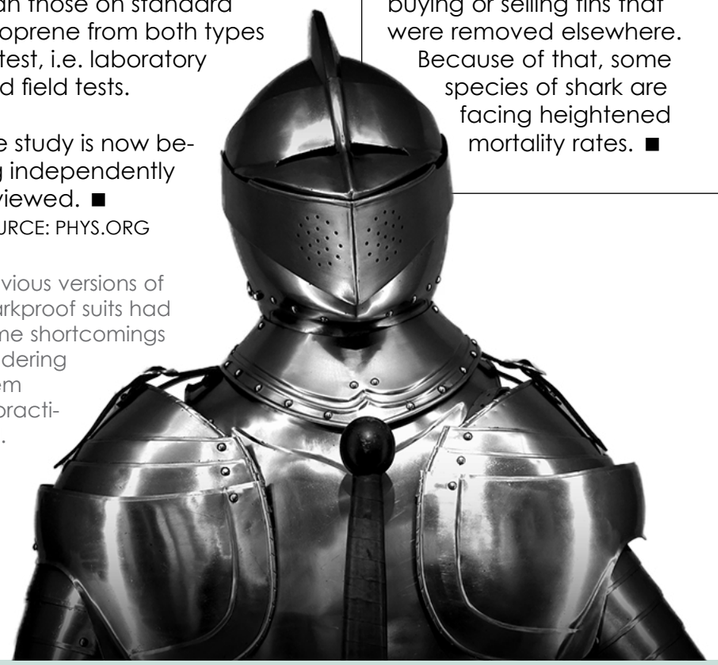
The suit's efficiency was studied in shark-infested waters off the coast of South Australia. "We tested the fabric on white sharks because it is the species responsible for the most fatalities from shark bites."

The tests included 10 variants of two different fabrics using two laboratory tests, puncture and laceration tests, along with field-based trials involving white wharks measuring 3 to 4m. The results showed that both fabrics tested may provide some protection against shark bite and could be used as part of a shark bite mitigation strategy.

The new neoprene was tested against standard materials commonly used by surfers and divers, with findings to be released later this year. "More force was required to puncture the new fabrics compared to control fabrics (laboratory-based tests), and cuts made to the new fabrics were smaller and shallower than those on standard neoprene from both types of test, i.e. laboratory and field tests.

The study is now being independently reviewed. ■

SOURCE: PHYS.ORG



PIXABAY

Previous versions of sharkproof suits had some shortcomings rendering them impractical.

US Congress passes bill banning sale of shark fin

The Shark Fin Sales Elimination Act was passed by the United States House of Representatives by a vote of 310 to 107. The bill prohibits the import, export, possession, trade and distribution of shark fin and products containing shark fins in the country.

The act of shark finning and possession of shark fin aboard a vessel is currently prohibited in US waters under the 2010 Shark Conservation Act, but this law does not stop domestic trade. While it prevents removing a shark's fins on ships in US waters, it does not prevent people from buying or selling fins that were removed elsewhere. Because of that, some species of shark are facing heightened mortality rates. ■

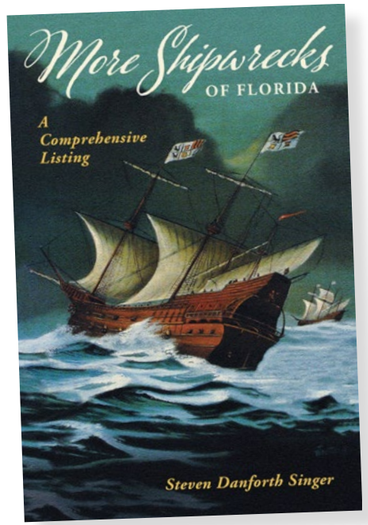
media

Underwater Archeology

In the Footsteps of Honor Frost: The life and legacy of a pioneer in maritime archaeology, by Lucy Blue

This book details the achievements of maritime archaeologist Honor Frost, who left a rich legacy through her research in the eastern Mediterranean on the remains of ports and harbours, sea-level change, shipwrecks and ship construction, and ancient anchors. It also gives a point-in-line assessment of ongoing projects in the region—which are in effect a continuity of her work—thereby giving readers an insight into the development of maritime archaeology from its infancy to the present. Two seminal articles are included, on Frost's life before she became a maritime archaeologist and an overview of her maritime archaeological career.

Hardcover: 300 pages
Publisher: Sidestone Press
Date: 10 December 2019
ISBN-10: 9088908311
ISBN-13: 978-9088908316

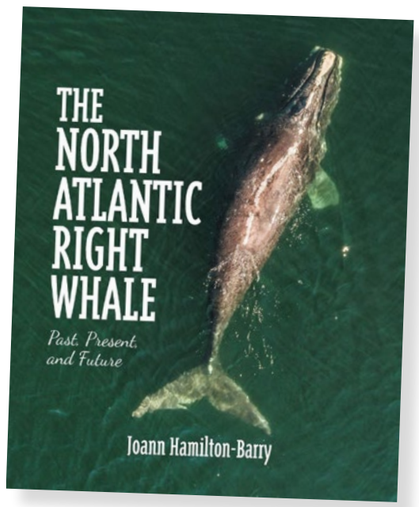


Shipwrecks

More Shipwrecks of Florida: A Comprehensive Listing, by Steven Danforth Singer

Meant as an accompaniment to the second edition to *Shipwrecks of Florida*, this book details more than 1,500 shipwrecks not previously listed, as well as additional information about many of the shipwrecks described in the first edition. This new edition also has GPS coordinates and more information on Florida's maritime history, together with tales of pirates, privateers, wreckers, and buried and sunken treasure.

Paperback: 544 pages
Publisher: Pineapple Press
Date: 2 December 2019
ISBN-10: 1683340264
ISBN-13: 978-1683340263

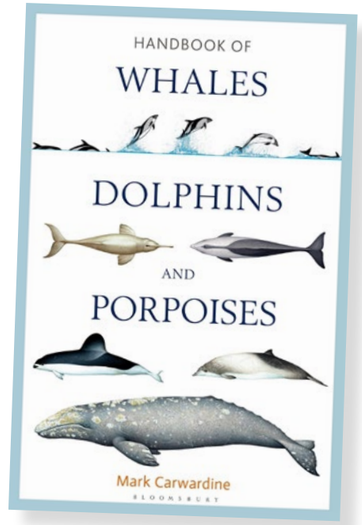


Right Whales

The North Atlantic Right Whale: Past, Present, and Future, by Joann Hamilton-Barry

Come face to face with one of the world's largest whales. Although conservation efforts in the late twentieth century enabled the North Atlantic right whale to recover from near-extinction status in the 1950s, commercial fishing-related deaths and the loss of at least 17 individuals in summer 2017 made the species critically endangered. This book contains information on the species' history, biology and behaviour, as well as the threats they face and how readers can help.

Paperback: 104 pages
Publisher: Nimbus Publishing
Date: 20 November 2019
ISBN-10: 177108748X
ISBN-13: 978-1771087483

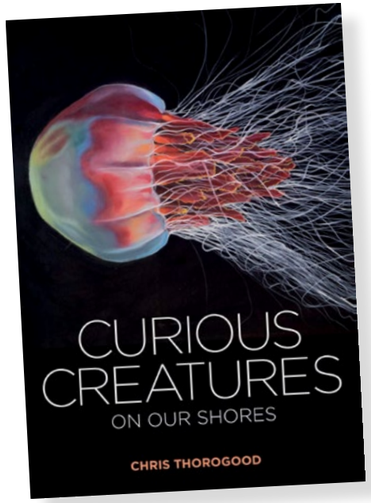


Cetaceans

Handbook of Whales, Dolphins and Porpoises, by Mark Carwardine

Be sure to pack this compact book on your next whale-watching trip. Covering every species of cetacean in the world, it features a comprehensive series of identification illustrations coupled with comparison plates, diagrams of dive profiles and typical spout shapes. The book also contains maps and photographs, as well as tips to facilitate identification when in the field.

Hardcover: 416 pages
Publisher: Bloomsbury Wildlife
Date: 19 November 2019
ISBN-10: 1472908147
ISBN-13: 978-1472908148



British Critters

Curious Creatures on Our Shores, by Chris Thorogood

Is there anyone among us who does not like walking along the beach on a lazy afternoon? Ethereal moon jellyfish pulsating in the current, baby sharks hatching from mermaids' purses, strands of seaweed in a rock pool… who knows what one may discover? Inspired by the Oxford University Museum of Natural History's zoology collections, this book contains oil paintings of more than 50 marine organisms found on British coasts, such as seahorses, starfish, sea potatoes and sea lemons.

Hardcover: 128 pages
Publisher: Bodleian Library, University of Oxford
Date: 30 November 2019
ISBN-10: 1851245340
ISBN-13: 978-1851245345

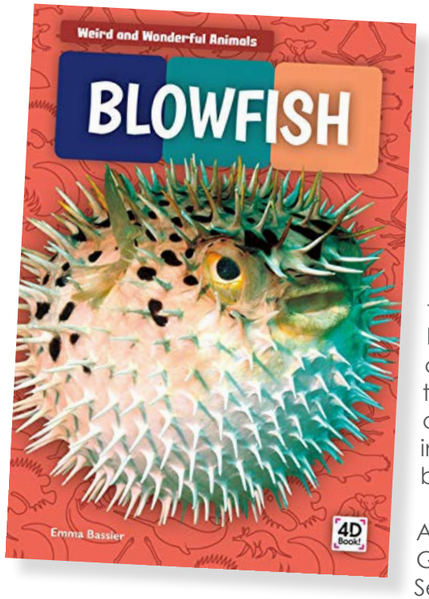
New Books for Kids

Deep-Sea

Deep-Sea Creatures, by Roxanne Troup

Ever heard about fishes with transparent heads? Or worms that look like tubes of lipstick? These strange creatures are just two of the animals that call the deep ocean home. It is a place without any light at all, but many animals live here, in complete darkness. This book explains how they do it, and adapt as hunters, farmers and even deep-sea recycling centres. Besides learning fun facts, readers also find out the importance of exploring and protecting the oceans.

Age Range: 10 - 13 years
Grade Level: 5 and up
Series: Creepy, Kooky Science
Paperback: 48 pages
Publisher: Enslow Publishing
Date; 15 December 2019
ISBN-10: 1978513712
ISBN-13: 978-1978513716

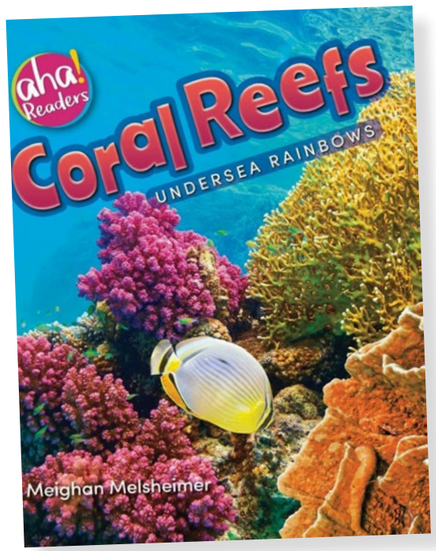


Blowfish

Blowfish, by Emma Bassier

Say hello to the blowfish, a strange-looking round fish that looks more at home rolling around on the seabed, rather than swimming in the ocean. Why does it have so many spikes and how does it survive underwater? This book tells you all that, relating information about its habitat, adaptations and life cycle, alongside colourful photos, fun facts, Making Connections questions and easy-to-read text. The book also contains an infographic, glossary and index, as well as QR codes that lead readers to book-specific resources to further their learning.

Age Range: 7 - 10 years
Grade Level: 2 - 3
Series: Weird and Wonderful Animals
Library Binding: 32 pages
Publisher: Discoverroo
Date: 15 December 2019
ISBN-10: 1532166044
ISBN-13: 978-1532166044

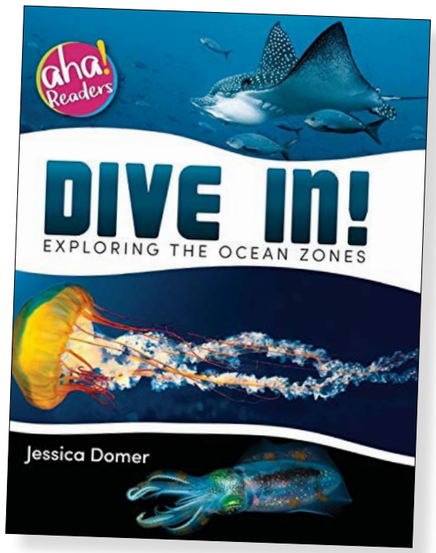


Coral Reefs

Coral Reefs: Undersea Rainbows, by Meighan Melsheimer

Close your eyes and imagine a bright, beaming rainbow underwater, with colourful fish swimming around it. This is what a healthy coral reef looks like. This book tells readers all about coral reefs and the marine animals that live there. Readers can also learn about how corals grow and why they are colourful, as well as coral bleaching, the importance of corals and how to protect them.

Age Range: 5 - 8 years
Grade Level: Kindergarten - 3
Series: Aha! Readers
Hardcover: 20 pages
Publisher: Bealu Books
Dates: 15 November 2019
ISBN-10: 1734106522
ISBN-13: 978-1734106527



Ocean Zones

Dive In!: Exploring the Ocean Zones, by Jessica Domer

Do you know that the ocean has a top, middle and bottom layer? These are what the grown-ups call the sunlit zone, twilight zone and midnight zone. Different types of plants and animals live in the three zones. This book tells you more about them, as well as the natural processes (like adaptation, photosynthesis, camouflage, bioluminescence) that help the plants and animals in the ocean to survive underwater.

Age Range: 5 - 8 years
Grade Level: Kindergarten - 3
Series: Aha! Readers
Hardcover: 20 pages
Publisher: Bealu Books
Date: 15 November 2019
ISBN-10: 1734106514
ISBN-13: 978-1734106510

Edited by Rosemary E. Lunn and Peter Symes

POINT & CLICK ON BOLD LINKS

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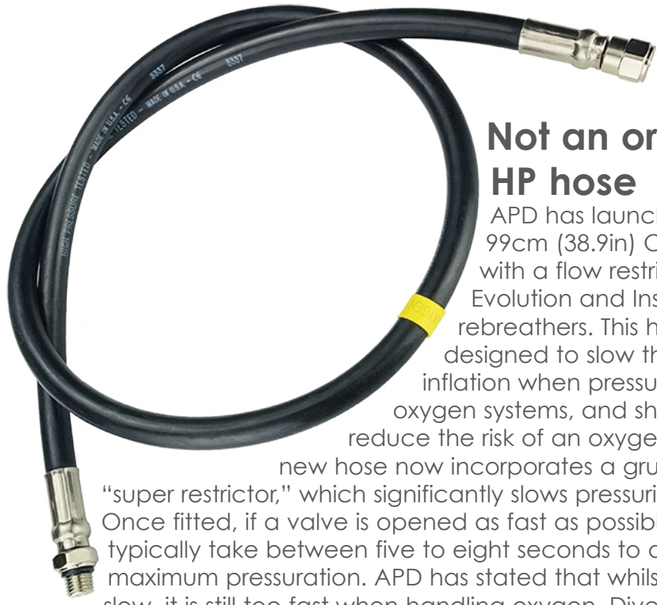
Equipment

Leg3nd

"The Legend 3 regulator is a full redesign of our famous Legend franchise," Aqualung writes, about its new top-end regulator, which was unveiled at DEMA 2019. The regulator is aimed at extreme diving. The first stage has an over-balanced diaphragm and comes with a redesigned heat exchanger, with a 70 percent larger surface. The second stage has been optimised for minimal work when breathing and comes with a "soft touch control" of the venturi switch. The Leg3nd will be released for sale on 10 January 2020. **Aqualung.com**

Light Monkey BAF

It would seem that Light Monkey's BAF 4,000-Lumen strobe is aptly named. This "bright as …" compact strobe has a depth rating of 150m (500ft) and a 480-minute burn time. It looks as though it will not flood, because you do not need to open this lightweight unit 400g (9oz) to charge the 28.75wH / 2.6aH Li-Ion battery. The on/off rotary switch is magnetic, and it has a lockdown screw. According to Light Monkey, divers are strapping this rugged strobe to their arms when they are doing low-visibility ice diving on DPVs, because it means other divers can keep track of them. **Lightmonkey.us**



Not an ordinary HP hose

APD has launched a 99cm (38.9in) O_2 HP hose with a flow restrictor for its Evolution and Inspiration rebreathers. This has been designed to slow the rate of inflation when pressurising HP oxygen systems, and should help reduce the risk of an oxygen fire. The new hose now incorporates a grub-screw "super restrictor," which significantly slows pressurisation. Once fitted, if a valve is opened as fast as possible, it will typically take between five to eight seconds to achieve maximum pressuration. APD has stated that whilst this is slow, it is still too fast when handling oxygen. Divers are reminded that they should always observe good practice when handling oxygen, i.e. pressurise an oxygen system extremely slowly at all times. **APDiving.com**

Waterproof D3

Waterproof states that the D3 Ergo is made from a special trilaminate that is soft and durable, and "the best lightweight fabric". (A men's medium suit weighs 4.1kg or 9lb). The D3 Ergo is derived from a military suit; hence, it comes in "Drab Olive" and black, and has been designed for unrestricted movement above and below the water. There should be less drag and unnecessary air migration—it is slim-cut around the torso and the legs—and the waist, at the back, has been elasticated. The soft rubber seals are taped, and it has exchangeable silicone seals and two cargo leg pockets. A relief or pee zip comes standard on the men's suit. The D3 Ergo comes in eight men's sizes and seven women's sizes. **Waterproof.eu**

Scubajet

The new Scubajet Pro is equipped with the latest generation of lithium-ion batteries and is 30 percent more efficient, Scubajet writes. The operational depth has been increased by 50 percent to 60m. The SJ Pro 200 and SJ Pro 400 models offer up to two and four hours of runtime respectively. The newly developed Dive Controller PRO Dual Hand is provided with a 2.4-inch LED display, which shows information like diving depth, remaining battery runtime, power rating and water temperature. **Scubajet.com**

Hydroid Aquabreather

The Russian Hydroid Aquabreather turned heads at DEMA 2019, which is no bad thing, since it just might inspire the genesis of a future innovative product. But my hunch is that the radical breathing helmet is vapourware, despite claims that one can dive it "up to 42m (137ft)" for "at least an hour." The physics, chemistry and physiology just do not stack up. The manufacturer states that one installs two replaceable regenerative cartridges of potassium superoxide in the helmet. These metal cans apparently absorb carbon dioxide and generate oxygen. Now, we all know that diving equipment may leak—that water tends to get into any breathing apparatus. Why do I write this? Because when water is combined with potassium superoxide, there is a dangerous explosive reaction and a very caustic solution of potassium hydroxide is formed—and that is *before* we start talking about hypercapnia, hyperoxia and hypoxia. **Aquabreather.com**

For the Love of Diving

— Interview with Cave & Technical Diving Instructor Marissa Eckert

Text by Michael Menduno
Photos courtesy of Marissa Eckert

Thirty-four-year-old Marissa Eckert is a passionate full-time cave and technical diving instructor who co-owns Hidden Worlds Diving in Fort White, Florida, USA, with her partner, James Draker. When she is not teaching, Eckert enjoys traveling all over the world, exploring new places, hiking through the jungle and doing challenging new dives that help her grow and learn as a diver. *X-Ray Mag* caught up with Eckert this fall at the beginning of Cave Camp in Tulum, Mexico, where she was one of the featured instructors.

X-Ray Mag: What inspired you to become a diver?

ME: Honestly, I grew up in Pennsylvania and I have always been obsessed with traveling and seeing the world. So, when I went to the Maldives on vacation, I decided that I wanted to try scuba diving. I set up a "Discover Scuba" where we just walked off the beach and dived in the lagoon. I got so excited, the minute we got out of the water, I decided right then and there that I wanted to become a scuba instructor.

From that moment, I knew I wanted to share that experience with as many people as I could. Ha! When I saw underwater caves for the first time, I thought, "Oh, my God! This is even more amazing!" I want to share this with everybody too.

X-Ray Mag: I heard that you sold all your belongings and moved to Florida a month later.

Marissa Eckert in trim

Marissa Eckert in Riveria Maya with her Liberty sidemount rebreather

ME: Ha! I did. I didn't know anyone. But I quit my job and moved there and that was it. That was ten years ago.

X-Ray Mag: You heard the call of the wild.

ME: Honestly, I never even knew places like the springs existed in the United States. I thought places like that with such clear, blue water were far, far away, in exotic places. So, when I first saw the Florida springs, I thought, I want to be closer to this.

I worked too hard, for too long at office jobs that I hated just to make money so that I could travel and have an adventure. I wanted to live a life of adventure. So, when I discovered diving, I thought, how can I do this? It was not an easy or quick path, but I feel super fortunate and lucky that I now get to do what I do every day.

X-Ray Mag: So, you became a cave instructor and opened a dive shop with your partner. What is it about caves that fascinates you so much compared to open water diving?

ME: You know, there are so many different aspects that fascinate me. There are definitely the technical challenges, particularly here in Florida where we have lots of flow. It is the challenge of mastering the technique to navigate through the cave. And then in Mexico, it is so delicate, so you find yourself trying to move through the cave in a way that has the least impact.

It is just amazing to me to be able to swim through the Earth and see places that are kind of like the final frontier. Not many of us are going to get to travel to outer space in our lifetimes, but the caves are almost like traveling in outer space and they are reachable. To get to go somewhere that so few people have ever been is really, really amazing. Especially with the caves in Mexico, as decorated as they are. I just love the formations, the rimstone and the stalactites and the stalagmites. And just to think that, at one time, they were dry, and people lived in there and hunted in there and went in search of water—it is just amazing to me.

Marissa Eckert's rig: a Divesoft Liberty (sidemount) rebreather

X-Ray Mag: I noticed that in most of your cave pictures, you are diving a rebreather. What motivated you to move to a rebreather?

ME: I steered away from rebreathers for a long time because there were many fatalities, and people said they were scary and they were dangerous. But then, my dives started getting longer and longer and I was doing more decompression. I wanted to go deeper, and I realized that rebreathers would be great tools for that. So I decided to see what all the hype was about. Were they really dangerous?

I took my first rebreather class on a manual rebreather. There are obviously pros and cons to manual versus electronic rebreathers. But once I started using it, I realized how simple it actually was. In fact, we divers are the weakest link on the rebreather. It seemed clear to me it could actually be a great tool and used safely. You just have to be diligent with everything and do your checklist.

That was six years ago. I was really fortunate because I dived my rebreather almost every day, so I got a lot of experience in a relatively short time. I still feel lucky that I get to dive one every day.

X-Ray Mag: I see that you and your partner teach a number of units. What rebreather did you originally learn on?

ME: My first rebreather was a KISS Sidekick.

X-Ray Mag: That's interesting. You started on a sidemount rebreather versus a backmount. Were you doing a lot of sidemount open circuit before you changed over?

ME: Well, I started my cave training in backmount doubles and I definitely think there is value in learning to dive doubles. They are a great tool for so many things—of course, so is sidemount. I always feel like the more tools you have in the toolbox, the better off you can be at picking the right tool for the job.

So, at the time when I got interested in rebreathers, I was mostly diving sidemount, and I just felt really comfortable in that configuration. So, that is why I went with a sidemount rebreather. I quickly realized that sidemount rebreathers are awesome, but again, only tools.

However, they are not always as easy for super deep caves where you also need to carry a ton of bailout gas. So, when I started diving Eagle's Nest and going to 300ft (91m) and doing 10- to 11-hour dives, and needed to carry half a dozen bottles of emergency bailout gas, I found it easier to put the rebreather on my back and my bailout on my side.

X-Ray Mag: Interesting.

ME: That's why I own and teach a few different units, because honestly, there is no perfect rebreather out there. If there was, that would be the one that we would all dive and that would be the end of it. And all the other companies would go out of business. You have to look at the rebreathers that are out there and ask yourself, "Okay, what type of diving am I doing, and what things about a particular rebreather are most important to me?"

Marissa Eckert just finishing a cave dive in Riveria Maya (left) and beginning a dive (below)

Marissa Eckert

I am certified on quite a few different units, but my main backmount unit now is the SubGravity X-CCR, and I would say my main sidemount unit is the Divesoft Liberty. Both of these units are rock solid and have great electronics. The Liberty has so many amazing features. I do not own or teach on the [Liberty] backmount unit, but I am contemplating getting a conversion kit, because it really is such a great, solid machine.

X-Ray Mag: How would you say diving has changed your life?

ME: Well, I would definitely say that diving *is* my life. I feel excited and happy to get up every day and go to work. I love what I do. I actually do not really feel that it is work. I feel really lucky because there are so many people out there that just hate what they do and they are just not happy. I feel fortunate that I get to do something that I love so much.

My father died when I was 10 years old, and he was only 45, which is crazy young. So, I have always had the mentality: Live each day like it is your last—live each day to the fullest. And if you are not happy, figure it out. I believe if you put your mind to it, you can achieve your dreams.

Of course, even though we are lucky and get to do something we love, James and I work very hard. Sometimes, it can be scary being a full-time instructor. There are a lot of unknowns. I never know if next month is going to be slow, or if next month all the caves are going to flood and reverse due to river rising. It is scary but it is also really rewarding too.

X-Ray Mag: You are teaching technical and cave diving, both open circuit and closed circuit rebreathers (CCR). Do you have a favorite course that you teach?

ME: Probably either CCR cave or diver propulsion vehicles (DPVs). Honestly, teaching an introductory class, like introduction to cave diving, is very rewarding and amazing. It is so much fun to introduce divers to caves for the first time, see the excitement in their eyes, and hear the excitement in their voices when they surface from their first cave dives. That never gets old. But from the perspective of planning long, complex dives, getting to go farther into the cave and seeing more of the things off the beaten trail, the rebreather just adds an extra element to the classes. DPVs add that extra element too. I do not get to teach those classes as much, so when I do get an opportunity to, it is a lot of fun.

X-Ray Mag: Do you have a most memorable cave dive or two?

ME: For me, there are definitely a few. Probably going to Diepolder 2 and Diepolder 3. In Diepolder 3, you basically go down the entrance, and it opens up into a huge room the size of a football field. Diepolder 2 has a really, really small crack that a lot of people have gotten stuck in and turned around and never made it in the cave. There is actually quite a substantial amount of cave at Diepolder 2, and it even goes to 350ft (107m)deep. For a time, that was my deepest cave dive, and I went all the way to the end of the line. Only one or two women have been that far in Diepolder, so that was really cool.

There are so many caves in Mexico that are memorable to me just because they are all so gorgeous there, and definitely Orda Cave in Russia is another one.

X-Ray Mag: I saw mention of Orda on your website. You have a trip coming up there.

ME: James and I went to scout it out and just dived it for ourselves for fun. We loved it so much, and had so many people interested, that we decided we would run a trip there.

X-Ray Mag: It is super cold there as well, right? Not like Mexico.

ME: Yeah, it is 40°F (4°C)—a huge difference from Florida or Mexican caves. I am originally from Pennsylvania, and I started diving in the Maldives, but I came back after vacation and immediately just was hooked and wanted to keep diving. So, I dived in Pennsylvania wherever I could, which meant diving in quarries and lakes and things. So, I had a little bit of cold-water experience, but that was 11 years ago when I first started diving.

Of course, we dive drysuits in Florida, but it is 70°F (21°C), so you can get away with a little leak-through here or there. So, that was definitely a learning curve. James and I both had some dry glove issues. We did have heated vests, heated gloves and really awesome Otter drysuits that kept us really dry. Honestly, it was cold, but it was surprisingly manageable with the right equipment.

X-Ray Mag: What else is next for you two? What are you looking forward to?

ME: We have a group trip that we are leading to Truk in Micronesia with Aron Arngrimsson's Dirty Dozen. James and I are featured instructors on that, so that is really exciting. We are looking forward to that. We also have a rebreather group coming to Mexico in December. We are leading a group trip, so that will be really cool. We are also going to Cocos Island in March with Becky Kagan Schott. I am really excited to see schools of hammerhead sharks and all that amazing stuff. And then, we are going to Bikini Atoll in 2021, so we are definitely excited about that as well. ■

DAN Safety

Diets for Divers

— *Ketogenic Diets & Diving*

Sponsored content by DAN

When talk of diving and food coincide, it is generally along the lines of where to find the best post-dive tacos. But lately, you may have heard some buzz about ketogenic diets and diving.

Interest among researchers has existed for a few decades, but it has increased in recent years as studies by such organizations as Duke University the University of South Florida have yielded intriguing results. The mechanisms underlying any connection between these two things are not entirely clear, and the research is still evolving, but studies involving military, commercial and technical divers have indicated that there may be some benefits to divers on ketogenic diets. Furthermore, some of those benefits may contribute to recreational divers' safety. Here is what we know so far.

Ketogenic diets

A ketogenic diet is one that causes the person on the diet to go into ketosis. Ketosis is a metabolic process that occurs when the body begins to burn fat for energy because it does not have enough carbohydrates to burn. Functionally, this involves following a carefully managed dietary plan that significantly restricts the individual's intake of carbohydrates. This typically involves consuming about 70 percent of one's daily calories from fats.

Rather than breaking down dietary carbohydrates or glycogen (an energy-storage molecule created primarily via the degradation of carbohydrates), the body uses fats from the diet and from stored body fat to create energy. This process involves the production of ketone bodies (beta-hydroxybutyrate and acetoacetate) via the degradation of fats, and those ketones can be used to meet some of the body's fuel needs. The process is not immediate, and transitioning into sustained ketosis can take several days. Ketosis can be confirmed by over-the-counter devices that measure ketone concentrations in the blood, urine or breath.

Current research

It is worth noting that ketogenic diets have been considered for seizure prevention in people with epilepsy for close to a century. There is some cross-talk in the research on epileptic seizures and seizures caused by oxygen toxicity, so it is not surprising that some recent studies have suggested a benefit for divers in that regard. Recently, the US Navy has begun research into ketone use to mitigate seizure risk in closed-circuit rebreather divers as well. These results are preliminary, but animal studies have indicated that ketogenic diets had significant anti-inflammatory affects, and in some cases, could reduce the efficacy of anesthetic drugs.

Future possibilities

Research that considers affects of ketogenic diets on divers is largely preliminary, but what has been published appears promising. A growing number of researchers are discussing a model for DCS that involves inflammatory processes in the body, which could have interesting implications for the theorized anti-inflammatory properties of ketosis. Ketone supplementation has been proposed by more than one researcher for protection against oxygen toxicity as well. Some neuroprotective properties of ketones have been theorized; these could affect narcosis, as could the anxiety-reducing properties of the process. ■

To learn more about dive research, medicine and safety, visit: ***DAN.org/Research****.*

ILLUSTRATION COMPILED WITH IMAGES FROM PIXABAY

Psych Skills for Diving

—The Impact of Life Stresses & How to Get Back in Control

Text by Matt Jevon

We (humans, psychologists and divers) love to be able to put things into neat and tidy boxes. Even if we have a "freeform" mind and emotions, we still like to have something upon which we can ground ourselves—a base, if you like, that gives us just enough stability to cope with the stresses life throws at us.

The base is made up of certainties—that is, the things we have been able to put into the boxes and are confident we have in place—which are managed or manageable, or are irrelevant to us. The more uncertainties we still have in life—which we perceive as relevant—the more stretched our resources in juggling the balls we have not yet found boxes for.

We then arm ourselves with resources, defences, experiences, skills and methods to cope with these vagaries and challenges of modern life. Even so, under stress and pressure, we can "default" to a fight-or-flight-type of reaction and behaviour. This usually happens when we perceive a mismatch between our resources and ability to cope with the challenges we face.

Of course, in a perfect world, each of these challenges would come in a series—i.e. one after the other—with time for us to gather our resources, work out a solution and sort it out. However, modern life is multimedia, multidirectional and multifaceted. Communication is instant, so issues hit us immediately and often impersonally. It can be hard to quantify problems. Then, in garnering resources for solutions, other people are often overwhelmed with messages, and struggle to answer or respond when we really need them.

Strategies

In some of my previous articles for this column, in which I talk about stress management, there is a more detailed description of these mechanisms and how to develop coping and stress management strategies. So, they are worth a reread or a look back.

The thing is to know when to use these strategies. We have to contextualise the full level of challenges and stressors that we face, and frankly, very few people do that. Life happens to 99 percent of people, not the other way around.

Deliberate choices

I watched a Youtube video recently

about karma. The CliffsNotes version is that most people think karma is some sort of external "force" in which what goes around, comes around. In the video, it was suggested that karma is totally within us—whatever we do, say, feel or think—creating a "memory" within us, and it is this memory that will eventually be balanced out.

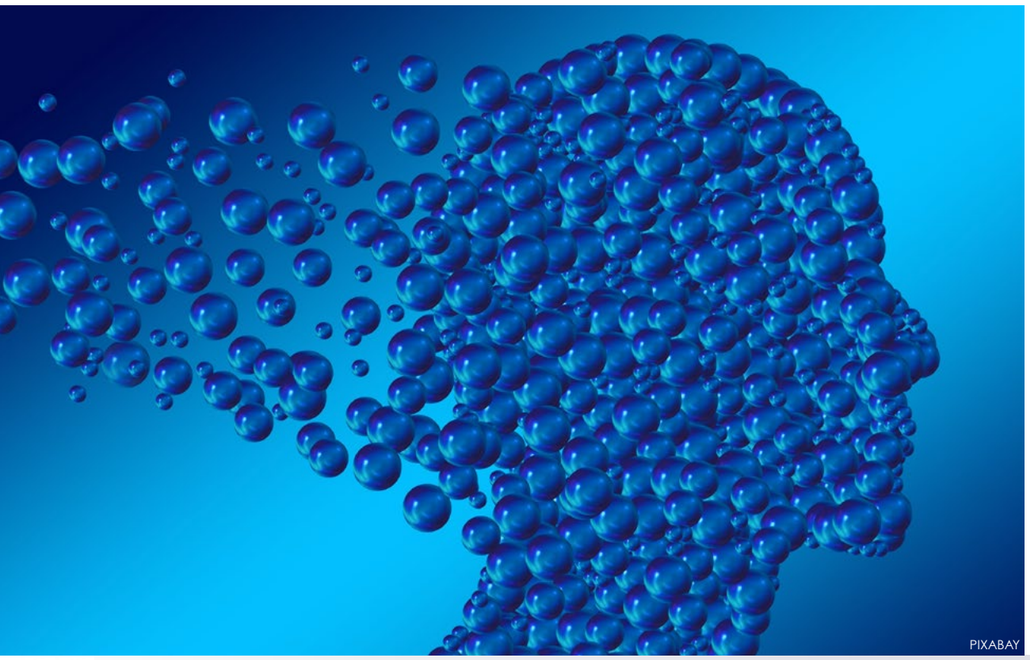
The video's message was: Through your own thoughts, feelings, actions, etc., you can take control of your own karma, or—if you are not into the Eastern mysticism—your own life. To me, the message, regardless of the philosophy, is the same: Make choices deliberately; don't just go along for the ride. So, easy to say, more difficult to do.

But think about your day today, from when you awoke. How much of today was your deliberate choice in what you did, in how you felt and in what you thought? How much was not in your control, not a conscious action and was part of routine, external demands (work/kids), or the unexpected/unplanned? Hmm… interesting, isn't it?

We have developed an almost autopilot approach to life, reacting to the odd gust of wind, programming in the odd course of direction, but mostly bounded by routine. Life happens to us; we don't take control of life. It is easier this way, especially if we can falsely justify to ourselves that the circumstances and factors that currently drive our directions are beyond our control (i.e. It is the government's or my employer's or the weather's fault).

Proactive decisions

In diving, we have to take more proactive approaches, especially at the more "extreme" ends of the sport—deep wreck and cave diving, for example. We must make proactive decisions, taking control to prepare and ensure safety. However—call it habituation, complacency or normalisation of deviance—after a while, even at these extreme ends, the dive preparation becomes routine and the dive happens *to* us.



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To borrow a quote from technical diving expert Mark Powell, "The majority of problems we face in the water, we carry into the water with us." This may include equipment failures due to lack of maintenance and sufficiently in-depth pre-dive checks, lack of preparedness, lack of sleep, hydration and energy, and failure to check weather, currents and environmental conditions on the dive.

It is not technically difficult to "fix" this. It requires a deliberate and purposeful approach to not just all the things we do, but to life itself. Part of this lately has been described as mindfulness (Kabat-Zinn), but really, it is nothing new. Plato himself said our true purpose should be liberation of the mind, not freedom of the senses.

Some of us in the First World have also developed a bit of a sense of entitlement. We expect effort to be recognised and rewarded. We expect talent to be applauded and to rise up. Yet, this attitude creates barriers of its own. Expecting something by right prevents us from continuing our own efforts over the controllables until we have actually achieved. So, what are the good habits to maintain?

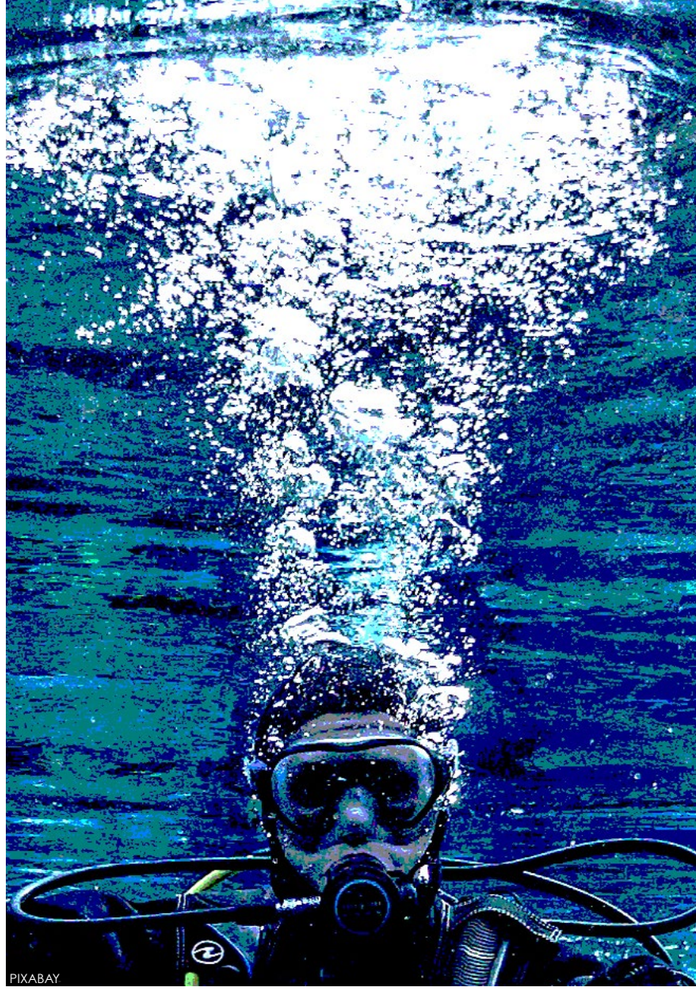
1. **Become aware**, whether you call it mindfulness, meditation, reflective practice or just a self or team debriefing. Learn to distinguish between what happened to you and what you made happen. Try and identify ways to increase the amount and quality of the things you made happen.

2. **Start taking control of the small things first.** Focus on your thoughts, behaviours and feelings. Something simple like making a drink for yourself and another person. Soon, you can begin the same process with bigger and more impactful things.

3. **Act, don't react.** Realise when something is happening and it feels like you have no control over what is happening that, in fact, you do have control over how you behave, think and feel about it. Honestly, *that is* full control.

4. **Be purposeful.** Plan and prepare to do things, go places and engage with people where you can be purposeful. Begin if you like—to steal from Stephen Covey—with the end in mind.

5. **Honestly assess** how you fare in habits 1 to 4 above, and gradually push your control and influence wider.



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So, what about my diving, you say? Well, work on gaining or regaining control in your life, from the mundane making of a coffee to the intensely emotionally-charged time spent with a loved one. You can apply these same approaches to your days diving. That way, when something unexpected or undesired occurs, you have control of your emotions and mindset, and will make great decisions and execute appropriate behaviours based on your degree of control.

Power is nothing without control. Make your life happen, don't allow life to happen to you. ■

Matt Jevon, MSc, F.IoD, is a CCR and OC full cave and mixed gas technical dive instructor as well as a sports psychologist and human performance expert. Jevon works in high-performance sport (Olympic, world-class and professional sport), business (private equity and strategy) and diving at the highest level, including original exploration.

Klocker, Lambert and Garlock dive underwater, while Lillestolen is on the portaledge and Elor is on the ropes.

Land of the Sumps

— Cave Exploration in the Cerro Rabón

ADAM HAYDOCK

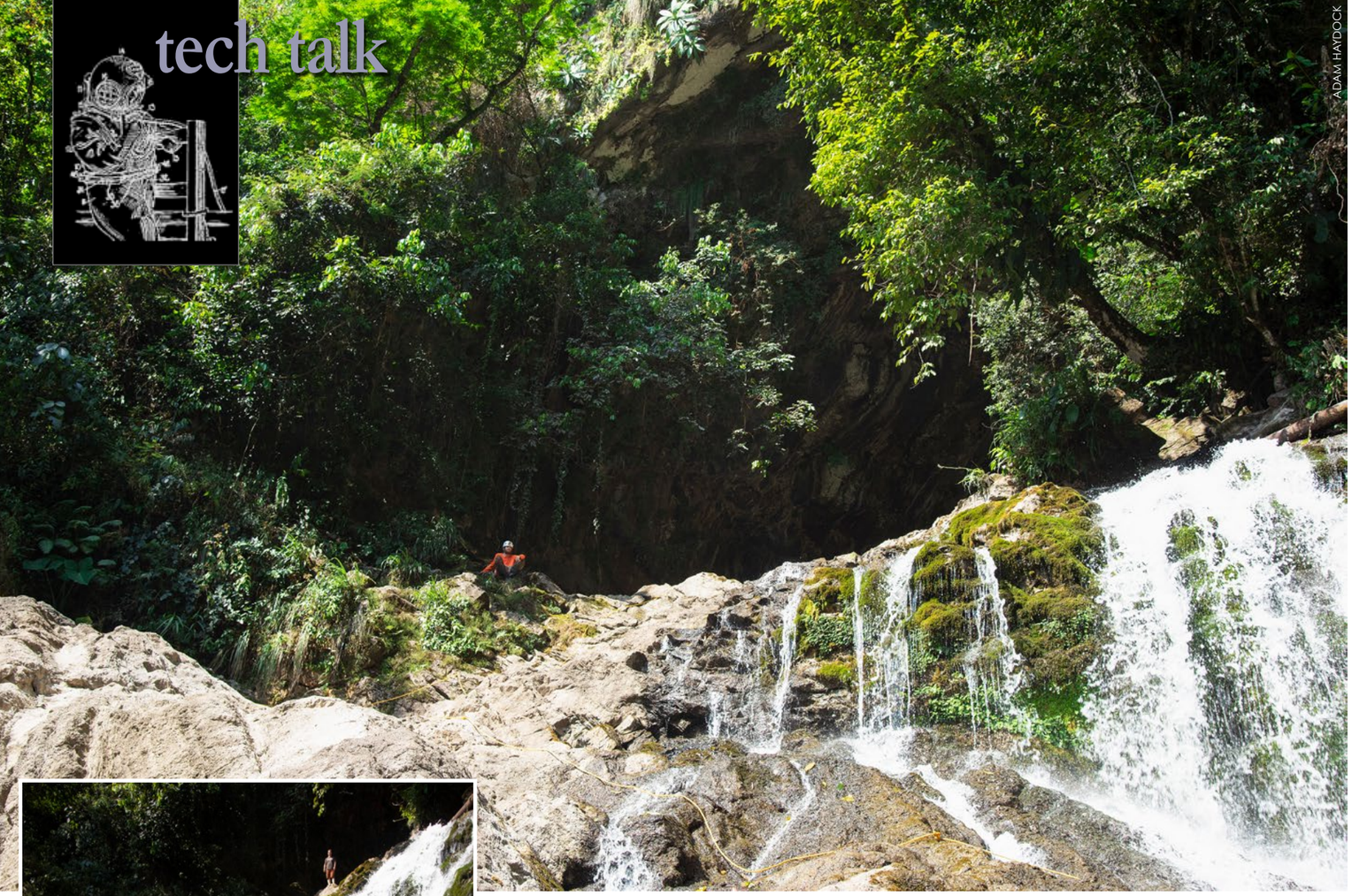
Text by Andreas Klocker and Steve Lambert
Photos by Adam Haydock and Teddy Garlock

What a resurgence! **I first saw this amazing resurgence in 2017. Fellow explorer Zeb Lilly and I had organized an expedition to the Huautla Resurgence that year, and, after we finished our expedition, drove towards the town of Huautla to help out on the American PESH (Proyecto Espeleológico Sistema Huautla) expedition, which focused on exploring the upper dry parts of Sistema Huautla that were the source of water emerging at the Huautla Resurgence.**

Together with Katie Graham and Gilly Elor, we made use of some spare time we had and took the scenic tour to Huautla along the slopes of the picturesque Santo Domingo Canyon, home to several of the world's deepest and longest cave systems (Sistema Huautla, Sistema Cheve and possibly multiple large systems under the Cerro Rabón).

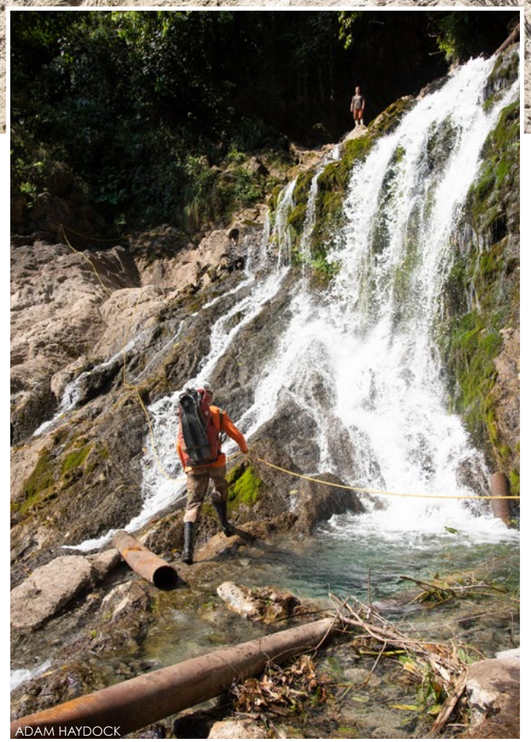
About an hour before reaching the town of Huautla, we made our last stop at the Río Uluapan resurgence, which we had heard of. The only map which existed showed a sump pool a few tens of metres into the cave, with the size of an Olympic swimming pool. The very limited reports that existed mentioned a tunnel of 40m diameter and crystal clear water. Only one diver, American cave explorer Bill Farr, ever made it through Sump 1, reporting a 14m high waterfall on the other side. Due to the complicated nature of access to this cave, nobody had ever returned since.

The following season, in 2018, our goal was to push a cave known as the Cueva de la Peña Colorada, which has been hypothesized to connect into Sistema Huautla. After a year of intense planning, we spent eight weeks in the field, with 24 cave explorers, to push the seventh sump in this cave, five kilometers into the mountain, only to find that the way on was blocked by a rock fall 20m beyond the previous exploration. And to top things off, on the return from Sump 7 after the final



ADAM HAYDOCK

Lambert at the entrance to the resurgence (left) and hiking across the waterfalls cascading from the cave (lower left)



ADAM HAYDOCK

push, six of us got flooded into the cave and spent 69 hours in our wetsuits, with four muesli bars and a space blanket, before managing to escape once the water levels had receded enough.[1]

Needless to say, morale was low, and after we recovered from this epic, we were desperate for some successful exploration on our next expedition. And what better option than the Río Uluapan? It had the largest flow of water emerging from all of the nearby resurgences, with the source of the water being unknown. We knew that our team had the perfect skills to deal with a waterfall beyond a sump and continue exploration.

[1] HTTPS://WWW.SIDETRACKED.COM/CUEVA-DE-LA-PENA-COLORADA/

A bit of history

It was not until the late '60s or early '70s that the existence of the Uluapan resurgence was brought to the attention of cavers (Kambesis, 2003). It was a team of Canadian cavers who noted the spring during one of their reconnaissance trips (Shawcross, 1970). In the early '80s, Huautla cavers were on the lookout for springs that would help them determine the depth potential of Sistema Huautla, and deemed it possible, though not probable, that this was the resurgence to Sistema Huautla.

It was not until 1986 that the Uluapan resurgence was first dived. The roots of this trip started in September 1985, when a magnitude 8.5 earthquake devastated large areas of Mexico City. American

Cerro Rabón

cave explorer Bill Stone was on the US federal team of structural engineers sent to evaluate the effects. Following a grim week seeing first hand what designs worked and what did not (with tragic human consequence), he and Angel Soto (a member of the 1984 Peña Colorada team[2]) went to Huautla to attempt to resolve some political problems that had arisen that spring. While there, they discussed the possibility of diving the Uluapan.

The following year, they drove to Ayautla, the closest town to the Uluapan resurgence. The bridge to Ayautla was completely destroyed by the summer floods, which issued from the Uluapan resurgence. The flow was still enormous, but no longer zero viz brown. A makeshift pedestrian crossing had been erected, and Stone used that to hike up to Ayautla from the bridge. In the meantime, the others had to return to their businesses in Mexico City, leaving Noel Sloan and Stone on their own.

Stone recalls:

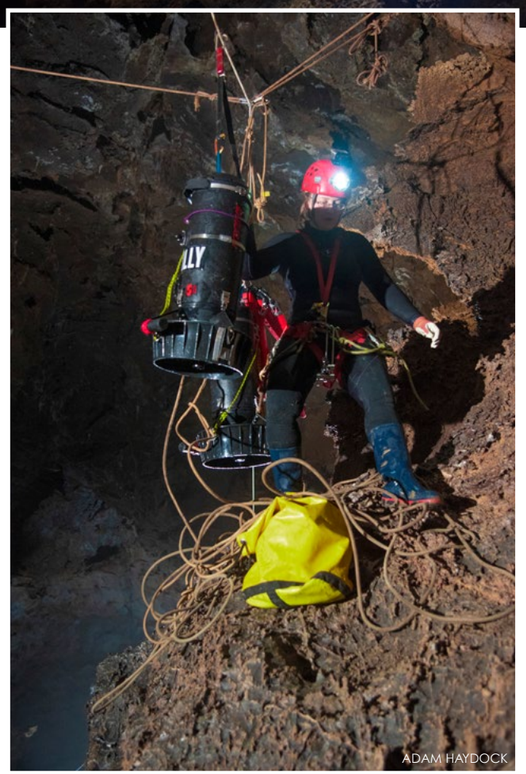
> "We spent the entire next day chopping a steep trail up the left side of the raging arroyo leading up to the entrance. The water coming out the entrance was frightening. I still remember taking a photo of Noel standing beside it. The water flying out over the travertine falls was deeper than Noel was tall and it arced out a good 20m before disappearing in a cloud of impact-induced spray and fog. We seriously considered aborting right then. But further investigation showed that the breakdown on the floor of the entrance chamber right there at the entrance was diffusing the flow—enough so that despite that ferocious waterfall just meters away, the deep, dark, long lagoon leading back into the mountain was tranquil, still.

"The following day, using 1984 Peña Colorada diving kit (S-glass composite tanks, Y-valves and specially modified Sherwood regulators that handled 5,500 psi) borrowed from Zambrano, Sloan and I suited up while the four Sherpas watched on. It has been 33 years since that day, but I still remem-

[2] HTTPS://WWW.BEYONDTHESUMP.ORG/84-PENA-COLORADA; HTTP://WWW.USDCT.ORG/PENA_COLORADA84.PHP

The resurgence in 1986, when Bill Stone and Noel Sloan explored the cave


ADAM HAYDOCK


ADAM HAYDOCK

Elor handling gear between sumps

ber the exchange I had with Noel before entering the water. He gestured with his arm towards the back of the blue-black lagoon and began nodding. Then he looked at me and said, 'Have you ever seen the movie *Caltiki—The Immortal Monster*?'

"I looked at him, and off towards the back of the lagoon, then back at him and said, 'Unfortunately, yes. Why the hell did you have to bring that up?' It *was* a spooky place.

"We inflated our BCs and swam as far as we could into the entrance chamber lagoon, to where it takes a westward jog. We tied off there and submerged. Each of us had two back-mounted, 9-liter tanks at 5,500 psi (air), so we were somewhat limited in what we could do. We did, however, have a lot of line with us.

"We stayed on the right wall at roof level, trying to keep as high as possible. We had pretty good primary cave lights, but probably nowhere near as tight and powerful as what we have today. Nonetheless, we spotted what appeared to be sculpted sand on the bottom, perhaps 30m below. The left wall was out of sight in the blackness. I remember the right wall being stratified and curving upwards. We tied off at 280m penetration when we hit thirds on our gas supply. We had no backup whatsoever so we were playing it conservative."

THIS PAGE: The team organizes and transports climbing, rigging and technical diving gear through a 500m sump.

Cerro Rabón

This exploration then remained a secret amongst a few of them until 1994, during the famous and tragic San Agustin expedition, when Stone and Barbara am Ende discovered Sump 9, now known as "The Mother of all Sumps," in Sistema Huautla.[3]

At that time, Stone gave a full debriefing on what they had done, to cave divers Tom Morris and Jim Brown. They readily expressed interest and, in the spring of 1995, returned with Paul Smith and Bill Farr. Only Brown and Farr dived; Brown essentially reached the limit of exploration set by Sloan and Stone. Farr then ostensibly reached a point 430m from the end of the entrance pool where he surfaced to conditions that have either been garbled or intentionally obfuscated. This was the last time anyone had dived this sump until 2019.

Gear

According to the information we had gathered about the cave from the previous exploration teams, our expedition was going to face some serious challenges. Not only did we need to be prepared for both deep technical diving and technical climbing in a remote area, we also had to transport the climbing and rigging gear through a 500m sump. Each of these tasks required specialized gear that is unavailable within any reasonable distance of our project. Any piece of gear that we were lacking could take days or potentially weeks to drive on location, therefore we had to be extremely thorough in evaluating our needs for the project. We were also limited to two vehicles to carry our equipment from the US East Coast where it was stored to the Río Uluapan, which further complicated the task of preparation.

After a thorough evaluation of what we needed for the project, the team created detailed checklists for all of the supplies and equipment that we would need for our month-long expedition, including all gear necessary for exploration, the spare parts

[3] HTTPS://WWW.BEYONDTHESUMP.ORG/94-SAN-AGUSTIN; HTTP://WWW.USDCT.ORG/HUAUTLA94.PHP


ADAM HAYDOCK

Lillestolen looking down on the tyrolean above Sump 1


ADAM HAYDOCK

Lilly making a plan as team members check to make sure they have all the correct supplies and gear to safely complete the tasks ahead (below); Garlock and Lilly ready to dive Sump 2 (right)

necessary for its maintenance, as well as supplies for daily life at base camp and any emergencies we might encounter. In the days and weeks leading up to the expedition, Zeb Lilly and other members of the team carefully went through the checklists, making sure we would have the correct supplies to complete our task safely.

Technical diving is an equipment-intensive pursuit, and the possibility of the cave going deep only added to the gear list. Because of the remoteness and depth of the cave, we chose to use closed circuit rebreathers, which would allow us to go farther with less gear, minimizing compressor use and saving us from frequent trips carrying heavy gas tanks up and down the mountain.

We brought multiple sets of almost every tank size available, so we would be prepared for any environment we could meet, as well as three "T-Bottles" for storing the large amount of oxygen and trimix we expected to use. We had a gasoline-powered compressor we used to fill air tanks, in addition to running our gas booster used to compress the different gas mixes we would need for deep dives.


ADAM HAYDOCK

Lillestolen working between the sumps

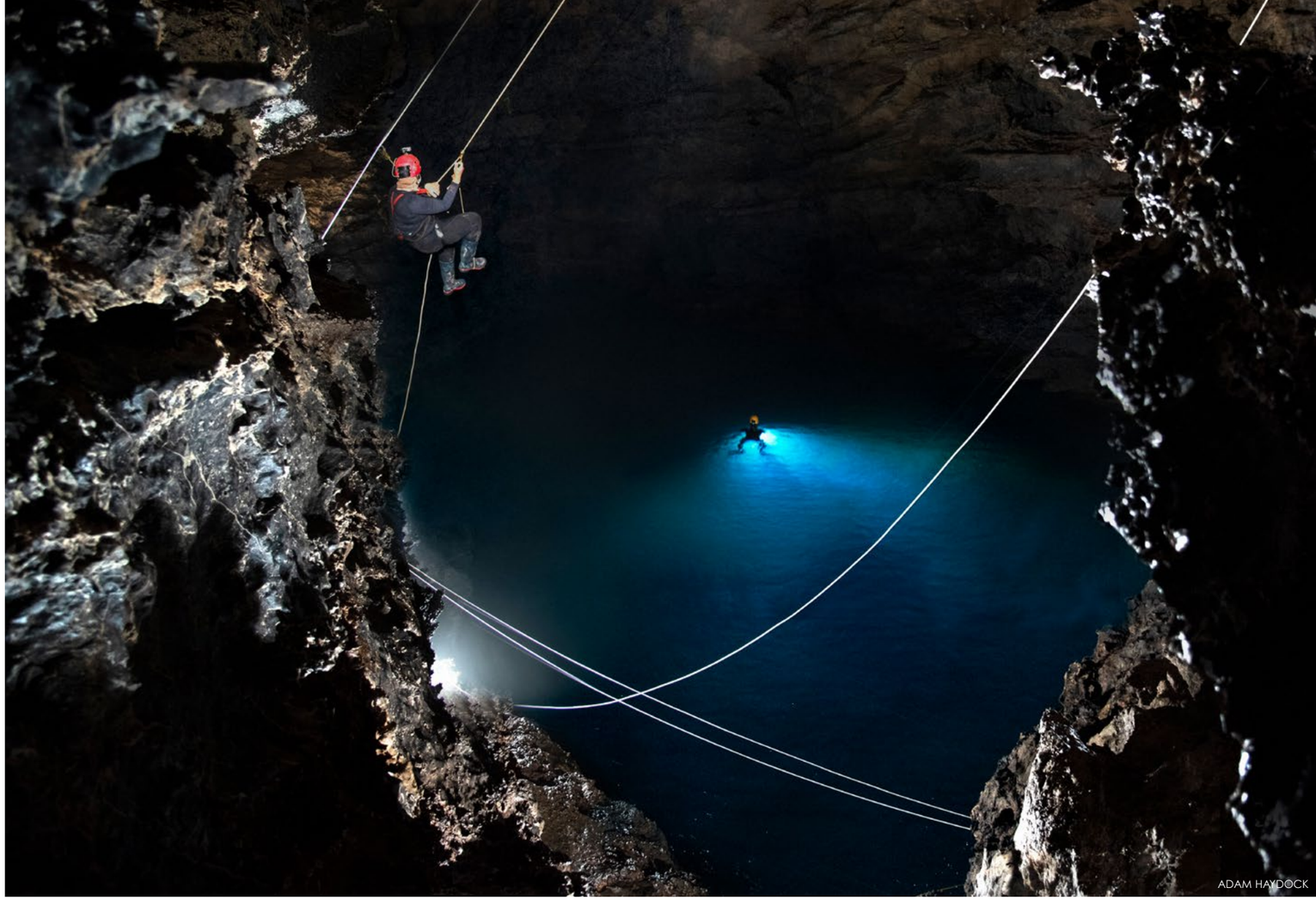
Aside from all of the gasses, we brought several tubs of CO_2 absorbent used for running our rebreathers. We had three Submersion Minnus DPVs (Diver Propulsion Vehicles), which were necessary for hauling gear between the cave entrance and the dry passage between sumps, and added a greater safety margin on deep dives. Each individual brought their own personal dive gear, including their rebreather, drysuit, undergarments, suit heaters, regulators, masks, fins, wetnotes, dive computers, multiple dive lights and helmets.

Besides diving, we had to prepare to safely climb to the cave entrance, and to climb up what we expected to be a 14m waterfall after Sump 1. We also needed to be prepared for any additional climbing problems we may encounter in further exploration of the cave. We packed hundreds of bolts for climbing and rigging, hundreds of meters of static caving rope, electric drills and bits, and two portable ledges that could be hung up to assist divers getting out of the water, preparing to climb, and to rest before climbing after a long dive.

In case of an emergency, we brought a rigid stretcher, which could be used to evacuate someone from the cave and back down the mountain. We had an adequate supply of oxygen in case of a diving incident, first aid supplies and emergency medicine and several satellite communication devices able to reach outside help. In addition to equipment and supplies, several members of the team were trained and highly experienced in emergency first aid and rescue.

A long way from home

A majority of the team departed from the US East Coast. Charlie drove his cave van from Florida with Gilly, and helped carry a majority of the individual dive gear. Zeb, Teddy, Steve and I (Andreas) took the expedition truck, an F350 with a camper shell and full roof rack, which carried all of the team supplies, overloaded with what we estimated to be over two tons of equipment. We picked up Joe in the expedition truck midway


ADAM HAYDOCK

THIS PAGE: Elor climbs over Victoria Falls, which drops into Sump 1, in which Lillestolen is diving

through the United States. It took a total of four days of driving to arrive at the Uluapan resurgence—two in the United States and two in Mexico.

We were lucky to have no issues with the vehicles during the drive there, and the border crossing went smoothly, with the only hiccup being trying to understand the process of paying an import tax on the compressor, and how much that tax should be. After crossing the border, we registered the vehicles and had no further issues on the drive. Other members of the team including Alejandra Mendoza, Jon Lillestolen and Adam met the team directly at the Uluapan resurgence.

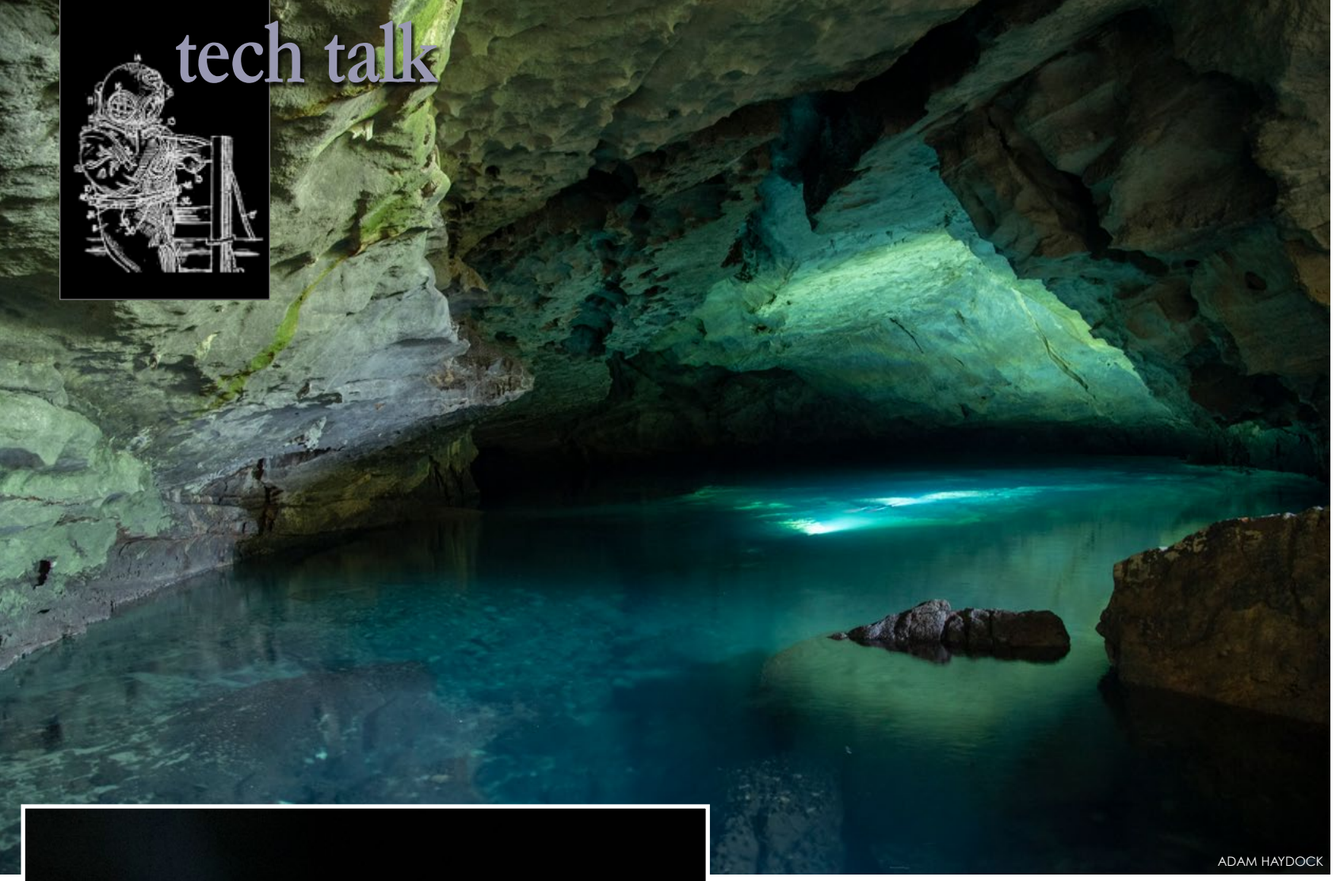

ADAM HAYDOCK

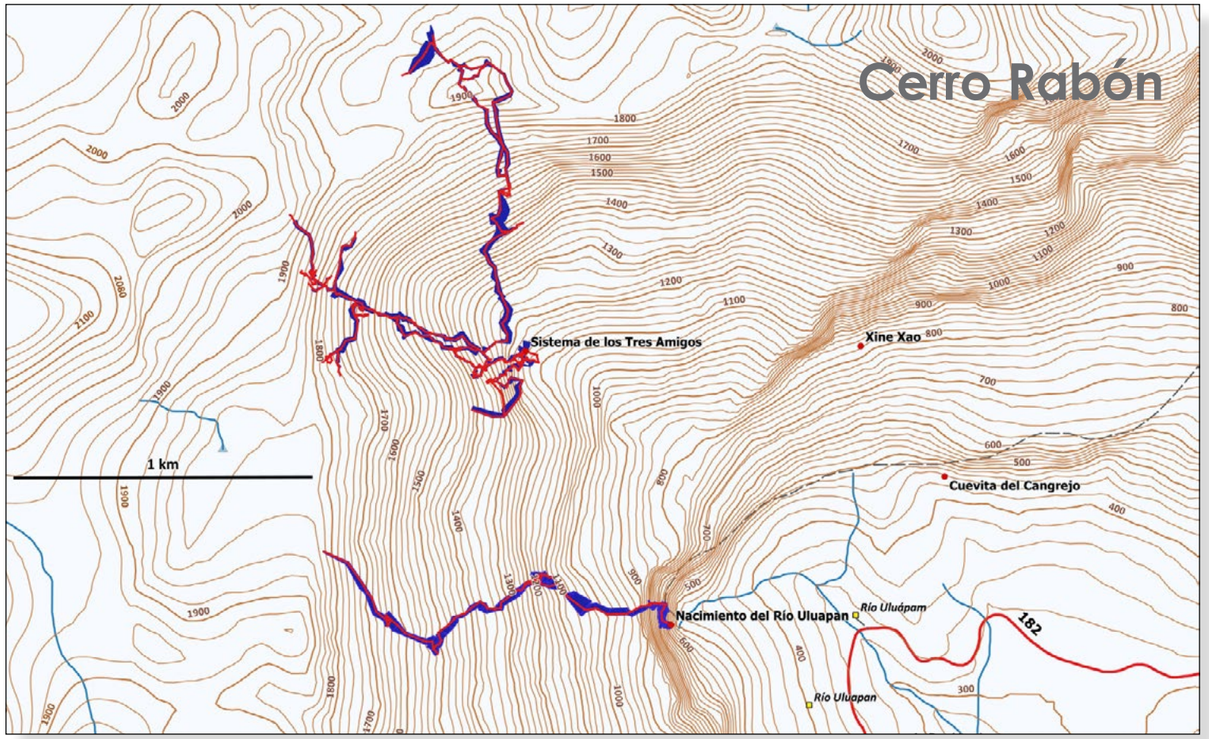
The search for the elusive waterfall chamber

Since divers found the waterfall chamber at the other end of Sump 1 in only two dives in 1995, using open-circuit dive gear and old-school torches, we thought we would be able to find this place again very quickly using rebreathers and state-of-the-art dive lights. Nevertheless, in the end, it took four dives—maybe because our great lights showed us too many possible ways to head. We also started early to survey Sump 1 in the hope that the survey would give us a clue as to where the continuation of the cave might be. But finally, it was on the fourth dive that we were successful.

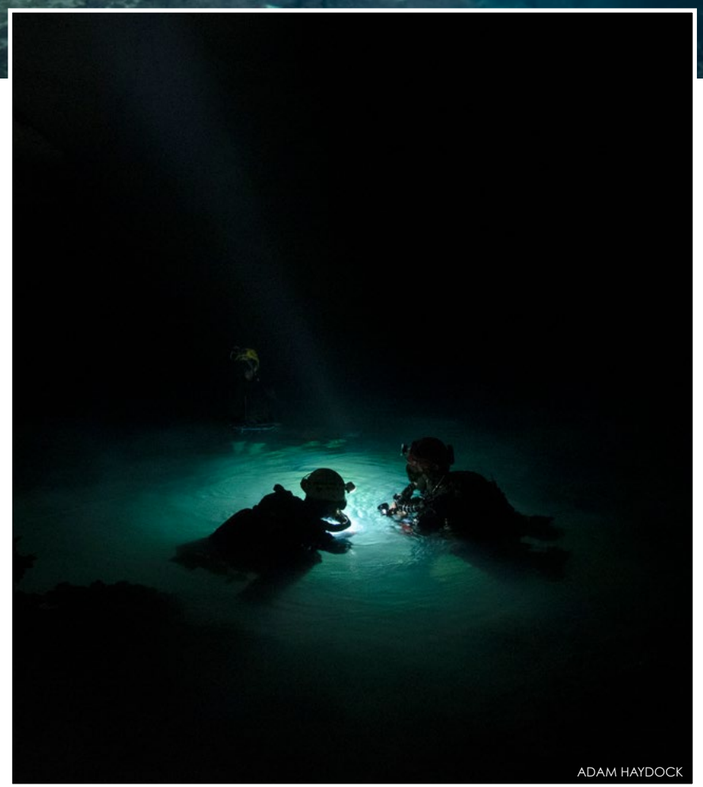
Steve Lambert gave the following account about finding the waterfall:

> "Team Steady (Steve and Teddy) had failed on our first attempt at the sump, and although we had put in 500m of line down that dive, we were pretty bummed that we hadn't made a glorious return full of stories telling of an incredible waterfall and a cavernous room crashing with waves caused by a hundred-foot cascade. Bill Farr, the original explorer of Sump 1, had managed to find it on the first try, using an archaic open-circuit kit. Not only had we not found the waterfall, going through oxygen unexpectedly fast while bobbing up and down to check air pockets, had forced us to turn early and shamefully commit the cardinal sin of exploration, coming back without survey data.
>
> "Once the others in our team had all had a crack at it, Team Steady once again trudged up the mountain, with unprecedented levels of stoke and determination to claim the waterfall. The main objective of our dive was to survey the 'big room' that we had been in on our first dive, so the team could get a better understanding of how the cave was shaped and where we should be looking for going passage. After going through all of the safety checks and donning our KISS Sidewinder rebreathers, we headed off, following the line back to the big room. We began to survey, starting from the end of survey marker left by Zeb and Charlie Roberson, but quickly realized it would be more efficient if one person surveyed while the other explored. I left Teddy to work on the survey and headed off to take a preliminary circle around the biggest cave passage I'd ever seen.
>
> "Teddy was reluctant to abandon his work, having just gotten into the survey groove and not wanting to once again end the dive without having collected any data. I persisted, and finally he agreed to come have a look. We swam back to my cookie, and Teddy could also hear the faint rumble. At this point, we began to get excited, and the more we swam in that direction, the more excited we were. We swam staring at the ceiling of the cave, wondering where the sound could be coming from, as we were surrounded by solid rock in all directions.
>
> "All of a sudden, when we were at the northeast end of the big room, the stone ceiling dropped away and turned to blackness. We tied off another line and headed up from a depth of 70ft. It took all of my self control to stay at a safe ascent rate, knowing what we had put all that effort into looking for was right above our heads.





Map of Uluapan's Three Amigos Area QGIS 10 (above); Divers leaving the sump pool just inside the entrance, which is about the size of an Olympic swimming pool (left); Divers returning from a dive in the cave (below)



Garlock and Lilly ready to dive Sump 2, supported by Lillestolen

"At around 40ft, we could see waves on the surface of the water, confirming the story from the original explorer. Teddy and I were yelling back and forth at each other, giddy like schoolgirls during the ascent, which seemed to take forever. A safety stop was out of the question, and we arrived at the surface in a massive room, thundering with the sound of the waterfall.

"We took a moment to revel in our discovery, then began to seriously look at how we were going to get past the falls. Before I had time to react, Teddy had already shed his gear, handing it to me as he said, 'Wait here. Don't let my tanks sink.' I was stuck watching the gear as Teddy free-climbed the falls, which were much smaller than had been reported. We had to scream at full volume to communicate over the tumultuous thundering of the falls.

From my perspective, I could see that Teddy had chosen the more difficult side to climb, but after a few minutes of screaming back and forth, he was on the right track.

"The flow of water was so strong, it was impossible to stay near the falls, so I floated on my back, turning my lights off to save batteries, and allowed myself to be pushed around the room by the flow. After what seemed like forever, I saw the faint glow of Teddy's torch as he climbed through the dry passage back to the falls. He jumped back into the pool, with news that Sump 2 was close and looked big.

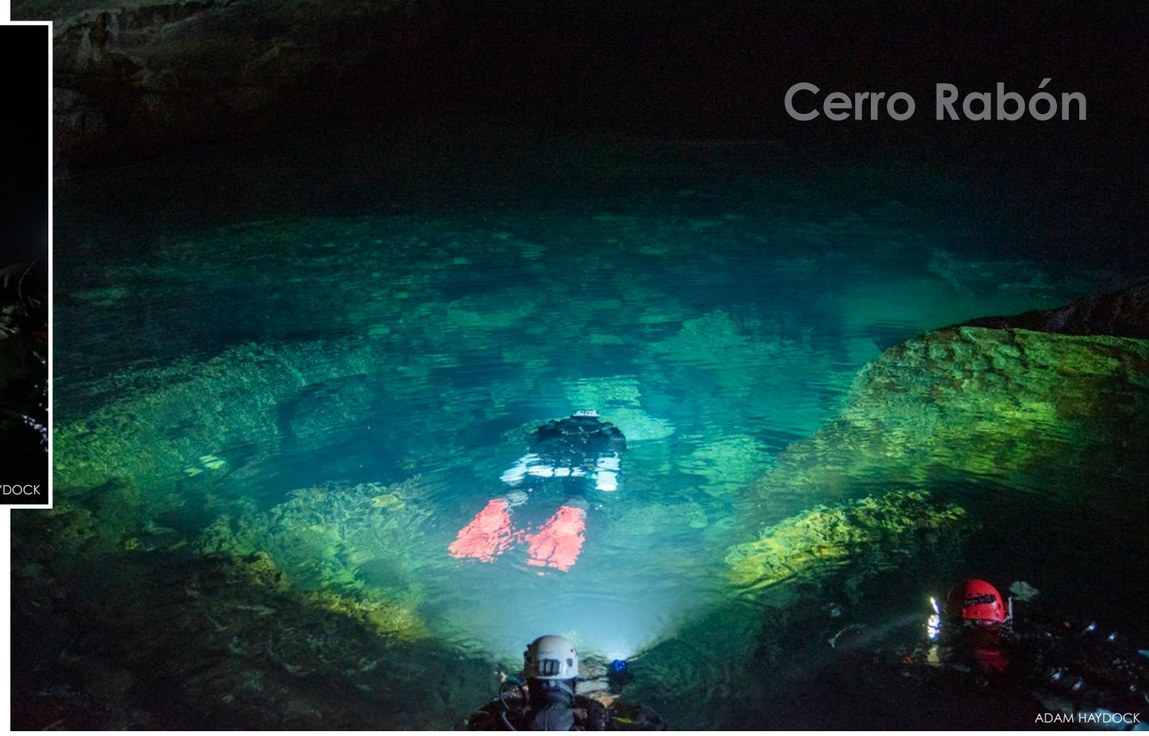
"Unfortunately, he had ripped a wrist seal on his DUI drysuit, and was afraid of the chilly 62-degree water flooding his suit on the scooter ride home. Faced with the shame of returning without data, we hastily completed our original task of surveying the big room while Teddy endured a soaked arm. We quickly scootered out, grinning throughout the entire ride, happy to share the good news with our team."

Encounter with a scorpion

On their first exploration dive into the

Garlock, Lambert and Klocker prepare to dive (right and below); Divers leaving the sump pool just at the entrance to the cave (far right)


ADAM HAYDOCK


ADAM HAYDOCK

Cerro Rabón

cave, Teddy and Steve followed the ceiling looking for the alleged waterfall. The multiple ascents and descents caused their oxygen supply to be used up faster than expected. After deciding it was time to turn around, they wanted to check what they thought was an air bell with a large sandy bottom that looked like a promising lead for the waterfall. Because Steve had used so much of his oxygen supply, he decided it was best not to make another ascent and that he would wait on the bottom while Teddy went to check the lead.

While waiting for Teddy in an area around 12m deep and several hundred meters from any known entrance, he saw movement in the sand out of the corner of his eye. He quickly swam towards it and was amazed to see that it was a scorpion. At first, it was suspected to be the body of a dead scorpion that had washed in from the water source and been pushed there by the flow. As Steve got his GoPro out to take a picture, he was amazed to not only see that the scorpion could move, but also that it was reactive to his presence, running away at first but then turning and taking an aggressive stance as he moved closer to it. It seemed like the scorpion was completely comfortable in that environment, reacting the same as a scorpion on land would. In that area, there was no source of light and no noticeable source of food.

Teddy had heard of scorpions being discovered in other caves in the Huautla area, and was very excited about the find. Unfortunately at the time it was discovered, they were not equipped to catch the scorpion and bring it back for study, but we were able to get over a minute of video footage, which we mailed to Oscar Francke of the Instituto de Biologia, UNAM, in Mexico City. He responded: "It is an amazing video! Undoubtedly, it is *Alacran tartarus* (Francke, 1982), a genus and species I described from Sistema Huautla 37 years ago!"

Later in the expedition, there was another sighting of a scorpion underwater, and many sightings in the section of dry cave between Sumps 1 and 2.

It is still unclear how the scorpions entered the cave, how they survive in complete darkness, and what their source of food is. The only other animal life that was seen in the cave was a single tadpole in the entrance pool of Sump 2, which must have been washed in at the water source.


ADAM HAYDOCK

And it goes deep: Exploration of Sump 2

After Steve and Teddy found the waterfall room and Sump 2, the plan was for Steve and myself to dive through Sump 1, rig hand lines in the dry cave in between sumps to help climb up the waterfall and other obstacles, and then do a reconnaissance dive in Sump 2 to find out what we will be dealing with on subsequent exploration dives. With an electric drill, which we transported through the sump in a large dry tube (essentially a scooter tube with a blank lid rather than a prop on the end), task one was ticked off relatively quickly. Nevertheless, while working in the dry part of the cave, neither Steve nor I could take our eyes off Sump 2. So, as soon as the ropes were in place, we hauled both Steve's and my rebreather, and one set of 7l bailout tanks, to the next sump pool.

Fortunately, on this trip, I pulled the lucky straw and had a first go at Sump 2. I was not sure what to expect, but assumed that it would very likely be huge due to the dimensions of Sump 1. And I was not disappointed! As soon as I had my KISS Sidewinder rebreather on, and clipped off my bailout tanks, I tied off my cave line and descended into what felt like outer space.

From a reasonably sized sump pool, the sump immediately became huge. I decided to follow the left wall, not far under the roof. My LED light felt like a candle in this huge space. I could see the floor at some distance, and occasionally the far wall. People often ask me if I get claustrophobic in caves, but I think in this situation, "agoraphobic" would be the word.

I descended, spooled out line, and descended some more, and after very little time, hit just over 40m, with the passage rapidly descending farther. On this dive, I was diving solo, with a wetsuit and small bailout tanks full of good old-fashioned air rather than some deep mix, and hence decided not to accumulate too much decompression time and returned with a big smile on my face.

As soon as I surfaced and told Steve what the sump looked like, there was no stopping him. He put on his rebreather, took the bailout tanks that I had just


ADAM HAYDOCK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Lilly, before exploratory dive of Sump 2

Cerro Rabón

used, and jumped into the pool. He followed my line and continued straight on. He kept close to the roof as I did, which suddenly took him to shallower depths, but following this, he soon found out that he only found another air bell, quite common on this cave, but the way on must be down.

With the adrenaline pumping in our bodies, we then hauled the rebreathers and tanks back to Sump 1 and dived out. What a day that was! Now we had to plan for deep dives, using trimix and scooters.

Before returning to Sump 2, the plan now was to finish some surveying in Sump 1, cleaning up some of the unnecessary lines that were the results of several dive teams trying to find the waterfall, which was done by Charlie and Zeb. This was followed by a trip by Gilly, Jon and Zeb to survey the dry cave to the waterfall, and a trip by Joe Heinrichs and Steve to take several safety bottles to Sump 2.

Charlie Roberson recalls one of those dives:

"Now that the waterfall had been located, I was determined to survey and clean up the lines in Sump 1 before pushing farther. Frustratingly, the first few dives had failed to locate the infamous waterfall or any going passage and the cave just seemed to end in a huge terminal room. We had started to doubt the existence of the waterfall and were exuberant when it was eventually found. I knew that if we didn't survey Sump 1 now, the excitement of new exploration beyond the waterfall would sidetrack this important task. Zeb and I set off on a three-hour survey dive in the huge passage. We decided to survey the line we had laid several days before when looking for going passage. Zeb, who was still getting over a cold that had swept through the team, scouted the walls for any missed leads while I surveyed the knotted line with a compass and depth gauge. The only modern addition to our survey kit was a hand-held sonar, which proved surprisingly useful for wall distances in the enormous passage.

"On the way out, we removed the line that Steve and Teddy had installed in their initial search for the waterfall as it went from air bell to air bell along the ceiling of Sump 1. We also removed numerous remnants of line from the previous expeditions as they created an entanglement hazard."

To prepare for transporting large amounts of dive equipment to Sump 2, it also quickly became clear that it would be easiest to install several tyrolean traverses across the dry cave to pull the heavy equipment along tensioned ropes rather than carrying it across relatively tricky dry cave full of sharp rocks, risking the damage of gear or injury of a diver. The tyroleans also made it easier for the support crew to move the equipment from sump to sump themselves, allowing the divers who return from a deep and long dive in Sump 2 to avoid any exhaustion. These tyroleans were installed by Jon and Gilly.

A few days later, Zeb and Charlie returned to continue exploration in Sump 2, again with wetsuits and 7-liter bailout tanks, but this time they dived as a team to have more bailout.

Charlie remembers:

"Jon and Gilly supported us at Sump 2 while they installed additional rigging and continued their Disto X survey of the dry portions of the cave. Unfortunately, on the way through Sump 1, the dry tube that Gilly was towing flooded, almost taking her down with it. Luckily, I was able to place the tube on top of a huge car-sized boulder and take off the 10+ kgs of lead that are normally needed to submerge the tube. Unfortunately, Gilly's Disto X was in the tube that flooded.

While Sump 1 was wide and relatively clear, it was also shallow with average depths around 20m. Ten minutes into the dive, we were already at twice that depth with twice the visibility of Sump 1. Blue water and white walls!

"I stuck to the right wall and followed the ripples on the white sand floor. At about 300m of penetration, we had reached 60m of depth and the maximum operating depth (MOD) of our gas. Zeb tied off and started to survey out.

"By the time we reached our first decompression stop, we had been underground for the better part of the day and still had to do our decompression, navigate down the waterfall with


ADAM HAYDOCK

Lillestolen supports Garlock and Lilly for an exploratory dive in Sump 2 (above); Divers leaving sump pool (top left)


ADAM HAYDOCK

Lilly, before exploratory dive of Sump 2 (right); Divers in the sump pool of Sump 1 (far right)

our rebreathers, dive back through Sump 1, stow our gear on the porta-ledge and hike down the mountain to our field house. Needless to say, it was well past midnight before we reached the field house, but all we could think of was entering the survey data and drinking a warm Victoria beer.

"From the previous dives in Sump 2, we now knew that we will be heading deep. So for the next dive, Zeb and I brought a set of 16-litre bailout tanks each, filled with 10/70 (this means 10% oxygen, and 70% helium, which can be dived to beyond 100m of depth),


ADAM HAYDOCK

Lillestolen working between the sumps

an extra staged bailout tank, two main scooters and a tow scooter as backup. Zeb ran the line while I was trying to find the way on, using a GoPro to also take some video footage.

"The cave stayed at about 70m for a while, with a wide open passage, but suddenly a large sand dune stopped our progress. We swam back a bit along our line and looked around. It looked like the cave might head shallower again, up a steep boulder slope, but by that time, we had accumulated quite a bit of decompression, and so Zeb surveyed back while I took more video. Including decompression, this dive was about four hours, and both of us were quite cold by the end."

The final two dives in Sump 2 were completed by Zeb and Teddy. They had in-cave support from Gilly and Jon, both of whom really did all the hard work in order to make these dives happen. After diving through Sump 1, they would take off their rebreathers and other equipment, which was then ferried to the start of Sump 2 by Gilly and Jon via a series of tyrolean traverses. This allowed Zeb and Teddy time to prepare for the push in a relaxed and calm manner.

Their first dive had Zeb in the front with Teddy laying the guideline. They put in a little less than 300m of line ending at a depth of 55m (with a drop to 82m on the way to the end of line). Teddy surveyed on the way out, and they were greeted with hot chocolate by Gilly and Jon.

On the second dive a few days later, Teddy had the chance to lead, taking off from the EOL (end of line) at 55m and ascending to a passage in 24m of water. Teddy's profile on the dive was comical as he had to ascend or descend with some extreme changes in depth in order to find the way on. They kept hoping the sump would end in more dry passage, so they spent a lot of time on the ceiling, seeing if it would surface.

They eventually found the right way on and began to descend, tying off at a depth of a little over 90m. They split up; Zeb began surveying out as Teddy tied in another reel and continued another 60m, finally turning at a depth of 101m in going passage. Decompression in this sump is a challenge, requiring decompression to be cleared to a depth of 15m before descending back to 82m and doing a final decompression to the air chamber between sumps.

In-cave photography

Photographer Adam Haydock recalls:

"Hauling an extra gear bag full of expensive photography equipment felt like a bag of feathers, knowing that I was about to enter one of the most inspiring and mystical caves that I have ever encountered. I was on open circuit with twin steel 85s and about to hitch a ride on Zeb Lilly's Valkyrie scooter by holding on to his crotch strap and basically keeping a low profile through the sump to photo-document the dry passage in-between sumps.

"I had to place the strobes and the camera in Pelican dry boxes and wrap both of those boxes in an amphibious dry bag, which was equipped with a drysuit zipper and purge valve. Once I was able to get this gear off and into a final large cave pack, the next challenge was to make the bag neutrally buoyant. Rocks and lead weights were put in place to get the bag to just about the right surface buoyancy.

"The camera gear was around 9kg, but I estimated that there must have been around 10 to 13kgs of extra weight. I was able to strap this pack

ADAM HAYDOCK


ADAM HAYDOCK

THIS PAGE: Elor climbs over Victoria Falls, which drops into Sump 1, in which Lillestolen is diving (right)

onto Teddy, and he was able to manage the bag by placing the pack on his chest in a position to deal with the negative buoyancy at depth. The bag would get heavier the deeper you would go as the buoyancy depleted, thus making this pack heavier. Teddy mentioned to me that he had a few interesting moments but was able to manage the pack and keep propelling forward on his scooter.

"Once we were able to surface and get the camera gear up to the next tier, we got the push divers set up to continue the exploration in Sump 2. Once this was complete, we had a couple hours to take photos in the dry passage in-between sumps.

"The dry passage was not all that extensive, but the rock in the upper passage was very sharp and crumbly, so care had to be taken to maneuver around without falling through into a crack or even down into the lower passage. I noticed the infamous waterfall was a bit set back in the chamber and a bit obstructed, so I opted to get shots from the top looking down.

"I was able to get some good angles overlooking the large lagoon where we entered the dry passage and continued over the waterfall. After a few more shots, my camera decided not to work anymore. It was a bit disappointing with all of the time and effort made, leading up to where I was standing, and I was not able to get all of the shots that I wanted. Thankfully, it turned back on, and I was able to get a couple more before it turned off again. Overall, I am happy with the shots and how it all worked out, which documented the cave and its characteristics quite well."

Preparing for the return

After this year's expedition came to an end, a few things became clear immediately. First of all, we would be back—next season! There was no way we could let one of the best leads in cave exploration found on this planet rest for some years to come.

Secondly, any further exploration would be challenging, to say the least. The farthest point reached this year was two kilometers into the cave, in the second sump, at a depth of 100m, continuing downward. We did not find any significant inflows, and we still have no clue where the huge amounts of water, which flow through this cave in the wet season, sink into the karst of the Cerro Rabón. There are several options of what this cave could do farther upstream.

Sump 2 could turn into a multi-kilometer sump at significant depth, requiring the use of dual or bailout rebreathers, since we would quickly hit a point where we could not haul enough open-circuit bailout tanks into the cave. Multiple scooters, and tow scooters for backup, will become necessary. And due to the water temperature of about 16°C, we will also need a habitat for decompression.

Due to the undulating nature of the karst in the area, as seen by a lot of substantial depth changes in the sumps, it would be no surprise if the sump would surface soon, and we would have to get out of our dive gear and continue exploration in a massive streamway—and that after

ADAM HAYDOCK


ADAM HAYDOCK


ADAM HAYDOCK

The team at the Huautla Resurgence, Oaxaca, Mexico

Cerro Rabón

a 100+m dive. In addition, there is no reason why we would not run into a third sump. This would pose the biggest possible challenge since we would have to haul all the dive gear to that point. And since every hyperbaric doctor will tell you not to carry multiple rebreathers and scooters through dry cave after a big dive, we would quickly be dealing with a situation that required camping in the cave—and not just any cave—a cave famous for discharging masses of water after rainy events.

No matter what happens, further exploration will be a challenge. Luckily, we have got an amazing team together, and have accumulated a lot of experience in diving sumps in very remote places. Above ground, the locals support us, and we have several gear manufacturers helping us prepare for next year's exploration. Bring it on!

Support

Expeditions into foreign countries would not be possible without the great support of the local communities whose land we are visiting. We were really lucky to have both communities—whose land borders the Río Uluapan, San Bartolomé Ayautla and San Felipe Jalapa de Díaz—welcome us and provide support. The locals showed great interest in learning about the caves on their land, and are hopeful that we can help them attract tourists by showing people, reading and hearing about our exploration efforts, what amazing places this region along the Santo Domingo Canyon has to offer. Hopefully, we will be able to help them with this.

Exploring caves—in particular, caves that involve challenging technical diving in some very remote places—involves large amounts of gear. This gear needs to be tough, and, since we have to be able to fix this gear several kilometers into a cave, as simple in design as possible. Luckily, we have several gear manufacturers that support us with cutting-edge equipment. Thanks go to KISS Rebreathers, Submerge Scooters, Light Monkey, Shearwater Research, Otter Drysuits, OC Lugo Co. Inc., XDEEP, Fathom Systems and Nalgene for supporting us—without your help and the amazing gear you produce, we could not do this sort of exploration. Thanks also go to the National Speleological Society for supporting our expedition with exploration grants.

The team

This year's Beyond The Sump team included Adam Haydock (USA), Alejandra "Alex" Mendoza (MEX), Andreas Klocker (AUT/AUS), Charlie Roberson (USA), Gilly Elor (ISR/USA), Joe Heinrichs (USA), Jon Lillestolen (USA), Steve Lambert (USA), Teddy Garlock (USA) and Zeb Lilly (USA).

Follow us

For all the background on our expeditions, current and past, visit: **beyondthesump.org**. For regular updates on our progress, follow us at: **facebook.com/cavedive**. ■

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SHAWCROSS, M., 1970, MEXICO '70. CANADIAN CAVER 2:38–52.


TEDDY GARLOCK

Locals from San Bartolomé Ayautla visit the team in the cave, watching them prepare for a dive (above); View from the cave entrance (top left)

photo & video

Exposure, Contrast & Curves

— Postproduction of Underwater Images

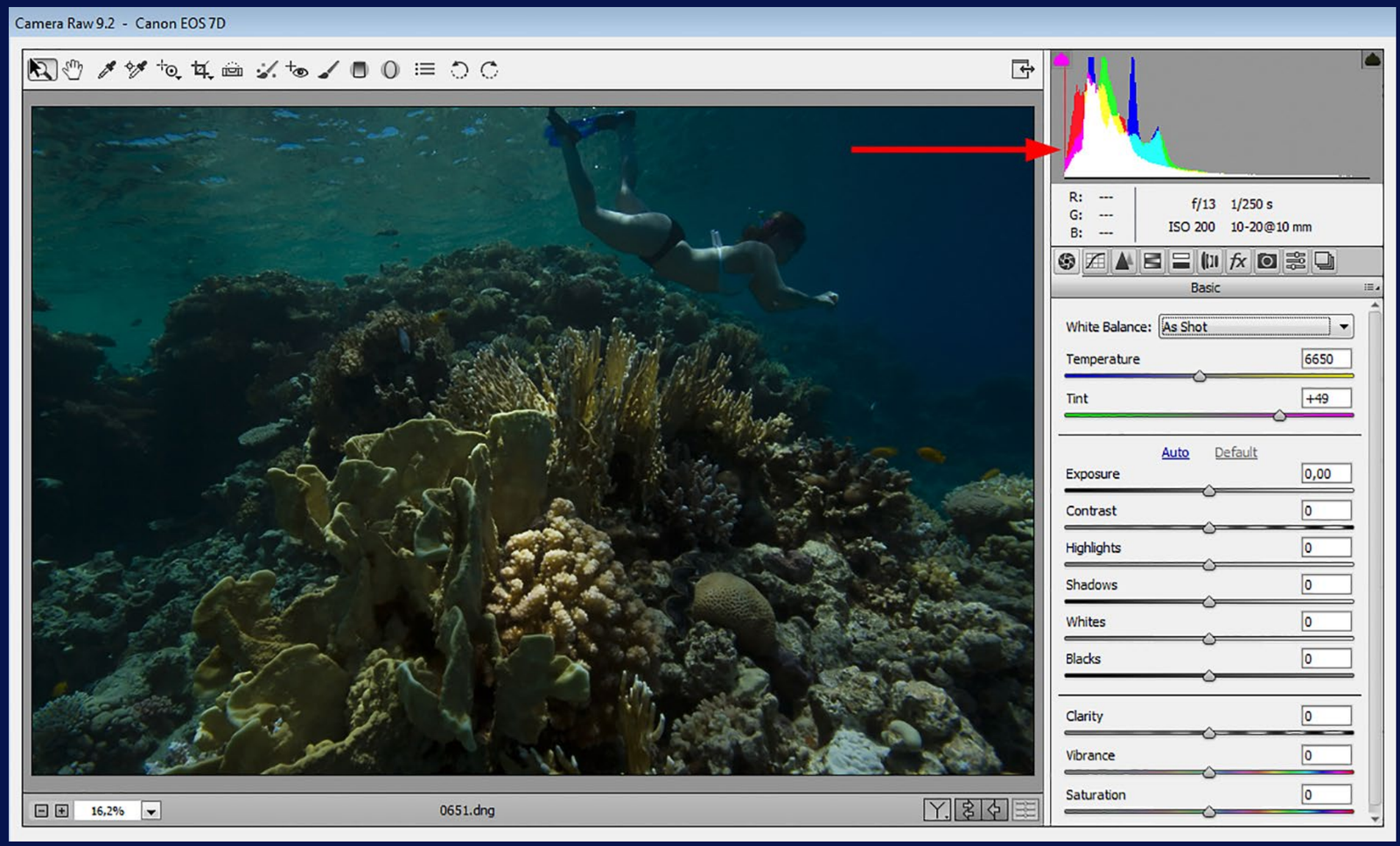

Image 2. The histogram in Adobe Camera Raw (ACR)

Text and photos by Rico Besserdich

As always, the best thing to do is to get the proper exposure of your underwater images while shooting them. But sometimes this is easier said than done, and there are shots with insufficient exposure, which we, for whatever reasons, simply want to keep and "rescue."

So, what is exposure?

In photography, exposure is the amount of light that reaches your camera's digital sensor, as determined by shutter speed, lens aperture and scene luminance. "Correct" exposure is an exposure that achieves the effect the photographer intended. However, cameras or editing tools such as Photoshop or Lightroom are not very interested in our intentions. They only judge the exposure by its technical aspects: counting the pixels, measuring all tones and showing the results in a histogram.

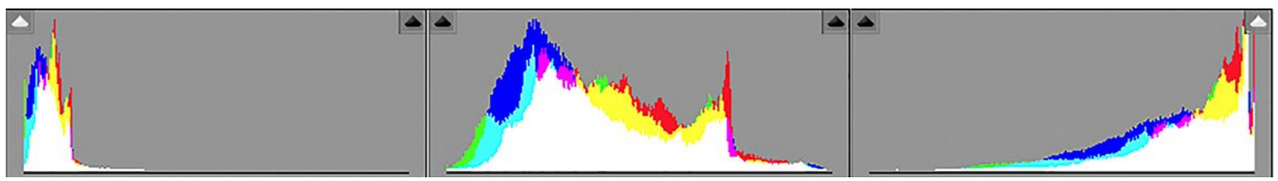

Image 1. The three types of exposures in photographs

This means that what a histogram might declare as "wrong" may not necessarily be so. Histograms have no knowledge of, for example, the high popularity of underwater images with a main subject in front of a black background. What a histogram tells us about an image can easily turn into a science, but for this tutorial, I will keep it simple.

Let's look at the three types of exposures in Image 1:

Underexposed: All displayed data in the histogram is pretty much left-orientated, even touching the left border. The white triangle symbol in the upper left indicates the blacked-out shadows ("clipped blacks"). Keep in mind: "too much left = too dark."

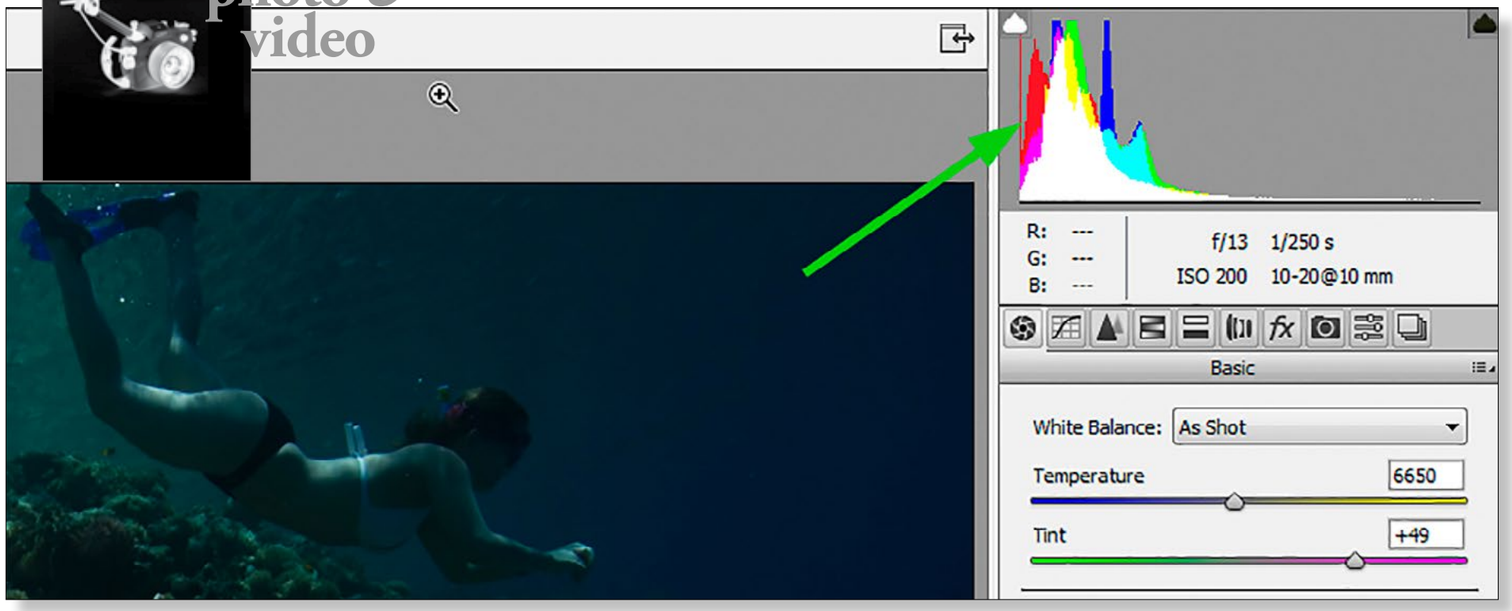

Image 3. The histogram is too dark

Correct exposure: We have a nice little "hill" of tonal information, which neither touches the left nor the right border of the frame. Both triangle symbols are black, which means: no clipping. Like I said, histograms show the "technical truth" and have only little tolerance for photographer's intentions.

Overexposed: All displayed data is right-orientated in the histogram and even touches the right border of it. The white triangle symbol in the upper right indicates burnt-out whites ("clipped whites"). Keep in mind: "too much right = too bright."

A few tips:

- Shoot RAW. Only RAW images store all information captured by your camera's sensor, thus providing sufficient image data for postproduction.

- An underexposed image might get "rescued" during digital postproduction, but there is only little to no hope at all to recover a totally overexposed image. White will stay white. You cannot restore image data where no image data exists.

- Review the histogram carefully. Sometimes it might appear as totally burnt out (whites or blacks) but if you see that the little "hill" is close to the right or to the left border of the histogram, but "falls down" just a tiny bit before it, then there is still image information to recover... nothing is "lost."

Now, let's look at Image 2 (previous page). Obviously, the photographer did not do a good job here. The image is underexposed. The histogram of ACR (Adobe Camera Raw) proves it as well, showing us a clipped area at the left. But since I cannot dive in such nice places every day, I wanted to fix this image by altering the exposure.

The histogram indicates it is "too dark," but let's have a closer look. See Image 3. Everything is pretty much at the left, but that little hill is "falling" down again, just a tiny bit before the left border of the histogram's frame. This tells me that these are not totally clipped blacks and that there is hope!

You cannot restore image data where no image data exists.

Both Lightroom and Photoshop ACR have an exposure slider right below the white balance section. I now carefully move the exposure slider (gently) to the right while simultaneously watching the result—one eye on the image itself, the other one on the histogram, checking for clippings and more importantly, checking how the overall image changes.

Now, the image looks like Image 4. The only thing I did was move the Exposure slider until the exposure was nice (until +1.40 in this example). Luckily, ACR's histogram agrees with me, showing me a proper tonal range, without clipped blacks and clipped whites.

I usually do not recommend going over +1.50 to prevent nasty noise in dark areas. This, however, also depends on the dynamic range of your camera's sensor. The better the dynamic range of the camera, the more values can get restored without the risk of too much

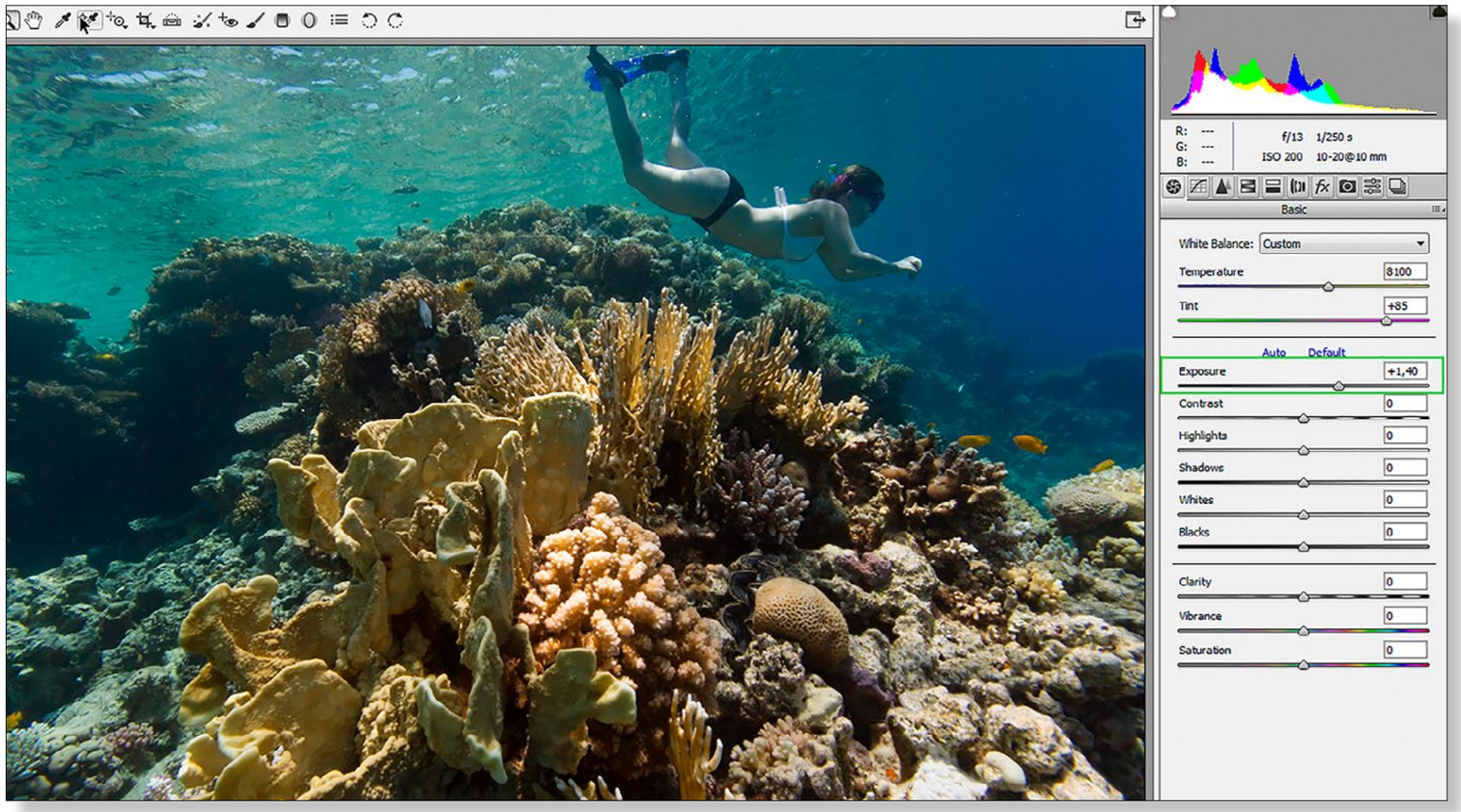

Image 4. Moving the Exposure slider until the histogram is correct

Image 5. Before exposure adjustment (far left)

Image 6. After exposure adjustment (left)

noise in darker areas of the image. The best way to check is by zooming in to 100% and taking a closer look. See Image 5 and Image 6 to compare the photo before and after adjustment.

Now, let's see how to do some more fine-tuning with the overall image exposure. For this, I have dug deeply into my archives and found a close-up shot of an octopus from my very first dive with a D-SLR. Straight from the camera and with no alterations done, the image looks like Image 7.

First of all, think about whether this shot is worthy of editing or not. For this octopus shot (and not to be sentimental here), I believe it has potential. The good news is, it takes only five minutes to get this image right.

So, after adjusting the white balance and applying a basic exposure correction, the image now looks like Image 8.

"Quite cool," one might say. But as we are photographers, it can be both a blessing and a curse to look at images in different and analytical ways. I like the image too, but I believe a few more fine exposure adjustments could be done, striving for a better result.

So, by looking again and very closely at the image, I spot a few things that I want to fix. Let's have a look at Image 9 together.

1. It is somewhat "greyish" and looks sort of "dirty." This area could use a slight exposure boost.

2. It is not "clipped" but pretty close to it. I would like to see some more details in the shadows.

3. I think that a fine adjustment of exposure for the eye could "punch" it a bit more.

Once again, it is important to train your photographer's eye, looking at the finest details and, if necessary, making fine adjustments. Less is often better, and the better your "source material" (i.e. the photograph), the better your final image after postprocessing will be.

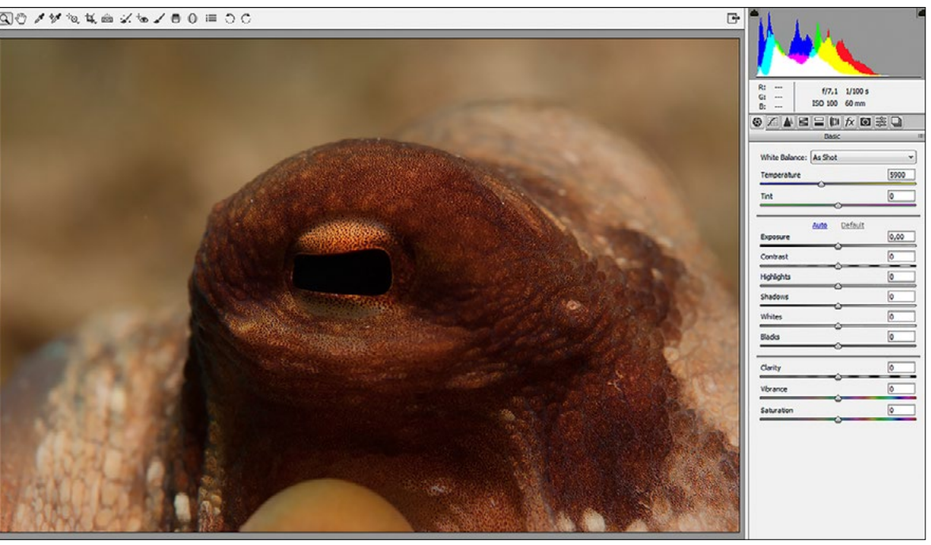

Image 7.

Image 8.

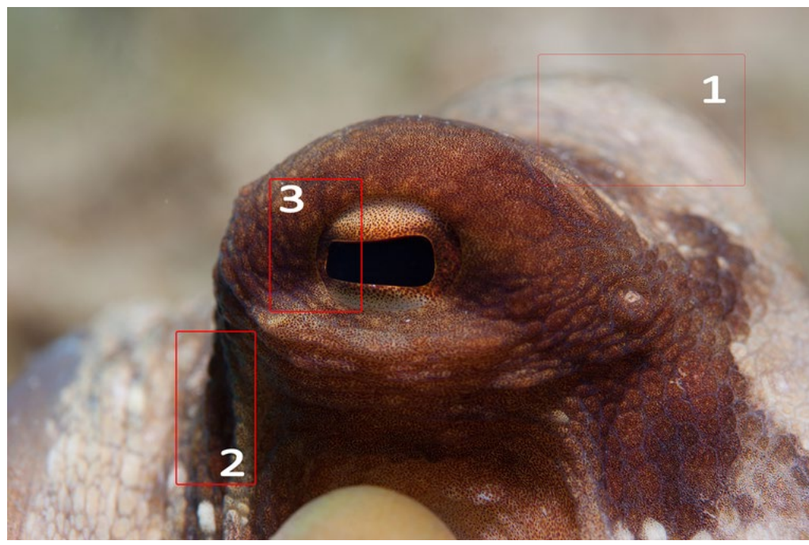

Image 9.

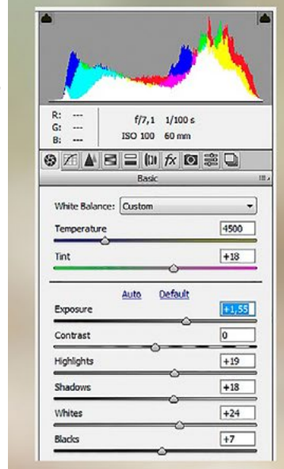

Image 11. After the white balance, basic exposure adjustment, and fine exposure corrections

Postprocessing

In Adobe ACR and in Lightroom alike, there are a couple of sliders on the right that allow us to make fine adjustments.

See Image 10 (below). The Highlights slider brings back or darkens the highlight detail. It is very useful for you to recover lost details in slightly "overexposed" areas, and it can also add a little pleasing glow to the overall image.

As for my example image, I found that a little glow would be just the right thing, and so I moved the Highlights slider to +19. This gave the image a slight punch and half-solved the critical (greyish) area "1."

With the Shadows slider, you can brighten up a lot of information in the shadows. Very dark shadows are not ideal. I was not so pleased with the few very dark shadows in the image (areas 2 and 3 in Image 9 on previous page), so I brightened the shadows up a bit by moving the Shadows slider to +18.

The Whites and Blacks sliders fine-tune the furthest extremes of your photograph's range by providing the opportunity to alter black-and-white points of an image. My intention was to give that octopus a bit more glow. I moved the White Slider to +24. Now problem zone 1 looks okay. I then moved the Black slider to +7, slightly lightening up the darker areas. As the last step, I moved the Exposure slider a bit more to the right (to +1.55), just following my own notion of how I want that photograph to look like.

Please bear in mind that you will need to watch the change of finest details in your image AND the changes in the histogram very closely and carefully while working with those sliders. After the white balance, basic exposure adjustment, and fine exposure corrections, see the result in Image 11.

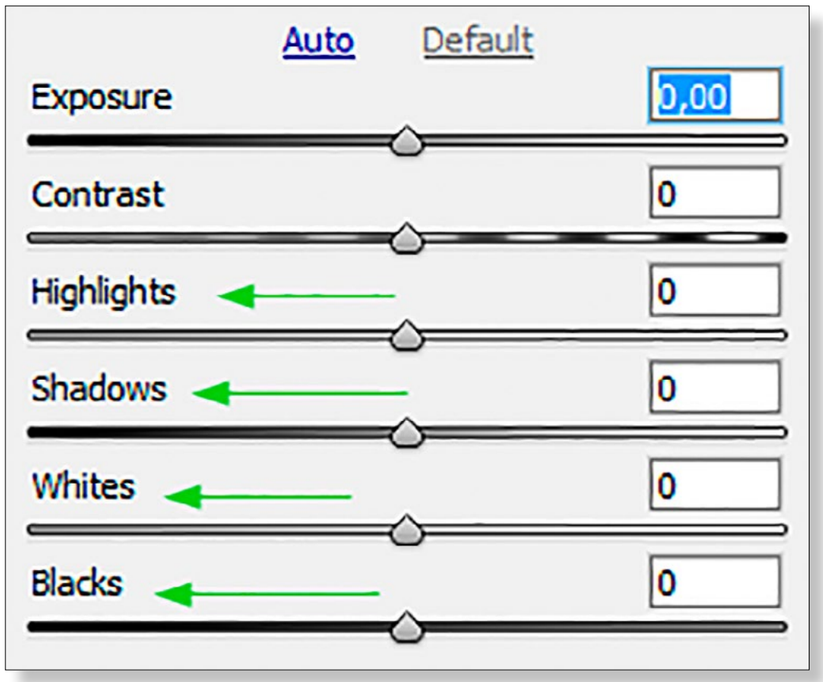

Image 10. Various sliders in Adobe Camera Raw (ACR)

The next step

Flat-looking images share one common problem: insufficient contrast. Of course, the best way to prevent contrast problems is "in the camera"—basically, by doing it the right way when shooting the pictures. But there are images that are not that bad and can be improved using slight contrast adjustments. Again, RAW or DNG are the ideal file formats with which to work.

Before grabbing the Contrast slider or manipulating curves in Photoshop's ACR (Adobe Camera Raw) or Lightroom, a general understanding of what contrast is helps us make fine postproduction adjustments that give an already good image the final kick.

In photography, contrast is the difference between dark and light; the larger the difference between dark and light areas, the greater the contrast. In very simple words, boosting the contrast in digital postproduction turns bright areas of an image brighter and dark areas darker. The same counts for colours and tones. Everything is about light.

Increasing contrast in digital postproduction should be done carefully and subtly, using very

Image 12. Red Sea reef scene

Image 13. A quick white balance adjustment and a very slight exposure correction (right)

Image 14. Contrast at -100 percent (far right)

gentle steps. Over-usage can destroy the image.

Now, let's look at a snapshot (Image 12 on previous page) I took in the Red Sea while snorkelling. A quick white balance adjustment and a very slight exposure correction altered the Image 12 into Image 13 (above). However, even though the image now appears more colourful, it still looks sort of "flat." Obviously, a contrast problem. Let's see how we can fix that.

The easiest way is by using the Contrast slider in ACR or Lightroom, which is placed directly below the Exposure slider. Moving the slider to the left reduces contrast, while moving it to the right increases it. And yes, extreme alterations cause extreme results.

Let's have a look at two extremes in Images 14 and 15. You might think that moving the contrast slider to the max (+100) improved the image a lot, but while we might have increased the contrast and made the image look "better," we actually generated a lot of new problems.

As a general rule: Do not overuse it. Always take subtle steps and fine adjustments and always keep your eyes open for the finest details in bright areas, dark areas, and in colours too.

After realising that the notion of "a lot helps a lot" might not be the ideal way to go here, let's take a critical look at what went wrong in the tutorial image after boosting contrast.

- We lost almost all the detail in the shadows.
- We lost detail in the bright tones.
- Colours are clipped.

Image 15. Contrast at +100 percent (below)

In fact, as the Contrast slider increases the overall contrast of the image, the result might look "better" at first glance, but when looking at details—and we should—our eyes catch lots and lots of mistakes. For demonstration purposes, I have used extreme examples, of course. However, whatever you do, always slide the contrast very slightly... or do not move it at all, as we can use the Curves tool for a much finer contrast adjustment.

Curves

Curves are versatile, powerful and scientific. Therefore, I only refer to what curve alterations can do to improve contrast. Modifying curves is the most powerful tool for adding contrast and making an image pop, far better than the Contrast slider can. Furthermore, curve alterations are the top tool for adjusting tones to brighten, darken, shift colours and turn your

Image 17. After applying the "strong contrast" pre-set and slight adjustments in the curve

image into a "better-not-eat-these-sort-of-mushrooms" piece of contemporary art.

Curve controls are found in ACR by clicking on the "tone curve" rider at the top right (second icon). In Lightroom, they are found below the "basics" chapter to the right. See Image 16.

As there are plenty of options here, you may choose one of the pre-sets (linear, middle or strong contrast) and make fine

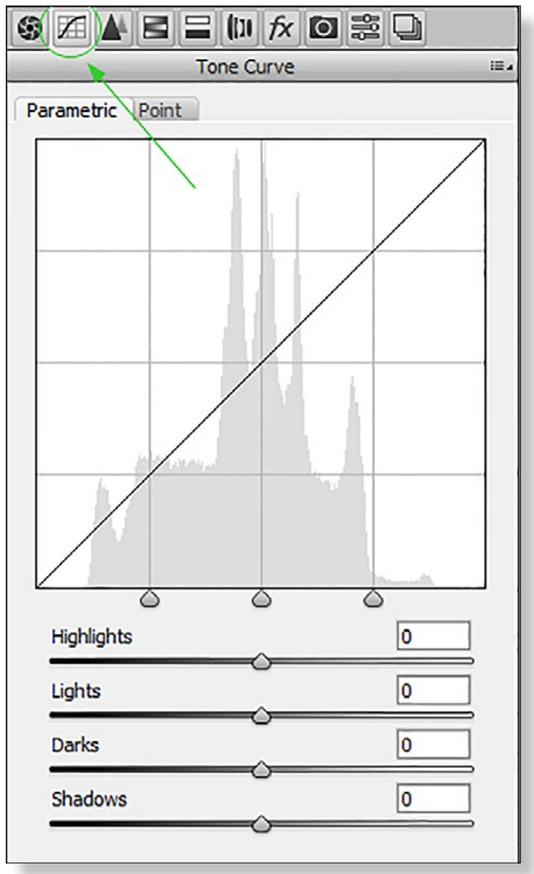

Image 16. Tone Curve controls

adjustments from there. There are plenty more options, but for starters, I will keep it simple.

The classic way to improve contrast is the "S" curve, where—after your alterations—the diagonal line in the curve controls window ends in an "S" shape. A more pronounced S-shape gives a greater effect to the image's contrast and makes the image pop.

By applying the "strong contrast" pre-set and slightly moving the points in the curve for fine adjustments, the photo now looks like Image 17. This image is still just a snapshot (and not really a "keeper"), but now it is at least a snapshot with better contrast, and no clipped blacks or whites.

In the end, always check the results of postproduction closely and carefully—the devil is in the details! Curves might look a bit difficult to understand and use in the beginning, but they provide much finer and more accurate options to improve contrast in an image than the Contrast slider. The good ol' "S" curve is a great place to start! ■

Rico Besserdich is a widely published German photographer, journalist and artist based in Turkey. For more information, visit: ***Maviphoto.com****. See his latest book at:* ***Songofsilence.com****.*

photo & video

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CineBags CB71 Jumbo Dome Port Case

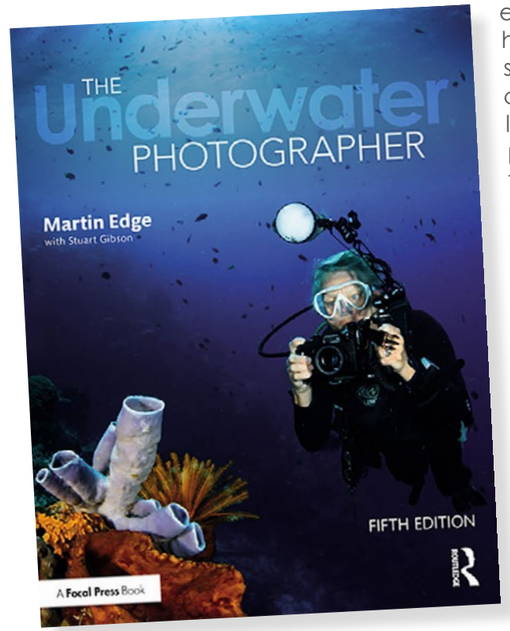
For safe transport and storage of fragile dome ports, CineBags created a specific case that will accommodate a dome port up to 9 inches in diameter, along with a cover and a shade. Various models from brands such as Nauticam, Zen and Sea&Sea will fit inside the pouch. The jumbo dome port pouch is crafted from durable, waterproof tarpaulin fabric. Additionally, it is equipped with a neoprene top handle for easy carrying. Two blank labels on the front provide a place to write your name and the model of the dome port stored inside it. The case weighs just 420g and features a grey exterior with black trim and a blue interior. **cinebags.com**

Backscatter MF-1 Mini Flash

With its compact dimension (comparable to a backup dive torch), the MF-1 Mini Flash from Backscatter is mainly designed for macro enthusiasts who favour a narrow beam angle and the possibility to point light to areas or subjects bulky underwater strobes cannot reach. However, this strobe, with its guide number of 16 and its ability to fire 1,400 flashes with a fully charged Nitecore NL1835HP 18650 battery, is, according to the manufacturer, capable of lighting smaller and mid-sized wide-angle scenes or subjects as well, when using the optional diffuser. The strobes support five power settings, is triggered by an optical cable, and has a built-in 500-Lumen focus light, which is adjustable to three different power settings. When combined with the optional OS-1 optical snoot, the Mini Flash can create a light beam of just 6mm in diameter, while still allowing shots with ISO 64 and F/32. Furthermore, the strobe allows mounting of colour filters, which will be available in the first quarter of 2020. **backscatter.com**

New 5th Edition of Martin Edge's Book, *The Underwater Photographer*

Considered "the Bible for underwater photographers" by many, the fifth edition of Martin Edge's popular book is available for pre-orders, due to ship from April 2020. The book covers everything from the basic principles, equipment and approaches to composition and lighting to creating an individual style. It includes 400 new images, with explanations about how every single shot was taken. New chapters cover the latest equipment, processes and techniques, including SLR cameras, water contact lenses (wet lenses), mirrorless interchangeable lens cameras, micro four-thirds systems, super macro techniques, motion blur, LED lighting and more. **routledge.com**



WhiBal G7 Grey-Card

Whilst nowadays most underwater shooters do their white balance correction during postproduction of images, there are still many shooting situations (such as several different light sources present in one shot) in which doing it "old school" comes with clear advantages and optimized workflow. For a manual white balance prior or during photography sessions, or as an incorruptible reference during postproduction, the grey-card from WhiBal simply does the job. The G7 is designed for low reflectivity, except that the sticker is intentionally highly reflective so that maximum TrueBlack Blackpoint level may be achieved by observing for maximum glare point. It is spectrally neutral, water- and scratch-proofed, and fits in a BCD pocket. **bhphotovideo.com**

AquaTech Leash for Underwater Housings

Originally designed for AquaTech's series of surf housings, the leash comes in handy at times when an underwater photographer needs both hands free but does not wish to release pricey camera gear into the abyss. The leash will keep the housing tethered to your wrist. This utility consists of a comfortable neoprene cuff with thick braided cord of approximately 50cm length. **aquatech.net**

Kim & Kay Vaudin

P O R T F O L I O

portfolio

Jellyfish, by Kay Vaudin, acrylic on canvas, 30 x 20 inches (right)

Mother-and-daughter team, Kay and Kim Vaudin, who are both divers and fine artists, often work together on canvases at their studio, Deep Impressions in the United Kingdom, to capture the dynamic effervescence and minute details of marine life as well as the sublime light and delicate ecosystems of the underwater world. *X-Ray Mag* interviewed Kim Vaudin to learn more about their artwork and their perspectives.

Turtle Cruising, by Kay Vaudin, acrylic on canvas, 24 x 24 inches (below); *Secret Seahorse*, by Kay Vaudin, acrylic on paper, 21 x 15 inches (far left); *Lobster,* by Kim Vaudin, acrylic on paper, 15 x 21 inches (previous page)

Kim & Kay Vaudin

Text edited by G. Symes
Photos courtesy of Kim and Kay Vaudin

X-RAY MAG: Tell us about yourselves, your backgrounds, how you became artists and how you work together as artists.

KV: My family is originally from Guernsey, and we spent all of our summers on the beach and in the sea. I was 14 when I did my first dive with my dad guiding me down the harbour steps at Portelet. I did not realise it at the time, but it would shape the rest of my life. My father is a BSAC First Class Diver and Instructor, so the house was full of divers. I loved their banter and stories of underwater adventures. Kay (my mum and fellow artist) would make their wetsuits and A flags. She was also well known for her potent home-brew, which fuelled many a raucous gathering around our kitchen table. The diving life was fascinating and infectious. So, after my degree, I travelled the world and worked my way around Australia so I could dive on the Great Barrier Reef. I can clearly remember the euphoria I felt on those dives to this day.

It was not until years later, after I had finished two years in art college, that I knew I had to try and combine this love of the sea with my urge to create. Using a Motormarine II camera, my underwater photos of Plymouth Sound and the Red Sea were disappointing. I was never going to be able to capture the beautiful reefs and topside in one image. So, I decided the only way was to start painting.

My mum had always painted, and when I mentioned my ideas, she was in. It was a huge challenge. Weeks later, I completed my first British underwater painting, *Beneath the Sound*, while Kay's *Between the Reefs* showcased the Red Sea where she loved to snorkel. We took a stand at the DIVE show in Olympia—absolutely the most nerve-wracking show I have ever done. Thankfully, our paintings were well received, and 20 years on, we are still exhibiting at the DIVE shows.

Ray of Light, by Kay Vaudin, acrylic on paper, 12 x 16 inches (left)

Kim & Kay Vaudin

The Wall, by Kim Vaudin, acrylic on paper, 23 x 17 inches

Working together has been invaluable as we will bounce ideas off of each other and discuss future projects. At times, it has tested our relationship, but we would not have missed a single minute of it.

X-RAY MAG: Why marine life and underwater themes? How did you come to these themes and how did you develop your style of painting?

KV: We have always lived by the sea and love being in the water. Painting enhances this feeling and keeps this connection alive.

I particularly wanted to showcase all the wonderful British marine life we have on our doorstep. Unlike a photograph, painting gives us full control over the picture. Diving and snorkelling around the world have always inspired new paintings, and so our collection has grown.

Recently, we have expanded our style and have started exploring new techniques and mediums. Our latest work is much looser with a more abstract feel and has opened up a much wider audience to us. This is an ongoing process for both of us, so who knows what direction our work will take in the future?

X-RAY MAG: What is your artistic method or creative process?

KV: After making rough sketches, we stretch our paper then begin adding many layers of washes and background formations. Once the foreground is painted, all the creatures and detail can be added. It can take many days and even weeks to complete a painting.

Our new work on canvas is far more organic. We never know how they will come out and it is very freeing and exciting. We use a lot of different texture effects, adding tissue paper, fabric and mixing in sand, which

I collect from the beach by our studio. This gives a 3D effect, and as we apply more layers, all kinds of creatures appear out of the texture.

Finally, once a painting is complete, we critique each other's work. This has proved a crucial, if painful, part of the process, testing on our relationship. But it always results in a far stronger painting.

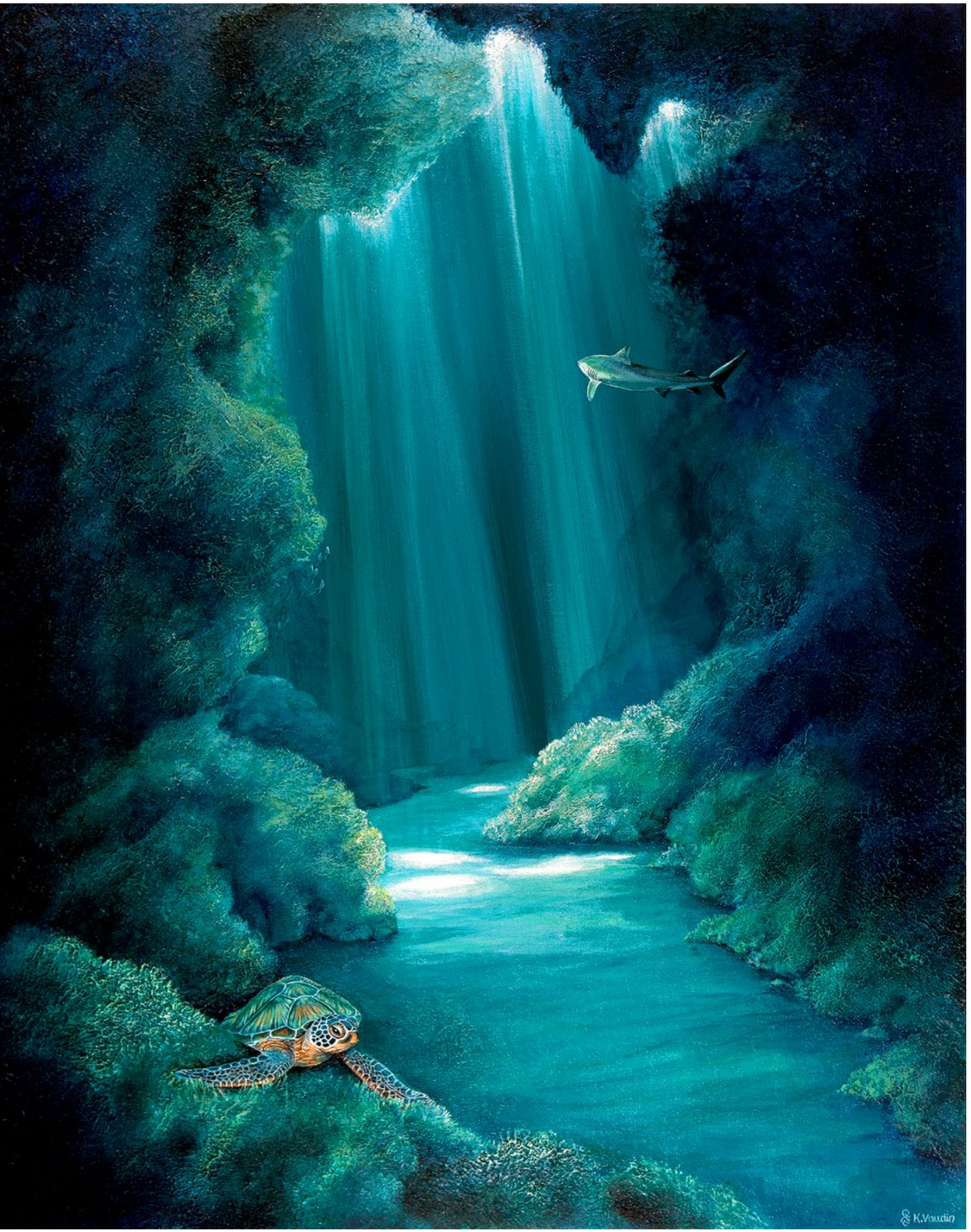
X-RAY MAG: What is your relationship to the underwater world and coral reefs? How have your experiences underwater influenced your art? In your relationship with reefs and the sea, where have you had your favourite experiences?

KV: For over 22 years, I have lived in Plymouth on a boat with my partner Mike, who is a marine biologist. We dive from our 43ft catamaran, as we have got some great sites and loads of life here. One memorable encounter was when we came across a huge common octopus fully out on a gully ledge, and I had forgotten to put the sim card in my camera! Although I did get five shots of this beautiful creature in the internal memory, I was kicking myself. Another time, we found a massive torpedo ray, and as it lifted off the sand like a space-ship, I stretched my arms—it must have been over 5ft. But sometimes you cannot beat simply lying in the sand face-to-face with a cuttlefish—

Mewstone Ledges by Kim Vaudin, acrylic on canvas, 16 x 23 inches

portfolio

Coral Garden, by Kay Vaudin, acrylic on paper, 15 x 21 inches (right)



Cavern by Kay Vaudin, acrylic on canvas, 30 x 24 inches

magic moments.

Topside, one of my best memories is jumping in with a basking shark off the Mewstone and finning like crazy trying to keep up with it. The fact that it defecated over my brother has etched this in my memory forever! So, when I painted the *Mewstone Ledges*, I had to include the basking sharks. Just off Guernsey this year, we came across large schools of bluefin tuna that were hitting the fish on the surface, it was amazing. That is definitely a painting for the future.

Every winter, we dive abroad, and after each trip, I always come back inspired and itching to get back to the easel. In Raja Ampat, we came across a huge school of fish being herded by a group of mobula rays. I felt like I was in the *Blue Planet* series. This dive alone inspired me to produce several paintings trying to capture the movement and light of being in this amazing fish ball.

We have been close to manta rays in many locations, but the giant mantas of Socorro were spectacular. In Yap, we enjoyed a two-hour dive alone in only six metres of water with mantas skimming over our heads and showing off for us.

We have been lucky enough to encounter hammerheads in several locations, but we never expected to see the sheer numbers that we saw in the Galapagos. There were hundreds racked up in the blue—pretty mind-blowing.

X-RAY MAG: What are your thoughts on ocean conservation and coral reef management and how does your artwork relate to these issues?

KV: As divers, we are extremely concerned about the state of our oceans, and in particular, the slaughter of headline species such as apex predators and manta rays. There have been many scientific studies that show that the economic value of these creatures is far higher alive than dead. So, it seems that the current trend of

The Wave, by Kim Vaudin, mixed media on canvas, 30 x 40 inches (left); *Undersea Sunswirl*, by Kim Vaudin, acrylic on canvas, 30 x 30 inches (right); *Manta Light*, by Kim Vaudin, acrylic on canvas, 36 x 24 inches (below)

assigning a value to the environment has a lot of potential. It is alarming to think that, unless we act now on a global scale, the reefs and marine life could be so very different by the time my nieces and nephews are old enough to dive and explore the world for themselves.

I think that we have come a long way with regard to looking after our oceans and managing the seas within my lifetime. Attitudes have really changed, and this process has accelerated, at least in part, due to ground-breaking productions such as *Blue Planet*. However, there is still a long way to go, particularly with the major challenges of climate change, overfishing and plastic pollution.

We think it is important for everyone to realise that although the oceans face many issues, they are still full of life and definitely worth preserving. For example, earlier this year, we dived in Sudan, and we were amazed at the healthy condition of the pristine reefs inhabited by numerous fish, sharks and turtles. By continuing to paint such beautiful scenes, we hope to inspire the next generation to encourage them to interact with our seas and care for the life within them.

X-RAY MAG: What is the message or experience you want viewers of your artwork to have or understand?

KV: There are all kinds of reasons people connect with our work. Divers are often reminded of a particular dive or underwater experience. For others, they may simply love the sea and are drawn to a particular creature or just love bright colours. If, by looking at one of our paintings, people can escape even for a moment to a place where they feel more alive, then we have succeeded.

X-RAY MAG: What are the challenges or benefits of being artists in the world today? Any thoughts or advice for aspiring artists in ocean arts?

KV: I have found trying to get a balance between creating art, keeping inspired, managing a business and marketing is a juggling act. It is definitely something I am still working on. The main benefit has to be doing the thing you love. It does not feel like work at all. We are always thrilled when people we do not know buy our work because it enhances their lives in some way. It's so gratifying.

To any aspiring artists out there, absolutely do it! You will always regret it if you do not try. Try to focus on the people who love and connect with your work. It is easy for a negative comment to block out all the good. Do not compare your work with others. There is room for everyone. And if you can gain any business and marketing experience along the way, this will be invaluable to you. It can be the most rewarding thing you will ever do.

X-RAY MAG: How do people—adults and children—respond to your works?

portfolio

Kay Vaudin (left) and Kim Vaudin (right) at work in their studio

KV: We meet so many interesting people at shows and in the studio. We thrive on their reactions and thoughts on our art. Plus, we get to talk about the thing we love through our paintings.

We often get customers saying things such as, "That's exactly like when I dived the Galapagos" or "It reminds me of my honeymoon in the Maldives." Others simply need a painting to match their décor. It is fascinating to hear what they respond to in a painting.

Children get totally immersed in our work, especially when we are painting live at shows. Some can identify all of the fish in a picture absolutely correctly. One of our youngest fans is 10 years old and he badgered his mum for weeks for a print of the *Mewstone Ledges* for his birthday. We always talk to kids about diving and snorkelling and hope that they will be inspired to start themselves. They may be the marine biologists of the future.

Plankton, by Kim Vaudin, acrylic on canvas, 24 x 36 inches

X-RAY MAG: What are your upcoming projects, art courses or events?

KV: We will be painting and restocking for the Country Living Spring Fair at Alexandra Palace next April, which is an exciting new show for us. In between, we will hopefully take a dive trip to recharge our batteries and get inspired for the next series of work.

X-RAY MAG: Lastly, is there anything else you would like to tell our readers about yourself and your artwork?

KV: We recently opened our own working studio in Plymouth along with my brother, Dave, so it is a real family affair. He is not only an excellent picture framer, but he also makes these amazing wooden surfboards from scratch, which are finished with his own designs. My favourite design, naturally, is his mackerel board. If you are ever in Plymouth, please drop in. We would really love to see you. ■

Whaleshark, by Kim Vaudin, mixed media on canvas, 30 x 20 inches

For more information and to order prints, please visit the artists' website at: ***deepimpressions.co.uk***.