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X-Ray Mag

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Galápagos Islands

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COVER PHOTO BY KATE JONKER

DIRECTORY

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PUBLISHER & EDITOR-IN-CHIEF
Peter Symes
Editor@xray-mag.com

PUBLISHER, MANAGING EDITOR & CREATIVE DIRECTOR
Gunild Symes
Gunild@xray-mag.com

ASSOCIATE EDITORS
Scott Bennett, Toronto
Scott@xray-mag.com
Catherine GS Lim, Singapore
Cat@xray-mag.com
Matthew Meier, San Diego
Matt@xray-mag.com
Michael Menduno, Berkeley
Michael@xray-mag.com

Russia - Moscow
Andrey Bizyukin, PhD
Andrey@xray-mag.com
Svetlana Murashkina, PhD
Svetlana@xray-mag.com

Sweden
Lelle Malmström
Lelle@xray-mag.com

ASSISTANT EDITORS
Rosemary E. Lunn, London
Roz@xray-mag.com
Don Silcock, Sydney + Bali
Don@xray-mag.com

USA
Larry Cohen, New York City
Larry@xray-mag.com

ADVERTISING
ASIA-PACIFIC
Juliette Myers, Sydney
Juliette@xray-mag.com

UNITED KINGDOM
Rosemary E. Lunn, London
Roz@xray-mag.com

USA & INTERNATIONAL
Matthew Meier, San Diego
Matt@xray-mag.com

Contacts page: Xray-Mag.com

IN MEMORIAM
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Barb Roy, Associate Editor

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Lawson Wood - *UW Photo*

CONTRIBUTORS THIS ISSUE
John A. Ares
Rico Besserdich
Andrey Bizyukin
Sheryl Checkman
Larry Cohen
Pierre Constant
Anita George-Ares
Kate Jonker
Catherine GS Lim
Kyo Liu
Matthew Meier
Simon Mitchell, PhD, DipAdvDHM
Brandi Mueller
Andy Murch
Malcolm Nobbs
Wesley Oosthuizen
Simon Pridmore
Gary Rose, MD
Michael Rothschild, MD
Gunild Symes
Peter Symes
Olga Torrey
Jamie Watts
Nate Wilson

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COVER PHOTO: *White-edged nudibranch, Kate's Secret Reef, Gordon's Bay, South Africa*
Photo by Kate Jonker (**katejonker.com**)

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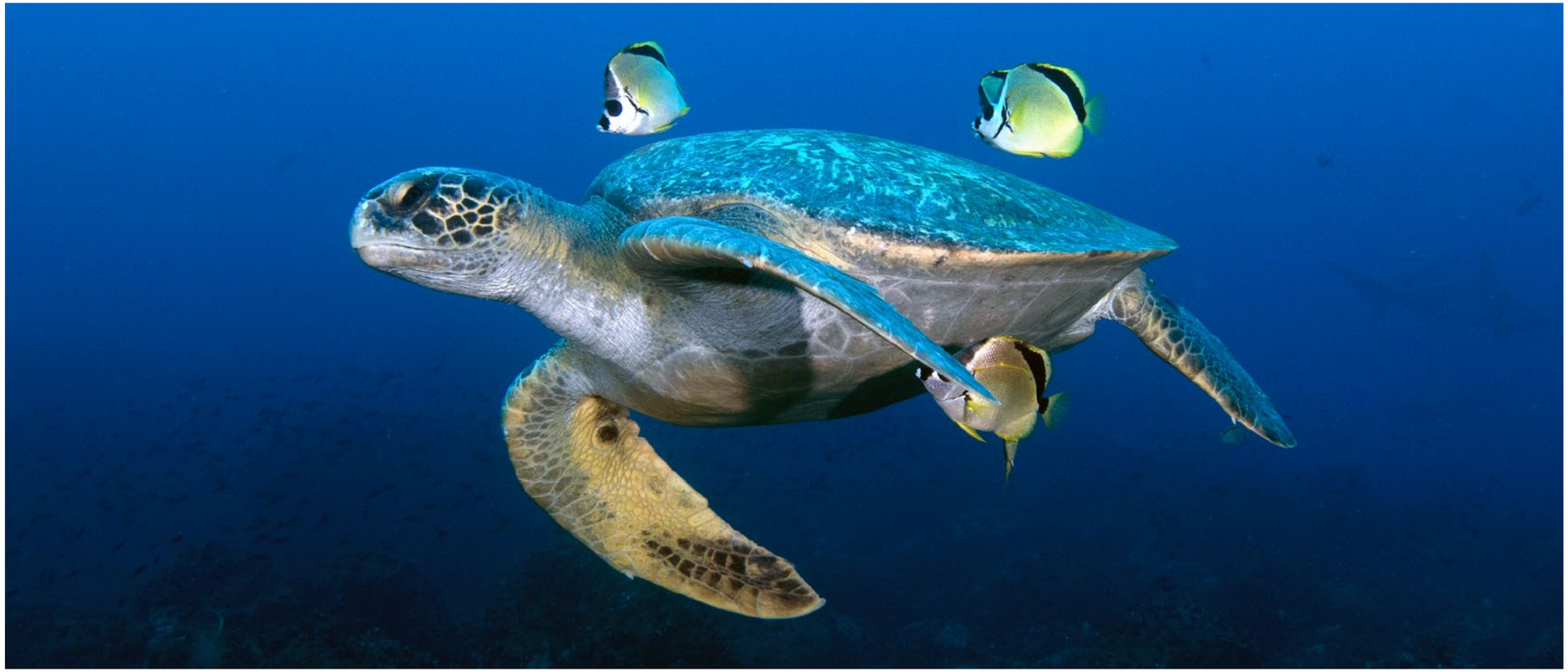
Green sea turtle being cleaned by barberfish, Galápagos Islands. Photo by Brandi Mueller



Competence & Confidence

Diving is a relatively safe activity and pastime. At least, it ranks low in statistics regarding injuries compared to many other sport disciplines. Certainly, we would not have dive programmes and certifications for young kids under eight years old if it was unsafe or risky.

But low risk is not equal to no risk, and whatever is considered an acceptable level of risk under various circumstances can always be lowered further—perhaps just in small increments, but it all adds up over time.

Risk mitigation and awareness is not about killing the excitement of diving but about making sure everyone always returns safely from a dive and does not suffer any injury. It is about making sure we live to dive again another day and have many more great experiences in the good company of fellow dive buddies. Not least, it is also about not having our loved ones worried sick every time we venture out to dive. We simply owe it to them to always be safety-minded and not cavalier about risk, because they will suffer too if we suffer any serious or lasting injury.

It is not like I am obsessing over injuries and accidents, but I find myself quite preoccupied with learning from incidents and finding improvements, however small, or coming to new realisations of where and how mistakes are made so recurrences can be avoided. They do this type of analysis in many other industries, as a matter of fact. The insights gained from them can also be quite interesting because one may learn a lot about the human psyche in the process.

Founder of *The Human Diver* and Global Underwater Explorer's director for risk management, Gareth Lock, who brought the concept of Human Factors into dive training, coined the term counter-errorism—I suspect as a fun yet serious pun, which turned out to be eye-catching on printed merchandise. In any case, I think it is a brilliant slogan, as it puts a single, memorable and highly descriptive word to the mindset we should cultivate.

Going methodically and calmly through my pre-dive checks, and keeping all my gear in good nick and well-maintained, puts me in the zone where I feel focused, confident and relaxed, yet never complacent or inattentive. This comes with a lot of benefits. It makes my dives significantly more enjoyable and more effortless, and it leaves me with plenty of mental reserves to deal with unforeseen situations, in a calm and collected manner. As a result, I take better pictures too, and I avoid the dreaded, excruciating, expensive flooding of my camera gear—knock on wood.

A lot of the techniques and mindsets are adapted from technical diving, where they were first developed and then trickled down to recreational diving. X-Ray Mag is not a technical diving magazine as such, but a big part of the reason why we publish a fair deal of articles on technical diving is because of all the useful insights, lessons and mindsets that all divers can benefit from, regardless of their level of certification.

Venturing into technical diving is a personal choice, and we are not suggesting that everyone should go down that route, but we do encourage all divers to pay attention to new developments and insights. Progress is constant and interesting to follow.

— Peter Symes
Publisher & Editor-in-Chief

Edited by
Catherine GS Lim

Deep-sea batfish (right); Highfin lizardfish, *Bathysaurus mollis* (below); Close-up of a flatfish, *Pleuronectiformes* (centre); Tribute spiderfish (centre right)

New species discovered off Western Australia

Ground-breaking research voyage in Australia's newest marine park makes rare deep-sea discoveries.

While on a mission to map the volcanic geography of Cocos (Keeling) Islands Marine Park off Western Australia, researchers aboard the vessel Investigator also surveyed the deep-sea life in the Indian Ocean Territories.

In doing so, they came face-to-face with many fascinating, and some previously unknown, species.

Besides filming videos of the vast marine life amidst the summits of seamounts, the team also collected specimens from depths as deep as five kilometres below the surface.

Once the expedition returned to port in early November 2022 after 35 days at sea, the researchers set about studying and documenting the specimens they retrieved from the deep sea. Some of the species include:

- The Sloane's viperfish, which have light organs along its underside and a long upper fin with light organs on the tip that it uses to attract prey;
- A previously unknown blind eel, covered in loose transparent gelatinous skin, that give birth to live young;
- The deep-sea batfish, with its arm-like fins and a small "fishing lure" in a small hollow on their snout that it uses to attract prey;
- The highfin lizard fish, with its long sharp teeth and an ovotestis with functional male and female reproductive tissue;
- The tribute spiderfish, with its long lower fns with thickened tips that enables it to prop upwards off the surface as if it were on stilts.

A previously unknown species of eel

During the expedition, the researchers had been sharing their discoveries with more than 850 school students and community members in Australia through real-time livestreaming.

The expedition was a collaboration between Museums Victoria Research Institute and CSIRO, in partnership with Bush Blitz, Parks Australia, Australian Museum Research Institute and the Western Australian Museum. ■

We have discovered an amazing number of potentially new species living in this remote marine park.

— Dr Tim O'Hara, Chief Scientist of the expedition and Senior Curator, Marine Inveterbrates at Museums Victoria Research Institute

BENJAMIN HEALLEY / MUSEUMS VICTORIA

Sloane's viperfish

RODRIGO FRISCIONE / PUBLIC DOMAIN

Sailfish hunting sardines in the open ocean off the coast of Mexico

How marine predators find food hot spots in open ocean

Marine predators, such as tunas, billfishes and sharks, aggregate in anticyclonic, clockwise-rotating ocean eddies.

Ocean eddies are coherent, rotating features that are ubiquitous at mid-latitudes and rotate clockwise in the Northern Hemisphere.

As these anticyclonic eddies move throughout the open ocean, a recent study suggests that the predators are also moving with them, foraging on the high deep-ocean biomass, which tends to accumulate within.

The research team was able to investigate predator catch patterns with respect to the eddies, concluding that eddies influence open ocean ecosystems from the bottom to the top of the food chain. This discovery suggests a fundamental relationship between predator-foraging opportunities and the underlying physics of the ocean.

Connection

This connection between the surface and deep ocean is essential to consider in impact assessments of future deep-sea industries. Understanding how eddies influence the behaviour of open ocean predators, specifically in food-scarce areas like subtropical gyres, should inform effective management of these species, their ecosystems and dependent fisheries.

"Harvesting the food that our food eats, is something we need to understand in order to ensure the methods are sustainable for both the prey and the predators that rely on them. That is critical to ensuring both ocean health and human wellbeing as we continue to rely on these animals for food," said Dr Martin Arostegui, WHOI postdoctoral scholar and lead author of the paper. ■

SOURCE: NATURE

Got an itch that needs scratching? Tuna use sharks as back scratchers

Scientists have observed instances in which tuna rub themselves against the side of sharks. Apparently, they do this to dislodge painful parasites that cling to their heads, eyes and gills.

"Shark skin is really smooth in one direction and it's like sandpaper in the other," said Chris Thompson, a Research Fellow at the University of Western Australia.

Thompson and his colleagues observed this behaviour after studying the footage of floating, baited underwater cameras, which they had deployed in 36 regions in the Pacific, Indian and Atlantic Oceans in 2012 to 2019.

Although their original intention was to observe generalised interactions between fish and sharks, they were intrigued when they saw the tuna's intriguing behaviour a total of 106 times.

In all, 44 percent of the incidents were initiated by yellowfin tuna, while southern bluefin tuna and skipjack tuna accounted for 16 percent and 3.8 percent of the time respectively.

In 17 percent of all rubbing incidents, the tuna rubbed against their own species.

On the other side of the interaction, it was the blue shark that was the preferred shark species 58 percent of the time. Interestingly, the sharks appeared not to be bothered by the activity at all.

Smaller fish like skipjack tuna were less likely to engage in such behaviour, possibly as a precaution to avoid ending up as prey.

It is possible that the decline in shark numbers may reduce the occurrence of such interactions, and this has implications for the benefits that the tuna receive from the rubbing behaviour. ■ SOURCE: PLOS ONE

CHRISTOPHER D. H. THOMPSON / OPEN ACCESS

news

Edited by
Peter Symes

LINDSEY KRAMER / USFWS / CC BY 2.0

Key reef-building coral species from left to right: cauliflower coral (*Pocillopora meandrina*), lobe coral (*Porites lobata*), and finger coral (*Porites compressa*)

Palau's Rock Islands harbour heat-resistant corals

The Rock Islands harbour two lineages of thermally tolerant corals; one shows no consistent growth trade-off and occurs on several outer reefs.

Palau's Rock Islands experience consistently higher temperatures and extreme heatwaves, yet their diverse coral communities bleach less than those on Palau's cooler outer reefs.

Scientists studying reefs in Palau have identified genetic subgroups of a common coral species that exhibit remarkable tolerance to the extreme heat associated with marine heatwaves.

Importantly, the scientists have also found evidence that larvae from these corals are travelling from their birthing grounds deep in Palau's lagoons to the outer reef, where they survive and grow, and maintain their heat tolerance.

This suggests that the Rock Islands provide naturally tolerant larvae to neighbouring areas. Finding and protecting such sources of thermally-tolerant corals is key to reef survival under 21st-century climate change.

The Palau research is directly related to the Super Reefs initiative WHOI launched with The Nature Conservancy and Stanford University to locate coral communities that can withstand marine heatwaves, and work with local communities and governments to protect them. ■

SOURCE: COMMUNICATIONS BIOLOGY

PHOTO COURTESY OF KIDS SCUBA / DIVEHEART MALAYSIA

Participants in the adaptive diving initiative on Langkawi Island, Malaysia, in December 2022

RHB Banking Group partners with Diveheart Malaysia

In its collaboration with Diveheart Malaysia, RHB Banking Group (through its subsidiary RHB Islamic Bank Bhd) has stepped up its sustainability efforts with an initiative to empower the special needs community.

This initiative took place on 3 December 2022, in conjunction with the International Persons with Disability Day, said the banking group in a press release.

Diveheart Malaysia is part of the US-based non-profit organization Diveheart in Chicago, which focuses on helping disabled persons become certified divers through the adaptive diving techniques specialty training of the Professional Association Diving Instructors (PADI).

RHB Banking Group's managing director and chief executive officer, Mohd Rashid Mohamad, said the bank was the first banking group in Asia with its own team of employees who are qualified PADI Adaptive Techniques support divers.

"Through this collaboration, eight of RHB's PADI advanced certified divers, which includes senior management team (members), have volunteered to be trained and certified by Diveheart Malaysia Ambassador Syed Abd Rahman as adaptive buddy support divers," he said.

A joint commitment

A spokesman for Diveheart said: "Diveheart is delighted to collaborate with RHB Bank as the first bank in Asia to have a qualified Diveheart adaptive buddy team. Through this, RHB divers are also able to assist persons with disabilities for water therapy—for them to feel zero gravity underwater.

"This great initiative truly reflects the joint commitment in reinforcing RHB's ongoing efforts to support and care for society by fostering inclusivity amongst Malaysians," he added.

The initiative was made possible by a Diveheart partnership with University Malaya Medical Center UMMC, Tourism Malaysia Langkawi, Scuba Club Langkawi SCL, Langkawi Autism Center LAC and the Diveheart team in the Northern Region of Malaysia.

Inclusivity, ocean conservation and financial literacy

On behalf of RHB Bank, Diveheart Ambassador Malaysia Rahman said: "This underlines our additional commitment towards championing inclusivity in support of UN SDG 10 'Reduced Inequalities,' alongside amplifying our main thrust of UN SDG 14 'Life Below Water,' where we continuously emphasize ocean conservation and preservation.

"In addition to this, we continue to reinforce financial literacy among the younger generation in Pulau Langkawi through a comprehensive ocean-themed Children's Financial Literacy Workshop, which combines the importance of marine conservation and financial well-being," he said.

Eco-friendly cards

Since the establishment of RHB Ocean Harmony in 2019, a part of RHB Banking Group's larger sustainability initiative, RHB Islamic Bank has actively promoted environmental sustainability and marine conservation. In a first for the Asia Pacific region, one of the ocean-themed initiatives under Ocean Harmony includes the issue of eco-friendly recycled plastic debit cards, in partnership with WWF-Malaysia. ■

For more information, please contact Hj. Syed Abd Rahman, Director, Scuba Educator, PADI IDC Staff Instructor, Advisor to the National Dive Council Malaysia, Chairman of Accessible Tourism Standards Malaysia, and Ambassador for Diveheart Malaysia, at KIDS SCUBA (a PADI 5-Star Dive Center, recipient of the PADI Youth Diver Education Award and PADI Outstanding Contribution to Diving Industry Award). Email: ***kidsscuba@yahoo.com****. Visit:* ***kidsscuba.com****.*

I started attending DEMA shows in 1994, so I have seen its up and downs.

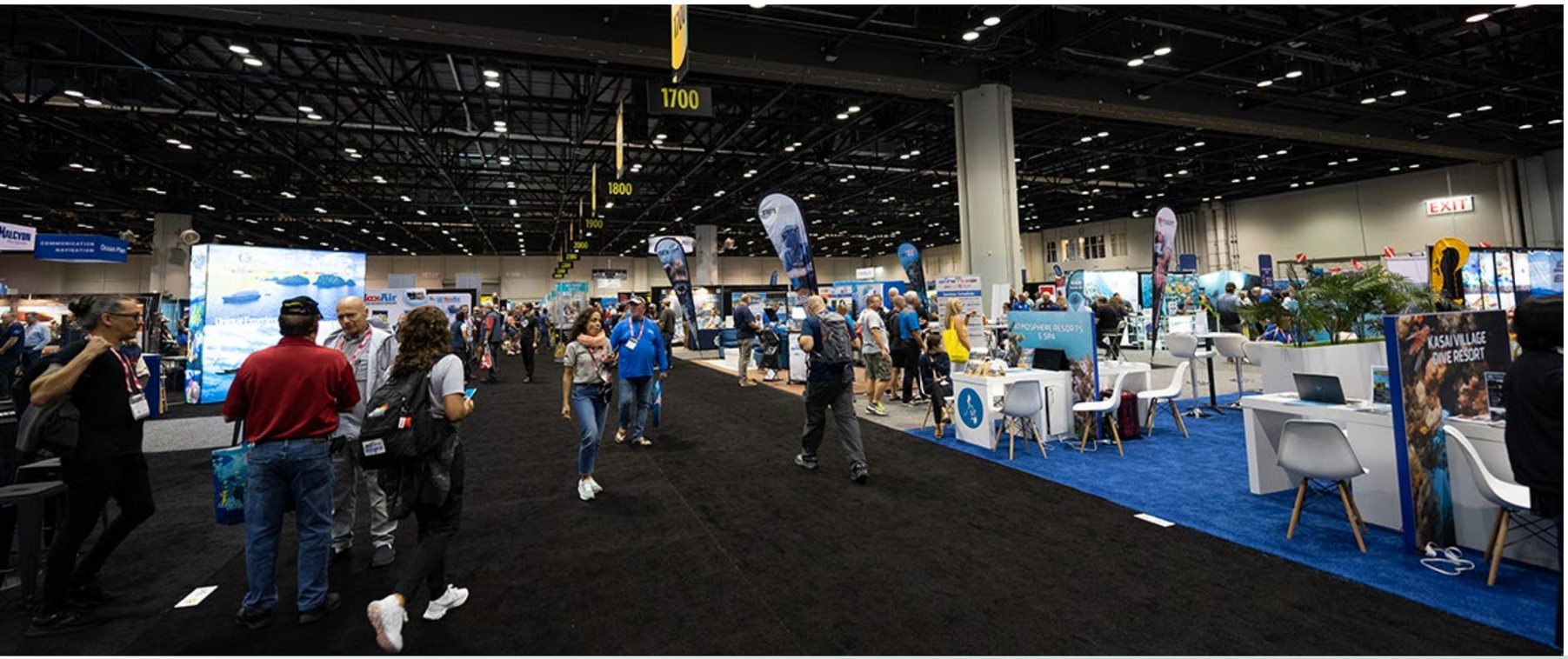
Skinny but upbeat DEMA Show 2022

Text and photos by Peter Symes

DEMA Show 2022 was held in Orlando, Florida, USA, on 1-4 November. This show was the first regular edition in three years due to the pandemic, the effects of which were still felt.

After two years of disruption because of the pandemic, DEMA Show was back in gear. Well, largely. It was still markedly more compact than the pre-pandemic editions but still a large show with far more booths than one could reasonably manage to visit during its four days. Also importantly, the mood appeared to be upbeat, with businesses eager to ramp up activities as the industry and travel activities pull away from the doldrums.

That said, a lot of important players and regulars were missing. Most notably, most of the larger equipment brands had given this show a pass, and that was probably the biggest single factor for the smaller number of booths this time around, as each of the big brands usually take out big islands. I was informed by the show organisers that around 850 booths were sold, which I take as booth units (and not the number of exhibiting entities), compared to around 1,200 in a "normal" year; they were pleased with the result under the circumstances.



Personally, I was quite disappointed by the big brands' decision not to take part and support the community that constitutes the ecosystem upon which they depend and from which they derive their revenue. I do appreciate that participation in the expo is quite an expense, but it is also an investment and a statement. In any case, their absence left me with the sentiment that the big brands copped out exactly when they needed to step up to the plate.

For perhaps the same reason, there was not much to be seen regarding new dive equipment or developments, but a couple of interesting inventions were on display, which we feature in our Equipment section. It was more of a travel show this time around.

Another factor that sprang to mind is the major economic impact the pandemic has had on many industry members with a number going outright out of business and many others being cash-strapped after haemorrhaging money. Anecdotally, I also noticed a widespread excitement that next year's show is going to be held in New Orleans for a change, and this factor may have played a role among those who decided to sit this one out.

All that being said, we were quite pleased with the event and the results of our efforts at the expo. Plenty of dormant business was reawakened, and prior clients came aboard again, along with several new clients. It is also always nice to meet new people. ■

wreck news

Edited by
Peter Symes

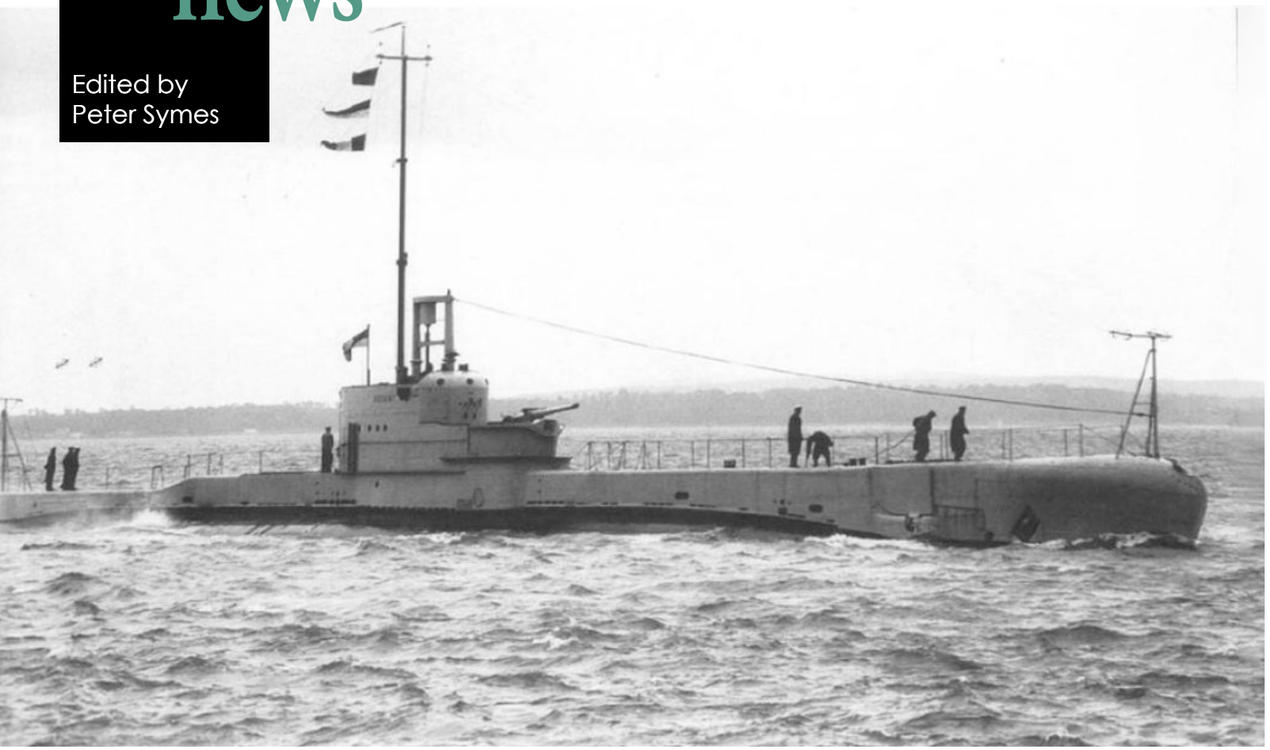


IMAGE COURTESY OF FABIO BISCIOTTI / IWM NON COMMERCIAL LICENCE

Historical photo of HMS *Regent*

HMS Regent, long lost WWII submarine, found in the Adriatic

The British submarine HMS *Regent* sailed to patrol the southern Adriatic but was lost with all hands at some point in April 1943, most likely after striking a mine.

The newly-found wreck lies off the coast near Villanova di Ostuni, some 19 miles from Monopoli.

First believed to be found by Italian divers in 1999, it was later determined in 2020 that the wreck thought to be *Regent* was in fact the Italian submarine *Giovanni Bausan* which had been sunk by the RAF in 1944.

Now, it seems another dive team has had better luck in identifying *Regent*. She rests off the coast near Villanova di Ostuni, some 19 miles from Monopoli, upside down in 70m of water. The apparent victim of a mine.

It is hoped the discovery will finally bring some closure to the families of the 62 crew who perished.

Dick Trice, who is the grandson of William Trice, the chief engine room artificer on the *Regent*, told the *Daily Mail* the location of the wreck "lines up perfectly" with what is known about the ship's final movements. ■

WESSEX ARCHAEOLOGY/ PRESS RELEASE

3D model still of 16th century ship found at Dungeness quarry

Remains of a rare Elizabethan-era ship found in quarry

Very few English-built 16th-century vessels survive, making this a rare discovery from what was a fascinating period in the history of seafaring.

Workers at a quarry near Dungeness made the dramatic discovery of a rare Elizabethan-era shipwreck on the coast of Kent while dredging gravel for building materials out of a lake in April.

The location is now some 300 metres from the coast, but archaeologists believe that the site was once right on the coastline. The vessel could have been wrecked or abandoned on the former shoreline, and then gradually buried in sediment as time passed and the headland expanded.

Over 100 timbers from the ship's hull were recovered, with dendrochronological analysis, funded by Historic England, dating the timbers that built the ship to between 1558 and 1580 and confirming that it was made of English oak.

This places the ship at a transitional period in Northern European ship construction—when ships are believed to have moved from a traditional clinker construction (as seen in Viking vessels) to frame-first-built ships (as recorded here), where the internal framing is built first and flush-laid planking is later added to the frames to create a smooth outer hull.

This technique is similar to what was used on the Mary Rose, built between 1509 and 1511, and the ships that would explore and settle along the Atlantic coastlines of the New World. ■

SOURCE: WESSEX ARCHAEOLOGY

WESSEX ARCHAEOLOGY/ PRESS RELEASE

Detail of a rare Elizabethan ship found at a quarry in Kent

wreck news

Edited by
Peter Symes

PUBLIC DOMAIN

The steamship SS *Pacific* went down in November of 1875 with the loss of at least 275 passengers and crew.

Steamship lost in 1875 off Washington coast located

The wreck of the side-wheel passenger steamship SS *Pacific* has finally been located by a team of local divers and historians after having been missing for almost 150 years.

The SS *Pacific* was on its way from Puget Sound and Victoria to San Francisco when it collided with a big sailing ship in the dark off Cape Flattery on 4 November 1875 and sank in less than an hour. The *Pacific* had an estimated 275 passengers and crew aboard of which only two survived, making the sinking the most deadly maritime disaster in Northwest history.

Only a handful of details of what happened came to light afterwards because there were only two survivors—one who floated around on debris for 40 hours, and another for 80 hours.

Discovery

The discovery of the wreck, by exploration company Rockfish, is set to clear up decades of debate about how the ship sank and whether there is gold among the artefacts that went down with the ship.

"There was cargo that was insured, so yeah, we think it's likely," said Rockfish founder Jeffrey Hummel who led the search in an interview. Hummel has been searching for the *Pacific* for about 30 years.

Hummel and his crew sent down remote-operated vehicles, which took some images of the wreck and the debris field—which they say clearly shows the two sidewheels on the bottom—as if they broke off as the ship sank.

Next steps

Now that Rockfish has located the wreck, it is focused on choosing the right equipment to excavate what is left of the wreckage over the next three years.The next thing is to do more site analysis next year, Hummel told KIRO Newsradio.

"We're planning on doing artifact recovery from the debris field next fall, so sometime like September, October of next year, we'll do that," Hummel said. "And the debris field is a few thousand square metres. And we're going to develop some equipment to recover and preserve the artifacts from there."

The exact location of the wreck is not available to the public. That being said, it is known that the wreck is somewhere off the coast of Washington, sitting in over 1,000 metres of water.

This ship is not to be confused with the SS *Pacific* that vanished in 1856 in the Atlantic. ■

SOURCE: KIRO NEWSRADIO

Photogrammetry-rendered virtual image of one of three well-preserved shipwrecks, over 300 years old, discovered in the Baltic Sea, at around 150m.

JD-CONTRACTOR A/S / PRESS RELEASE

Nearly intact ancient shipwrecks found in the Baltic

A team from the Sea War Museum Jutland have located and filmed three unique and exceptionally well-preserved shipwrecks in the Baltic Sea. The ships are presumed to be over 300 years old and appear virtually untouched on the seabed.

The discoveries in the Baltic Sea are unprecedented and have revealed shipwrecks hundreds of years old. Two of them are with great certainty cargo vessels from the Netherlands, while the third and largest is supposed to be a Scandinavian vessel.

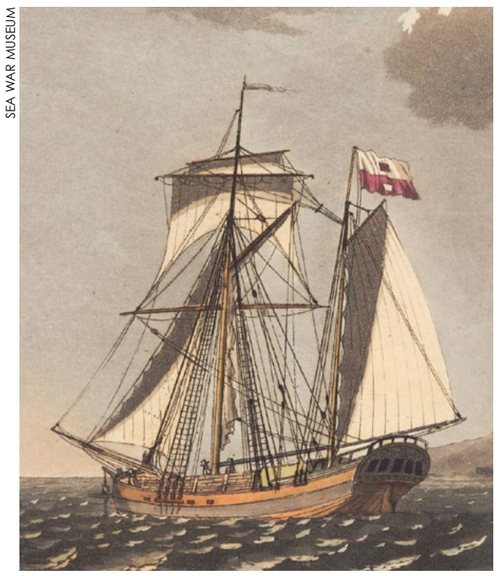
All three shipwrecks stand like ghost ships almost unscathed in total darkness on the seabed at a depth of approximately 150 metres and beyond the reach of modern fishing vessels.

"It was fantastic to see the wrecks appear on the screen when we sent an underwater robot with a camera down to the seabed. The wrecks stood almost as they did the day they sank hundreds of years ago. I have been diving all my life and have examined hundreds of wrecks, but I have never seen anything like this. The ships stood as if they had just been abandoned," says Gert Norman Andersen, expedition leader and director of Sea War Museum Jutland.

The expedition took place in October in collaboration with Danish JD-Contractor, who provided the offshore ship *Sima* and underwater robots with advanced technology, and with the participation of experts from the National Museum. The expedition, with a total of 27 participants, set out with the aim of investigating the breakdown of wrecks and materials underwater. But no one expected to find wrecks that are so well preserved, says Andersen.

In order to obtain the best footage, two Swedish photogrammetry experts Ingemar Lundgren and Fredrik Skorg from the company Ocean Discovery took part in the expedition. An underwater robot equipped with an advanced camera brought thousands of images to the surface and reproduces with great precision a virtual image of the wrecks as they actually appear.

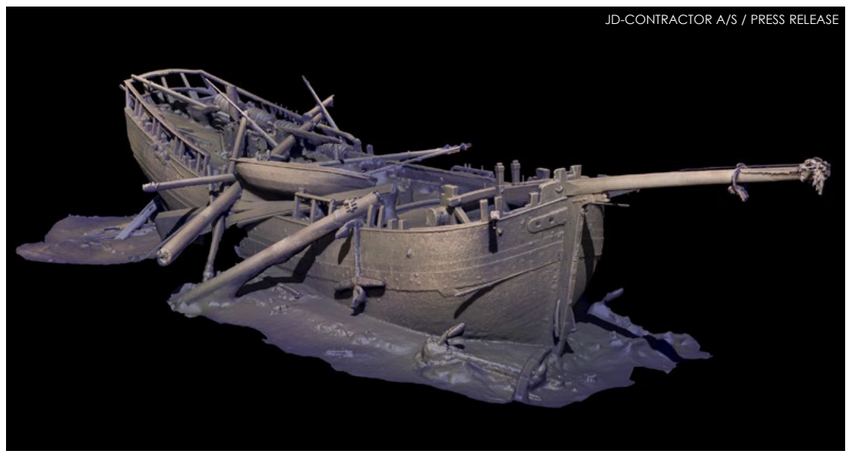
The pictures are so detailed that you get the feeling of being able to walk around a ship that sank hundreds of years ago. ■ SOURCE: SEA WAR MUSEUM



SEA WAR MUSEUM

Stettiner galeas of the same type as the wreck. Painting by Niels Truslew, 1805.

JD-CONTRACTOR A/S / PRESS RELEASE



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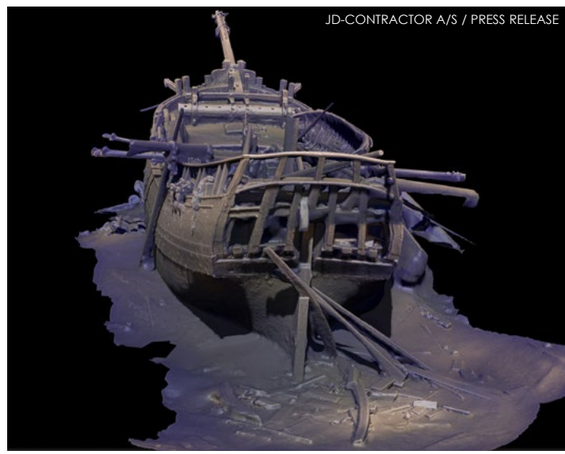


JD-CONTRACTOR A/S / PRESS RELEASE

LEFT TO RIGHT: Cannon wreck seen from the starboard bow; View of the port side of the wreck; View of the stern; Detail view of the aftdeck (centre-right)


VRAK - MUSEUM OF WRECKS/ PRESS RELEASE


VRAK - MUSEUM OF WRECKS/ PRESS RELEASE


VRAK - MUSEUM OF WRECKS/ PRESS RELEASE


VRAK - MUSEUM OF WRECKS/ PRESS RELEASE

Diver on *Äpplet*, port side by lower gundeck (top right); Lower gun deck (top centre); Port side with recess for gunport (top left); Gunport (centre); Comparison of *Äpplet* and *Vasa* (right)

Vasa's sister ship discovered

Swedish maritime archaeologists have discovered the wreck of ship *Äpplet* (*The Apple*), the long-lost sister ship of the 17th-century warship *Vasa*, which sank on its maiden voyage, the Swedish Museum of Wrecks has said.

Launched in 1629, *Äpplet* was built by the same shipbuilder as the famed 69-metre *Vasa*, which was carrying 64 cannons when it went down in a strait off the island of Vaxholm, just outside the capital, Stockholm. *Vasa* was meant to serve as a symbol of Sweden's military might at the time but capsized after sailing just over 1,000 metres. It was salvaged in 1961 and is on display at the *Vasa* Museum in Stockholm, one of Sweden's most popular tourist spots.

On several occasions, the museum's maritime archaeologists have collaborated with the navy to survey a strait at Vaxholm, an island outside Stockholm. In December 2021, a huge shipwreck was discovered there. Parts of the ship's sides had fallen to the bottom of the sea, but the hull was otherwise preserved up to a lower gun deck. The fallen sides had portholes on two different levels, evidence of a warship with two gun decks.


JAVIERKOHEN / WIKIMEDIA COMMONS / CC BY-SA 3.0

Vasa on display in its museum in Stockholm

Identity confirmed

Measurement data, the ship's technical details, wood samples and archival data confirm that it is indeed *Äpplet*, *Vasa*'s sister ship. "Our pulses spiked when we saw how similar the wreck was to *Vasa*," said Jim Hansson, a maritime archaeologist at the museum.

The discovery of *Äpplet* provides important new knowledge. "With *Äpplet*, we can add another key piece of the puzzle in the development of Swedish shipbuilding," Hansson said. "And it's only now that we can really study the differences in the constructions of *Vasa* and *Äpplet*."

"This will help us understand how the large warships evolved, from the unstable *Vasa* to seaworthy behemoths that could control the Baltic Sea—a decisive factor in Sweden's emergence as a great power in the 1600s," said Patrik Höglund, another maritime archaeologist at the museum.

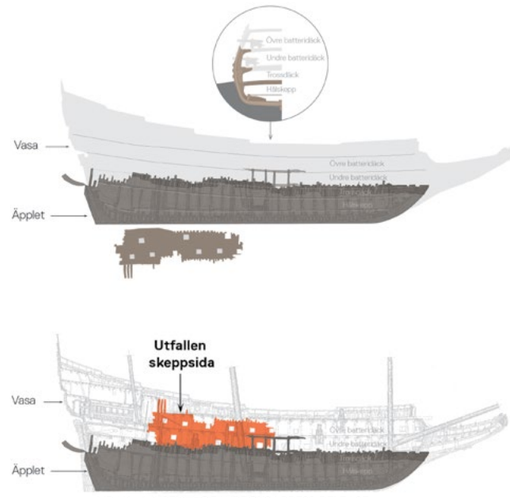
History

Äpplet was completed in 1629 by the shipbuilder Hein Jacobsson. He had completed *Vasa* the year before and suspected, even before the ship was launched, that *Vasa* had been built too narrow and was therefore likely to be unstable. So *Äpplet* was built wider, with a slightly different hull shape.

When Sweden joined the Thirty Years' War, *Äpplet* was among the ships sailing towards Germany. It had about 1,000 men on board, of which 900 were soldiers. Following the war, the ship was in active service until 1658. It was probably idle most of the time—larger ships were rarely used because they were expensive to maintain, inferior as sailing vessels and more difficult to manoeuvre than smaller ships.

Scuttled

Äpplet was inspected in 1658 and deemed to be no longer in such condition that it would be worth repairing. The following year, it was sunk.



VRAK - MUSEUM OF WRECKS/ PRESS RELEASE

As early as the mid-1500s, the Swedish navy began work on blocking a narrow strait off Vaxholm. During the 1600s, at least ten large Swedish warships were deliberately sunk on the site. One of them was *Äpplet*.

There is a diving ban in the area where the wreck is located. ■

SOURCE: VRAK - MUSEUM OF WRECKS

ANDERS GUTEHALL, VISUELL ARKEOLOGI

Photogrammetric overview of Varbergskoggen 1 (right) and Varbergskoggen 2 (centre)

Varberg cogs dated to the 1300s

The two cogs found in Varberg on the western coast of Sweden last spring were built in the middle of the 14th century and came from afar, new analyses show.

The two cogs, named Varbergskoggen 1 and Varbergskoggen 2, were found at the former shoreline next to Varberg's medieval predecessor Getakärr. During the Middle Ages, Getakärr was a town in northern Halland, located immediately north of the current centre of Varberg, which is a city on the west coast of Sweden.

Varbergskoggen 1 consists of an almost complete port side, which is approximately 20.5m long and 5m high. Varbergskoggen 2 consists of the first part of a bottom section, approximately 8m long and 4.5m wide.

ANDERS GUTEHALL, VISUELL ARKEOLOGI

The cog was a common ship type during the period 1150–1450, but nonetheless, only a handful of cogs have been found in Sweden.

The two cogs have features that are characteristic of medieval shipbuilding techniques: The bottom of the hull is carvel-built (where the planks are laid edge to edge) while the sides are clinker-built (where the edges of hull planks overlap each other); the seal between the boards is made with moss and special sealing strips; and the strong crossbeams have their ends sticking out through the sides of the hull.

Interesting finds

Several interesting finds were made on the wrecks, such as leather shoes, wooden household utensils and ceramics, which can tell a lot about life on board. In Varbergskoggen 1, which is the larger of the two, there were also a lot of equipment and spare parts for the ship.

THE ARCHAEOLOGISTS / NATIONAL HISTORICAL MUSEUMS / PRESS RELEASE / CC-BY

Excavation work on the site of Varbergskoggen 1, found in Varberg, Sweden

"We have fine wooden objects that the crew used in their everyday life such as wooden bowls and spoons; we also have a number of barrel locks and barrel bottoms with engravings. In the field, we have collected soil samples for analysis, which may contain food remains and show the type of cargo that was on board. From that we can learn where they came from and where they were going," said Elisabet Schager, an archaeologist at the National Historical Museums of Sweden.

The first wooden samples from the wreck have now been analyzed and show that Varbergskoggen 1 was built with wood that was felled after 1346 somewhere around the Netherlands, Belgium and northeastern France.

The smaller Varbergskoggen 2 was built from oak that was cut in 1355–1357 in northern Poland. The analyses suggest that both ships were long-term guests in the port. To specify the dates and get an idea of how long the kegs were in use, further samples will be analysed in the future. What is unclear is why they sank, said Schager.

THE ARCHAEOLOGISTS / NATIONAL HISTORICAL MUSEUMS / CC-BY

Small figurine found in one of the cogs

"When we clean the timber prior to the 3D scan and look at each part, we may be able to see what is the cause. What we have been able to ascertain already is that when the larger cog came to rest on its side, it was still rigged for some reason."

Two cogs close together

Finding wrecks of cogs is unusual, and finding two cogs only ten metres apart is almost unique.

Varbergskoggen 1, which consists of an almost complete port side, is also the best-preserved cog wreck so far investigated in Sweden. As the dimensions of the timber in the ship's construction as well as the execution of certain construction details differ between the two wrecks, they complement each other in an extraordinary way.

The cog wrecks found around Europe vary in age, size, construction and cargo capacity. This means that knowledge of the ship type's origin, development and spread over time is still very limited. The cogs in Varberg can contribute important knowledge here. ■

SOURCE: NATIONAL HISTORICAL MUSEUMS OF SWEDEN

Decarbonising aviation is possible

Research published in the journal *Nature Sustainability* shows a pathway toward full decarbonisation of US aviation fuel use by substituting conventional jet fuel with sustainably produced biofuels.

Who among us has not felt at least a twinge of guilt in booking a flight to a far-flung dive destination, knowing very well that the trip will add a significant contribution of CO_2 and other greenhouse gases to the atmosphere? Being both a keen traveller and avid environmentalist, I surely have felt conflicted.

Dive travel is a luxury and not a necessity, so are we not a bunch of hypocrites when we try to stand for the environment yet fly long-distance just for leisure?

Surely, we can buy off our indulgences by paying an extra voluntary fee for "bio-sustainable fuel" or some other carbon-offsetting scheme (sometimes of questionable quality or efficacy).

But perhaps there is now hope on the horizon. At least, a new study shows full decarbonisation of US aviation sector is within our grasp, and, I suppose, by extension, ultimately the whole world's too.

The study, led by a team of Arizona State University researchers, found that planting the grass *miscanthus*, also known as silvergrass, on 23.2 million hectares of existing marginal agricultural lands—land that often lays fallow or is poor in soil quality—across the United States would provide enough biomass feedstock to meet the liquid fuel demands of the US aviation sector fully from biofuels, an amount expected to reach 30 billion gallons a year by 2040.

HAMSTERDANCER / WIKIMEDIA COMMONS / CC BY-SA 3.0

Miscanthus giganteus, an energy crop, growing in Germany

SIMON SEES / WIKIMEDIA COMMONS / CC BY 2.0

Hydrogen-powered engines

Hydrogen has long been touted as a sustainable alternative to traditional jet fuel, either as a combustible fuel or used to generate electricity via fuel cells.

The European aircraft manufacturer Airbus is currently developing a hydrogen-powered fuel cell engine—and it plans to test it on the largest commercial airplane ever to take to the skies. The plane builder has previously revealed concept designs for an aircraft utilising liquid hydrogen fuel and combustion engines, but has also suggested fuel cells alone might be sufficient to power smaller commercial aircraft.

The engine uses fuel cells to convert the hydrogen into electricity, which then powers a propeller. "At scale, and if the technology targets were achieved, fuel cell engines may be able to power a 100-passenger aircraft with a range of approximately 1,000 nautical miles," said Airbus' vice president of Zero-Emission Aircraft Glenn Llewellyn. ■

SOURCE: NATURE SUSTAINABILITY

New US law threatens dive operators

The new liability requirement is already causing the cost of passenger vessel liability insurance to substantially increase, and threatening to put many operators throughout the industry out of business.

The liability requirement was included in the recently passed National Defense Authorization Act (NDAA). Lawmakers had been led to believe that Section 11503 of the NDAA was simply a "fix for the families who lost loved ones" in the tragic Conception Dive Boat fire of 2019, DEMA writes.

But the new law goes far beyond one tragedy—it lines the pockets of trial lawyers and does nothing to make sure dive boats are operating safely.

Already, the cost of passenger vessel liability insurance has started increasing substantially, threatening the business of many dive operators, warns DEMA.

According to DEMA, dive vessel operators around the US started reporting exponential increases in their premiums in December 2022 as insurers cited this new law. Consequently, dive vessel operators will have no choice but to pass on these added costs to their customers and increase their rates.

What can be done?

A new US Congress has just been seated and therefore there is still hope for repeal, the trade organization writes in a newsletter. DEMA, therefore, asks that American businesses reach out to their two US Senators and US House Representative to educate them about the true impact of the law on both their business and the industry as a whole. ■

SOURCES: DEMA

Maya Train from Cancun to Tulum will have cable-stayed bridges

Mexico's president, Andrés Manuel López Obrador, says that 70 percent of Section 5 of the Maya Train, which passes through cave-diving country, will be elevated by using cable-stayed bridges.

Tren Maya is a 1,525km (948mi) system of new and revitalized railways designed to connect Caribbean tourist resorts, such as Cancun, with cities, cultural sites and lesser-known destinations inland. The new rail system will pass through the states of Chiapas, Tabasco, Campeche, Yucatán and Quintana Roo—the main regions of the Yucatán Peninsula.

Section 5, which runs from Cancun to Tulum, is divided into two sections. Section 5 North will run around 50km of track from Cancun to Playa del Carmen, and then Section 5 South, will see around 60km of track laid between Playa del Carmen and Tulum.

Controversies

The railway has deeply divided Mexicans, and the controversies surrounding the construction exemplify the struggles developing countries across the globe face to balance economic progress with environmental responsibility.

Critics point out that Mexico's Tren Maya railway line is "splitting the jungle in half" as construction reaches some of the world's most vulnerable species. They fear the train, due to passing so close by, will disrupt wildlife routes and attract too much development to fragile ecosystems. Its hasty construction may critically endanger pristine wilderness and ancient cave systems beneath the jungle floor, droves of scientists and environmental activists say.

Assurances

Lopez Obrador assured that the cable-stayed bridge project of the Tulum-Cancún section has an ecological and cultural dimension. "It means the protection of underground rivers, caves, cenotes, and it is being fought, truly protecting the environment, not in a demagogic way," he added.

Quintana Roo Governor Mara Lezama pointed out that "with the Maya Train construction (the bridge), many archaeological remains have been rediscovered." ■ SOURCE: RIVIERA MAYA NEWS

LARRY COHEN

Jungle being cleared in Yucatán, Mexico

PETER SYMES

Indonesia bans cohabitation and sex outside marriage—also for tourists

Now what, for dive resorts in Indonesia such as this one in Tulamben, Bali?

Indonesian lawmakers have passed a sweeping new criminal code, which also applies to foreign residents and tourists, which bans cohabitation before marriage and penalises sex outside marriage with a punishment of up to one year in jail.

If you are thinking about going on a romantic getaway to Indonesia with your significant other, you should probably reconsider your choice of destination if you are not married. Indonesia's parliament has approved a new criminal code that bans sex outside marriage with a punishment of up to one year in jail.

Will new laws affect tourists too?

The new code, which will apply to Indonesians and foreigners alike, also prohibits cohabitation between unmarried couples. The code will not apply immediately but takes a maximum of three years to transition from the old code to the new one.

Cause for alarm

The changes to the criminal code have not only alarmed human rights advocates, who warned of their potential to stifle personal freedoms, but also travel industry representatives—who worry about their potential effect on tourism, scaring away tourists from Indonesia's tropical shores.

The island of Bali, for example, relies heavily on tourist revenue and is still recovering from the pandemic slowdown that kept travellers away.

Taufik Basari, a legislator of the NasDem Party, said if a tourist visiting Bali, for instance, had consensual sex with an Indonesian national, and it was reported to police by the Indonesian's parent or child, the tourist could be arrested, *The Guardian* reports.

Visitors "not at risk," says governor

Seeking to reassure visitors and dismissing concerns that revised laws, which include articles criminalising sex outside marriage, may scare away tourists from its shores, Bali's governor Wayan Koster has stated that visitors to the island will not be put at risk by this newly ratified criminal code. The new laws, which come into effect in three years, could only be prosecuted if there was a complaint by a parent, spouse or child, the island's governor said. ■ SOURCE: REUTERS

Special Treasures

Yucatán

in Mexican Cenotes

Text and photos by
Pierre Constant

Maya Chenes archaeological site (50 AD) at Hormiguero, near Xpujil (above); Funerary mask of a Maya ruler at the Calakmul Museum of Nature and Archaeology (centre inset); Turquoise-browed motmot (or Toh bird), *Eumomota superciliosa* (right)

Entrance to Cenote Zapote in the sunlight (above); Diver with inverted mushroom stalactites in Cenote El Zapote (previous page)

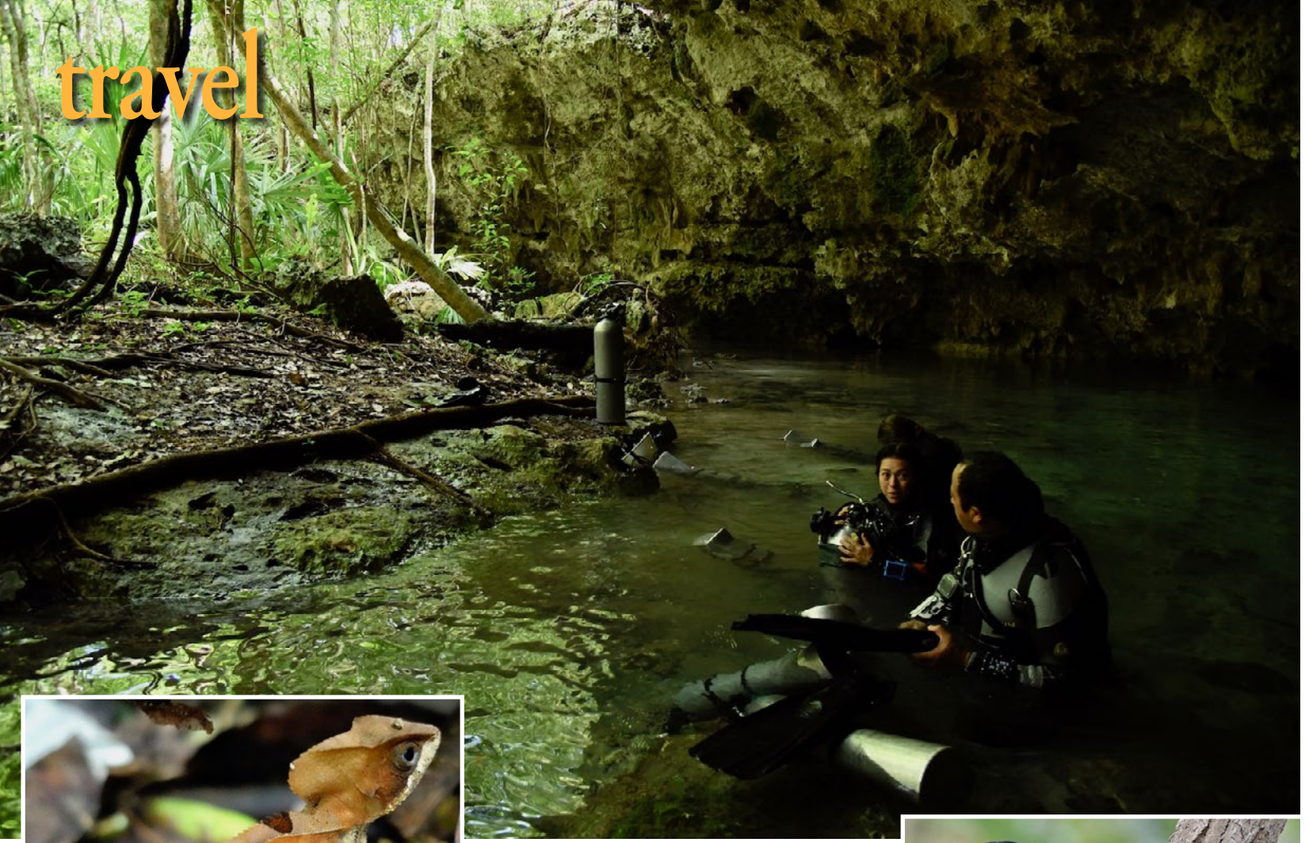
There is no doubt that Yucatán in Mexico is a fascinating region. Not only for its culture, its unique nature and wildlife or the archaeological sites of the ancient Maya, but for the simple fact that it is a cave diver's paradise. Pierre Constant has the story.

It was my fifth time visiting Yucatán in the last five years. Back in 2017, I had taken part in a TDI Sidemount Cave Course in Playa del Carmen. In 2018, I dived the cenotes around Merida and was back again the following year for more. In 2020, my cave training was pushed one step further with a Stage Cave Course in Playa and with a DPV Cave Course (Diver Propulsion Vehicle) in Tulum—even more exciting, but nonetheless challenging. At this level, you cannot use an underwater camera anymore, since you need both hands to deal with the equipment.

As a new diver to the cenote world, you cannot pretend that you have done Yucatán after a single trip! A normal Open Water diver would only be allowed "cavern dives" in a cenote, meaning to say, dives in which daylight is in sight at any given point in the dive. Anything in an overhead environment requires specific cave training, followed by Advance Cave training, well before the Sidemount Cave level and so on…

Needless to say, most divers experiencing cenotes for the first time would only enjoy limited access. Furthermore, they would only get to know the most classic sites, which everybody dives—the tourist side of it, essentially.

With thousands of cenotes to choose from on the Yucatán Peninsula, it is reasonable to assume that it would take a lifetime to explore it all, in the best-case scenario—assuming you have the level, the experience and the guts to do so, that is! Only the most



Casque-headed lizard, *Coryto-phanes sp.*, at Palenque (left); Cave divers at Cenote Concha (above); Yucatan jay, *Cyanocorax yucatani-cus*, at Cenote Crystal (right)

dedicated, hard-core, resident cave divers keep on discover-ing new cenotes every now and then, or push farther into the unknown in existing cave sys-tems. Ponder this for a minute: The longest underwater cave system known today connects 187 cenotes together, with a mind-blowing 365km in length.

Geology

Who has not heard of the meteorite that struck the earth, just northwest of the Yucatán Peninsula, 66 million years ago during the Cretaceous-Paleogene boundary? The result of the impact of an asteroid, the Chicxulub Crater is located northwest of Merida, carved well into the continental crust. Measuring 300km in width and 20km in depth, it was responsible for the second mass extinction on the planet (that of non-avian dinosaurs), as well as the demise of 75 percent of all plant and animal species. The whole world was affected at the time. This marked the beginning of the secondary era (Mesozoic).

What most people do not know, however, is that 170 mil-lion years ago, Yucatán was not yet part of Mexico. Before the breakup of the supercontinent Gondwana—comprising, among others, North America, South America and Africa—Yucatán was temporarily attached to the northern side of South America (Venezuela). As the proto-Atlantic and the Gulf of Mexico began to form, Yucatán broke away from the continent and became an isolated plate 140 million years ago. Rotating counterclockwise and drifting west for the next

Entrance to Cenote Tak Be Ha (far left); Exiting Cenote Chulo (above); Skull of sabretooth tiger (left) and skeleton of gomphothere (below) at Museo de la Prehistoria

50 million years, Yucatán collided with Mexico. A fracture zone emerged on the east of the peninsula, and the Yucatán basin was formed.

Moving westward, the Caribbean Plate came into being from an Atlantic hotspot that faded in time. The oceanic crust of the South American Plate is in subduction under the Caribbean Plate, underlying Central America and the Caribbean Sea. The borders of the Caribbean Plate are regions of intense volcanic activity.

The Yucatán plateau is made of 144-million-year-old Cretaceous limestone. No surface rivers exist. The subsoil is like a sponge, through which water seeps. Although it seems obvious to me that the meteoritic impact created a vast spiderweb of fractures underground, over the millions of years that followed, the rains dissolved the limestone further—creating water streams below the surface—with the occurrence of sinkholes. Most surprisingly, the longest underground rivers in the world are found in the coastal region of Quintana Roo, east of Yucatán. These impressive underground rivers are classified as "systems."

Prehistory

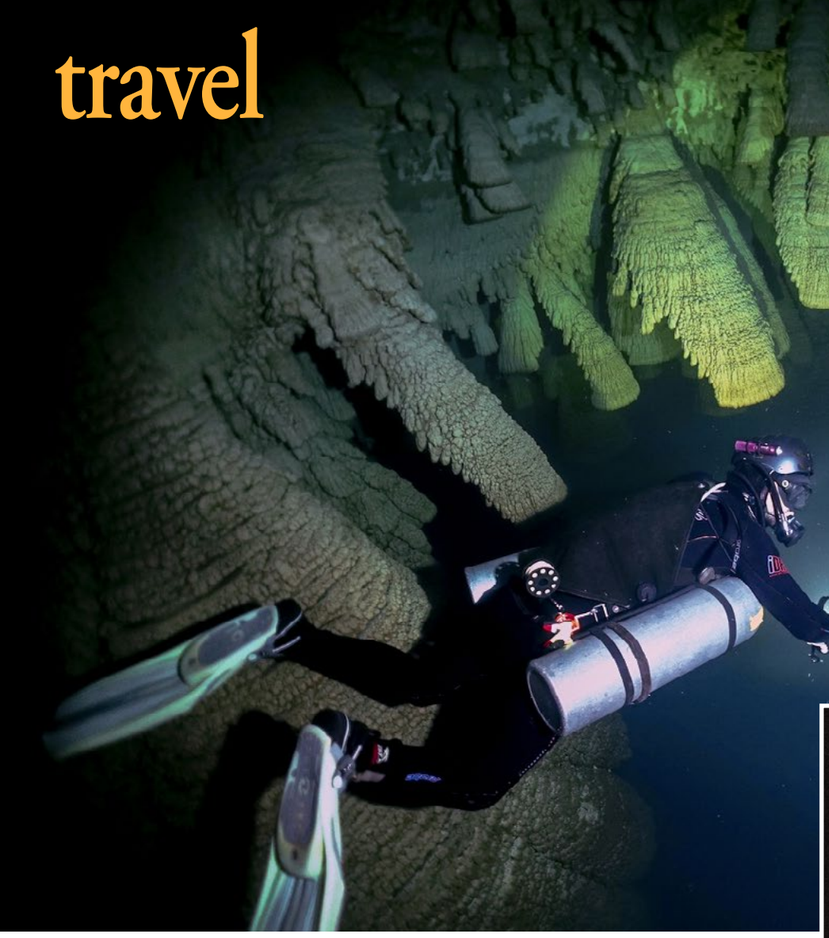
Ice ages affected the Yucatán Peninsula between 150,000 and 20,000 years ago. The last ice age saw the arrival of people from Asia, via a land bridge, through the Bering Strait. Due to extremely cold conditions, people lived underground. The sea level was 65m below actual levels back then.

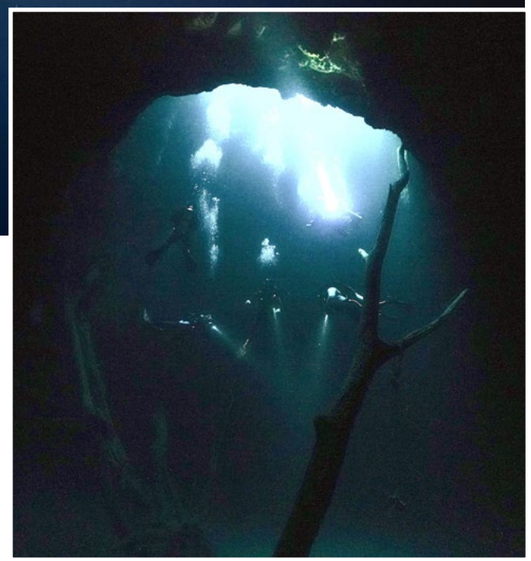
Prehistoric animals also made their home in those caves, including bears, giant ground sloth (*Nothrotheriops shastensis*) and the saber-tooth tiger (*Smilodon fatalis*). Above ground roamed the mammoth (*Mammuthus columbi*), mastodon or gomphothere (*Cuvieronius tropicus*), glyptodont or giant tattoo (*Glyptotherium floridanum*), which was 9ft long. So did llamas, camels and horses—the latter two made their way into Asia.

At the end of the last ice age, about 8,000 years ago, sea levels rose. Most of the caves were flooded by seawater. Fresh water from rains naturally formed a distinct layer on top. In-between is a blurred layer, known as a "halocline," where salt and freshwater mix.

Cenotes

Much later in time, caves played an important role in Mayan cosmogony. The word *cenote*





Divers descending (right) and dive guide Max with inverted mushrooms stalactites (above) in Cenote El Zapote

word *dzonot*, meaning something deep, a chasm or cavern, filled with water. These cenotes symbolise the entrances to *Xibalba*, the underworld or abode of the dead, but also a fertile place where life originates. It is the symbolic path between the earthly world and the "infraworld."

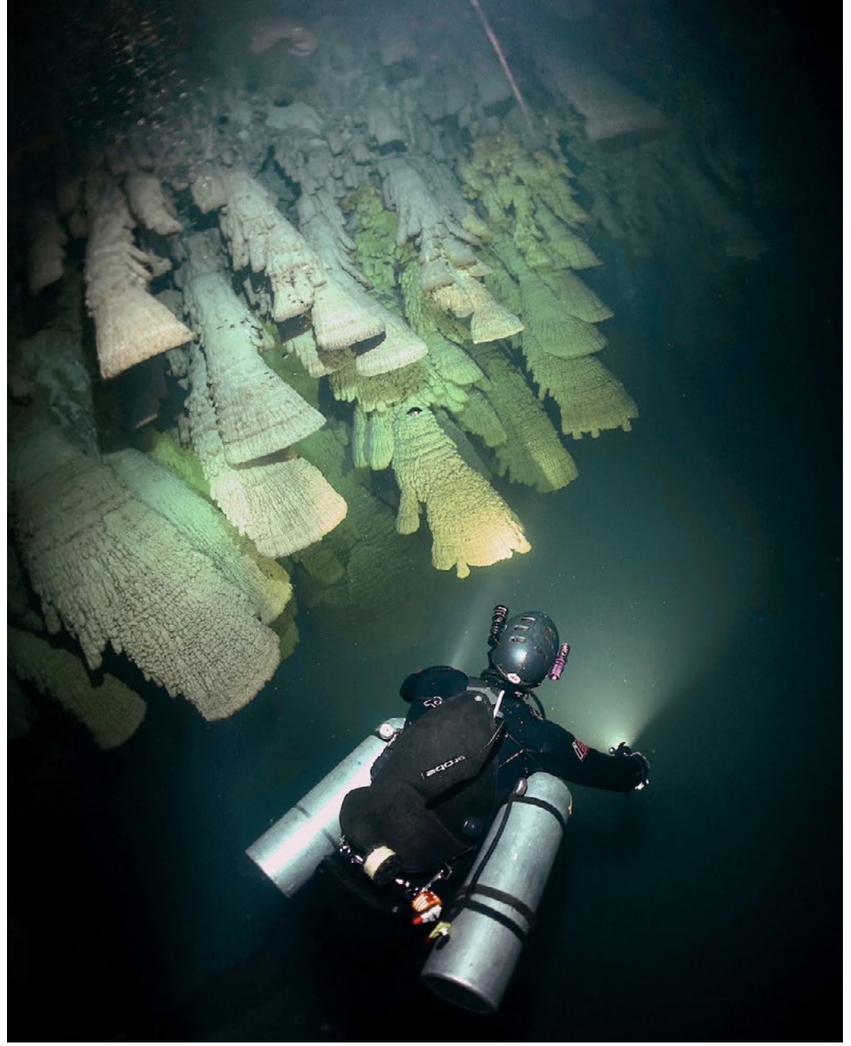
Vases and potteries have been found in these sinkholes, but also offerings such as human sacrifices of young girls. They sometimes served as burial grounds for older people or dignitaries. Nowadays, Mayan people regard the cenotes with respect, as places for *aluxe*, or cave spirits.

On to Playa del Carmen

The Air France flight to Cancun landed at night. After I got the car hire sorted out, I reached the hotel one hour later, slowed by some rain on the highway. Once in Playa del Carmen, I finally made it to bed well after midnight.

A transition day was compulsory, to prepare my dive equipment and underwater camera. I was to meet Max, my cave diving guide, on my second day here. It was by sheer coincidence that we had met four years earlier, while on a Merida cave diving trip together.

In very professional form, Max started with a thorough revision of my cave diving gear, complaining about a thing or two, like the absence of a long hose on my second regulator, a line cutter, spools, etc. The truth was, I had not been cave diving for two years, and a refresher was needed.



Dive guide Max with the mushroom stalactites in Cenote El Zapote (above and right)

I felt a bit of tension at the thought of being in an overhead environment again. So, I needed to be fully focused to undertake the task. When not practising regularly, one forgets things. In this type of activity, there is no room for error. At any rate, I had already done 25 cenotes/caves in past years and was now looking for something new, exciting, and if possible, "special."

Ruta de los Cenotes

Our initial drive took us north to Puerto Morelos, from where we turned west onto the "Ruta de los Cenotes" (Cenote Route). Rather dry, the Yucatán jungle is 10 to 15m tall maximum, home to amazing birds and fascinating animals such as jaguar and puma. "I have been placing infrared cameras in remote spots of the forest and managed to get shots of the creatures," said Max proudly.

Cenote El Zapote. Our plan was to dive El Zapote, a dome-shaped cenote in the dense jungle. The hourglass-shaped sinkhole is rather dark, once one is underwater. There is a poisonous layer of hydrogen sulphide at a depth of 30 to 35m. The trunk of a zapote tree emerges from it like a ghost. "Deep down, the skeleton of a subadult giant ground sloth (*Xibalbaonyx oviceps*) was found by researchers in 2017," said Max.

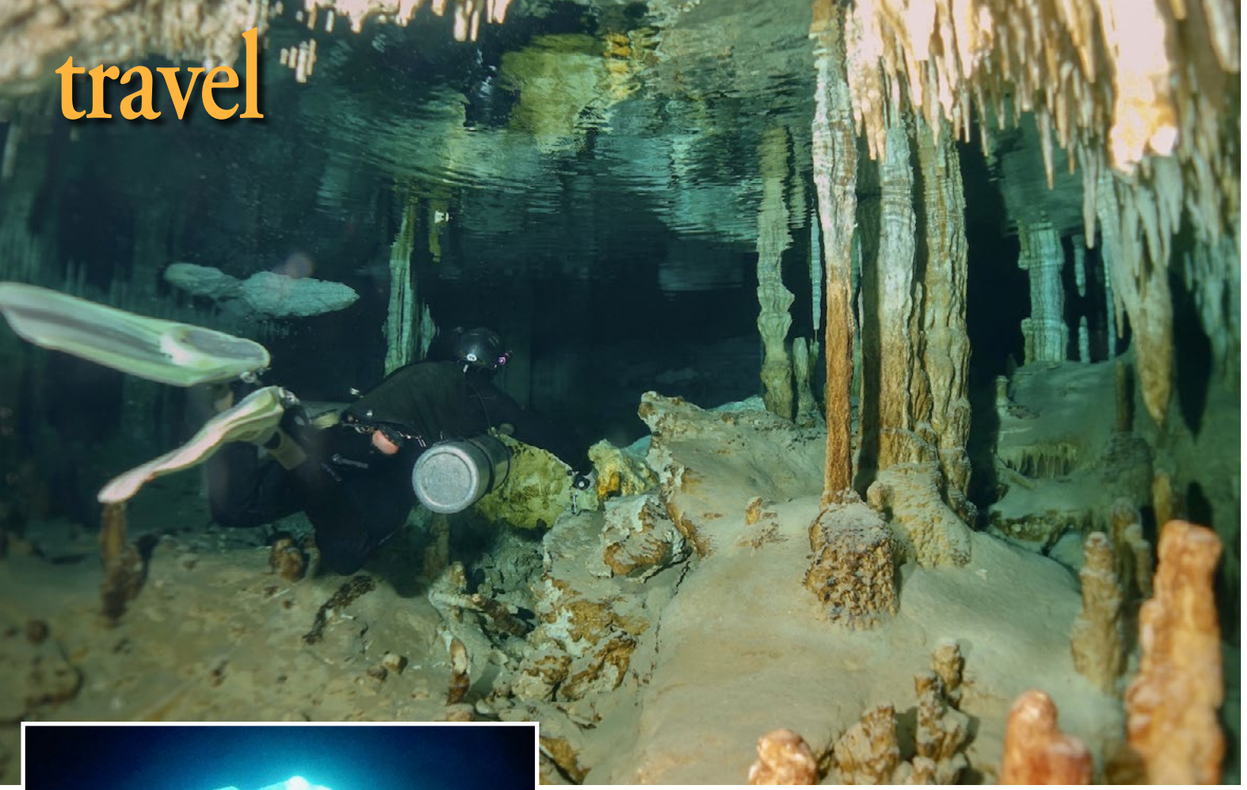
What makes Zapote so unique are the so-called "Hell's Bells" (or inverted mushroom-shaped stalactites) hanging from the walls. The anomily here is that these formations are made in water, resulting from a biogeochemical mechanism, whereas bacteria trapped in the hydrogen sulphide layer create the bells.

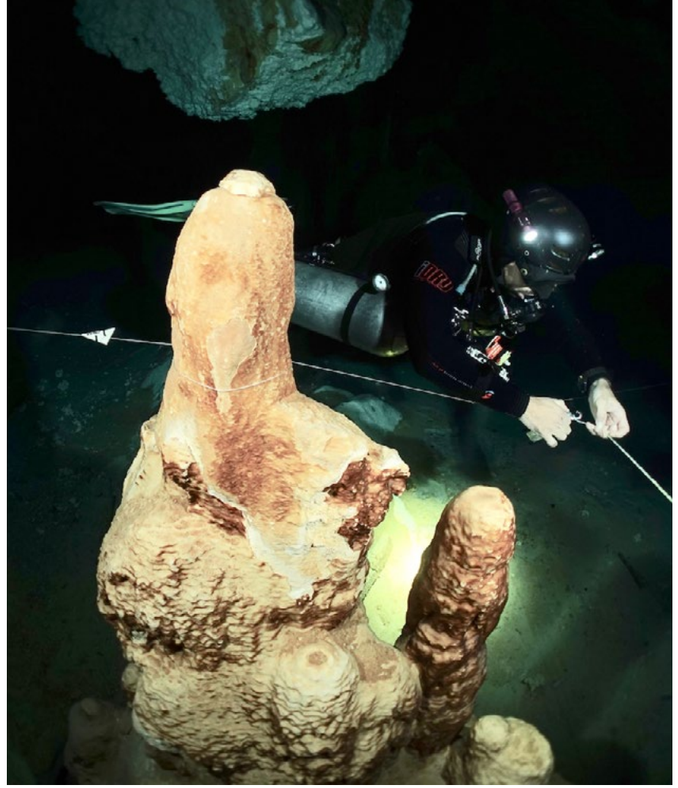
Known as "extremophiles," these tiny creatures thrive in extreme environments, processing sulphur, raising the pH of the water, and causing unique formations to develop above the halocline. The bells are therefore alive on the outside, and sulphur-powered organisms are contributing to the calcium build-up.

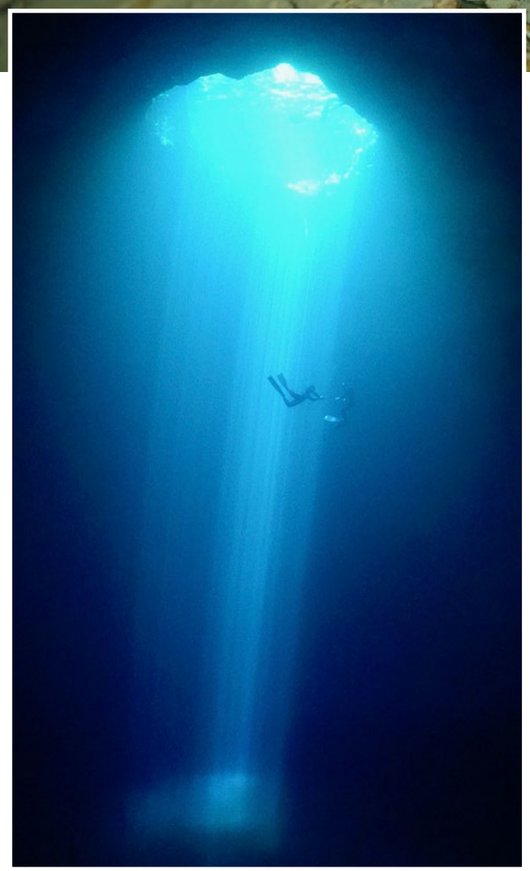
Forming only near the layer at a depth of 90 to 115ft, the bells require a low-light environment. In 2020, a researcher's theory projected that the bell-shaped stalactites were formed that way due to carbon dioxide bubbles rising from the deep, being trapped against the almost horizontal ceiling. Some of these funny mushrooms can be 1 to 2m in length, and 80cm wide.

The micro-organisms consume carbon dioxide, facilitating the deposit of calcite by metabolising nitrogen from alkaline to acidic compounds, under the influence of sulphur and nitrogen redox processes, thus forming biofilms on the surface of the bells, by producing polymers that concentrate calcium.

German researcher Wolfgang Stinnesbeck of the University of Heidelberg investigated the bells, as they are something of a natural wonder. Neighbouring sinkholes also contain similar structures. The zapote tree, at the bottom at 54m, turned out to be 4,500 years old and displayed "baby bells" as well! Radiometric dating of some of the bell specimens indicated that they had grown during the middle and late Holocene, starting over 5,200 years ago.







Freedivers training in Cenote Maravilla

Columns in the shallows of Cenote Tak Be Ha (top left)

Cenote Maravilla. For our second dive, Cenote Maravilla was just nearby. It was a circular sinkhole, partly blown up by the owner, with a steep wooden stairway climbing down into it.

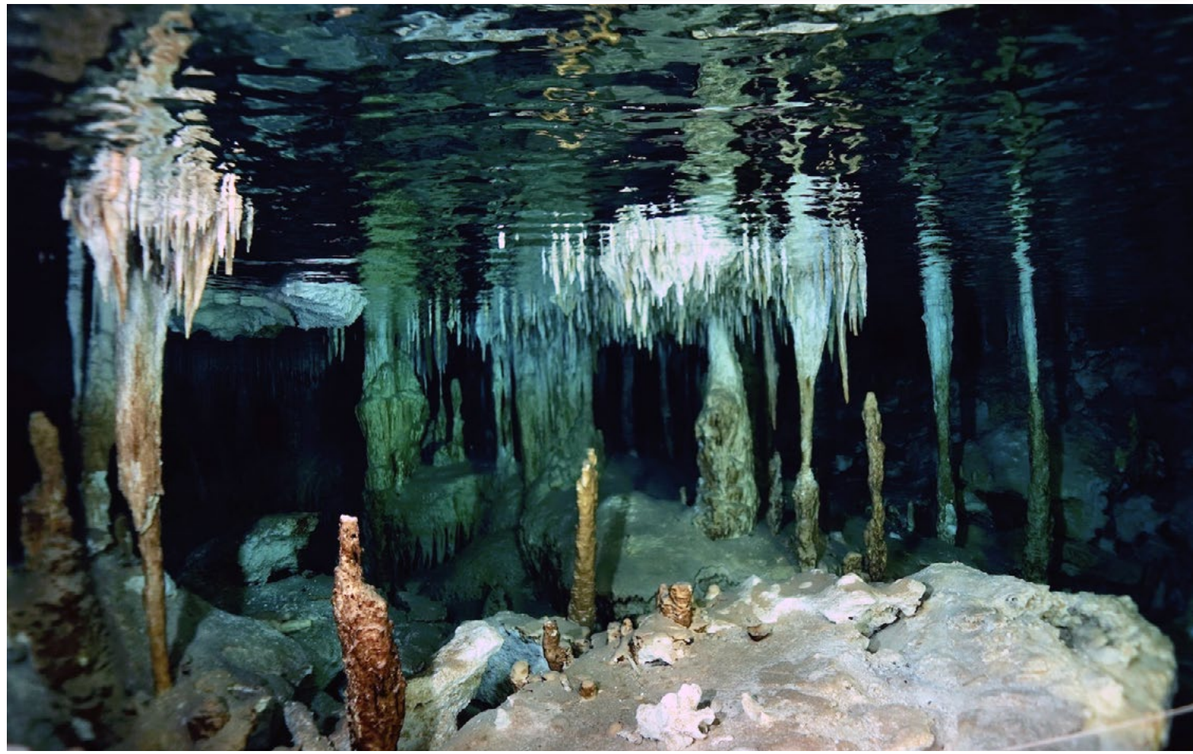
Once underwater, one realised the conspicuous dome shape. No formations worth mentioning here, but there was great visibility and a magnificent shaft of light that pierced down into the deep, in the early afternoon. In addition to the ambiance that it offered for underwater photography, it was a training site for free divers. The water temperature was 25°C.

Sac Actun cave system

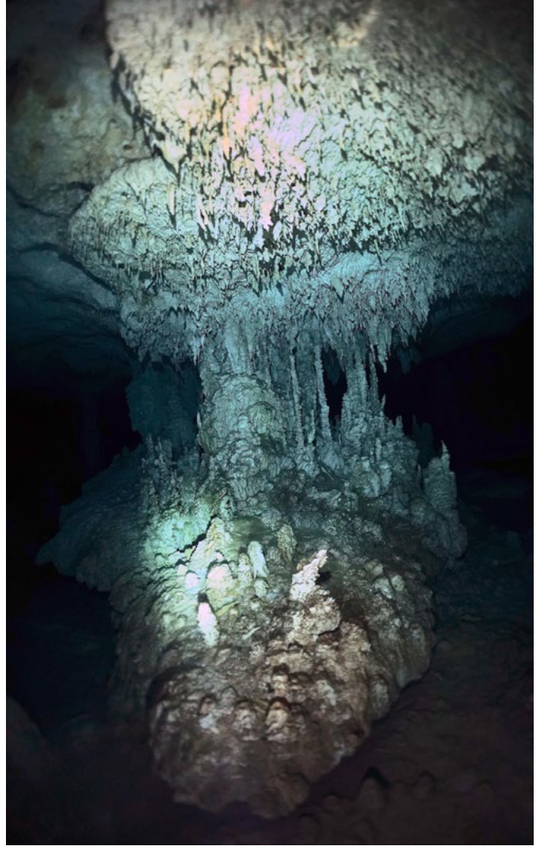
Over the next couple of days, we headed south. Our dive trip took us near Dos Ojos, to the Sistema Sac Actun, which was found to be the longest underwater cave system in the world in 2018, connecting 187 cenotes!

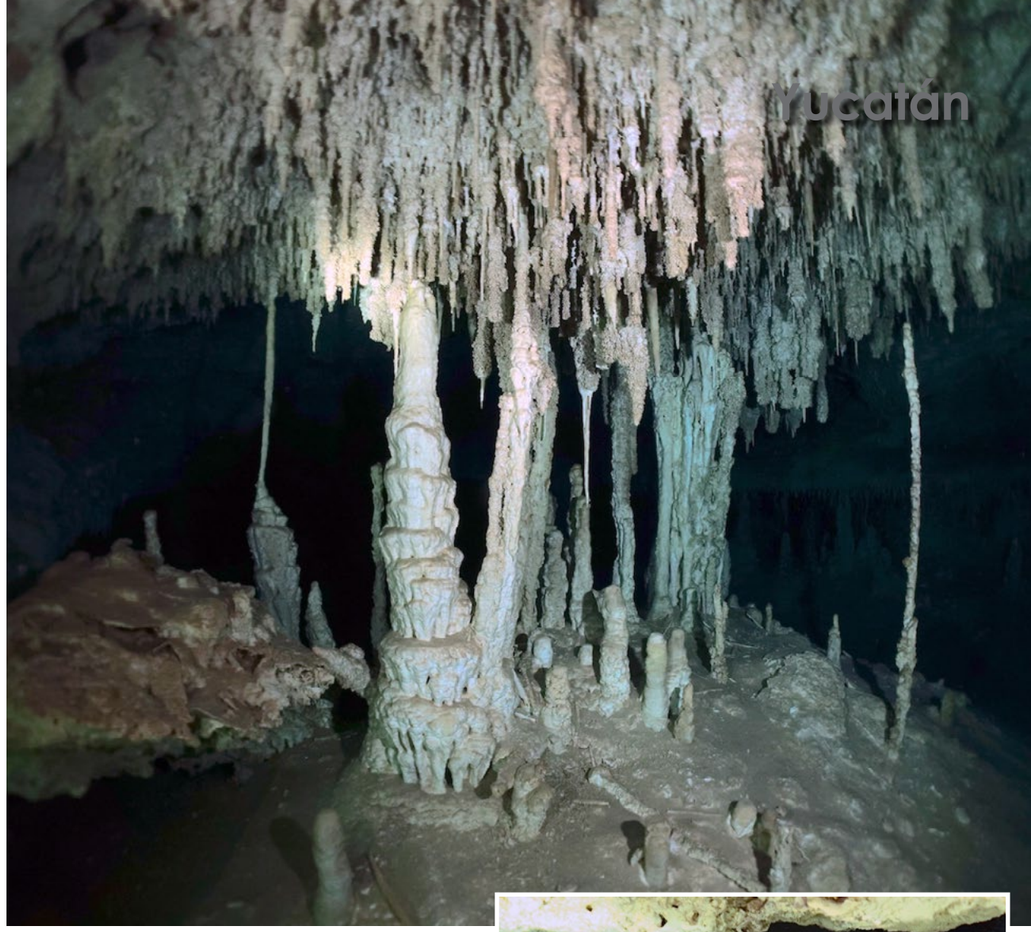
In March 2008, three members of the "Proyecto Espeleológico de Tulum" (Tulum Speleological Project) explored the Hoyo Negro pit and found the remains of a mastodon, measuring 60m. In addition,at 43m, the skull and bones of a teenage Mayan female, now referred to as "Naia," a Paleo-American, was found and dated to 12,000 to 13,000 years old.

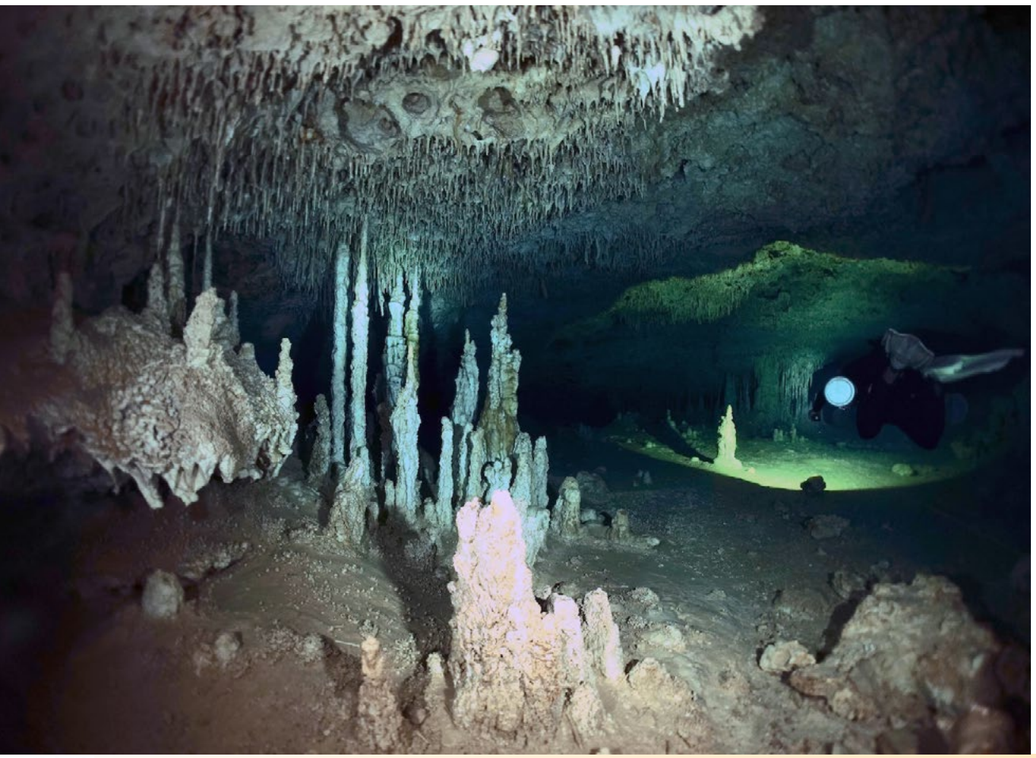
Cenote Tak Be Ha. At Cenote Tak Be Ha (Secret Water), our tanks were brought by rope through a chimney hole in the ceiling, down to the water level. I assisted with receiving the tanks. A rather steep stone stairway allowed us to walk down into a large, wide cham-



Columns under the surface (above) and dive guide placing a jump marker on the main line (top right) of Cenote Tak Be Ha







Curtain of stalactites under an umbrella (top left), pillars and stalactites (top centre and top right), skeleton of giant ground sloth (lower right) and dive guide in the tunnel (left) at Cenote Concha

ber, with lots of decorations and artificial lights.

Cenote Concha. Farther away in the forest, an 8km potholed dirt road led to the site of Concha—a half-collapsed sinkhole with a huge alamo tree, extending its roots like the tentacles of a crawling octopus. The atmosphere of the jungle was overwhelming. Entry to the water was very shallow, over white sand. Outside the cave were tall leafy trees, and beautiful "motmot" birds flew by.

Sneaking through a narrow gateway in the limestone, we immediately plummeted down to a depth of 14m for the rest of the dive. Visibility was gin-clear. At the first T-junction of the guide line, we veered left, soon to meander through various chambers with columns, stalagmites, stalactites and helictites hanging from the roof like darts.

After 30 minutes, my gauges displayed 140 bars, and Max pointed out an overhang above the cave floor. To my surprise, I discovered a full skeleton of a giant ground sloth (*Xibalba oviceps*) from the last ice age, over 10,000 years of age. It rested precisely in the same position where it died. On the way back, Max drew me aside, into a small chamber. A little signboard with the number 285 on it marked the bones of a small gomphothere (*Cuvieronius tropicus*), an extinct mastodon with straight forward tusks. Impressive.

Following the narrow jungle trail back to the car, with a tank on my

shoulder, I noticed with awe a tiny snake coiled neatly on top of a white rock. Of course, I rushed back to take a photo. "Be very careful, this is a *nauyaca*!" warned a Mexican cave diver, who happened to be

Yucatán rust rump tarantula, *Brachypelma epicureanum* (left), and dive guide Max under the bulbous stalactites (top left) in Cenote Koi; Tannin refraction in Cenote Xuxi (top right); Bulbous column in Cenote Koi (bottom right); Ultimate pit viper, *Bothrops asper,* or "nauyaca" ("four noses") in Maya, at Cenote Concha

passing by. "A friend of mine got bitten and remained in intensive care at the hospital for four days."

The *cuatro narices*, or ultimate pit viper (*Bothrops asper*), is one of the most poisonous snakes of Yucatán. Also known as *fer-de-lance*, it can spit venom at a distance of two metres. I was no more than 50cm away when I took the shot. Soon after, Max found a hairy Yucatán tarantula (*Brachypelma epicureanum*) on the forest floor. Black with a reddish abdomen, it swiftly hid in its hole.

Cenote Koi and Cenote Xuxi. On my fourth day of cave diving, Max

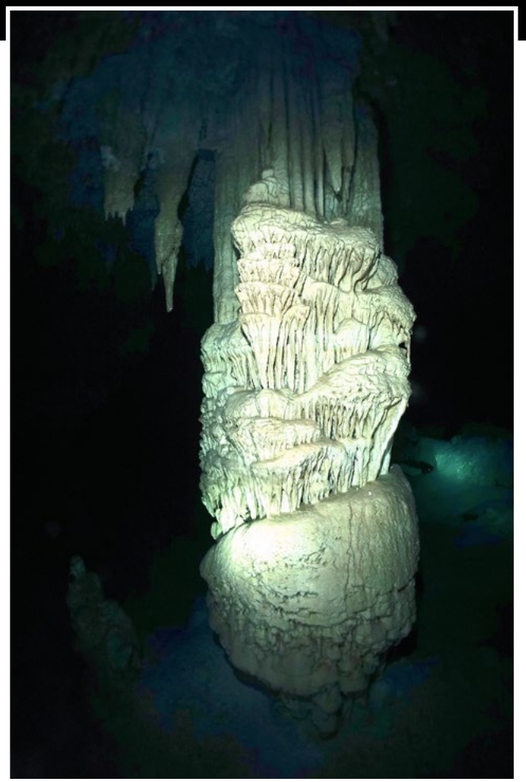
took me to one of his favourite sites, located 20km from Tulum and 8km inland. It proved to be a total immersion with nature.

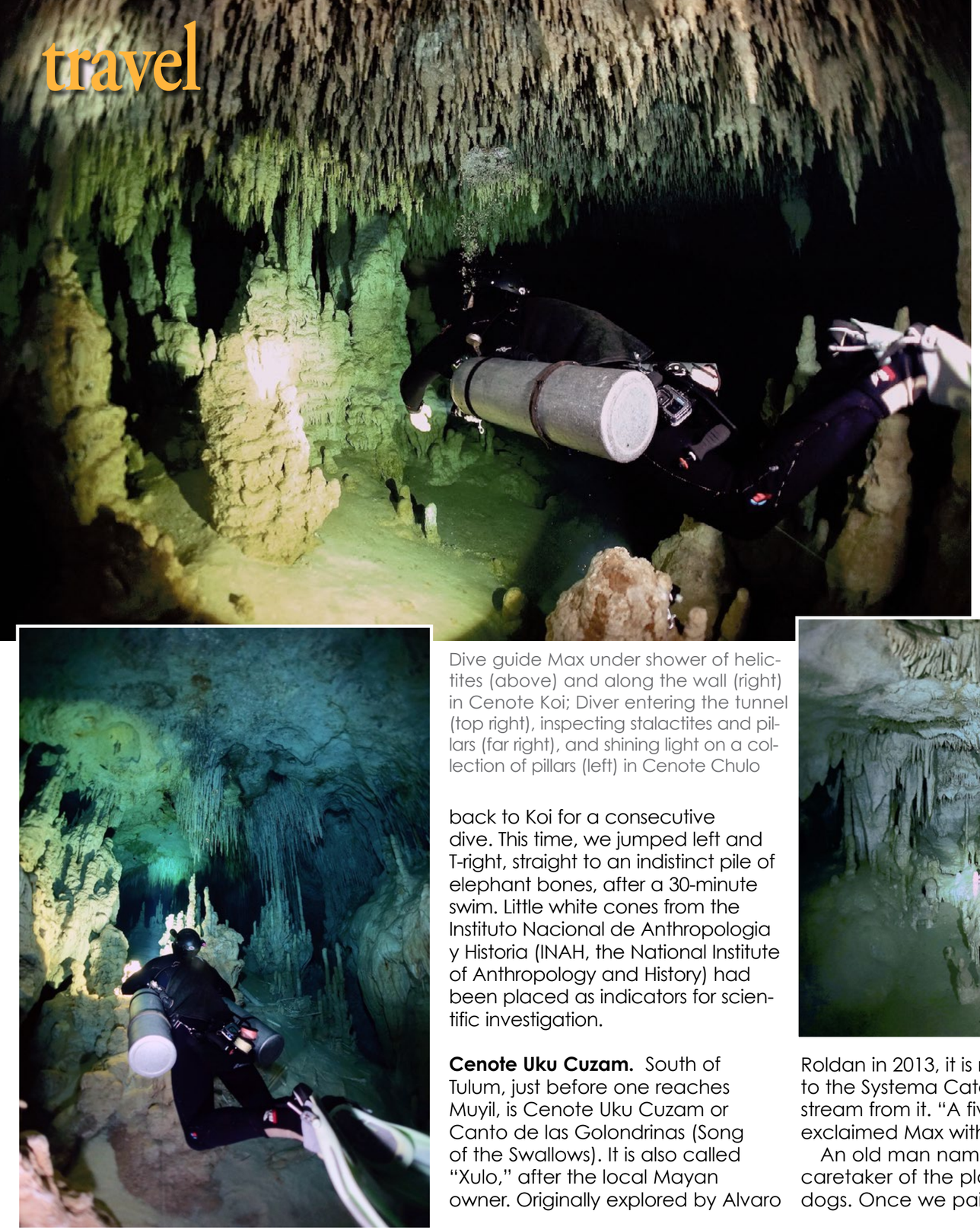
An inquisitive tarantula came to welcome us at the car park, as we prepared our gear and tanks. On the 50m stroll to Cenote Koi, a 60cm long southern Yucatán variable coral snake (*Micrurus apiatus*) slithered along the forest floor. It was dark red in colour and had black bands outlined with narrow yellow bands. It was a gorgeous creature—rather shy, but poisonous.

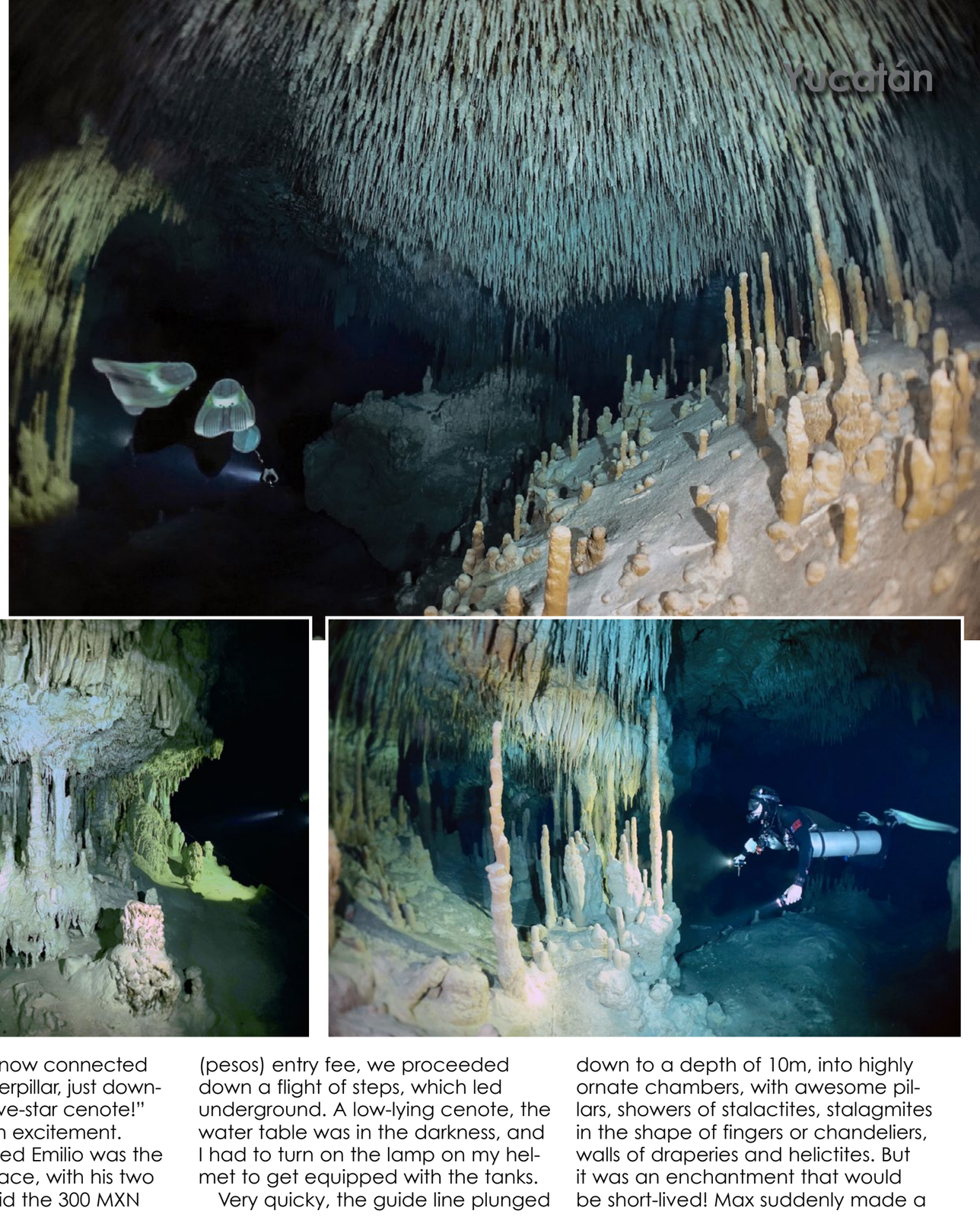
A rusty iron stairway spiralled down into the narrow opening of the cenote, straight to the water table. A few cement blocks made it convenient to lay down the tanks in shallow water. The cave had a wide dome, with a low ceiling, ornately decorated with stalactites, plus a few bats. The cave floor was composed of black and volatile bat guano. The walls were white limestone.

At a depth of 10 to 14m, Max led me underwater to Cenote Xuxi. "I'll show you something special!" he said. There, I marvelled at an incredible sight. During the rainy season, soil and leaves caused a lot of tannin to seep down into the water subsurface. This translated into a breath-taking variation of red, orange, yellow and green hues in the water column—like a vision from the film *Apocalypse Now*. We pushed farther into various chambers, heading the other way around.

After a picnic of tacos, we were







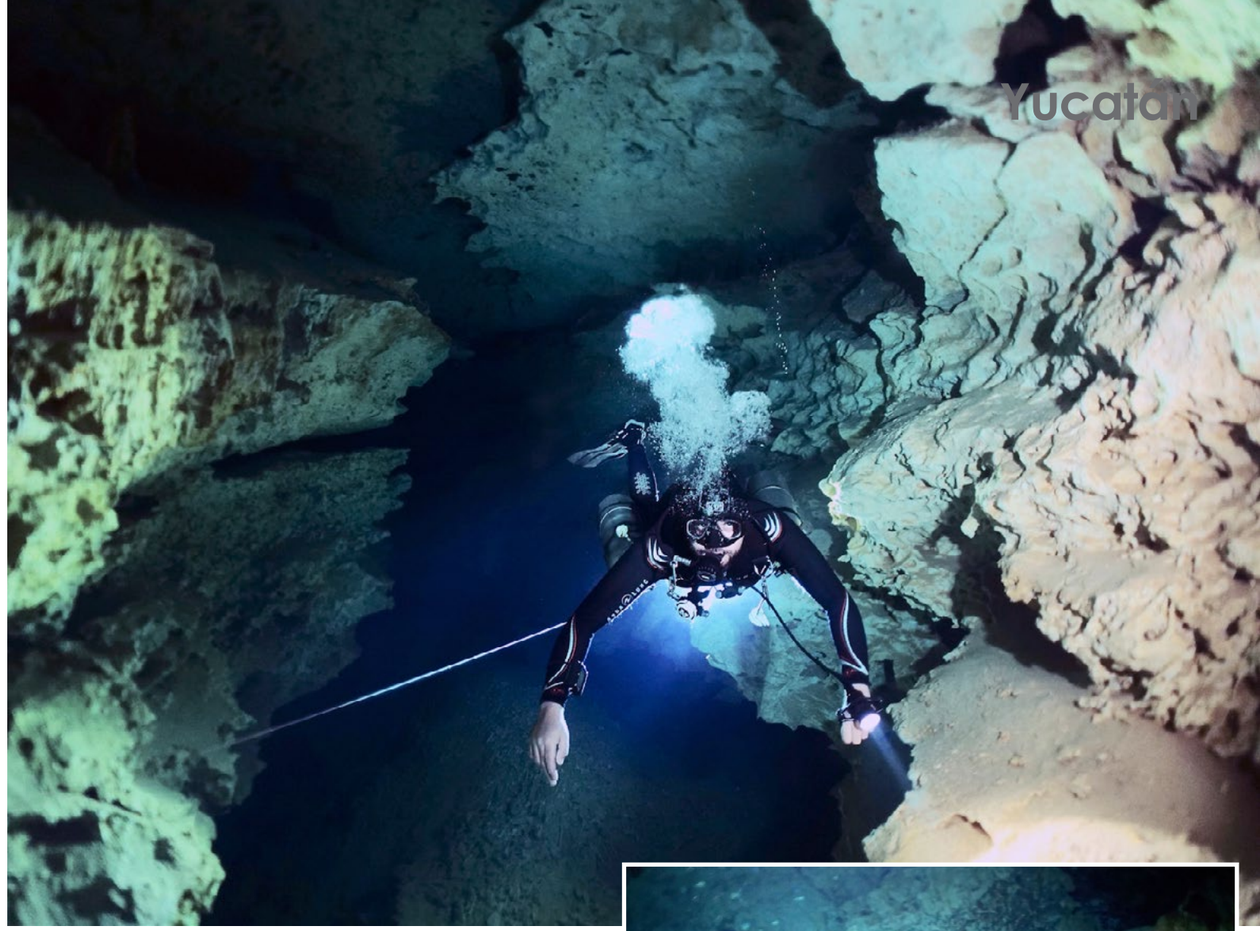
Dive guide Max under shower of helictites (above) and along the wall (right) in Cenote Koi; Diver entering the tunnel (top right), inspecting stalactites and pillars (far right), and shining light on a collection of pillars (left) in Cenote Chulo

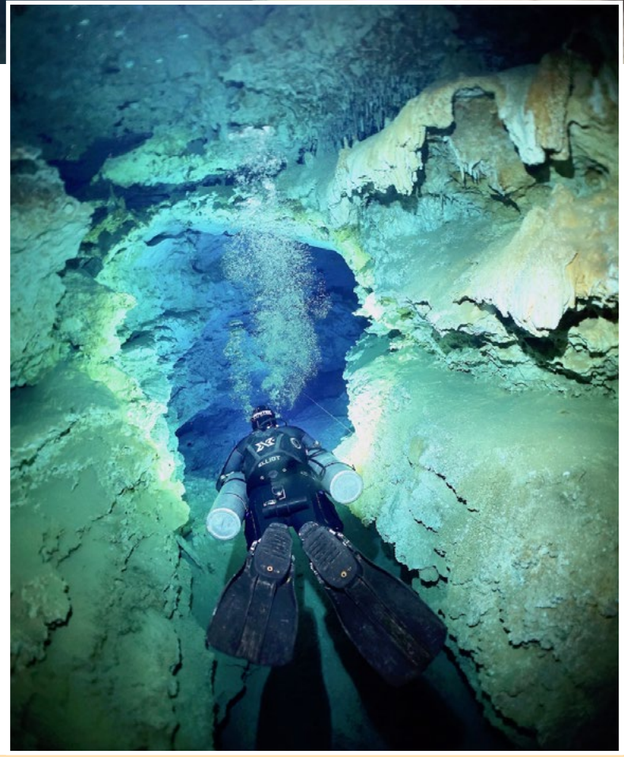
back to Koi for a consecutive dive. This time, we jumped left and T-right, straight to an indistinct pile of elephant bones, after a 30-minute swim. Little white cones from the Instituto Nacional de Anthropologia y Historia (INAH, the National Institute of Anthropology and History) had been placed as indicators for scientific investigation.

Cenote Uku Cuzam. South of Tulum, just before one reaches Muyil, is Cenote Uku Cuzam or Canto de las Golondrinas (Song of the Swallows). It is also called "Xulo," after the local Mayan owner. Originally explored by Alvaro Roldan in 2013, it is now connected to the Systema Caterpillar, just downstream from it. "A five-star cenote!" exclaimed Max with excitement.

An old man named Emilio was the caretaker of the place, with his two dogs. Once we paid the 300 MXN (pesos) entry fee, we proceeded down a flight of steps, which led underground. A low-lying cenote, the water table was in the darkness, and I had to turn on the lamp on my helmet to get equipped with the tanks.

Very quicky, the guide line plunged down to a depth of 10m, into highly ornate chambers, with awesome pillars, showers of stalactites, stalagmites in the shape of fingers or chandeliers, walls of draperies and helictites. But it was an enchantment that would be short-lived! Max suddenly made a





Magnificent pillar (left) and stalactites and thin pillars (above) in Cenote Chulo; Dive guide Elliot in the salt water of Alexis Passage at depth (right) and entering the underground river of Alexis Passage (bottom right) in Cenote Regina

jump to the right, into a corridor of restrictions under a low ceiling.

Turning around was unthinkable. With its extended strobe arms, I needed to turn my camera sideways, in order to proceed forward. It was rather uncomfortable. Eventually, we caught up with the main line running in a side tunnel. Another jump and it was back to base from here. All in all, it was a 56-minute dive. The strobes stopped working, functioning below satisfaction, and I suspected the batteries were low. I would leave the camera behind for the next dive.

This was a wise decision, since my dive guide made a jump to the left, after a third set of double arrows and led us through restrictions and very narrow passages under the cave's ceiling, snaking sideways non-stop! He even signalled me to stop in key moments, so he could take a video of me in action, with his GoPro camera.

After 67 minutes, apparently happy with my performance and optimal buoyancy, Max shook my hand positively before exiting the cave. Sitting peacefully in front of his wooden shack, Emilio was waiting for us with a *Caguama*, a one-litre bottle of beer, and the dogs resting flat on the ground beside him. A couple of keel-billed toucans (*Ramphastos sulfuratus*) flew overhead, and landed on a branch to have a peek at us, but took off as soon as I grabbed my camera.

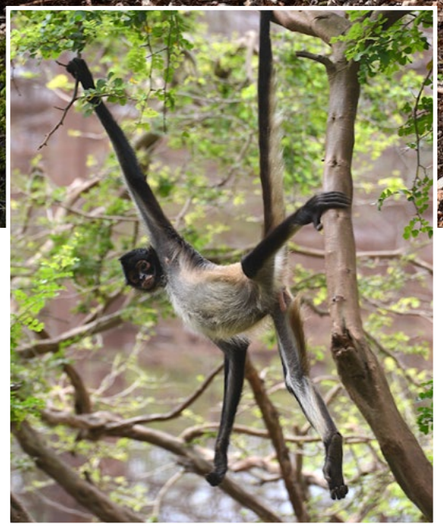
Tulum

Cenote Regina. Based in Tulum for the next three nights, my last day of diving would be with dive guide Elliot. The dive site was called Cenote Regina. Originally explored in 2004 by Robbie Schmittner, it was now connected to Sistema Ox Bel Ha (via Mayan Blue). It was not well-known to divers, except for the lucky ones!

Here, there was a large pool of water with a wooden deck, surrounded by palm trees. The entrance hole was murky and started with a restriction. It opened up into a rather dark cave with a wide tunnel. The plan was to take a T-left, then another T-left, until we plunged deep into a canyon at a depth of 25m.

All of a sudden, it lit up as if by magic, in the so-called "Alexis Passage," an underground riverbed that was white and light blue in colour. We then met a halocline, where the saltwater below met the fresh water above it. For 30 seconds, it was all a blur. A mesmerising environment indeed, but it was already time for us to turn around.

For the next dive, the plan of action was to take a T-right, then a T-left and T-right. Once again, we dropped into a deep saltwater pas-



The cutting down and clearing away of forest to make way for the "Tren Maya" project (top left and above); Mottled owl, *Strix virgata*, near Cenote Calavera (right); Hooded warbler, *Setophaga citrina*, at Villahermosa (centre); Spider monkey, *Ateles geoffroyi* (far left)

sage below 18m. As I gazed at Elliot disappearing into the haze of the halocline, my right ear became terribly painful under the pressure. I realised at once that I could not go deeper without some serious trouble. This could turn into a nightmare in seconds. I waved my light frantically until Elliot understood my signal of calling off the dive. Better safe than sorry.

Tren Maya

In September 2018, Mexican president-elect Andrés Manuel López Obrador announced project "Tren Maya" (Maya Train). Slated for construction around the Yucatán Peninsula, it would be 1,525km long. Owned by the Mexican Armed Forces, it would connect the cities of Palenque, Escárcega, Merida, Cancun, Tulum, Bacalar and loop back to Escárcega. A referendum, conducted in the various cities, showed that 92 percent of the people were in favour of the project, because of the tourism development and other benefits to the population.

Construction started in June 2020 and is expected to be completed by 2024. Funding would be primarily from a tourism tax levied in the region. In October 2020, the cost was estimated at 321 billion MXN, about 16 billion US dollars. Twenty-five percent of the project had been completed by February 2022.

However, environmental and indigenous rights activists objected to the construction of new railway tracks through the jungle. Environmental concerns raised awareness of a projected disaster for nature.

In January 2021, crews had uncovered more than 8,000 ancient artefacts and structures during excavation. In Quintana Roo, there were protests against the construction work that involved the cutting down of jungle areas without first conducting the required environmental studies.

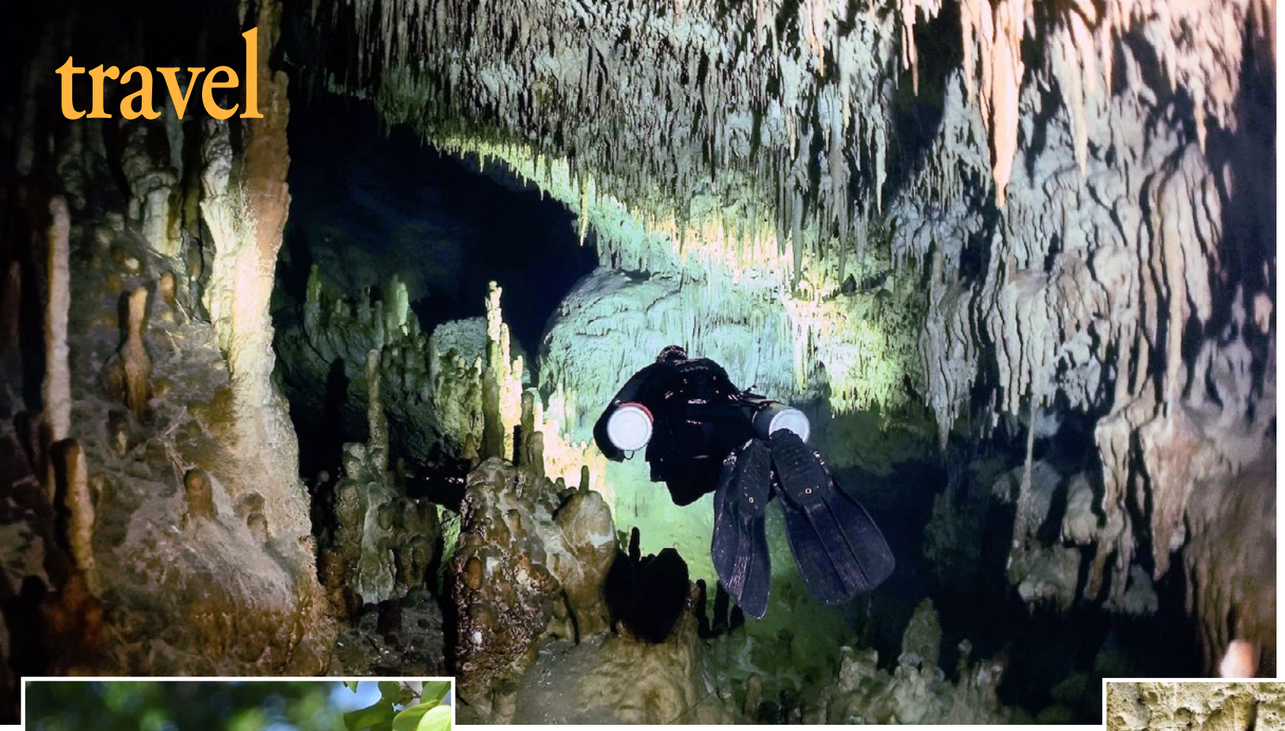
To the cave diving community, this whole project was outrageous, because it would trigger the collapse of many cenotes and caves along the way. Sadly, this has already happened. In Quintana Roo, 1,800km of caves and underground rivers run through thousands of cenotes, which would be violated by the Maya Train project. In fact, at least a hundred cenotes have already been affected.

Infrared cameras have shown that wild animals (like the jaguar, puma, spider monkey, ocelot, aguti and motmot (toh) birds, among others) use the cenotes for drinking water. The Maya Aquifer is at high risk of pollution from freight trains and other factors.

President Lopez Obrador had designated the Mexican Army as the contractor of Section 5 of the railroad track (which connects Cancun with Tulum) and the beneficiary of the project. This move was considered controversial as the Tren Maya project had never complied with environmental legislation. However, the president has rejected all concerns raised and forged ahead with the project, aiming to have it completed before the end of his term.

[ed. – In August 2022, construction of Section 5 was temporarily suspended by a federal judge, on the grounds that an environmental impact statement (EIS) had not been completed or approved. Since then, the same judge has lifted part of the suspension, after the federal Environment Ministry approved the EIS for Section 5 North. However, as of 29 September 2022, the suspension order halting the construction of the controversial Playa del Carmen-Tulum section of the railway, which is the southern stretch of Section 5, is still in place. (Source: *Mexico News Daily*)]

On my way to various cenotes, I have seen these wide highways of destruction through the Yucatán jungle. I must say that this vector of deforestation looks horrifying, and I am deeply saddened by the impact on nature and wildlife in the area. The government has only shown the positive side of the Tren Maya project, economically and as a tourism develop-



Diver under roof of stalactites in main tunnel (above) and following Alexis Passage (bottom right) of Cenote Regina; Gran Acropolis (ca. 650-700 AD) at Yaxchilan (top right); Stelae of Bonampak ruler, at Gran Plaza, Bonampak (centre); Pair of great kiskadee (left)

ment tool. But all the negative aspects of the project have been carefully and deliberately hidden from the public.

The original plans called for electric locomotives on the trains, but the government announced a switch to diesel to reduce costs. In August 2020, it confirmed that half of the Merida-Cancun-Chetumal route would still be electric. In November 2021, the Interior Department exempted Tren Maya and other infrastructure projects from environmental review. As usual, so-called "progress" cannot be stopped, for ultimately, it is all for the sake of making money.

Yucatecan boa

Topside excursions

Besides the limitless opportunities of cave diving—unless you are a beachcomber or a party animal—there is still much to do around Yucatán. Whether it is visiting old colonial towns, ancient Mayan archaeological sites, or nature reserves—the choice is yours.

Having done a number of land tours to these sites in past years, I opted this time for a road trip to the southwestern area of the peninsula, all the way to Chiapas. Out of Tulum, Palenque can be easily reached in one day, with a hire car. I skipped a visit to the famous archaeological site of Palenque; it is all commercial these days, with not much to see, and the fine cultural museum was closed for maintenance!

Instead, I made it my goal to visit two remarkable sets of ancient Mayan ruins to the southeast, on the border with Guatemala: Bonampak, for its astounding murals of the Templo de las Pinturas; and the remote Yaxchilan, in the lush Lacandon jungle, which can only be reached by river boat. Here, howler monkeys were omnipresent, vocalising loudly and unchallenged during the whole duration of my visit. In these parts, Mayan communities were authentic, and pristine Nature was queen, at last. ■

For more information, contact Didier at Phocea Mexico dive centre in Playa del Carmen, Quintana Roo, Mexico. Email ***info@myphocea.com*** *or visit:* ***myphocea.com****.*

With a background in biology and geology, French author, cave diver, naturalist guide and tour operator Pierre Constant is a widely published photojournalist and underwater photographer. Visit: ***calaolifestyle.com***

Enchanting Quietude

Galápagos Islands

in Pandemic Times

Text & photos by Brandi Mueller

Galápagos

Green sea turtle on rocky reef in the Galápagos Islands (above); Nazca boobie with chick (center); Sunbathing marine lizard (top right); Sea lion frolicking underwater (previous page)

An enchanting and ecologically unique place, immortalized by Charles Darwin's seminal work on evolutionary biology in 1859, the Galápagos Islands hold a revered spot as one of the truly magical locations of the world. During pandemic times, when stillness and quiet replaced the cacophony of tourists, it seemed even more captivating. Brandi Mueller reports.

It was an hour before sunset, and I was snorkeling at Playa Punta Carola, a blinding white crescent of a beach with jet-black lava rocks marking both edges. Looking closely, some of the rocks moved, giving away that they were actually camouflaged marine lizards shifting or expelling salt from their noses with a loud puff.

At high tide, there were two surf breaks, but it was low tide during a global pandemic, and I was the only person in the water. Two families were on the beach when I entered the water, but it was hard to believe I was at one of the top places to see in San Cristobal, Galápagos. It felt more like a private beach property.

Sea lions

With my underwater camera in hand, I swam out to the edge of the rocks, sticking my head up to check where I was going. Watching a wave break, I noticed in the white froth a black spot with whiskers—a sea lion body-surfing! I laughed, causing my mask to flood, and kicked like mad to get to that spot. I wanted to surf with the sea lions.

Getting there, I waited, looking behind me at the incoming waves and underwater for the sea lion. I saw a shadow coming in from the distance. Two sea lions jetted out of the blue, one coming right up to me and spinning full circle and then, as if realizing it was about to miss the wave, the sea lion took off, almost flying as it joined its friend, catching the wave and disappearing into the break.

Santa Cruz

Over on the island of Santa Cruz, I got up most mornings by six to go jogging to Tortuga Beach. Often rated as one of the best beaches in the world, I accessed it by a stone pathway that took about 30 minutes of walking.

A sea lion (above) and squads of pelicans (left) waited for scraps from local fishers as they cut up their catch on the dock.

Only wide enough for two people to pass, the trail cut through a thick landscape of arid opuntia, palo santo and matasarno trees.

I only saw a few other running enthusiasts until 8 a.m., when the tours began, with guides pausing to point out opuntia, a cactus known to most as prickly pear that grows here to heights double the size of humans, and palo santo, "holy wood," used in traditional medicine, which has a lovely, musky smell and can be burned to ward off mosquitos. Even though I passed a group or two, it seemed eerily quiet.

After arriving at the empty beach, I would jump into the crystal-blue water to cool off after dodging marine lizards roaming about, oblivious to my being there. On the sun-drenched, blindingly white sand beach, there was no one there but me.

Enchanting

In Spanish, it is called Las Islas Encantada—"The Enchanted Islands"—and I can think of no better way to explain the Galápagos. Even walking through Puerto Ayora, the most populated town, there was wildlife wherever I looked.

Local fishers cut up their catch on the dock where a squad of pelicans patrolled, waiting for scraps. But it was an adorable sea lion pup, begging at the fishers' feet like a puppy, that got most of it. More than once, I really did almost trip over a sea lion sleeping in the middle of a walkway, or a marine iguana spread over the entire length of a pathway. And do not even think about sitting on any of the numerous park benches; they were occupied by the sea lions.

Blue-footed booby (left); Hammerhead sharks (above); Male frigate bird puffing out its big red pouch to attract a female (top right); Yelllow land iquana (right); Booby chick (bottom right)

North Seymour Island

Early one morning, I took a boat to North Seymour Island where it was frigate-bird mating season. The males puffed out their enormous red pouches to show off how pretty they were to the females. On the ground were bright yellow land iguanas displaying more vibrant color than normal, in hopes of finding a mate.

Blue-footed boobies, several with eggs in their "nests" (simply a spot on the rocky ground), called to one another. I kept to the designated path in hopes of not disturbing the animals, but that did not stop them from crossing mine.

Pandemic requirements

The islands, known best for Darwin's theory of evolution and giant tortoises, continued mostly as if the pandemic was not happening, except for the lack of tourists observing it. The few people who had ventured here, like me, had to undergo not one, but two, PCR Covid tests: one required entering Ecuador within ten days of arrival and another to enter the Galápagos within 96 hours.

Masks were required (and promoted by fun signs in the streets of sea lions masked-up). Social distancing was encouraged as well as the spraying of disinfectant isopropyl alcohol onto your hands, luggage and entire body, constantly.

Wolf and Darwin islands

I spent a week scuba diving, visiting the northern remote islands of Wolf and Darwin to see schooling hammerhead sharks (just weeks before Darwin's Arch crashed and became Darwin's Pillars.) The most amazing part of being

Penguin swimming underwater (above); Seahorse on rocky reef (right)

there was that no one else was. The boat I was on usually took 16 passengers, and we were only six. Only once did we see other divers, and they were researchers tagging sharks.

We snorkeled with penguins, had sea lions spin circles around us and got into the middle of a pod of bottlenose dolphins. Even when we were not underwater, the magic of this place was all around us. There were dolphins leaping at the bow of our boat and mobula rays launching themselves out of the water like spaceships coming from the wrong direction.

Park fees and tourist limits

Decidedly one of the most unique and important places on Earth, I kept wondering to myself how we would recover from the global pandemic and return to the dive travels so many of us love, but also protect these places. I heard gossip and whispers among guides and staff of park fees increasing; currently, foreigners pay US$100 and a US$20 transit visa fee. These are park fees that hopefully support park protection. Raising fees has been discussed for quite a few years, but perhaps post-pandemic may be a good time to implement the change.

I also found myself in more than one conversation with guides and Galápagos residents discussing the idea of limiting the number of tourists allowed. I see this as a two-sided issue. I think limiting the number of people trampling foliage and disrupting the natural habitats of wildlife is obviously a way to

Napping sea lions at San Cristobal (top left); Tern tries to steal a meal from a pelican (above); View of Isabela Island (right)

The sea lions own the town.

better preserve the delicate and unique ecosystem. But limiting tourists will likely drive up prices, making it more of a place where only those with excess financial means can visit.

In my opinion, being able to experience this place, and others like it, is the best way to educate, inform and create a sense of responsibility in people. It is easier to make pro-environmental changes in one's everyday life, making less of an impact, when you have seen the losses and what is at stake.

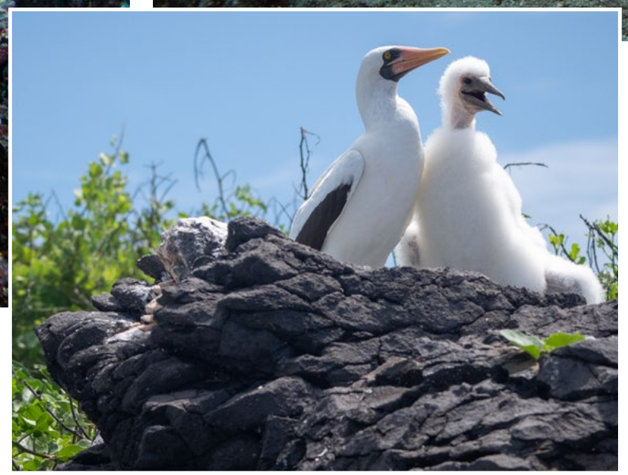
Environmental threats and recovery

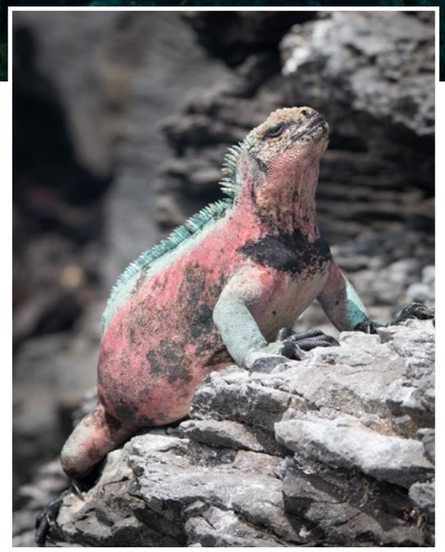
The Galápagos faces threats of severe El Niño events, which in the past, have destroyed corals; trash washes up on beaches from three continents, due to the currents that meet here; and illegal fishing continues to plague the area right outside the park. By making the Galápagos less accessible, an opportunity to inspire a love for this environment in the masses may also lead to its demise.

The tourists I met on half-filled tours and on empty beaches asked the same question I did, "Is the pandemic helping the wildlife?" The one recurring consensus I heard from guides and islanders was that the bird populations seemed to be doing better. They were seeing more penguins, boobies and frigate birds. This is obviously purely observational anecdotes from people who have spent years here and not long-term scientific research, but I found that information encouraging. It also made me wonder about how even low-impact observation by humans may be disturbing birds.

Española

Traipsing over rocks with the brutal sun still burning my heavily sun-screened shoulders on the island of Española, a few other visitors and I walked among Nazca boobies, many of which were juveniles that could not fly yet. One bird





Española marine lizard (left); Parrotfish (above); Nazca booby adult and baby (center); School of barberfish (top right); Sea lion bunk beds at the port (far right)

was still sitting on an egg, and there was a featherless chick that looked as if it must have just hatched. The squawks of the ugliest-adorable white fluff balls drowned out our whispered conversations. They did not seem to notice us. One bird walked up behind us and into the middle of our group before we even noticed.

But perhaps the constant streams of camera-toting tourists do change behavior, maybe causing mother birds to become nervous or leading to other negative consequences. I feel it must have some impact, even though it may not be apparent, as the birds go about their business on the cliffside overlooking one of the most amazing views I have ever seen.

Another perspective

To examine another side, while the majority of tourism boats were sitting in the harbor with no passengers during the height of the pandemic, the expansive waters of the Galápagos National Park had fewer observers of bad behavior. Two summers ago, a fleet of over 300 Chinese fishing vessels was seen pillaging the seas just outside the border. Unfortunately, marine life does not see the lines we draw marking protected and unprotected areas.

It is my suspicion that the tourism boats just "being there" reduced the rule breakers that do damage when no one is watching. Huge expanses of water are hard for anyone to patrol, particularly for countries that might struggle with finances, manpower and patrolling during a pandemic.

If it were not for other commitments, I would have stayed longer. I think one could stay for years and still not see all of the enchantments of the Galápagos Islands. Every season brings different flora and fauna to observe. I am glad the Galápagos got a little break from excessive tourism, and I hope as more people go back to traveling, it is in a manner that supports this enchanted place and, indeed, all of the world's unique environments. ■

American underwater photographer, dive writer and regular contributor Brandi Mueller is a PADI IDC Staff Instructor and boat captain living in Micronesia. When she is not teaching scuba or driving boats, she is most happy traveling and being underwater with a camera. Mueller's book, The Airplane Graveyard, *featuring her underwater photos of forgotten American WWII airplanes at the bottom of the Kwajalein Atoll lagoon, is available at Amazon.com. For more information, please visit:* ***brandiunderwater.com***.

Xiaoliuqiu

Dive into Taiwan Part 3

Text by Simon Pridmore
Photos by Kyo Liu

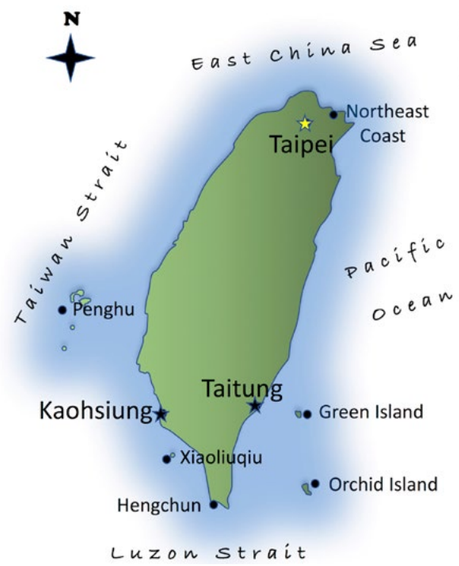
Bluespotted stingray cruising by (above); Diver and colorful coral on bow of Broken Shipwreck (far right); Map of Taiwan (right); Deep Venice Shipwreck (previous page)

Near the urban city of Kaohsiung in Taiwan is the tiny picturesque coral island of Xiaoliuqiu—a section of uplifted ancient limestone reef. It is the only place in Taiwan where one can dive in warm water all year round. Simon Pridmore has the story.

Taiwan is a group of Pacific islands surrounded by warm tropical seas. It is easy to get to and get around, and it is a first-world society with outgoing, friendly, laid-back people. Taiwan has some very good scuba diving and a network of dive centres and resorts with first-class professional staff, equipment and services. They offer scuba experiences, basic training courses and fun diving for a young, enthusiastic first generation of Taiwanese divers.

Yet, when divers elsewhere in the world think about diving destinations, Taiwan is unlikely even to be a blip on their radar screen. Very few people outside Taiwan have ever thought to enquire about the diving here, and very few people inside Taiwan have ever thought to tell anyone about it. Until a couple of years ago, that is, when some far-sighted folks asked me and Taiwanese underwater photographer Kyo Liu to write a book.

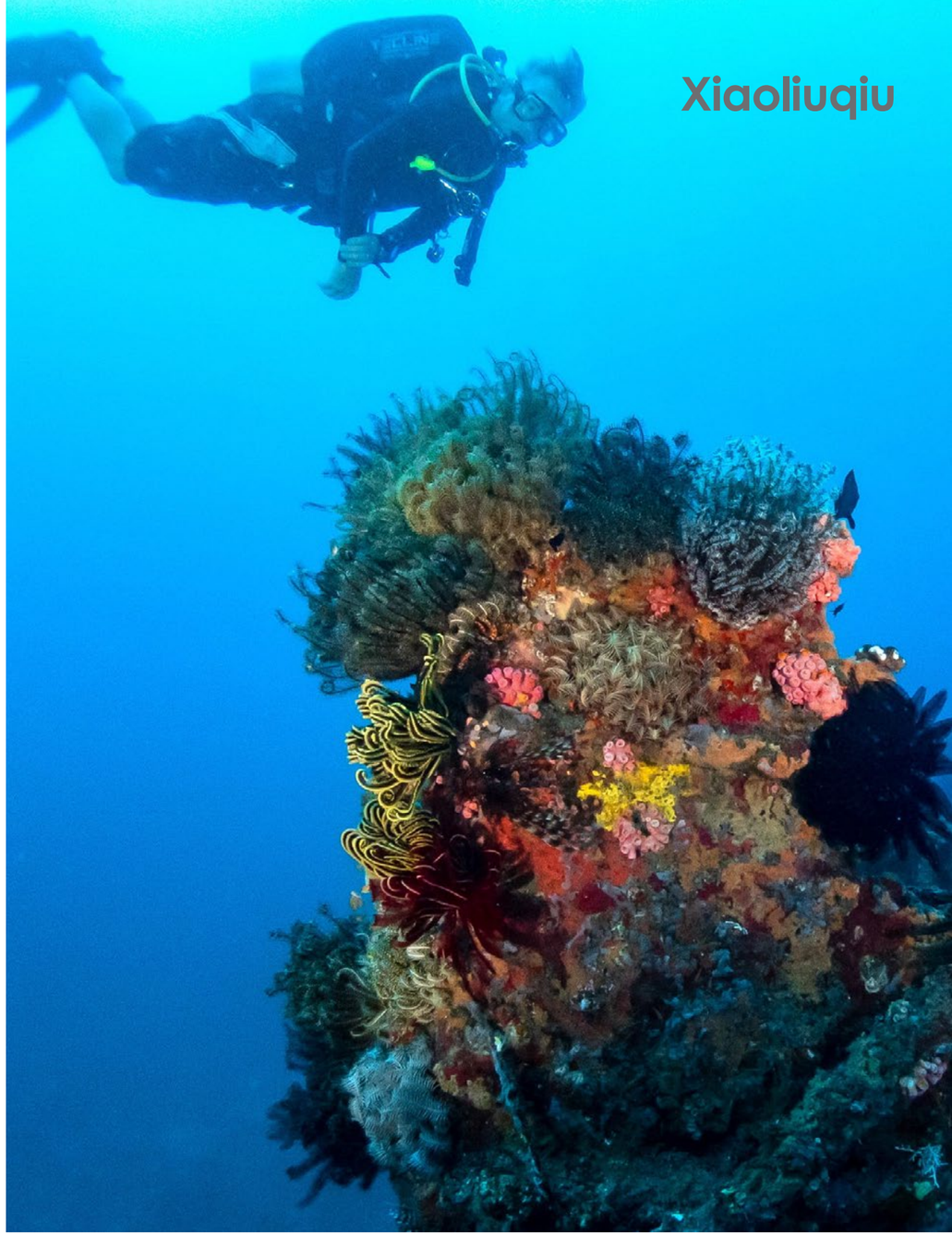
The book is called *Dive into Taiwan*, and this is the third in a series of six articles, each covering one of Taiwan's diving regions, designed to give you a flavour of what to expect from a Taiwan dive trip. The book covers much more than diving. It talks about the people, countryside, cities, food and lifestyle to give readers a fully immersive experience—diving into Taiwan in every way. But, in this series, I will just focus on the underwater attractions, with the help of Kyo's amazing photographs.



SOFIE HOSTYN

Xiaoliuqiu

Xiaoliuqiu (Little Liuqiu or Little Ryukyu) is a tiny coral island, a section of uplifted ancient limestone reef, that lies right on the doorstep of the two million or so people who live in the urban areas in and around Kaohsiung. The sea crossing is short, and it is a pretty place with a benign climate. Even in winter, the surrounding ocean never gets cold. There are some nice trails in the hills to wander around, the coastline is attractive, and there is one exceptional dive site in particular that makes a short trip here particularly worthwhile. Xiaoliuqiu is the only place in Taiwan where you can dive in warm water all year round.



Diver and steel hull plates on Broken Shipwreck (left); Divers enjoy classic blue Xiaoliuqiu visibility (above).

In the late 20th century, Xiaoliuqiu underwent a rapid transformation from fishing village to tourist haven. For the past 30 years or so, Taiwanese people from the cities have been flocking here for fun. The island has one industry, and it never takes a day off. Over 80 percent of the population is involved in tourism in one form or another, so everyone is focused on giving visitors a good time.

As you might expect, in the early days, mass tourism brought environmental problems. However, in recent years, the government, tourism industry and island residents have begun taking remedial action. They have introduced conservation measures designed to reduce trash, improve the sustainability of tourist activity, and protect reefs and other marine life.

Legislation has been introduced to ban drift gillnet fishing within 5.5km (3 nautical miles) of the island and fishermen are being encouraged to use more sustainable techniques, such as pole-and-line fishing. Artificial reefs have been established, the island's large population of turtles is protected by law, and the beaches where they commonly lay their eggs are closed during the hatching season. Marine volunteer teams arrange frequent beach and underwater clean-ups—visitors are welcome to join in—and many bars and cafes have phased out single-use plastic and are now giving customers washable stainless-steel straws and cutlery instead.

Diving

Xiaoliuqiu is very easy to get to, even just for a day out of Kaohsiung, although it is much more rewarding to stay over for a night or two, especially if you want to get some boat diving in, as the dive boats typically leave the dock early in the morning. Most operators on the island offer packages that include scooter rental, accommodation and ferry tickets as well as diving.

If you are doing a beginner's course or a scuba experience, your diving will be from the shore. If you are an experienced diver, make sure you book boat dives to get to the best sites and escape from the crowds.

Conditions

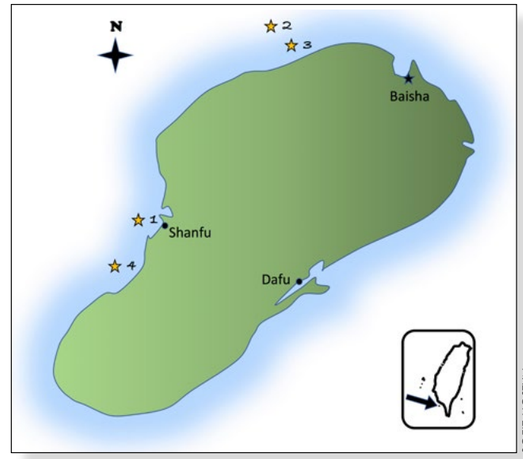
Xiaoliuqiu is warm all year round. It is hotter during the busy summer months, but that is also when there is most rain, and the typhoon season is between July and August. All of which means that the best time to dive here is between November and April.

You will have clear skies, dry days and air temperatures in the mid-20s°C (high 70s°F). The sea will be a balmy 26°C (79°F), as the current that cools Penghu's waters in winter does not affect Xiaoliuqiu. Tucked in close to Taiwan's western shore, the island is also protected from the worst of the northeastern winds.

There should be fewer people around in winter than in summer; but, having said that, it is no secret in Taiwan that Xiaoliuqiu is lovely at this time of year. So, at weekends, it may still be quite crowded. Visit on weekdays if you can.

Broken Shipwreck

The top dive site in Xiaoliuqiu is Broken Shipwreck, otherwise known as Shan Fu Shipwreck after the small west-coast port nearby. The ship looks like it might have been a small cargo vessel. It was deliberately sunk as a fish aggregation device, but it has been beaten up by storms and now lies in two sections. A fixed descent line brings you down to the first section, which consists of the remains of the bow, a squat pile of twisted steel rising from a patchy, sloping reef at 15m (50ft) and a mess of hull plates and



Map of Penghu Islands in Taiwan

Octopus eyes watching you (above); Divers explore half of the Broken Shipwreck (right).

other debris strewn over the seabed.

The second section, the stern, is more intact and wedged into a white sand patch at 19m (63ft). Here is where the fish are aggregating. A large goldspotted sweetlips holds court in what remains of the ship's small superstructure, along with lionfish, which hunt for prey among the massed schools of copper sweepers and other small fish. The interior is open and free of any obstacles or cables.

Among the fish schools are several types of cardinalfish. There are silver-lined, gold, fine-line and Sagni cardinalfish, among others, and some of them are evidently paired up in couples. They swim in choreographed moves, one of each pair following the other's every move. Their dance is entertaining and entrancing. In fact, the whole fishy scene inside this shipwreck is a videographer's delight.

There are small groupers in and around the stern. Look out too for the distinctive swirly-blue-patterned juvenile emperor angelfish and the gaping mouths of moray eels poking their heads out of holes in the steel.

There are other attractions on this site as well. Swim away from the wreck across the sand flat, parallel with the sloping reef and down to around 22m (73ft), and you will find a couple of artificial reef structures, cages of steel, surrounded by a field of garden eels. There is no need to hurry over there, though. Move slowly and keep your eyes open as you make the crossing, and you may find octopus, flounders, tobies and ghost pipefish. We have found both rough snout and robust ghost pipefish here and, on one occasion, we found one of each paired up together in an unusual combination.

If you are diving on air, then, having spent quite a long time at around 20m (66ft), there is a good chance that you may be low on no-decompression time by now, so keep an eye on your dive computer and be prepared to make your way back to the sloping reef and the mooring line. Here is where you will find some of Xiaoliuqiu's signature green turtles. They tend to mass on the reef top, as well as closer to shore next to Shan Fu Port itself, which is a popular beach diving spot.

If your primary focus is on critter hunting, rather than exploring the wreck, then do this dive in reverse, visiting the deeper section around the artificial reef structures first, before moving up to the stern, and finally the bow.

Net Cage and Beauty Cave

Near the northwestern tip of Xiaoliuqiu are two dive sites. Net Cage is a boat dive while Beauty Cave is a shore dive. The first is named after a failed fish farming operation, which bred fish in large, closed nets but lost its stock when thieves cut through the netting at night and spirited away all the contents.

This means there is no longer a focal point for the site, and it is now just an hour-long potter back and forth over a hard-coral reef top. Keep your eyes open, and you will be amply rewarded. Every dive here has its highlights, such as juvenile sweetlips wiggling about, schools of razorfish drifting along head down and tail up, trying to look like a patch of floating weed to deceive their prey, spotted crouchers, Mozambique scorpionfish or gorgeous blue and yellow ribbon eels.

Look among stands of Acropora coral for beautiful babies such as mimic filefish, butterflyfish and angelfish. There are plenty of anemones on the reef, garden eels in the sand patches and octopuses eyeing passing divers warily from their lair, hoping that their camouflage and quick wits will keep them safe.

There are also sea turtles here, either cruising over the deeper reef or surfing the waves in the shallows near Beauty Cave, where the snorkelers and try-divers are. You will not be making as much noise as the begin-

Swirling school of glassfish inside Broken Shipwreck (above); Double act of a robust and an ornate ghost pipefish (right)

ners splashing around near the shoreline, so expect the turtles to come your way for a little peace and quiet and have your camera ready.

Venice Shipwreck

Farther south along the western coast from the Broken Shipwreck is another buoyed sunken cargo vessel, completely intact this time. It is named after Venice Beach, the nickname given to an attractive stretch of white sand in nearby Geban Bay.

The wreck has been dropped onto the seabed at 40m (132ft), again in the hopes of attracting fish, but in this case, the aim has not yet been achieved. The descent line is attached to the bow at 30m (100ft), where there is some lovely, colourful coral growth. In fact, corals have taken hold all over the ship and decorate most of the available surfaces. Sadly, however, with the exception of some small fry, there is not much fish life on the wreck.

There is a large cargo hold to swim around, and the engine room is open, with plenty of artefacts still in place. The superstructure is clean and easy to explore, with light coming through large holes in the deck, illuminating the interior. This is a fun dive, although it is also a short dive. There is no reef wall nearby, which means that you need to stay at 30m (100ft) or deeper the whole time. ■

Xiaoliuqiu dive operators include Liuqiu Dive (liuqiudive.com), A-Gui Dive and Homestay (aguidive.com) and Odyssey Divers (odysseydivers.net).

Simon Pridmore is the author of the international bestsellers Scuba Fundamental: Start Diving the Right Way, Scuba Confidential: An Insider's Guide to Becoming a Better Diver, Scuba Exceptional: Become the Best Diver You Can Be, *and* Scuba Professional: Insights into Sport Diver Training & Operations, *which are now available in a compendium. He is also the co-author of the* Diving & Snorkeling Guide to Bali *and the* Diving & Snorkeling Guide to Raja Ampat & Northeast Indonesia. *His recent published books include* The Diver Who Fell From The Sky, Dive into Taiwan, Scuba Physiological: Think You Know All About Scuba Medicine? Think Again! *and the* Dining with Divers *series of cookbooks. For more information, see:* ***SimonPridmore.com.***

Showing Scale

Contributors' Picks from Around the World

Text and photos by John A. Ares, Sheryl Checkman, Larry Cohen, Anita George-Ares, Kate Jonker, Matthew Meier, Brandi Mueller, Gary Rose and Olga Torrey

In underwater photography, "scale" can mean a couple of things: how big or small a thing is or the myriad of tiny plates on the skin of a fish. We asked our contributors what their favorite underwater photos were that showed scale. And playing on the pun, they came back with a creative mix of macro, wide-angle and close-up abstract images. Here, *X-Ray Mag* contributors share their favorite images from the tropical waters of the Solomon Islands, Micronesia, the Philippines, Indonesia, the Red Sea, the Bahamas, the Cayman Islands, Bonaire, Honduras, Malpelo Island, Hawaii, the Soccoro Islands and the Galápagos Islands to the temperate waters of South Africa and the US East Coast.

MATTHEW MEIER

Diver hovering behind a massive red sea fan, Russell Islands, Solomon Islands. Gear: Nikon D810 camera, Sigma 15mm fisheye lens, Subal housing, two Sea&Sea YS-250 strobes. Exposure: ISO 200, f/5.6, 1/30s

Scale

Diver in the main cavern in Ben's Cave, the main cavern is approximately 200ft long, 100ft wide and 50ft deep, Grand Bahama Island, Bahamas. Gear: Nikon D3 camera, Nikon 17-35mm lens, Subal housing. Exposure: ISO 800, f/4, 1/5s

The Diver as Reference Point

Text and photos by Matthew Meier

For those viewers of underwater images that are unfamiliar with the incredible array of creatures, both big and small, hidden beneath the surface, a sense of scale helps to lend a point of reference from which they can place the subject into a world that they recognize. Adding a diver to the scene not only provides that reference point but I think it also allows the viewer to connect to the subject on another level. The human interaction makes it easier for the audience to relate on a more personal level and perhaps develop a sense of empathy and caring. From the weird and wonderful little creatures like the red-lipped batfish in the Galápagos, giant underwater caverns such as Ben's cave on Grand Bahama Island, massive sea fans in the Solomon Islands that likely took decades (if not centuries) to grow, to impressive apex predator interactions with colossal tiger sharks at Tiger Beach, each of these photos gives the observer a glimpse into the underwater realm and hopefully provides a connection to something that they may never get a chance to see for themselves. Visit: **MatthewMeierphoto.com**

Diver observes a 6in-long red-lipped batfish, Pinzón Island, Galápagos, Ecuador (above). Gear: Nikon D3 camera, Nikon 24-50mm lens, Subal housing, two Sea&Sea YS-250 strobes. Exposure: ISO 200, f/11, 1/125s; Three large, female tiger sharks approaching the feeder, Tiger Beach, Bahamas (previous page). Gear: Nikon D810 camera, Sigma 15mm fisheye lens, Subal housing, two Sea&Sea YS-250 strobes. Exposure: ISO 200, f/8, 1/100s

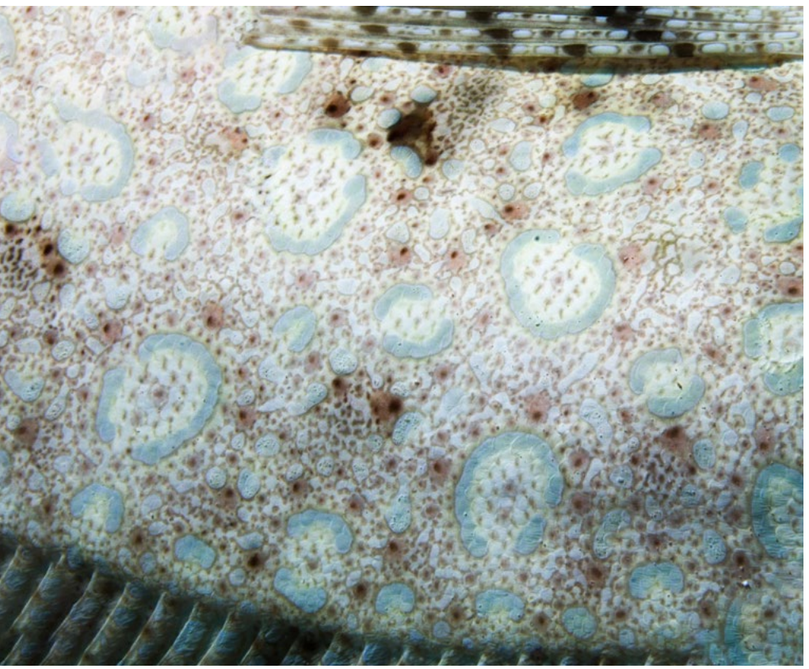


Photo 3: Flounder (above). Gear: Canon 10D camera, Canon 100mm f/2.8 USM macro lens, Ikelite housing, twin Ikelite DS161 strobes. Exposure: ISO 100, f/32, 1/160s

Photo 1. Sturgeon (top right). Gear: Canon EOS 7D Mark II (land camera), Sigma 150-600mm lens at 600mm, using available light. Exposure: ISO 800, f/6.3, 1/1250s; Photo 4: Whitetip reef shark (top left). Gear: Canon 10D camera, Canon 100mm f/2.8 USM macro lens, Ikelite housing, twin Ikelite DS161 strobes. Exposure: ISO 100, f/5.6, 1/125s

Scale Textures

Text and photos by John A. Ares

The photos presented here were originally part of a project I had been compiling for a while, under the keyword "texture." Scales are features found on both fish and reptiles.

The juvenile Atlantic sturgeon (Photo 1) was washed up on the beach in Staten Island, New York, and had been there for quite some time. The scale pattern was still intact and fascinating. The image was converted to black and white using NIK Silver Efex software.

The cowfish (Photo 2) had compelling scales that scream. Scales can camouflage or make the fish stand out strikingly, as in this instance in Bonaire.

The skin or scale pattern of the flounder (Photo 3) helped it blend in with the bottom in Bonaire.

Shark scales differ from that of bony fishes and are called dermal denticles or placoid scales.[1] The whitetip reef shark (Photo 4) was particularly tolerant while getting its portrait taken. It is not a normal practice to shoot sharks with a 100mm macro lens. The resulting photo was a happy accident taken in Kauai, Hawaii.

The image was converted to black and white using NIK Silver Efex software. Selective color was then applied, using the techniques I wrote about in my article **Selective Color in Underwater Photography** in *X-Ray Mag #110*. Visit: **JohnAres.com**

[1] HTTPS://EN.WIKIPEDIA.ORG/WIKI/FISH_SCALE

Photo 2: Cowfish. Gear: Canon 10D camera, Canon 100mm f/2.8 USM macro lens, Ikelite housing, twin Ikelite DS161 strobes. Exposure: ISO 100, f/8, 1/160s

Photo 2. (above) Bluestripe fangblenny, Sponge Wall, Roatan, Honduras. Gear: Olympus OMD EM5 Mark II camera, Olympus M.60mm f/2.8 at 60mm, Olympus PT-EP13 housing, Sea&Sea YS D-1 strobes. Exposure: ISO 200, f/11, 1/125s

Photo 3. (above) Reef shark with "remora" diver, Cara-a-Cara Marco's Place, Roatan, Honduras. Gear: Olympus OMD EM5 Mark II camera, Olympus M.9-18mm f/4.0-5.6 at 9mm, Olympus PT-EP13 housing, Sea&Sea YS D-1 strobe. Exposure: ISO 200, f/8, 1/160s

Context

Text and photos by Sheryl Checkman

Life beneath the sea comes in all different sizes—from the barely visible varieties of nudibranchs and blennies to enormous pelagics, like whales and whale sharks. When viewing photographs of these animals, it is often difficult to judge the scale without some form of context. When shooting macro subjects, we often fill the frame with our subject, closing in to get detail, but losing sight of just how small that critter actually is.

In Little Cayman, while diving on Cumber's Caves, my buddy and I spotted a spinyhead blenny (Photo 1) poking its head out of the sand. In order to show just how small this blenny was, my buddy placed her index finger alongside it.

In Roatan, I encountered a bluestriped fangblenny (Photo 2) on sunray lettuce coral, while on a dive at Sponge Wall. The neon bluestriped fangblenny, lying on top of the comparatively larger coral's linear ridges, stands out as a tiny, curved line, while at the bottom of the image, another tiny blenny (only noticeable by its dark eyes) almost blends in with the similarly colored coral.

The same idea goes for photographing large animals. I once photographed a 30ft whale shark but neglected to have a photo of a diver in the frame to give the photo scale. In photographing the over 6ft gray reef shark (Photo 3), also in Roatan, at the dive site Cara-a-Cara Marco's Place, I showed just how large this shark was by photographing fellow diver and photographer Brandi Mueller beside it.

On a night dive in Roatan on Emily's Escape Wall, if you look closely, you can see the small Pederson's cleaner shrimp giving this spotted scorpionfish a cleaning. Visit: **Instagram.com/sherylcheckman**

Photo 1. (above) Spinyhead blenny, Cumbers Caves, Little Cayman, Cayman Islands. Gear: Olympus OMD EM5 Mark II camera, Olympus M.9-18mm f/4.0-5.6 at 9mm, Olympus PT-EP13 housing, Sea&Sea YS D-1 strobe. Exposure: ISO 200, f/14, 1/125s; Photo 4. (right) Spotted scorpionfish and Pederson's cleaner shrimp, Emily's Escape Wall, Roatan, Honduras. Gear: Gear: Olympus OMD EM5 Mark II camera, Olympus M.60mm f/2.8 at 60mm, Olympus PT-EP13 housing, Sea&Sea YS D-1 strobes. Exposure: ISO 200, f/8, 1/160s

Photo 2. Type 95 Ha-Go tank on the *San Francisco Maru*, Chuuk Lagoon, Micronesia. Gear: Olympus E-620 camera, Olympus 7-14mm f/4 lens, Olympus housing, ambient light. Exposure: ISO 200, f/4, 1/60s

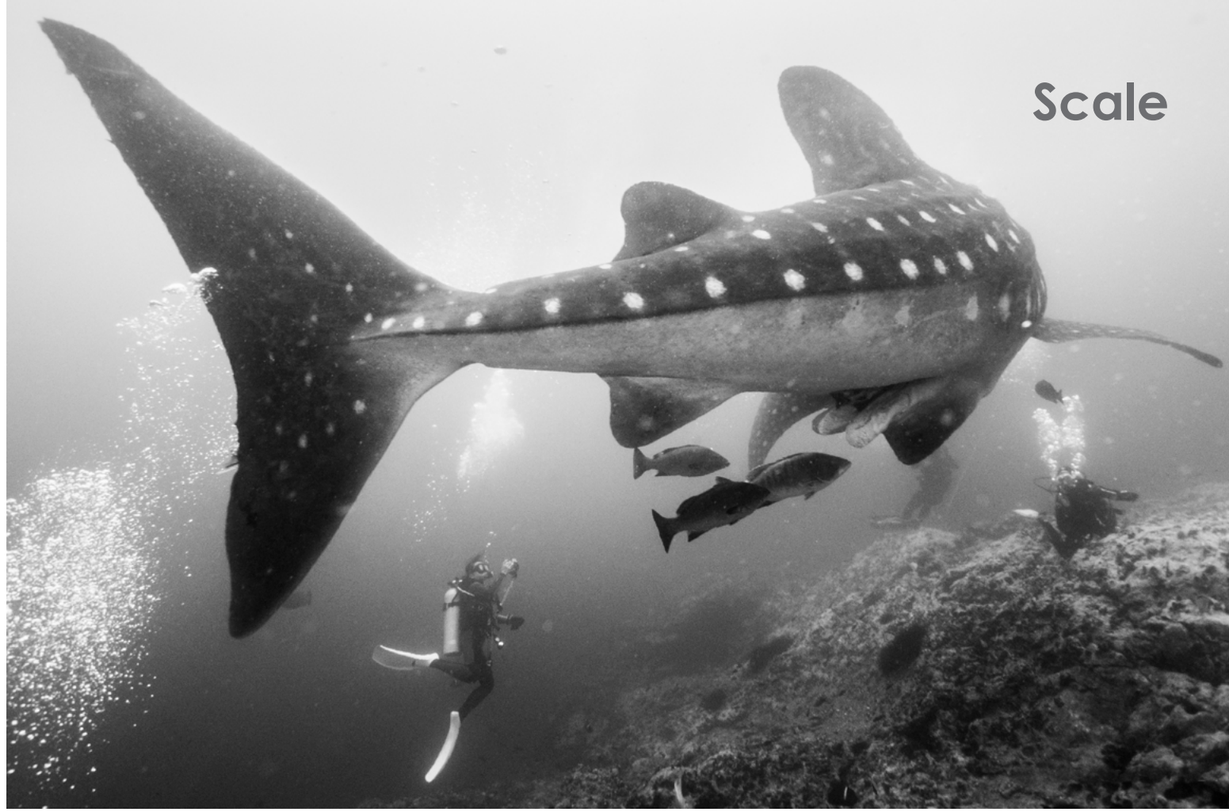


Photo 1. The largest fish in the world is the whale shark, Malpelo Island, Colombia. Gear: Olympus OM-D E-M1 camera, Olympus 9-18mm lens, Aquatica housing, Sea&Sea YS-D1 strobes. Exposure: ISO 400, f/5.6, 1/125s

Wrecks & Whale Sharks

Text and photos by Larry Cohen

When taking photos underwater, the viewer does not get a sense of the subject's size unless there is a familiar object in the image. By adding a diver to the image, the viewer can automatically judge the size of everything in the photograph.

When diving Malpelo Island in the Pacific Ocean, 400km west of the Colombian mainland, we encountered the largest fish in the world: a whale shark. Usually, whale sharks are observed feeding at the surface. But instead, this friendly fish enjoyed our company and stayed with us on the deep walls. This allowed plenty of time to capture images at different angles. Usually, I do not show pictures of the backside of marine life, but I found this image of the whale shark's tail appealing. In addition, the divers taking photos of the whale shark adds scale and a human element to the photograph.

Diving and documenting shipwrecks is always exciting. There is no better location than Chuuk Lagoon in the Federated States of Micronesia. The US Navy attacked the area on 17 to 18 February 1944, in what is known as Operation Hailstone. For this reason, many Japanese shipwrecks are in this small lagoon.

The *San Francisco Maru* carried many supplies for the Japanese war effort, including several small Type 95 Ha-Go tanks. They are in 165ft of water, on the deck. By having a diver swim over the tank, the viewer of the photos has a better idea of how small these tanks are. I took this image with and without strobes, then decided that the image taken with ambient light was more dramatic.

The wreck of the *Aikoku Maru* is also in Chuuk Lagoon. One of the best photo locations is the large stern gun. This anti-aircraft gun is still pointing up, trying to protect the ship from the Avenger aircraft that sent the freighter to its resting place. Again, having a diver in the photo is essential to get an idea of the size of this gun. I also found this image to be better using only ambient light. Visit: **liquidimagesuw.com**

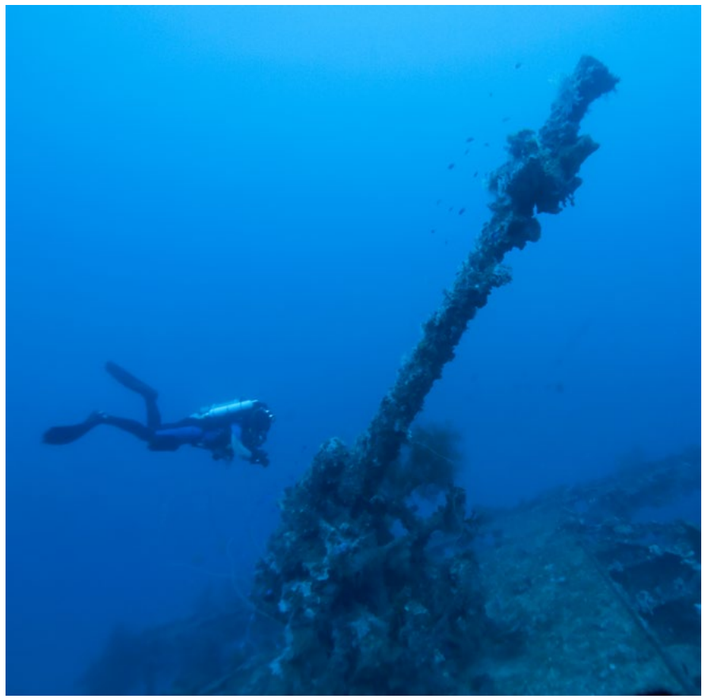


Photo 3. Stern gun on Aikoku Maru, Chuuk Lagoon, Micronesia. Gear: Olympus E-620 camera, Olympus 7-14mm f/4 lens, Olympus housing, ambient light. Exposure: ISO 200, f/5.6, 1/40s

ANITA GEORGE-ARES

Photo 1. (bottom left) Shrimp goby and pistol shrimp, Dumaguete, Philippines. Gear: Canon EOS Rebel SL1 camera, Canon EF-S 60mm f/2.8 macro USM lens, Ikelite housing, one Ikelite DS161 strobe, Bigblue VL4200P video light. Exposure: ISO 200, f711, 1/160s

Photo 2. (center) Shrimp goby and cleaner shrimp, Dumaguete, Philippines. Gear: Canon EOS Rebel SL1 camera, Canon EF-S 60mm f/2.8 macro USM lens, Ikelite housing, one Ikelite DS161 strobe, Bigblue VL4200P video light. Exposure: ISO 100, f/11, 1/160s

ANITA GEORGE-ARES

ANITA GEORGE-ARES

Photo 3. (top left) Ghost gobies and bubble coral shrimp, Dumaguete, Philippines. Gear: Canon EOS Rebel SL1 camera, Canon EF-S 60mm f/2.8 macro USM lens, Ikelite housing, two Ikelite DS161 strobes. Exposure: ISO 200, f/11, 1/200s

Photo 4. (top right) Sea urchin and red emperor snapper. Dumaguete, Philippines. Gear: Canon EOS Rebel SL1 camera, Canon EF-S 60mm f/2.8 macro USM lens, Ikelite housing, one Ikelite DS161 strobe, Bigblue VL4200P video light. Exposure: ISO 400, f/11, 1/160s

ANITA GEORGE-ARES

Roommates

Text and photos by Anita George-Ares

Photographing different species of shrimp gobies and their partner shrimps is a fun project for me. The slantbar shrimp goby and its resident tiger pistol shrimp in Photo 1 were particularly relaxed. Normally, I must approach a shrimp goby burrow slowly and patiently wait for the pistol shrimp to emerge. The goby stands guard duty while the shrimp constantly clears the burrow of excess material.[1] When I visited another shrimp goby burrow, I was delighted to find a cleaner shrimp on top of a banded shrimp goby's head (Photo 2).

A bubble coral shrimp and two common ghost gobies share a bubble coral home in Photo 3. The ghost gobies reach a length of about 3cm, while the bubble coral shrimp grows up to 1.5 cm. I like the proximity of the gobies and shrimp in addition to the warm colors of this image.

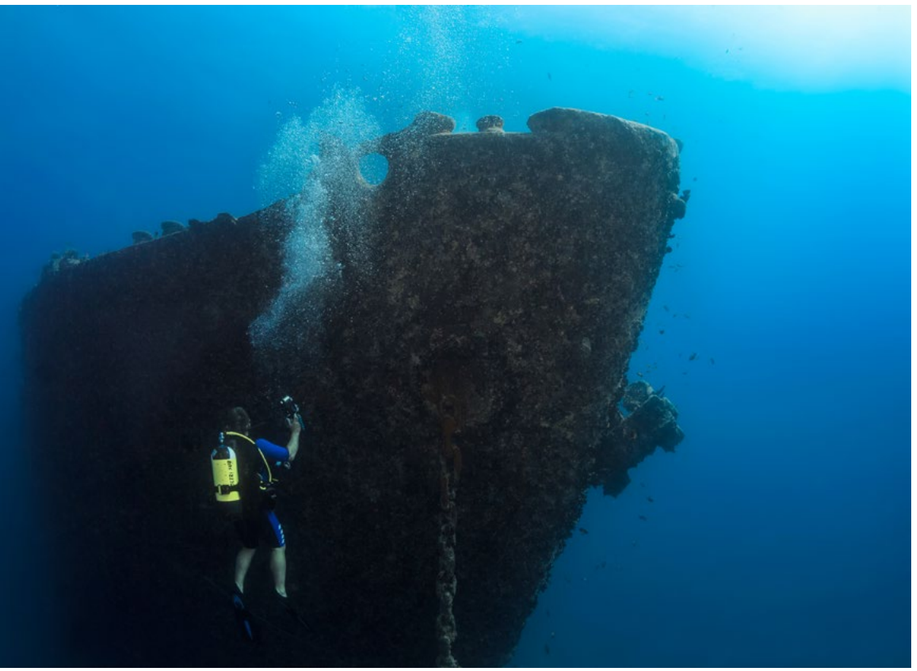
A juvenile red emperor snapper shelters among the venomous spines of a blue-spotted urchin in Photo 4. Juveniles, 3 to 13cm long associate with the urchins (Allen et al., 2015).[2] Juvenile snappers, less than 20cm long also closely associate with lionfish (Seveso et al., 2018).[3] Please visit: **facebook.com/profile.php?id=100016947967639**

[1] EXPLOREBIODIVERSITY.COM/HAWAII/SHRIMP-GOBY/GENERAL/

[2] ALLEN, G., R. STEENE, P. HUMAN, AND N. DELOACH. (2015). REEF FISH IDENTIFICATION TROPICAL PACIFIC. NEW WORLD PUBLICATIONS, INC.

[3] SEVESO, D., S. MONTANO, AND D. MAGGIONI. (2018). IN THE SHADOW OF THE LIONFISH: INTERSPECIFIC ASSOCIATION INVOLVING RED EMPEROR SNAPPER (LUTJANUS SEBAE) IN MADAGASCAR. CORAL REEFS 37 (4):1. DOI:10.1007/S00338-018-01747-8

Group of divers dwarfed by the *Salem Express* wreck, northern Red Sea (above). Gear: Canon EOS 600D camera, Tokina 10-17mm fisheye lens, Sea&Sea housing, two Inon Z-240 strobes. Exposure: ISO 100, f/6.3, 1/100s



Diver at bow of SS *Thistlegorm*, northern Red Sea (left). Gear: Canon EOS 600D camera, Tokina 10-17mm fisheye lens, Sea&Sea housing, two Inon Z-240 strobes. Exposure: ISO 100, f/6.3, 1/100s

Divers with gorgonian sea fan, Straits of Tiran, northern Red Sea (above). Gear: Canon EOS 7D Mark II camera, Tokina 10-17mm fisheye lens, Sea&Sea housing, two Inon Z-240 strobes. Exposure: ISO 160, f/8, 1/160s; Candy nudibranch is only 5mm, Steenbras Deep, Gordon's Bay, South Africa (right). Gear: Canon EOS R5 camera, 100mm macro lens with +12.5 diopter, Marelux housing, two Inon Z-240 strobes. Exposure: ISO 100, f/25, 1/200s

Adding a Sense of Scale

Text and photos by Kate Jonker

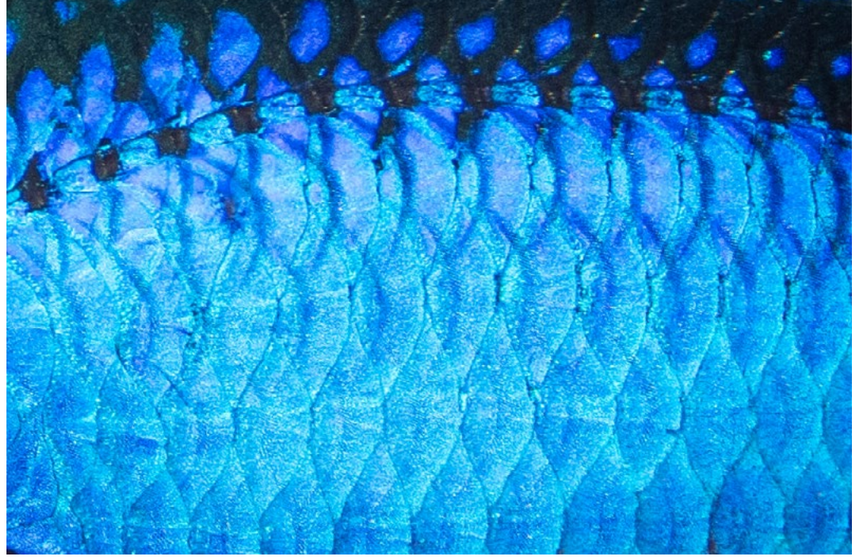
When one dives into the world of underwater photography, things are not always as they seem. A photo of a nudibranch can fill a page, while an image of a wreck can give the impression of being small and unassuming. What can we, as underwater photographers, do to give our viewers a sense of scale? And is it always important to do so?

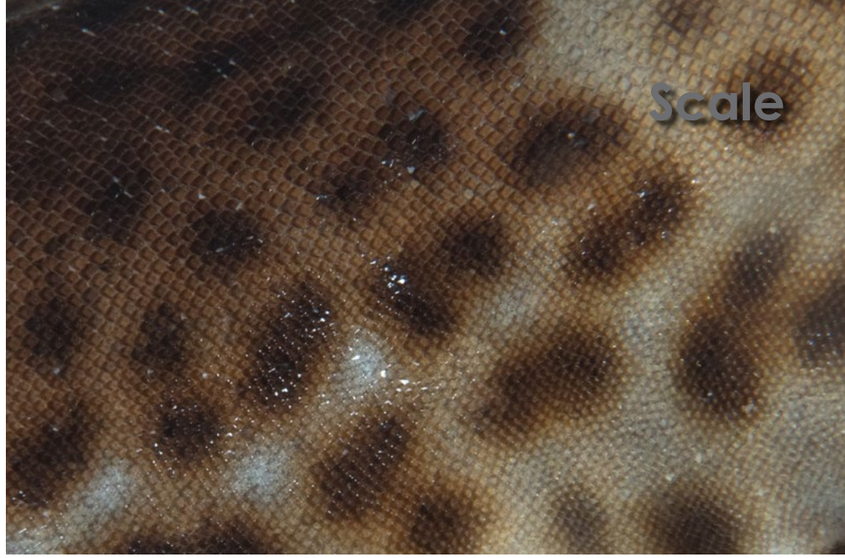
When photographing wrecks, we can add divers. Adding a diver gives a good frame of reference to the size of the wreck, especially if there is no reef or other structure close by to compare it to.

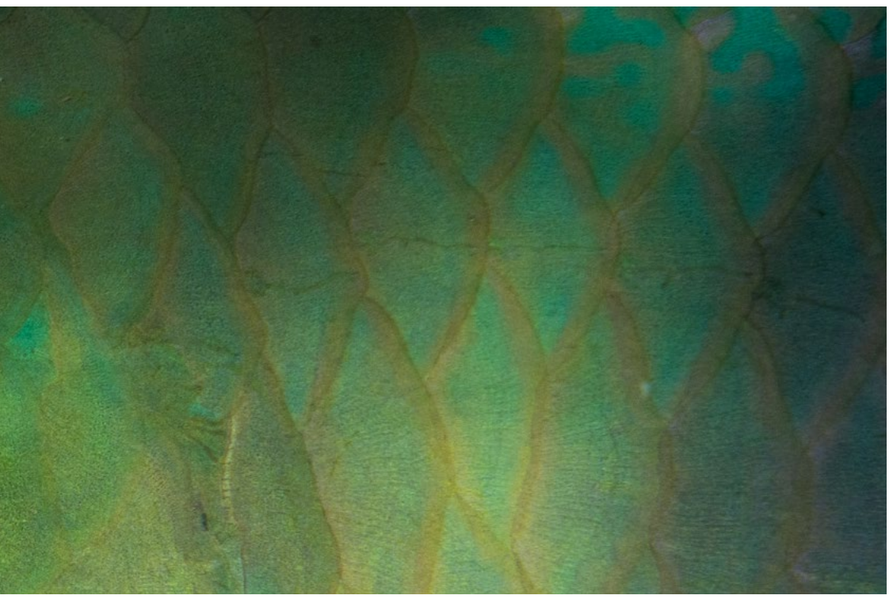
Furthermore, when capturing large reefs or huge gorgonian sea fans, especially those that flourish in the nutrient-bearing currents in the Red Sea, including a diver can add a sense of scale. Non-divers, or those who have never seen these enormous sea fans before, will be amazed. The sheer size of the sea fan compared to a diver next to it can be breathtaking!

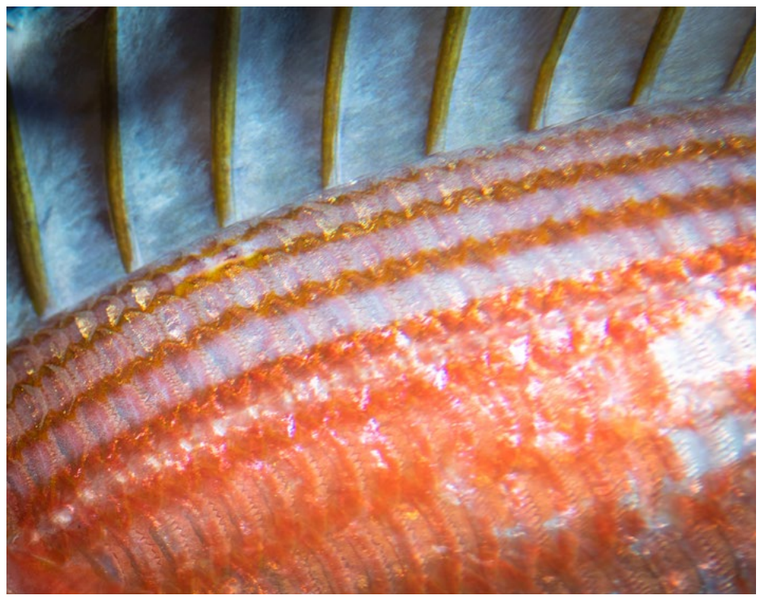
On the smaller end of the scale, monstrous-looking creatures that appear to be the size of a small puppy can turn out to be super-macro photos of critters no larger than of a grain of rice. In macro photography, the absence of a sense of scale can be used creatively, resulting in gasps of wonder when the actual size of the creature photographed is revealed.

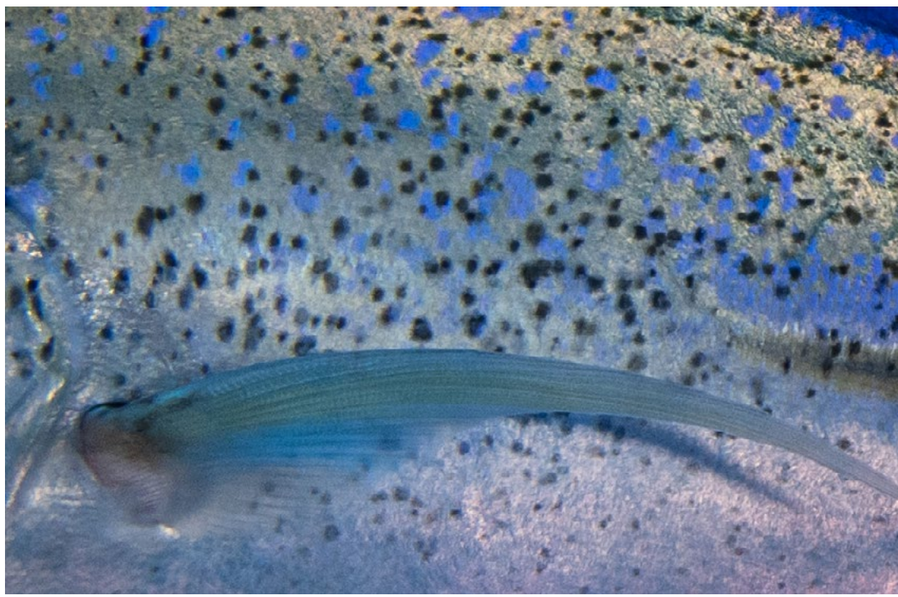
In underwater photography, a sense of scale can amaze and intrigue the viewer. It all boils down to how the photographer chooses to use it! Visit: **katejonker.com**











Anthia, Red Sea (top left). Gear: Nikon Z 7II camera, 105mm lens, Ikelite housing, dual Ikelite DS230 strobes. Exposure: ISO 200, f/5, 1/200s

Blue chromis, Bahamas (top center). Gear: Nikon D850 camera, 105mm lens, Ikelite housing, dual Ikelite DS161 strobes. Exposure: ISO 250, f/8, 1/250s

Epaulette shark, Raja Ampat, Indonesia (top right). Nikon D850 camera, 105mm lens, Ikelite housing, dual Ikelite DS161 strobes. Exposure: ISO 200, f/13, 1/200

Fish Scales Up Close

Text and photos by Brandi Mueller

Fish scales or close-up macro shots of marine creatures is one of my favorite photographic subjects. I love the intricate color patterns and textures of fish scales, and I find the variety and variations amazing. It is often my "go-to" on days where visibility is bad or there does not seem to be much going on underwater. If you look closely, there is always plenty to photograph and see.

For instance, parrotfish never disappoint, and colors vary from fish to fish. (Keep an eye out for the most colorful alpha females.) Scales can vary with tones of blue, green, yellow, pink and purple. Bluefin trevally can have yellow, purple and blue tones and spots, and almost glisten like a metal reflection.

A small pink anthia seems to glitter as it flits about, and its scales are yellow dots surrounded by pink. I also could not resist putting in a photo of an epaulette shark. Shark scales are flexible and called dermal denticles; they are teeth-like structures that feel like sandpaper. Visit: **brandiunderwater.com**

Parrotfish, Red Sea (bottom left). Gear: Nikon D850 camera, 105mm lens, Ikelite housing, dual Ikelite DS161 strobes. Exposure: ISO 250, f/16, 1/200s

Squirrelfish, Bahamas (bottom center). Gear: Nikon D850 camera, 105mm lens, Ikelite housing, dual Ikelite DS161 strobes. Exposure: ISO 250, f/4.5, 1/250s

Trevally, Socorro, Mexico (bottom right). Gear: Nikon D850 camera, 8-15mm lens, Ikelite housing, dual Ikelite DS161 strobes. Exposure: ISO 320, f/11, 1/160s

Photo 1. Great white shark (above). Exposure: ISO 320, f/8, fl 16mm, 1/125s; Photo 2. On the wall—a whitetip shark (right). Exposure: ISO 200, f/8, fl 12mm, 1/100s. All images were taken with a Nikon D500 camera, Tokina 10-17mm lens, Nauticam housing, Inon Z330 strobes.

Photo 3. Diver and giant manta (left). Exposure: ISO 320, f/8, fl 10mm, 1/100s; Photo 4. Giant manta and diver (above). Exposure: ISO 100, f/14, fl 10mm, 1/125s

Scale Matters

Text and photos by Gary Rose, MD

When I give my "Shark Behavior and Identification" lecture, it does not matter where in the world, or to which group I am giving it to, someone in the audience will shout, "That great white shark is huge!" or "I have never seen one so big!" In Photo 1, you can clearly see why.

This beautiful great white shark truly looks gargantuan and of epic proportion. The divers in the cage are dwarfed. And that is exactly the point. If you want to emphasize size, you need to include a size reference in the photo. It is also fun to play with the size reference to create an effect like this. In this photo, the divers in the cage are 30ft behind the sharply focused and light-bathed great white shark. Let's look at a few more examples.

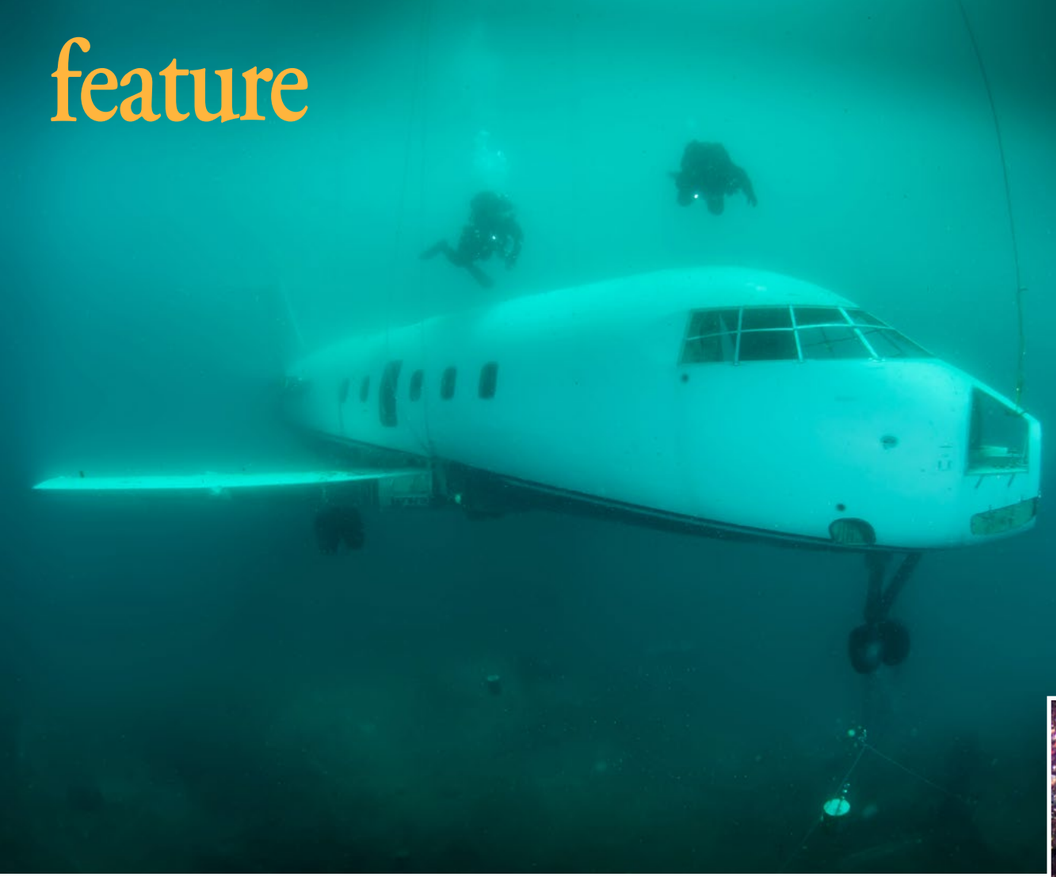
In Photo 2, the whitetip reef shark looks large, but not of epic proportion. I was originally taking this photo of the diver to show the steep and deep drop-off of the wall at Roca Partida, when this whitetip reef shark photobombed the photo. It clearly added to the beauty of the scene and emphasized the grandeur of the wall, as well as supplied an element of 3D to the photo. It does look larger than its 6ft length, swimming 10ft closer to me, and becomes part of the photo—not "the photo," as we saw with the great white shark.

Shooting up from below, with the diver reaching up, almost as if she is touching this beautiful giant manta ray, diminishes the actual size and importance of the manta in Photo 3. The giant manta appears to have a four-foot wingspan, compared to the size of the diver, and appears to be casually passing above the diver. This would be considered a dramatic photo if it was about the diver and not the manta.

In Photo 4, again shooting up, the diver is viewed immediately beneath a giant manta ray. The proximity of the diver and the ray places the scale in proper perspective, allowing the viewer to appreciate the majesty of this giant manta with its 18ft wingspan. This proximity permits the viewer to properly judge scale by properly using the diver as a size reference. This photo emphasizes the very real connection between the diver and the giant manta ray.

"Scale matters." To prove this point, let's look at Photos 3 and 4. The viewer might assume that these are two different giant manta rays, one being relatively small, and the other a more typical giant. Look again. Now, observe the identifying markings on the underside of the manta in each image. The ventral markings are identical. It is the same magnificent giant manta ray in each photo.

Supplying the scale in these examples, with a diver and positioning, allowed me to completely alter the viewer's interpretation and enjoyment of each of these photos. Visit: **garyrosephotos.com**



Challenger 600 aircraft at Dutch Springs, Pennsylvania, USA (above). Gear: Olympus OM-D E-M5 camera, Panasonic 8mm fisheye lens, Nauticam housing, dual Sea&Sea strobes. Exposure: ISO 320, f/5.6, 1/200s

Giant Pacific manta ray, Revillagigedo Islands (Socorro), Mexico (left). Gear: Olympus OM-D E-M5 camera, Panasonic 7-14mm lens. Nauticam housing, dual Sea&Sea strobes. Exposure: ISO 400, f/11, 1/125s

Night snorkeling with giant Pacific manta ray, Big Island, Hawaii, USA (below). Gear: Olympus OM-D E-M5 camera, Panasonic 8mm fisheye lens, Nauticam housing, dual Sea&Sea strobes. Exposure: ISO 800, f/6.3, 1/200s

Giant barrel sponge, Gabriella's Fish Point, Tufi, Papua New Guinea (center). Gear: Olympus OM-D E-M5 camera, Panasonic 8mm fisheye lens, Nauticam housing, dual Sea&Sea strobes. Exposure: ISO 320, f/11, 1/60s

From Jets to Rays

Text and photos by Olga Torrey

In March 2016, my dive partner Larry Cohen and I were on the photography team that documented the sinking of a Challenger 600 aircraft in the 50-acre freshwater lake known as Dutch Springs in Pennsylvania, USA. The plane sank to 45ft in cold water. The Challenger 600 series business jet replaced the Sikorsky CH-37 helicopter, another favorite attraction for divers at the quarry. My friend Pete Venoutsos, Larry and I were excited to check out the new dive site the following weekend. I used both divers as a human element for scale when photographing the plane's length, which was 20.9m (68ft 5in), and wing area of 45.4 sq m (489sq ft).

It was the year 2018 when I first saw a giant Pacific oceanic manta ray. For a long time, I had wanted to visit the Revillagigedo Islands (Socorro) in Mexico to see these majestic creatures. I traveled there on the luxurious *Nautilus Belle Amie* liveaboard. On the last day of the trip, we swam with ten manta rays, which engaged us with their graceful acrobatic movements. I used the divers as a human element to show the scale of these giant manta rays, which can be impressive in size, with bodies up to 9m (30ft) in length, weighing about 3,000kg (6,600 lbs).[1]

My first visit to Kailua-Kona in Hawaii, USA, was in October 2019. The trip's highlight was the night diving and snorkeling with pelagic manta rays. In addition to the rays, we met a lovely young diver, Angelique Reinke, who came along to do night snorkeling with the mantas. We used lights to attract plankton, which attracted the mantas rays. The animals were active, giving us plenty of opportunities to capture them in action. For one shot, I asked Angelique to swim in the direction of my light and align herself near a giant ray.

In October 2018, I visited Papua New Guinea. It was a childhood dream of mine to go to this mysterious and faraway place. Finally, my dream came true, and I set my foot on the same ground where the 19th century explorer Nicholas Miklouho-Maclay, whom I had learned about in school, had lived and studied the indigenous people.

My favorite location in Papua New Guinea was Tufi Resort. It was an excellent location for macro and wide-angle photography. The colorful corals on vertical walls at Gabriella's Fish Point were healthy and enormous. I asked the dive guide to swim toward the giant barrel sponge, at a distance, to emphasize its size in the shot. Visit: **fitimage.nyc**

[1] WIKIPEDIA.ORG

POINT & CLICK ON BOLD LINKS

Equipment

Edited by
Peter Symes

Unimatic Modello Quattro

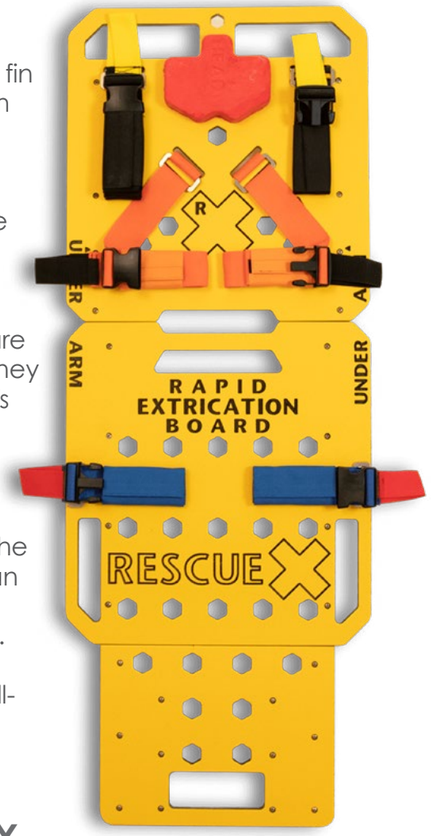
Is this elegant watch (actually, a diver's watch) or not? Well, its water resistance is stated at 300m, and since the requirement for a diver's watch is 200m / 20Atm, it must be, based on this general guideline. On the other hand, it does not have a bezel, like a classic diver's watch. However, since virtually everyone these days dives with a computer, this probably no longer has any major significance. With its 40mm diameter and 12.4mm thickness, the watch is relatively compact. The watch is also self-winding, with a reserve that lasts 38 hours. This model is a limited edition, with only 120 numbered copies produced. **Unimaticwatches.com**

Waterproof W8

Similar in design and fit as the already excellent W7 wetsuit, but equipped with front zip instead of back zip, the W8 is (like all models in the Neoflex series) made of extremely soft, flexible and comfortable four-way super-stretch neoprene. The W8 is also equipped with the WaterDam, Waterproof's unique solution that prevents water from streaming down your neck and spine when moving your head. The double Zipper Seal System behind the front zipper reduces the water flow through the suit to a minimum. Double seals with zippers at arms and legs add comfort and easy donning/doffing. **Waterproof.eu**

Folding fins

I spotted this sci-fi-looking fin at the DEMA show. As can be seen in the photo, the fin can be folded so that it does not take up much space in one's luggage. The foot pocket fits all shoe sizes, since the size of the pocket can be adjusted or tightened, using straps that are inserted into the sole where they are attached with clips—this is nicely illustrated on the Polish manufacturer's website. The thin fin blade is made of a flexible material, which appears to be carbon fibre. The manufacturer describes it as an "innovative bio-mimetic membrane" designed like a fish's tail. My immediate impression, when I held it in my hands, was that the fin was solid and well-designed. It did not seem like just another fancy idea but was a proper new design for fins. **Foldingfins.com**



Dive Rite Azimuth reels

Dive Rite's Azimuth reels are made with a one-piece trapezoidal handle that provides a high-strength, corrosion-free frame and an ergonomic grip, with or without gloves. The innovative, angled, lock-down screw design is more ergonomic and streamlined than traditional solutions. The dimensions of the reel have been thoughtfully chosen for comfort and ease of use, combined with being low profile when clipped off and stowed. The unique inline clip slots on the handle orient the reel to sit closer to the body when clipped to a D-ring. **Diverite.com**

RescueX

It is not only a frightening experience to have to rescue an injured diver, but in many cases, it can also be physically difficult. How do you, for example, lift a heavy diver into a boat, onto a dock or up a steep shore? Those who have tried it, either for real or during exercises, will know what I am talking about. At the DEMA show, I, therefore, hit the brakes hard when I came down the aisle and spotted this Rapid Extrication Board, which is basically a thin and light stretcher that makes it much easier to pull a diver out of the water while at the same time stabilizing the injured person. We understand it was developed by some firefighters (who are also divers) who realized that the boards which lifeguards on the beach were equipped with, were not suitable for divers, as they were initially designed to be pulled by a jet ski. **Rescuextraining.com**

Lefeet S1 Pro Scooter

Many underwater scooters are quite bulky and heavy, as they have been designed for technical divers, photographers and others who need to get around large, deep wrecks or do long penetrations into caves and mines. But for divers with less demanding needs, something more nimble would do. To that end, the Lefeet S1 Pro is a compact design weighing just 2.5 kg (depending on accessories), making it easy to carry, even on flights—the manufacturer states that the battery is "airline-approved." The scooter has three speeds—low, medium and high—and can go down to 40m depth. Endurance is 45 to 70 minutes on a full charge, and the battery can be easily and quickly replaced. For greater performance, two units can be connected. **Lefeet.com**

FLEX2 CCR

What respectable diver's household could be without a side-mount rebreather? All joking aside, niche products and cutting-edge technological developments can be interesting for everyone to follow, because inventions and new principles tend to ultimately find their way to ordinary consumers, or divers. This rebreather, which is carried along the side, can either be used as an independent primary rebreather in tight spaces, for instance, or as a bailout rebreather and backup for another rebreather. Diluent and oxygen tanks can either be mounted and carried on the unit or can be connected to off-board gas. There are two radial scrubbers. The controller is a Petrel from Shearwater Research. **IQSub.com**

XDEEP recalls NX700 regulators

All NX700 regulators are being removed from the market due to an identified potential life safety issue, XDEEP writes. If you own an NX700 regulator, stop using it immediately and contact the dealer where you purchased it, or contact XDEEP directly at **support@xdeep.pl** for more information regarding the next steps.

Mark Derrick

Founder of Dive Gear Express

Interview by Matthew Meier
Photos courtesy of
Dive Gear Express

"Treat customers the way you want to be treated" is a tenet of client relations for which many businesses strive but, sadly, not all achieve. This concept of customer service was the primary building block with which Mark Derrick developed Dive Gear Express (DGX) since its infancy in 2002. In light of the five-star independent Google reviews from 97 percent of DGX patrons, I would say they are on the right track.

Recently, I had the opportunity to talk with Derrick to learn more about his history and that of the company. My takeaway, which he emphasized time and again, was that the success of DGX was only made possible due to his team of dedicated employees and their focus on satisfying the customer's needs.

For the uninitiated, Dive Gear Express is a US-based online dive gear retailer with a global clientele, specializing in equipment for experienced divers and those in the technical diving community. They do not carry gear for beginning divers, and as Derrick says, "You won't find any jacket-style BCs or pink snorkels." Most of their customers are looking for brands and/or gear setups that their local dive shops do not carry. This circles back to the importance of the DGX team, because nearly every order must be personally customized to satisfy their clients' wishes and demands. Several of the staff members are technical divers with trimix and/or full cave qualifications, plus a few have rebreather certifications, and each dives the equipment they sell.

DGX is based out of a dive shop and warehouse in Pompano Beach, Florida, considered by many of their clients around the planet to be their "local shop" and a destination to which they come to tour the "mother ship" when in the area. The dive shop is an extension of their online store where customers can order gear from a website kiosk up front and have it brought out from the warehouse in the back. This family-owned and -operated small business is run by a staff of only eight.

Mark Derrick (center) teaching students in a pool session

History

Derrick is a self-described tech nerd and was an early adopter of technical diving, based in part on his educational background in physics and chemistry. That knowledge allowed him to understand concepts such as blending nitrox and accelerated decompression, and helped fuel his fascination with being on the bleeding edge of technical diving. In 1993, Derrick became a certified trimix diver through the renowned instruction of Billy Deans, and a few years later, transformed into an instructor himself for diving rebreathers.

By the early 2000s, Derrick envisioned retirement and was living and diving in the Florida Keys after successfully selling off an internet service provider (ISP) company. However, his days as a dive bum did not last long, and in an effort to, as he called it, "be closer to civilization," Derrick relocated to Pompano Beach in 2002 and started a technical gas fill company called Fill Express. Derrick stated that, at the time, it was nearly impossible to get technical gas fills in a reliable or timely fashion. So, with his tech knowledge and background, he created a fill station company that consistently, and with precision accuracy, banked nitrox at 32, 36 and 40 percent, as well as several trimix blends, all available as easily as getting an air fill. Using inspiration from his uncle,

Staff at work filling customers orders and checking gear in the DGX warehouse. Several are technical divers who dive the type of equipment they sell.

who worked as a golf pro when he was not out golfing, Derrick opened the doors to the shop when he was not out diving.

Soon after its launch, Fill Express began exclusively carrying the Dive Rite brand in an effort to provide tech gear for Derrick's fill clients, while simultaneously making a conscious effort not to compete with dive gear sold at local shops. Realizing that by leaning on his recent experience running an ISP company he could sell more gear online, Derrick approached Lamar Hires (CEO of Dive Rite) and eventually got permission to publish dive gear prices on the internet. Commonplace today but unheard of in 2002, the newly created Dive Rite Express website was built and had its first sale on 1 March 2003. The products sold were shipped and delivered the very next day.

Derrick soon became Dive Rite's largest dealer, though both he and Lamar took a lot of flak for supposedly "destroying the dive industry" by selling dive equipment on the internet. Over the next few years, Derrick and his staff carefully curated the addition of gear from other manufacturers and also started selling cylinders online, all with the caveat that "if the Divers Direct website sold it, he did not."

The online store was rebranded to Dive Gear Express in 2009, and the following year, DGX moved to its current physical location in Pompano Beach's Powerline Business Park. Derrick also separated the Fill Express business from DGX, creating individual LLCs, before selling Fill Express in May of 2010. As part of the sales contract, Derrick agreed to a non-compete clause stating that he would not sell air fills from the new DGX location. In keeping that promise, Derrick instead gives away air to his technical diving students from the nitrox and trimix banks he still maintains at the mother ship—further illustrating his desire not to compete with local dive shops.

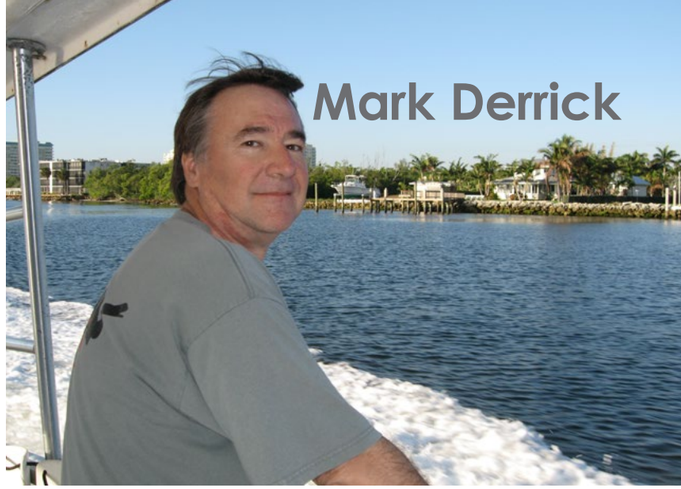
A family business

From the beginning, Derrick has sourced gear from manufacturers and sold it online directly to his primarily consumer-based customers. Though Dive Gear Express does not manufacture any products directly, it does place its brand on a few items. By eliminating the middleman, DGX does not offer discounts, nor wholesale pricing, but there is a segment of the website called the Bargain Annex, with a nod to Derrick's late father, where you can find discontinued and clearance-priced items.

Derrick learned a lot about business practices and financial statements from working with his father, who ran a chain of small furniture stores. His dad's "Bargain Annex" was a section of the store that contained discounted furniture, and when Derrick created the website for DGX, he kept the name as a way to honor his father.

Keeping the family theme

Mark Derrick in Florida (right) and enjoying marine life on a dive (below)



going, Derrick's sister Lisa has worked with him at DGX since 2006. She started out filling tanks and photographing gear, which she continues doing to this day while also working on graphics and helping to manage the shop. In recent years, Derrick configured the documentation for his business so that it is 100 percent cloud-based, thus allowing his other sister, living in their home state of Alabama and an accountant by trade, to become his office manager, logging in remotely to handle bookkeeping and accounts.

User-friendly website

The unsung hero of the business is the website itself. Derrick designed it to be easy to navigate and filled the pages with "Tek Tips" to help answer questions from everything related to technical diving to shipping and return policies. Most customer questions are answered on the site, but if the staff discovers an unaddressed issue, they will make a note so it can be added in the future.

Speaking of shipping and returns, DGX offers free shipping on everything they sell and guarantees the safe arrival of every order. They ship to over 100 countries worldwide and have one of the best return policies in the industry. Everything is explained in detail on the website.

I asked Derrick if he knew the percentage of their international sales, and he stipulated that while DGX does not track that specifically, he estimates it to be approximately 40 percent. Though he also admitted that now it may be slightly lower due to the ongoing shipping problems over the past few years, further explaining that there are a few countries to which he can no longer ship as he cannot guarantee delivery.

Global sales

Looking back at how DGX rode out the pandemic, Derrick said that his sales were down by more than 50 percent in April and May of 2020. As June and July came around and more divers got back in the water locally, his numbers began to climb. By year end, Derrick said that while their numbers were not terrible, his 2020 sales were certainly worse than normal.

Business continued to increase in 2021, and so far, 2022 is on track to keep pace with 2021, but he is still not back to pre-pandemic levels. Derrick explained that the ongoing challenge is dealing with decreasing margins on gear, as the cost of rent, payroll, wholesale goods, materials, shipping and other expenses continue to rise.

Undaunted, Derrick vowed that he and his staff will carry on providing the impeccable customer service upon which Dive Gear Express was built while doing their best to stay on the cutting edge of technology, as they continue to deliver high-quality dive gear around the globe. ■

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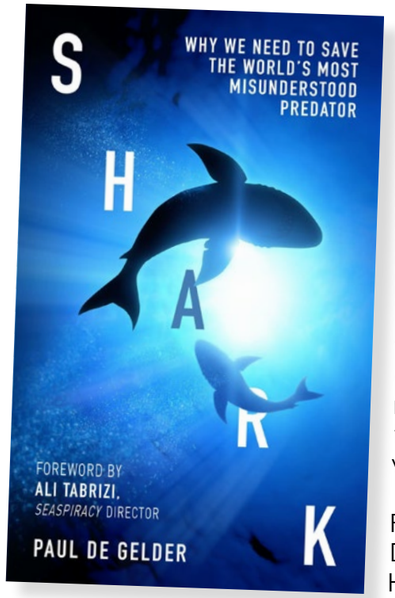
Edited by
Catherine GS Lim



Sharks

Shark: Why we need to save the world's most misunderstood predator, by Paul de Gelder

Written by Paul de Gelder, a man who lost two limbs in a shark attack, this book shines a light into the true nature of sharks. With more than 500 species of sharks in existence today, it is important that we match our fascination of sharks with the truth of what they really are—a species essential to maintaining the balance of the ocean's ecosystem, as well as our own existence.

Publisher: Mudlark
Date: 17 January 2023
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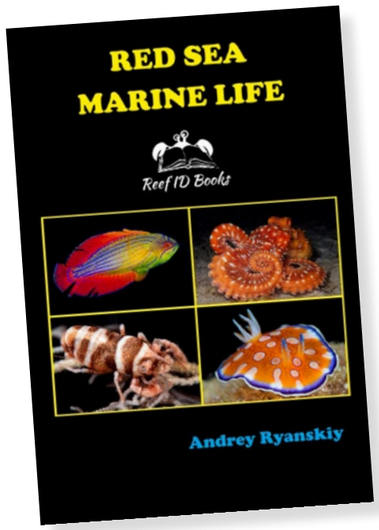
ISBN-13: 978-0008529666



Red Sea

Red Sea Marine Life, by Andrey Ryanskiy

This 300-page hardcover book contains 2,900 colour photos of marine life, including 810+ fish species, 250 cnidarians and nearly 350 species of nudibranchs and sea slugs. Besides well-known species that have been photographed with unprecedented quality, it also contains many species which were discovered by the author and his colleagues. The latest research findings in marine biology have been incorporated into the book's comprehensive content.

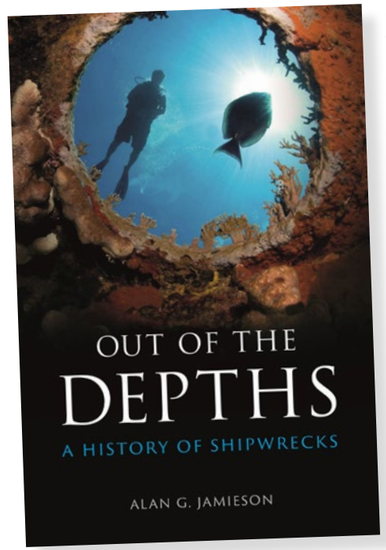
ASIN: B0BHNWYY8V
Publisher: Andrey Ryanskiy
Date: 7 October 2022
Hardcover: 300 pages
ISBN-13: 979-8986828718

Marine Archaeology

Doggerland: Lost World under the North Sea, by Luc W.S.W. Amkreutz and Sasja van der Vaart-Verschoof

Doggerland is one of Europe's most important archaeological sites, beneath the North Sea. This was where early hominids left the first footprints in northern Europe, where Neanderthals lived alongside woolly mammoths, and where the first modern humans left their traces. As eons passed, Mesolithic hunter-gatherers came along, successfully adapting to a constantly changing world. Around 6150 BC, ongoing submergence and a huge tsunami marked the beginning of the end. It then took only several centuries for the last islands to vanish under the waves, taking the story of Doggerland with them. Until now—this book brings the world of Doggerland back to present times.

Publisher: Sidestone Press
Date: 21 September 2022
Paperback: 210 pages
ISBN-10: 9464261137
ISBN-13: 978-9464261134

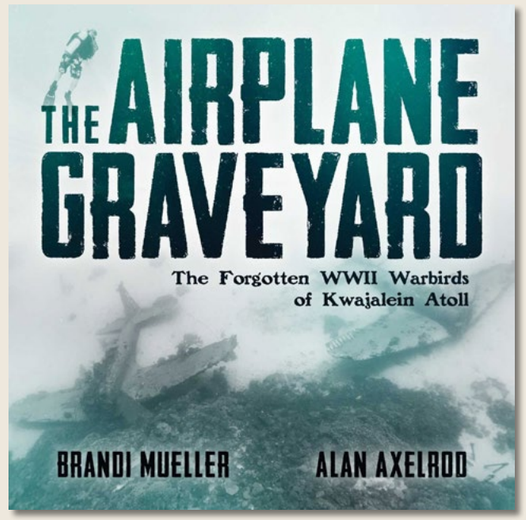


Shipwrecks

Out of the Depths: A History of Shipwrecks, by Alan G. Jamieson

This book takes readers on a comprehensive voyage across 4,000 years, exploring shipwrecks and their historical context and significance. Author Alan G. Jamieson shows how shipwrecks shed light on long-departed societies and civilisations, and discusses technological developments of the last sixty years that have boosted our appreciation of shipwrecks. The book also covers shipwrecks in culture and maritime archaeology, their appeal to treasure hunters and their environmental impact.

Publisher: Reaktion Books
Date: 3 November 2022
Hardcover: 320 pages
ISBN-10: 1789146194
ISBN-13: 978-1789146196



Never before published in book form, see extraordinary images of the forgotten American WWII airplanes resting on the bottom of the Kwajalein Atoll lagoon, from award-winning underwater photographer Brandi Mueller. Available on: **Amazon.com**

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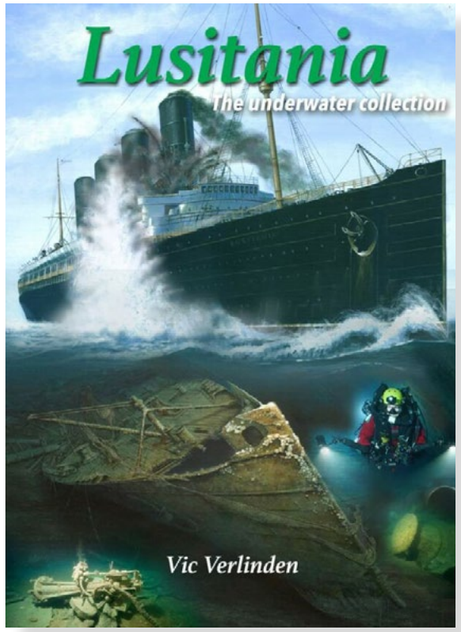
Edited by Catherine GS Lim

Cave Diving

Cave Diving: Everything you always wanted to know, by Stratis Kas and Matteo Ratto

As the title says, this book covers all aspects of cave diving—everything you might wish to know about it. Written by *X-Ray Mag* contributor, diving instructor and adventure filmmaker Stratis Kas (with Matteo Ratto), this book includes information about diving physics and physiology that have been written in collaboration with scientists, doctors and specialists. More essentially, the book's unique feature is the 32 inserts by top world-class cave divers on their personal take on important elements of cave diving. Alongside a foreword by tech diving pioneer Michael Menduno, this book contains more than 75 colour photos as well as large-scale, detailed illustrations presenting information on navigation, gas management, etc.

Publisher: **Stratiskas.com**
Date: 15 January 2023
Paperback: 244 pages



Lusitania Shipwreck

Lusitania: The Underwater Collection, by Vic Verlinden

On 7 May 1915, the transatlantic liner RMS *Lusitania* was sunk by a German submarine. This incident, in which 128 Americans lost their lives, prompted an outcry from America, and was one of the reasons for its entry into World War I two years later. Today, the *Lusitania* wreck is 19km from the southern coast of Ireland, resting at a depth of 92m in tidal waters with a visibility of about six metres. *X-Ray Mag* contributor, wreck diver and underwater photographer Vic Verlinden and his team conducted "*Lusitania*—Project 17," a five-year thorough study documenting and photographing the wreck. His efforts over five expeditions have resulted in this hardcover book, telling the story of this illustrious vessel. Many of its 160 photos (alongside 240 historical photos and illustrations) show portions of the wreck that have been photographed for the first time.

Publisher: **Self-published**
Date: September 2022
Hardback: 200 pages
ISBN: 9789464038071

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Interview by
Peter Symes

New Two-Volume Series on Nordic Wrecks

That the Scandinavian waters are simply cold and dark is a point of view you often come across, even among some divers from the region. However, the waters here offer an enormous wealth of shipwrecks that can compare with the most famous sites—from Viking ships, well-preserved medieval wrecks in the brackish waters of the Baltic Sea to war wrecks from the world wars and sunken merchant vessels. In a comprehensive new work spanning two volumes, René B. Andersen and Andrew Marriott review a large number of exciting wrecks worth seeing and describe the dramatic events that led to their sinking. We had a chat with René B. Andersen about the books.

Why did you write these books?
I really like the stories of the wrecks and thought it might be a good project to combine them with my photos. A lot of books have been written about wrecks in warm waters, but many of the Nordic wrecks and the stories about them can easily compete with the southern ones. The Nordic region seems like a forgotten area when it comes to wreck diving.

When and how did you get the idea?
I had gone with an idea for a "coffee table" book, but after I won the "Underwater Photographer of the Year" competition in 2019, I was contacted by Andrew Marriott, who suggested we team up and write a wreck book. It ended up becoming two books.

How long did you spend on the book from conception to publication?
We spent three years on the project, including half a year just getting them published.

What have been the biggest "hurdles" and challenges?
The biggest challenge has been time. We began with a single book but quickly realised that we could not fit it all into one book. We therefore decided to make it two volumes, which took longer to create.

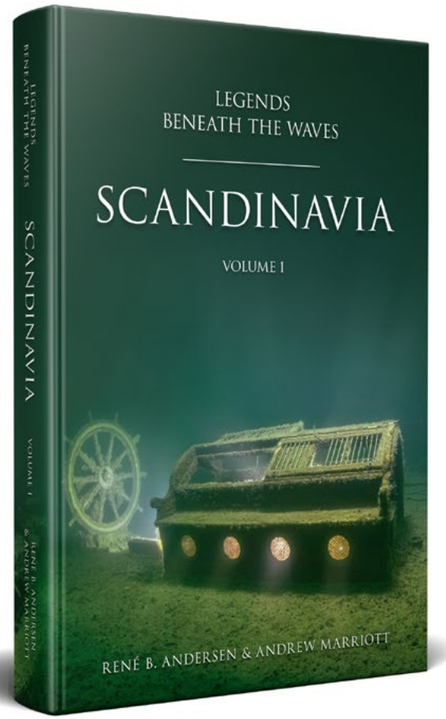
Then came the harder part of getting it published. In the end, it ended up being self-published, and self-financed. This is a completely unknown world for me, so there were again lots of new things I had to follow up on, and that gave me many challenges along the way.

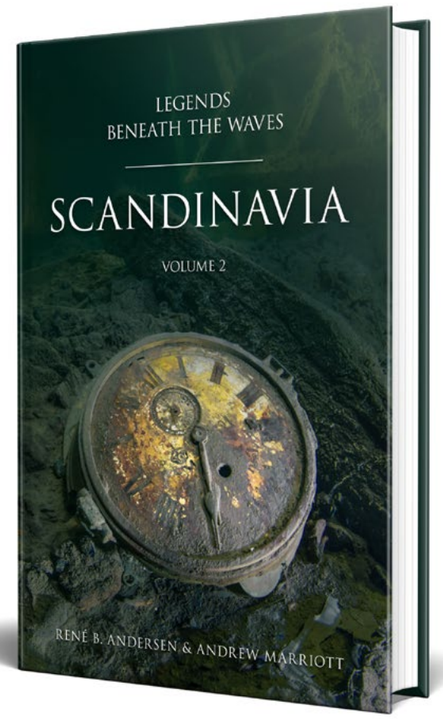
What were the criteria for including a wreck in the book?
The best wrecks, pictures, or a really cool story about the ship.

Have you visited the wrecks you wanted, or are there still some on your wish list?
There is a wreck that is still haunting me, and which I think is a shame that we did not get into the book. It is the Norwegian wreck D/S *Tinn,* which lies at a depth of 102m in Lake *Tinn,* which is 130km west of Oslo, Norway.

What was the most exciting wreck to visit or work with? Which wrecks are among your favourites and why?
The *Oldenburg* and *Sao Paulo* wrecks are probably the best because of their stories. *Oldenburg* was a privateer in WWI, so this wreck has a great history; as for *Sao Paulo*, it is for its participation in the invasion of Norway during WWII as well as its cargo that makes it incredibly exciting to work with.

These two wrecks probably have the longest mentions in the books. *Undine* was the wreck where I could collect the most artefacts from, so it was also exciting to visit the people who have a lot of artefacts lying around, and I got some good stories from them.





How many years of diving or number of dives did it take to visit all these wrecks and collect material?
The materials go back 15 years. Some of the photos are more recent, but I was only able to take those photos because I had gotten to know the wreck better after visiting it in previous years.

Is there anything you have learned or experienced over these many dives that you can share with other wreck divers?
At first, I took pictures of everything: wrecks, macro, fish and a little video. But it was only after I dropped the other things and solely focused on wrecks that I found my niche and things succeeded—and I improved my technique since my focus was only on wrecks.

Another thing that is important is knowledge of the wrecks. To get good shots, it is important to really know the wreck. For example, I was out on *Bonita*, which I actually think I covered well. But on another dive this year, I ditched the camera and went exploring in the engine room. There, I found a new way in and got all the way in where there were some cool motifs of the workshop and machine parts. So, even if you think you have documented the whole wreck, there may be items yet to be found.

What is your next project?
Next year's project will be Vis Island and its beautiful B17 aircraft; Åland's cool wrecks: *Blücher* in the Oslo fjord, and finally being able to get to the D/S *Tinn*. ■

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Turning Tek

Is It For You?

Text by Simon Pridmore
Photos by Andrey Bizyukin,
Larry Cohen and Olga Torrey

Once considered an extreme activity reserved only for a fringe set of explorers and adventurers, technical diving has grown in popularity since the '90s and has become mainstream. However, technical diving is not for everyone. Aside from an advanced skill set, it also requires a certain mindset. How do you know if you have got it? Simon Pridmore offers insights into what makes a good technical diver.

ANDREY BIZYUKIN

After almost three hours underwater, the divers surface silently behind the boat and fin slowly to the ladder where the crew is waiting to relieve them of the torpedo-like propulsion vehicles they are towing. They unclip unused cylinders clipped to the side of their harnesses and hand them up carefully.

Back on deck, they close the mouthpieces integral to their full-face masks and check the twin monitoring devices strapped to their forearms before shucking off their shell-clad electronic life-support devices and laying them down gently.

The atmosphere is calm. There is no whooping, hollering or back-slapping, even though they have just accomplished the sort of dive that would have been impossible a couple of decades ago. Tomorrow, they will carry out a similar dive. Then, on Monday, they will be back sitting behind desks wearing a different kind of dark suit.

These are not professionals, military divers or explorers; they are just two guys out of the city on a long weekend break, indulging themselves in their hobby. Their chosen sport is technical diving: extreme diving performed with a high degree of preparation and precision.

A little history

The term "technical diving" was adopted in 1991 by *aquaCORPS*

OLGA TORREY

LARRY COHEN

A technical approach to a dive involves objective analysis of the risks involved and calculation of the type and amount of gas required and the right equipment to use. It also involves the consideration of what potentially life-threatening events might occur on the dive and an assessment of the skills and backup equipment that the diver will need to be armed with in order to survive.

magazine founder Michael Menduno to describe the activities of a number of disparate groups of adventurers and explorers who were using military and commercial diving technology, ideas, equipment and decompression tables to make dives well beyond the bounds of normal sport scuba, as safely as possible.

A community coalesced, procedures were tried and tested, specialised training agencies were established, information was shared, and news spread quickly. This was the most exciting development in diving in decades.

Some people in the sport's mainstream were appalled at its popularity. They forecast disaster. They feared that members from the extreme outer reaches of the sport, who were leading the charge, would act irresponsibly, leading to a spate of diver deaths, destroying scuba's carefully crafted image as a "sport for all" and attracting government intervention and regulation—something scuba diving had always managed to avoid, at least in the USA, mainly thanks to its excellent safety record.

Publicity campaigns were launched, encouraging divers to reject this "dangerous" new trend and seeking to set deep planned-decompression mixed-gas diving apart from the mainstream. Sport divers should stick to air, no decompression-stop diving, no overhead-environment diving and a maximum depth of 39m (130ft), they said.

Anyone who engaged in activities beyond these limits was not a sport diver. They were outliers, to be ignored and excluded by the sport-diving world. This had been the attitude towards cave divers since the 1960s—not that the cave divers cared.

But the lure of hitherto unimagined opportunities was too strong; divers continued to queue up to acquire the necessary equipment and training, and the feared deluge of diver deaths did not transpire. Before long, the sport-diving hierarchy gave in to popular demand, and today, plenty of technical diving initiatives, such as nitrox, delayed surface marker buoys and harness-and-wing BCDs, have become part of mainstream diving, and most sport-diver training agencies offer technical diving courses.

A particular mindset

So, what is technical diving? Many think of technical divers as crazed

Contrary to common misconception, very few people come into technical diving drawn by the quest for a thrill or adrenaline rush. After all, rather than court danger, the whole ethos of the sport is to counter risk through the application of planning, training and technology.


LARRY COHEN

individuals dressed head-to-toe in black, foolhardily festooned in the contents of a small dive shop, launching themselves into the depths without a thought for their own safety. This image is reinforced by the common practice of defining technical diving in terms of the extreme nature of the dive or the equipment used—for instance, a dive below 40m (130ft) or deep penetration inside an overhead environment such as a cave or shipwreck.

The true definition of technical diving owes far more to the mindset of the diver than the particulars of the dive. A technical approach to a dive involves objective analysis of the risks involved and calculation of the type and amount of gas required and the right equipment to use. It also involves the consideration of what potentially life-threatening events might occur on the dive and an assessment of the skills and backup equipment that the diver will need to be armed with in order to survive.


OLGA TORREY

Motivation

Contrary to common misconception, very few people come into technical diving drawn by the quest for a thrill or adrenaline rush. After all, rather than court danger, the whole ethos of the sport is to counter risk through the application of planning, training and technology. Most technical divers are thoughtful people who are attentive to detail, sometimes to an obsessive degree.

Most early technical divers were explorers driven to go further to set records, visit virgin shipwrecks, solve maritime mysteries, penetrate flooded cave systems, learn more about the sea, and record and research marine life. Some of those that have followed them share similar ambitions, but there are also those who are just motivated by curiosity, a desire to test themselves or a fascination with the science and technology involved.

Technical diving is not for everyone. Some of the best divers in the world may use nitrox and may have adapted some of their equipment after seeing what technical divers use and how they streamline themselves, but they have no need to go deep or into flooded caves or wrecks, or encumber themselves with extra equipment. Being a technical diver does not mean you are necessarily a better diver than others.

There are also some people around who really should never go anywhere near technical diving because they do not have the right mindset. How can you tell in advance if this is you? Would you make a good technical diver?

Here are a few essential prerequisites and some red flags to be aware of.

Experience

It does not matter how many certification cards you hold or how many dives you have done. The nature of the diving you have done matters more. You should have been exposed to some relatively testing marine environments and water conditions, and managed to stay comfortable and calm, before you embark on technical diver training.

Self-reliance

In the technical diving world, you will perform as an independent part of a mutually supportive team, always responsible for your own dive but always ready to assist a teammate if neces-

LARRY COHEN

sary. Technical diving is not for the selfish or self-obsessed.

Competence

You need to have mastered standard scuba diving skills before progressing to this level. This means, for example, being able to control your buoyancy instinctively and effortlessly, and being completely comfortable not wearing your mask underwater. You should also have a firm understanding of decompression theory.

Self-discipline

You must be able to stick to a dive plan. While standard no-decompression single-cylinder diving offers guidelines to follow, technical diving has strict rules based on physiological and physical limits. Your life and the lives of your teammates depend on you sticking to a plan and being able to resist any narcosis-fuelled urges to abandon it and make up a new plan on the fly.

Meticulousness

If you are the type of diver who regularly jumps in without securing your BCD to the cylinder or turning your air on, then technical diving is not for you. Ask the people you dive with. Do they privately think that you are an accident waiting to happen? If they do, listen to them.

Fitness

You should be mentally and physically fit. Technical divers carry more gear, swim farther and stay underwater longer.

Acceptance of risk

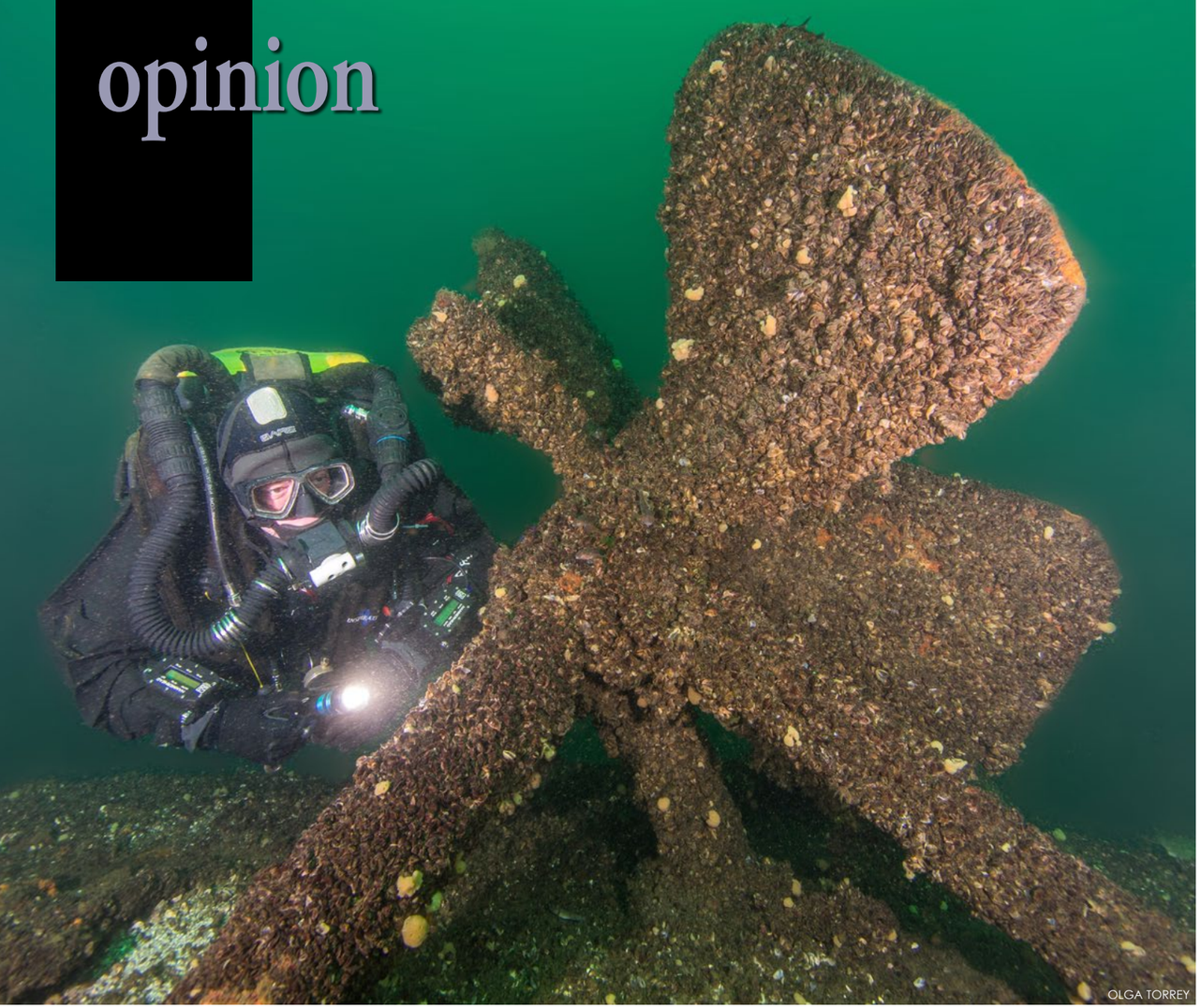
Technical diving involves a higher level of risk. Are you prepared to accept this? Is your family also prepared?

Financial health

Finally, technical diving requires a substantial investment in training, equipment and travel. There are no shortcuts. Cheap training at this level is likely to be inadequate training. If you cannot afford to do it the right way, do not do it at all.

Open or closed?

If you (and your friends) see no red flags, then your next decision is whether to stay with open-circuit or buy a rebreather. Now is the time to make this choice—if you can—before you start technical diver training. If you are expecting eventually to be diving below 50m (165ft), and therefore using mixes heavy on helium, then closed-circuit really is the only way to go, as the quantities of helium required for deep open-circuit diving make it extremely expensive. And



OLGA TORREY

OLGA TORREY

helium will only become pricier as the years go by. It is a finite resource, and scuba divers are not at the head of the line to purchase it. We even come behind balloon sellers!

Yes, rebreathers are expensive to buy, but once you start using helium, you will earn back your investment very quickly, because your costs will be much, much lower than they would be if you did the same dives with open-circuit equipment. These days, it is rare to see any open-circuit divers on deep-diving trips.

If you do technical diver training on open-circuit equipment, and then subsequently decide to buy a rebreather, your certification levels are not transferrable. You must begin all over again, with a shallow depth limit and no planned decompression, and work your way back up, logging a number of dives at each level along the way. This will take some time, as I mention below.

Once you dive with a rebreather for the first time, you will see how much sense this makes. Closed-circuit diving is a new world, and the best way to approach it is with the mindset that you are learning to dive all over again, keeping your mind entirely open to new ways of thinking and doing things.

Concluding thoughts

Technical diving is challenging and rewarding, and it can take you to places on our planet seen first-hand by very few. Whichever path you choose, you have a lot to learn before you get there, so prepare for a lengthy journey. There are several levels of training to pass through, and the courses only scratch the surface in terms of experience, just introducing you to the concepts and allowing you a few practice dives under supervision.

You then need to do plenty of diving to assimilate the new techniques and build your skills before moving on to the next level. So, take it slowly, enjoy the journey and do not let anyone rush you. There is no finishing line. You will never be as good as you can be. ■

Simon Pridmore is the author of the international bestsellers Scuba Fundamental: Start Diving the Right Way, Scuba Confidential: An Insider's Guide to Becoming a Better Diver, Scuba Exceptional: Become the Best Diver You Can Be, *and* Scuba Professional: Insights into Sport Diver Training & Operations, *which are now available in a compendium. He is also the co-author of the* Diving & Snorkeling Guide to Bali *and the* Diving & Snorkeling Guide to Raja Ampat & Northeast Indonesia. *His recent published books include* The Diver Who Fell From The Sky, Dive into Taiwan, Scuba Physiological: Think You Know All About Scuba Medicine? Think Again! *and the* Dining with Divers *series of cookbooks. For more information, please visit:* ***SimonPridmore.com***.

Cyerce sp. sacoglossan sea slug, or butterfly sap-sucking slug, Green Island, Taiwan.

Butterfly Sacoglossan

The Sap-Sucking Slug

Text and photos by Wesley Oosthuizen

Many divers, and especially macro underwater photographers, adore the lovely, colorful, and photogenic sea slugs found in the deep. We often call them nudibranchs, the "butterflies of the sea." But not all sea slugs are nudibranchs. Have you ever heard of the sacoglossan? Underwater photographer Wesley Oosthuizen takes a closer look at a special sacoglossan species—the butterfly sap-sucking slug.

"Don't you mean 'nudibranch,' Wesley? Because that looks very much like one," you may say, cocking your head to one side. Actually, I specifically do *not* mean "nudibranch." In fact, after so many years, I am now just becoming aware of how incorrect many of my IDs were, when I boldly claimed a sea slug species was a nudibranch, when it most certainly was not.

When people see most sea slugs, they (myself included, until not too long ago) will (if they know anything about sea slugs) probably refer to them by what most know as a nudibranch. Nudibranchs are characterized by having a *nudi* (naked) *branch* (gill), which one can see sticking out of the backend of them. The butterfly sap-sucking slug (see photo), however, is actually a *sacoglossan* and not a nudibranch, as it does not possess a gill at the rear of its body.

Yes, sacoglossans belong to the phylum Mollusca (mollusc) and the class Gastropoda, like snails do, but they are not the same as nudibranchs in many ways. Take, for instance, the fact that nudibranchs are carnivores, but sacoglossans are herbivores, as they only eat sap from seaweed leaves (hence, the name "sap-sucking slug"). Of course, I could go on and on about the differences, but what I really want to do is dive a little deeper into the characteristics of the sacoglossans, and why this specific one is called the butterfly sap-sucking sacoglossan.

First a little backstory.

I found this little wonder on Green Island, thanks to butterfly sacoglossan specialist and macro dive guide Michael Chen, who took me to a site where he himself had personally discovered a new kind of butterfly sacoglossan, which is currently going through analysis to be included in the world database of animals. If I were him, I would be blown away to discover a new creature not yet known

Cyerce sp. sacoglossan sea slug, or butterfly sap-sucking slug, Green Island, Taitung, Taiwan. Camera gear: Olympus OMD EM1 MarkII, M.Zuiko 60mm f/2.8 Macro lens, Olympus PT-EP14 housing, dual AOI UCS-Q1 compact strobes, Orcatorch D900V focus light. Exposure: 1/160s, f/14, ISO 100. Postproduction software: Lightroom Classic and Adobe Photoshop.

to science. And on top of that, he gets to name it!

The back story is done, so let's continue.

Why butterfly?

What's the reason for people calling this a butterfly sacoglossan? It is named so because when the wing-like appendages (called parapodia) on its back fold down, it looks like a butterfly with its wings spread wide open. I saw it first-hand on this dive but did not manage to get an image, worthy of the name, that I could justify sharing with all of you here.

Hopefully, I will get to make another trip to the same location in the winter, and then I can get some better shots. Now that I know where to find them when I go back, I know where I will be diving every dive I possibly can. That site really has a lot of gorgeous gifts just waiting to be found. I feel it in *me bones*, I tell ya!

Characteristics

Sap-sucking slugs, like nudibranchs, come in a huge swathe of shapes and sizes. While the majority are 1cm or less in length, there are larger sacoglossans out there.

Some of these slugs have small external or internal shells as well, even though they are not snails per se, but the majority have a pair of wings or flaps, called parapodia (as I mentioned earlier about the butterfly sacoglossan). The parapodia can be large and leafy, tucked around the long body, or they can even have structures on them.

It can be tricky to spot a sap-sucker, as they often take on the shape and colour of the seaweed they eat. Couple that with their small size, and you truly have to stare at something until your eyes can adjust to the fact that an animal is literally looking you slap-bang in the face, but you have no idea that it is actually even there.

Able to retain chloroplasts

Ok, this is where this slug becomes truly remarkable.

Not all, but some of these slugs have the ability to retain chloroplasts (which have chlorophyll), and sacoglossans that consume brown or red seaweed even keep the parts of the seaweed alive that are able to photosynthesize! If you are still a bit confused about what that means, it means this: It is able to FARM ITS OWN FOOD.

I had to emphasize that last part, because I seriously doubt many people would think an animal like this can do a thing like that. I am pretty amazed, myself!

So, I told you that bit, but here is the thing: Up until recently, it was thought that the chloroplasts basically continued to photosynthesize and only supply the sacoglossans with more nutrients. However, in more recent studies, researchers now believe that something far more complicated is going on. Let's hope they figure it out soon.

Defense mechanism

And there is one more thing: Some sacoglossans will even retain the poisons that the seaweed uses for self-defence and will excrete them to repel its own potential predators.

Common name

So now that we know all about what this little slug can do in terms of storing chloroplasts and using the power of the sun to farm crops for food, and furthermore—inside itself, I would now like to tell you about this kind of slug's common name, which many use.

Usually, one will hear it being referred to as the "solar-powered nudibranch," but after all we have learned today, we should know by now, it should be more correctly called the "solar-powered sacoglossan." The reason for the name should be fairly self-evident at this point, so warrants no further explanation.

Hermaphrodite

Lastly, these slugs are hermaphrodites (having both male and female parts) and can fertilize eggs as well as carry them. When the slug performs its male role, a white tube (or penis) comes out of its neck and is then inserted into the female genital pore. In others, they simply pierce the body anywhere with this appendage, to impregnate their partner. After internal fertilization has taken place, they will then lay their eggs in a ribbon. ■

Wesley Oosthuizen is an internationally published professional underwater photographer, originally from East London, South Africa, who is now based in Taiwan, where he founded a production company. For more information, visit: ***facebook.com/WJOart***

Text by
Catherine
GS Lim

NOAA / PUBLIC DOMAIN

Blue whale
(*Balaenoptera musculus*)

Acoustic signals show blue whales go to oceanic upwellings to feed

Sound reveals that blue whales (and their prey) are drawn to oceanic upwellings.

From March to July, phytoplankton blooms emerge along Calfornia's Central Coast, as seasonal winds push the top layer of the waters out to sea, thereby allowing the cooler, nutrient-rich waters to rise to the surface.

Many marine animals are drawn to such oceanic upwellings, which consequently turn into their feeding grounds. For instance, krill gather to feed on the abundant phytoplankton, whilst blue whales converge to feed on the krill. Once the upwelling ceases, these marine creatures move elsewhere.

In a study involving Monterey Bay Aquarium Research Institute (MBARI) and their collaborators, researchers used whale calls to track the whales' movements and discovered that they would travel to the location of such ocean upwellings in search of food.

The study built upon research by MBARI Senior Scientist Kelly Benoit-Bird: "Previous work by the MBARI team found that when coastal upwelling was strongest, anchovies and krill formed dense swarms within upwelling plumes. Now, we've learnt that blue whales track these dynamic plumes, where abundant food resources are available," said lead author John Ryan, a MBARI biological oceanographer.

Although scientists have known all along that blue whales travel to Monterey Bay during the upwelling season, this research revealed that the whales could track the upwelling process very closely, in terms of space (kilometres) and time (days to weeks).

Analysing the data

For the study, hydrophones were installed at the MBARI observatory, one in 2015 and another one in 2019. From the acoustic data in the recordings, it was possible to deduce the direction from which the whale calls originated.

According to the press release, the researchers "combined satellite and mooring data of upwelling conditions and echosounder data on krill aggregations with the acoustic tracks of foraging blue whales logged by the directional hydrophone."

"Tracking many individual wild animals simultaneously is challenging in any ecosystem. This is especially difficult in the open ocean, which is often opaque to us as human observers," said William Oestreich, a postdoctoral fellow at MBARI. He was previously a graduate student at Stanford University's Hopkins Marine Station.

"Integration of technologies to measure these whales' sounds enabled this important discovery about how groups of predators find food in a dynamic ocean. We're excited about the future discoveries we can make by eavesdropping on blue whales and other noisy ocean animals," he added.

Findings of the study was published in the *Ecology Letters* journal, Vol. 25, Issue 11. ■ SOURCES: MBARI, ECOLOGY LETTERS

marine mammals

Text by Catherine GS Lim

CHARLIE JACKSON / FLICKR / CC BY 2.0

Pair of long-finned pilot whales. Brains of stranded marine mammals have shown the hallmarks of Alzheimer's disease, according to new research.

Toothed whales show signs of Alzheimer's disease

Necropsies of beached toothed whales show that older animals have brain changes similar to those seen in humans with Alzheimer's disease.

A study of 22 toothed whales which died in strandings along the Scottish coast shows that some of them exhibited hallmarks of Alzheimer's disease, and this might have—at least in part—caused the stranding incident.

The dolphin species involved in the study were five species: Risso's dolphins, long-finned pilot whales, white-beaked dolphins, harbour porpoises and bottlenose dolphins.

As part of the study, researchers examined the animals' brains for the presence of brain pathology that were hallmarks of Alzheimer's disease, like the formation of amyloid-beta plaques, the accumulation of phosphor-tau and gliosis (a change in cell numbers due to damage to the central nervous system).

According to co-author Mark Dagleish, a senior clinician in anatomic pathology from the University of Glasgow, "Critically, [it] examined the whole brains to provide lesion (abnormality) profiles using more markers of Alzheimer's disease."

JOHN_NATURE_PHOTOS / PIXABAY

The bottlenose dolphin was one of five dolphin species involved in the study.

Dementia-related pathologies

It was found that all the aged dolphins in the study (18, out of the 22 specimens) had amyloid-beta plaques. In fact, three of them—a long-finned pilot whale, a white-beaked dolphin and a bottlenose dolphin—also had a number of other dementia-related pathologies in their brains.

Co-author Tara Spires-Jones, a professor at the University of Edinburgh, said that the researchers were fascinated to see that the brain changes in aged dolphins were similar to those in human ageing and Alzheimer's disease. "Whether these pathological changes contribute to these animals stranding is an interesting and important question for future work," she added.

Cognitive deficits

Dagleish said, "These are significant findings that show, for the first time, that the brain pathology in stranded odontocetes [toothed whales] is similar to the brains of humans affected by clinical Alzheimer's disease. While it is tempting at this stage to speculate that the presence of these brain lesions in odontocetes indicates that they may also suffer from the cognitive deficits associated with human Alzheimer's disease, more research must be done to better understand what is happening to these animals."

The study findings appear to support the "sick leader" theory, in which an aged leader becomes lost, disoriented or confused and subsequently leads a pod of healthy dolphins into dangerously shallow waters. ■

SOURCES: EUROPEAN JOURNAL OF NEUROSCIENCE

Text by Catherine GS Lim

NOAA / PUBLIC DOMAIN

Smaller in size than other common bottlenose dolphins, the new subspecies is called the Eastern Tropical Pacific bottlenose dolphin (*Tursiops truncatus nuuanu*).

New subspecies of bottlenose dolphin identified

The new subspecies is smaller than the common bottlenose dolphin, and is found only in the eastern tropical Pacific.

A new bottlenose dolphin subspecies has been identified, and it is found only in the eastern tropical Pacific Ocean, according to a study published in the *Journal of Mammalian Evolution*.

Called the Eastern Tropical Pacific bottlenose dolphin (*Tursiops truncatus nuuanu*), it is smaller than other common bottlenose dolphins, and is likely to prefer the deep offshore waters between southern Baja California and the Galapagos Islands.

In the study, the researchers examined the skulls and total body lengths of more than 130 bottlenose dolphin specimens from the eastern Pacific and western North Pacific held in museum collections across the United States. Multivariate and clustering analyses were used to determine the level of differentiation among the bottlenose dolphin populations.

Differences

Significant differences in form were found, thus prompting the researchers to classify the specimens into two distinct clusters. "The bottlenose dolphins found in offshore waters of the eastern tropical Pacific formed one single cluster, and they were significantly smaller—based on skull and body length—than common bottlenose dolphins forming the other cluster," said Ana Costa, a marine researcher with the Rosenstiel School of Marine, Atmospheric, and Earth Science at the University of Miami.

"Our findings indicated that the offshore bottlenose dolphins of the eastern tropical Pacific are speciating from the globally distributed common bottlenose dolphins and should be described as a different subspecies."

The study's findings may have have implications when it comes to the protection of the dolphins. "By better understanding the biodiversity in the ocean, we can better understand the relationship of the dolphins with their environment and the threats they face, and in this way better define conservation and management strategies," said Costa. ■ SOURCE: JOURNAL OF MAMMALIAN EVOLUTION

ERIC CHENG

Sperm whales form clans with diverse cultures

Sperm whales in the Pacific Ocean exhibit human-like patterns of symbolic cultural identifiers, a study suggests.

After studying more than 23,000 sperm whale vocalisations recorded from 1978 to 2017 in the Pacific Ocean, researchers have concluded that sperm whales use distinctive vocalisations to identify themselves with specific whale clans.

Called "identity codas," these vocalisations comprise sequences of clicking sounds that distinguish different social groups. They are different from non-identity vocalisations used across all the different whale clans.

After analysing the vocalisations, researchers isolated specific identity codas used by each clan to distinguish themselves. Codas are passed on to the younger generation, which learn them by mimicking the adults in the clan. Codas remain consistent over the passage of time.

Co-author Mauricio Cantor, assistant professor in Oregon State University's Marine Mammal Institute, described codas as a way the whales would "advertise membership of a particular group," in the same way that people wear football jerseys of a particular team.

He said that such symbolic markers were universal in human cultures but were assumed to be very rare in animal cultures.

He added, "one of the main things that used to separate us is the ability for humans to have culture. This notion is slowly being eroded over time with studies showing that animals do learn, and they pass that information on, which can become little traditions that are stable over time."

New clans discovered

Based on the research, the team discovered a previously unknown whale clan and also named two lesser known clans for the first time. This brings the number of distinct clans in the Pacific to seven, with possibly more to be found in less-studied regions.

They also found that identity codas were more distinct in areas where there was more spatial overlap between the different clans. In contrast, the codas were less distinct and more "relaxed" in the areas where the clans were more isolated from one another.

The findings of the research was published in *Proceedings of the National Academy of Sciences*. ■ SOURCES: PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (PNAS), ROYAL SOCIETY

shark tales

The broad-nose sev-engill shark, also known as cow shark, has seven gill slits.

Sixgill & Sevengill
— Ancient Sharks in the Kelp

MALCOLM NOBBS

Text by Jamie Watts
and Malcolm Nobbs
Photos by Malcolm Nobbs
and Andy Murch

It certainly looks "prehistoric"—whatever that means. Cigar-shaped, blunt-snouted, with that slightly "sock-puppet-looking" smirk, the overall look of this big beastie is very much that of an ancestral shark, like some of the deep-water dogfishes, the sleeper sharks and others. Indeed, fossil remains similar to modern sevengills and sixgills are known from the Jurassic and perhaps much earlier. And the way this shark is built, as far as we can tell from an incomplete fossil record, is very much how the first sharks were put togeth-er. Jamie Watts and Malcolm Nobbs have the story.

Hexanchiformes is the tiny order of just one family and five species that includes sixgill and sevengill sharks with (as their name suggests) six or seven pairs of gill slits, as opposed to the five pairs that almost every other shark and ray has. Hexanchiformes also have just a single dorsal fin (most sharks and many rays have two), and the "ancient, dead-eye" look is per-haps enhanced by the lack of nicti-tating eye membranes. Also known as "cow sharks," these sharks have simple, unspecialised skeletons and digestive systems, with none of the evolutionary fine-tuning seen in many of the sleeker, "fancier" shark families.

Behaviour

We were warned that they were not shy and could be "nippy," especially if there was bait in the water. And they are sizeable, solidly built sharks, two metres or more in length as adults. Pretty widespread and found in temperate regions around much of the world, they are not shy of cruising kelp forests in shallow water and are curious about—and not intimidated by—divers.

shark tales


MALCOLM NOBBS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Malcolm found them to be "sneaky sharks, appearing from all points of the compass as well as above and below." They nibbled on his first stage and camera housing, apparently exploring with their mouths, much like a seal. Not surprisingly, they are frequent scavengers, as well as predators of quite large fishes and invertebrates.

Extra gill slits

A couple of species of rays (of the thousand or so species known) have extra pairs of gill slits, as do three others of the 500 known species of sharks, including the two species of bizarre eel-like and snaggle-toothed frilled sharks, and the sixgill sawshark. Evolutionarily, it is relatively simple to "add" another gill slit. As best as we understand it, one gill slit is simply the appendage that the segmented-wormlike ancestor of all vertebrates had at the sides of its head segments.

Eventually, some of these gill support segments (or something very like them) evolved and differentiated into jaws, jaw supports, spiracles and pectoral and pelvic limb girdles. It does not take much of a genetic change to "add" an extra one—or in the case of the sevengill, two—segments, but it does seem odd that it only happened a handful of times. Evolution seems to have given five as the most successful number.

Where to see them

Of the five members of its family, the broadnose sevengill is by far the easiest for divers to encounter. They come up shallow into temperate kelp forests around

Sevengills can be found in temperate kelp forests around the world, except in the North Atlantic.


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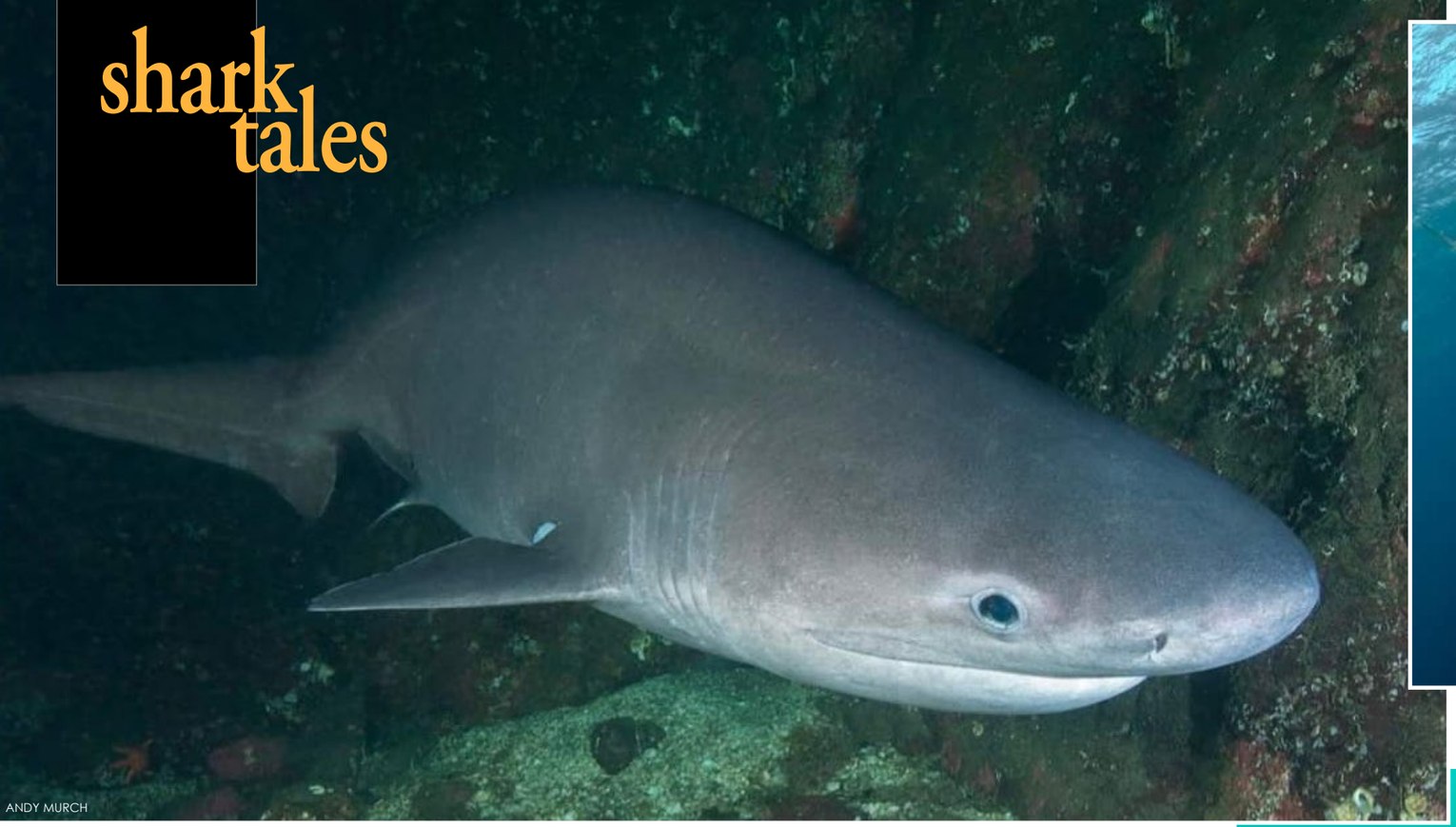
shark tales


ANDY MURCH


ANDY MURCH

The bluntnose sixgill shark (above and left) is the giant of the *Hexanchidae* family, and is rarely seen by divers but may be spotted in night dives off Vancouver Island in Canada.


MALCOLM NOBBS

much of the world (although not the North Atlantic).

Simons Town in South Africa was long regarded as the best location to see them, although in recent years, orcas moving in to predate these sharks have been blamed for their absence from this area for a couple of years. It appears that they are back, albeit in small numbers.

Three other members of the family are rarely seen by divers, as they spend much of their time below diving depths, and are rather smaller, slimmer and shyer. Then there is the giant of the family, the bluntnose sixgill, which was recently brought to wider public attention by some spectacular footage in the BBC's *Blue Planet II*, with some huge specimens jostling with each other and the film crew's sub while feeding on a whale carcass.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Broadnose sevengill sharks (above and left) have large, thick bodies, with broad heads and blunt snouts.

shark tales


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Sevengill sharks are scavengers but also prey on large fishes and invertebrates.

Spending most of their time far deeper than diving depths, bluntnose sixgills can nonetheless be seen in a handful of places in shallow water, and have been encountered on night dives off Vancouver Island for many years.

Sixgill characteristics

Sixgill sharks are one of the biggest non-planktivorous sharks. As adults, they probably average almost the same length as great whites, although nothing as heavily or powerfully built. An adult bluntnose sixgill may weigh half a tonne, with the largest females probably well over a tonne; they are bigger than the largest tiger or hammerhead sharks, and similar in size to the big sleeper sharks.

Like sleeper sharks, these deep-water giants seem to live less active lives than those of the familiar shallow-water requiem or mackerel sharks, probably scavenging more and preying on a range of slower-moving animals, and none of the cow sharks are considered a threat to humans. ■

The sevengill and sixgill sharks photographed for this article were all encountered with Big Fish Expeditions, at Vancouver Island and in South Africa.

Jamie Watts is a marine ecologist, expedition leader and naturalist guide. Logging more than 290,000 sea miles on 2,300 days at sea and 145 expedition voyages, he has worked in the planet's most spectacular marine ecosystems, including two years with the British Antarctic Survey, ten summers shipboard in the Antarctic Peninsula, and nine northern summers around the High Arctic and northern Atlantic islands. In addition, he has also led and guided expeditions through Indonesia, Papua New Guinea, the Solomon Islands and Vanuatu.

Based in Nelson Bay in New South Wales, Australia, UK native Malcolm Nobbs is a widely published underwater photographer and regular contributor to both Australian and dive magazines around the world. Formerly an active member of the British Society of Underwater Photographers (BSoUP), he moved to Australia in 2009, after penning his first underwater magazine article. Teaming up with Jamie Watts in 2013, the pair have produced a constant stream of articles. Over the years, Nobbs has steadily expanded his website into one of the world's largest scuba-related websites, with over 10,000 categorised and searchable marine life images, numerous dive site location reports, published works and videos. Visit: ***malcolmnobbs.com***


MALCOLM NOBBS

shark news

Edited by
Peter Symes

PETER SYMES

Tiger beach, Bahamas. Are sharks getting bigger because of tourists, or is it the bigger sharks that are interacting with tourists?

Tiger sharks that interact with tourists are larger, study shows

Female tiger sharks that frequently visit Tiger Beach, a popular dive spot in the Bahamas, are larger and have higher hormone levels than other individuals of the same species that spend less time there, researchers find.

That feeding or attracting wildlife with food to enable better viewing opportunities by ecotourists (i.e. provisioning tourism) has the potential to alter the natural behaviour and physiology of animals has long been well established. But how the physiological state of wildlife might be related to the nature and magnitude of these effects remains poorly understood.

However, as regards tiger sharks, a group of scientists in Brazil and the United States have discovered that females that frequent Tiger Beach in the Bahamas are larger and have higher hormone levels than other individuals of the same species that spend less time there. Tiger Beach is world-renowned for its tiger shark diving encounters, making it one of the premier dive destinations in the world.

Harmful or not?

The findings point to possible effects of mass tourism on these sharks, but it is not clear whether it is overall positive or negative.

"We can't say whether tourism is or isn't harming these animals, as we were unable to collect material for testing before and after interaction with divers, which would have been ideal. However, we now have a body of evidence that will be helpful for future evaluations," said Renata Guimarães Moreira, second author of the article and supervisor of the study.

Cause or effect?

While more studies are needed to explore whether sharks are making these decisions because of their physiological state or whether spending more time at provisioning sites results in an altered physiological state, the findings highlight the importance of considering animal life stage, endocrine regulation and nutritional condition when evaluating the biological impacts of provisioning tourism. ■

SOURCES: ANIMAL BEHAVIOUR

More than 50 species of sharks given further protection

Landmark decision limits or regulates the commercial trade in 54 shark species of the requiem family, including tiger, bull and blue sharks.

The186-nation Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has voted for the first time to regulate the trade that kills millions of sharks every year.

The measures regulate the commercial trade in 54 shark species of the requiem family, including tiger, bull and blue sharks, which are the most targeted in the fin trade. Most requiem sharks are threatened with extinction, according to the International Union for Conservation of Nature Red List.

Six small hammerhead shark species were also listed for protection, along with 37 types of guitarfish, which are shark-like rays.

Together, the new regulations place nearly all shark species traded internationally for their fins under CITES oversight and controls, up from only 25 percent prior to the CITES CoP19.

The shark species proposals were keenly anticipated. Many marine species have seen large drops in their numbers either due to overfishing or being caught as by-catch where another species is being targeted. The proposal on requiem sharks included a number of species, not necessarily endangered but for the reason that they are hard to tell apart from other species that are endangered. The recommendation to include all such species is to try to conserve those at risk. ■

SOURCE: CITES

PETER SYMES

The lemon shark (*Negaprion brevirostris*) is classified as a Vulnerable species.

A manta ray near Isla de la Plata, off the coast of Ecuador (right); Graphic showing the demographics and dynamics of the world's largest known oceanic manta ray population in coastal Ecuador (bottom left)

FUNDACION MEGAFAUNA MARINA DEL ECUADOR / PRESS RELEASE

Largest known manta ray population is thriving off the coast of Ecuador

Scientists have identified off the coast of Ecuador a distinct population of oceanic manta rays that is more than 10 times larger than any other known subpopulation of the species, Oregon State University reports.

Although manta rays are readily capable of long-distance movements of hundreds if not thousands of kilometres, most populations appear to be philopatric (tending to return to or remain near a particular site or area — ed.) with few examples of long-distance dispersal.

Oceanic manta rays, the largest ray species, were listed as threatened under the US Endangered Species Act in 2018. In 2019, their threat category increased from vulnerable to endangered on the International Union for the Conservation of Nature's Red List.

Population dynamics are, however, notoriously difficult to study because the rays tend to spend their time in offshore locations that are hard for researchers to access, and their visitation patterns can be unpredictable.

But in the late 1990s, it was discovered that a population of oceanic manta rays aggregate in August and September each year around Isla de la Plata off the coast of Ecuador, where they are relatively easy to locate and study. It is also a popular diving area, and visitors take numerous photographs of the animals, providing researchers with a trove of data.

Unique pattern

As each manta ray has a unique spot pattern on its belly, photos of individual rays taken by researchers and scuba divers made it possible for scientists to identify individual animals and track their movements and locations over time.

Data collected between 2005 and 2018 enabled the researchers to identify more than 2,800 individual rays and estimate a total population of more than 22,000. The researchers' findings suggest that conditions in the region are particularly favourable for a large, healthy manta ray population.

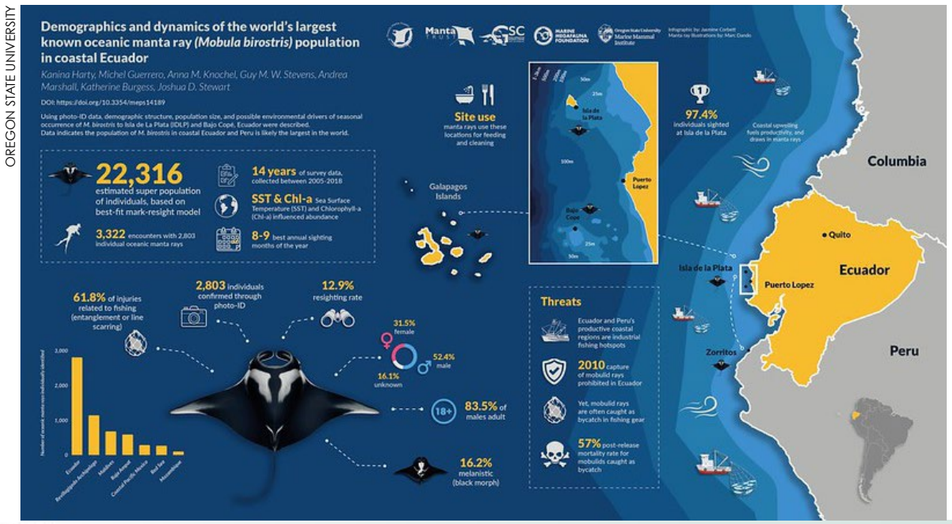
That is significantly larger than what we've seen in oceanic manta ray populations elsewhere. This is by far the largest population that we know of.

— Guy Stevens, chief executive and founder of The Manta Trust

Facts

The best-fit mark-resight model estimated a super-population size of 22,316 individuals, with annual estimated abundances of 949-7,650 females and 5,226-9,340 males. A localised sampling of this highly mobile species limits the interpretations of mark-resight analyses, but provides lower bounds for total abundance that indicate the population of *M. birostris* in coastal Ecuador and Peru is likely the largest in the world. ■

SOURCES: OREGON STATE UNIVERSITY, MARINE ECOLOGY PROGRESS SERIES



OREGON STATE UNIVERSITY

Ear Problems in Diving

Part III: The Inner Ear

Text and illustration by Mike Rothschild


DIVEDOG / STOCK.ADOBE.COM

Many people suffer from ear problems during and after diving. Technical rebreather diver and underwater photographer Dr Michael Rothschild is an ear, nose and throat specialist in New York City. In this series, he walks us through some of the common causes of dive-related ear problems, and how to treat and prevent them.

I am an avid scuba diver and an ear, nose and throat specialist, which means that I end up answering a LOT of questions about this topic! The majority of medical problems encountered by divers involve the ears. While they are rarely as serious as other life-threatening conditions, they are common and can ruin a dive trip.

In the last installment of this series (in **issue 115**), I discussed conditions affecting the middle ear. We now turn to the problems of the inner ear, and their prevention and management.

The inner ear

The inner ear (figure 1) is deep inside the base of the skull, and is an extension of the brain. It contains the cochlea, which is the organ of hearing (like the retina in the eye); it converts sound vibrations into electrical impulses that the brain can interpret. It also contains the labyrinth, which is a part of the ear that plays a major role in maintaining balance and spatial orientation, as well as the awareness of motion.

The inner ear is behind the bony back wall of the middle ear. It connects with the middle ear through two small holes—the round and oval windows—which are normally sealed. The round window has a thin membrane covering it, and the bottom ("footplate") of the stapes bone closes off the oval window. Unlike outer and middle ear problems, inner ear injuries cannot be seen by examining the ear canal and eardrum. However, patients with diving-related inner ear disease may also have an associated middle ear injury.

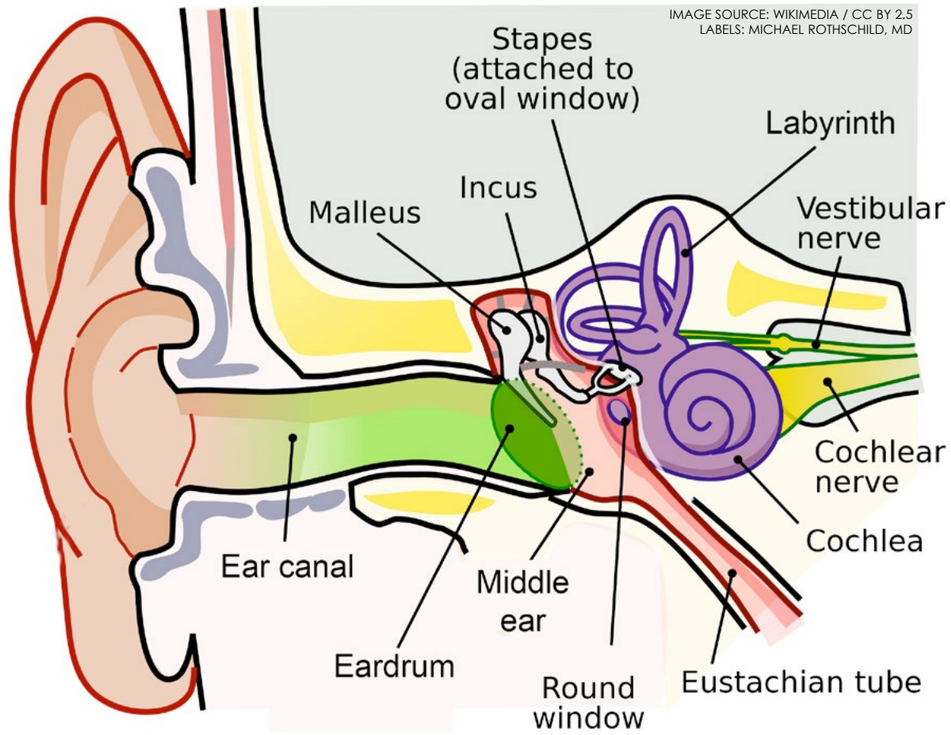


Figure 1. Diagram of the ear, showing the anatomy of the inner ear

These inner ear problems are rare, but have the potential to cause permanent hearing loss, and result in secondary injuries if they occur at depth and interfere with the safe execution of a dive. There are two main types: inner ear decompression sickness (IEDCS) and inner ear barotrauma (IEBT). These require immediate attention, and in the case of barotrauma, surgery may be necessary.

Inner ear decompression sickness

A thorough discussion of decompression illness is beyond the scope of this article, and the exact mechanism of this ear condition is still unclear. However, every certified diver has learned about the risk of bubble formation in the tissues on ascent, especially when inert gas (e.g. nitrogen) loading is high. IEDCS results in vertigo (and less commonly, hearing loss) when bubbles cause injury to the inner ear structures.

There are two theories about how the damage of IEDCS occurs. One is that bubbles form in the inner ear tissue and cause direct injury like they do in the joints (possibly through an inflammatory reaction). The other is that they form elsewhere in the body and are carried to the inner ear after bypassing the lungs, moving from the venous circulation to the arterial blood vessels (through a patent foramen ovale or other abnormality).

If the second theory were correct, this condition should technically be


GUSTAVO / STOCK.ADOBE.COM

called decompression illness, since DCI includes both DCS and arterial gas embolism. However, the term IEDCS is standard usage.

Inner ear barotrauma

IEBT can happen in a number of ways, involving a sudden pressure change in the inner ear fluid (known as perilymph). A sharp increase in middle ear pressure happens with a rapid descent, especially with poor equalization. This can also happen with an overly forceful Valsalva maneuver, especially if the ET opens suddenly. This can cause the stapes (the bone between the middle and inner ear spaces) to be pushed into the oval window, resulting in a spike in perilymph pressure, potentially breaking the seal at the round window.

Alternately, Valsalva with a blocked ET can result in another type of rapid pressure gradient across the round window. Cerebrospinal fluid surrounds the brain, and increased CSF pressure from straining can be transmitted to the inner ear through a structure known as the cochlear aqueduct. The risk of injury is high if the ET is blocked and equalization is not adequate, worsening the gradient.

This sort of trauma can result in a "perilymph fistula" (PLF). Such a fistula causes leakage of inner ear fluid into the middle ear, potentially causing a progressive and often permanent hearing loss, as well as (less commonly) vertigo and nausea.

One other rare condition that can result in inner ear problems with diving is superior canal dehiscence, in which the bony covering of the inner ear is thin or missing. This can cause pressure changes to be transmitted directly to the balance organ of the inner ear.

Diagnosis of IEDCS and IEBT

Diagnosis of inner ear problems can be difficult, as the eardrum is usually normal on exam. Treatment for IEDCS and IEBT is very different, and recompression of a patient with IEBT can actually make the ear injury worse. Some authors have suggested that if the diagnosis is uncertain, holes should be made in the eardrums (myringotomy) before entering the chamber to prevent this complication. In actual practice, this is rarely necessary as the two conditions have different presenting features.

IEDCS may be suggested by the dive profile—excessive nitrogen loading, rapid or multiple ascents, aggressive decompression plans or skipped decompression stops. Also, there is usually a short symptom-free interval after surfacing, with the vertigo generally starting within two hours. Symptoms of IEBT, on the other hand, usually develop during the dive, often following a forceful equalization. In both conditions there may be nystagmus—rapid movements of the eye away from the injured inner ear. While vertigo is more common with IEDCS and hearing loss with IEBT, either of these can be present. See Table 1 (on next page) for a summary of the different presentations of these two conditions, as well as other ear problems encountered by divers.

Prior to decompression, all patients with any sort of suspected decompression illness should be treated with 100% oxygen and hydration (if conscious and able to drink). Even if the diagnosis is actually IEBT, there is no harm of doing this, so this initial treatment should not be delayed because of any uncertainty.

A formal hearing test can distinguish between the conductive hearing loss seen in middle ear disease, and the sensorineural hearing loss of inner ear injury, and therefore should be a part of the evaluation of any diving-related ear problems. Other tests include an assessment of the function of the balance mechanism, which can be measured in a special lab. A CT scan is rarely helpful for the ear diagnosis itself, as an acquired PLF caused by barotrauma cannot be seen on an x-ray. However, a CT is often obtained prior to recompression to rule out other neurological conditions.

Treatment of IEBT

Initial treatment of IEBT involves limiting any further injury. Resting with the head elevated can help. Valsalva maneuvers should be avoided, as should any other type of straining (some doctors recommend the use of stool softeners). Heavy exertion, especially lifting heavy objects, can worsen IEBT. And diving should not be resumed until receiving clearance from an appropriate specialist.

When there is enough of a suspicion of a PLF, an operation may be recommended. This condition can only be definitively diagnosed by surgical exploration of the ear (you cannot see the inner ear fluid by looking in the ear canal). The procedure involves lifting up the eardrum to visualize the middle ear directly.

If what looks like inner ear fluid is seen leaking from the space around the round window (or anywhere else), fat


MIKE WORKMAN / STOCK.ADOBE.COM

Most ear pain, dizziness or hearing loss after diving goes away by itself in a short time ... Thorough evaluation of persistent ear problems should be done by a doctor with the tools and experience necessary to distinguish these conditions.

grafts are used to seal the area. This leakage can be very subtle, as the volume of perilymph is small. However, early closure of a PLF can mean the difference between a recovery of hearing and a progression to complete deafness. Since the operation itself involves very little risk, it should be strongly considered in cases where PLF is a possibility.

Other causes of vertigo

Dizziness without the risk of permanent damage can be caused by other conditions that arise during diving. These have in common a lack of normal, symmetric inputs from the sensory organs of the ears to the brain. Either asymmetric signals from each side, or inconsistent information from the ears and the eyes will result in nausea, vomiting and/or vertigo—this is the brain's response to such confusing inputs.

The balance organ of the inner ear (the semicircular canals) can be cooled by exposure to water in the ear canal, which causes the fluid inside the canals to move—this is a cold caloric response. If one ear is exposed to more cold water than the other (for example, from a poorly fitting hood or wax in one ear canal) the brain will get different signals from each ear. Similarly, if one ear equalizes before the other, there will be a pressure difference between the ears, with differential stimulation of the left and right inner ear sensory mechanisms. This is known as altenobaric vertigo.

Both of these conditions are generally temporary, and resolve as the temperature stabilizes and the flow stops, or as equalization is completed. However, it can be very disconcerting to have sudden dizziness during a dive. Awareness of this phenomenon and taking any steps necessary to address it (such as careful and thorough equalization) can prevent a spiral into panic and bad decisions.

SUBPHOTO / STOCK.ADOBE.COM

Sea sickness

Another condition well known to boat divers is sea sickness. Here, the vertigo is caused by inconsistency between the inputs to the brain from the eyes and the ears.

If you are on a moving boat, your ears are telling your brain that you are moving up and down in space. But if your eyes are looking at any part of the boat, they will send the signal that you are standing still. This is why staring at the horizon helps—it coordinates the information received by the brain from the ears and the eyes.

A complete discussion of seasickness remedies would be too long for this article. But most people manage this condition with medications, best taken several hours before departure. First-generation over-the-counter antihistamines (like Benadryl or meclizine) are popular. Prescription scopolamine is also quite effective, and is usually used as a patch that lets the drug pass through the skin. Other people have had success with acupressure wristbands or crystallized ginger.

Mal de Debarquement

Finally, there is the condition known as Mal de Debarquement ("the sickness of getting off a boat"). Some people are unsteady and have difficulty walking after reaching dry land. This is thought to be an issue with the brain's adaptation to a new environment, and not an ear problem.

In such cases, inner ear testing is normal, but the symptoms may last for a long time (months). Treatment with vestibular suppressants (like Bonine or Dramamine) rarely works, but sedatives and specialized physical therapy (vestibular rehabilitation) may be helpful.

Conclusion

Most ear pain, dizziness or hearing loss after diving goes away by itself in a short time. However, without an examination, a diver may not be able to tell whether the problem is in the outer, middle ear or inner ear, and treatment depends on accurate diagnosis. Thorough evaluation of persistent ear problems should be done by a doctor with the tools and experience necessary to distinguish these conditions. ■

Read Part One on the outer ear at: ***https://xray-mag.com/content/ear-problems-scuba-diving-part-1****, and Part Two on the middle ear at:* ***https://xray-mag.com/content/ear-problems-diving-part-2-middle-ear****. Visit:* ***dive.rothschilddesign.com****.*

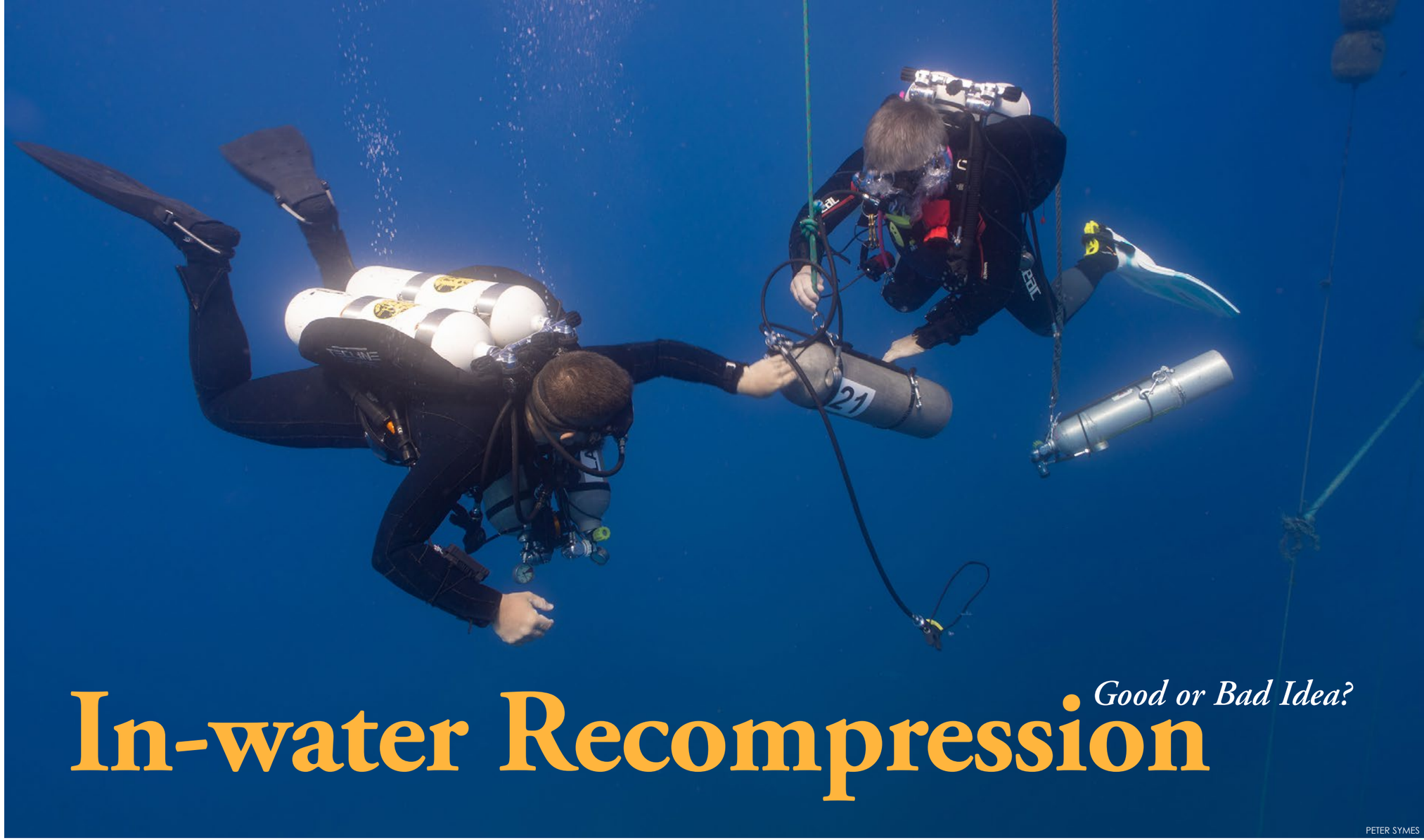
DIVE RELATED EAR PROBLEMS

	Pain	Hearing loss	Vertigo / Nausea	Tinnitus	Eardrum appearance	Onset	Treatment
ME Barotrauma	Moderate	Common	Occasional	Rare	Retracted, perforated, effusion, hemotympanum	During dive, descent > ascent	Equalization, steroids, myringotomy?
IE Barotrauma	Fullness	Common	Occasional	Occasional	Normal or as in ME Barotrauma	During dive, after forceful equalization	Steroids, rest, raise head, stool softeners, surgery?
IE DCS	Atypical	Occasional	Common	Occasional	Normal	Soon after surfacing (< 2 hours)	O2, hydration, recompression
Swimmer's Ear	Severe	If debris not removed	Atypical	Atypical	Normal or poorly seen	Gradual after long exposure	Cleaning, drying, drops (antibiotic/steroid or alcohol/vinegar)
Alternobaric Vertigo	Occasional, asymmetric	Atypical	Significant	Atypical	Normal	During dive, ascent > descent	Equalization, safe ascent, rest
Caloric Response	No	No	Significant	No	Normal	Asymmetric cold exposure	N/A
MdDS	No	No	Significant	No	Normal	Min-hr after docking	Sedatives or vestibular rehab. Vestibular suppressants ineffective

MICHAEL ROTHSCHILD

Table 1. A comparison of various types of diving-related ear problems

dive medicine



In-water Recompression

Good or Bad Idea?

PETER SYMES

Text by Simon Mitchell, PhD, DipAdvDHM (ANZCA), DipOccMed, FUHM, FANZCA

Say you are in some far-flung location where it will take quite some time to get to any recompression chamber. What do you do if you get decompression sickness? Get back in the water and recompress?

The prevailing wisdom in recent years has been that in-water recompression is too risky and should be avoided but the case may not be so black and white after all. The following is an excerpt and abridged version of a presentation Dr Simon Mitchell held at Diving Talks in Portuga, transcribed and edited by Peter Symes.

I bet you there is not a single one of you, who is a diver for any length of time, who has not been asked: **"If you get decompression sickness, why don't you just get back in the water and treat it there?"**

The medical profession has been very negative about the concept of in-water recompression but why did it have such a big problem with it? Because there are obvious risks such as oxygen toxicity. If a diver goes back in the water after a long dive breathing oxygen, there is a small risk of having a seizure. Furthermore, the environment could be hazardous. You could get cold, for example. The diver could deteriorate in the water and get worse. Obviously, it would also delay getting the diver into a chamber and could occur in settings without medical support.

Benefits

But there are also potential benefits. And the key benefit is very early recompression, and that has a particular advantage to it. Also, when there is no realistic possibility of getting to a chamber, recompressing somebody in the water becomes an option to consider. It is something we can do. It has however been quite hard to find solid data supporting the benefits of very early recompression. So, whereas we always try to balance risks and benefits and take the path of least risk for our patients, the point about in-water recompression is that the benefits were essentially unproven.

Finding out

Four years ago, I and David Doolette —a colleague who works for a naval experimental diver unit in Panama City, Florida—took on the task of looking specifically at in-water recompression. In this project, we tried to answer some questions. The first question was: Does very early recompression actually improve outcome? The second question: Can shorter shallower recompression, than we can achieve in a hyperbaric chamber, actually work? Does it help cure decompression illness?

Data from a French study based on 259 cases of spinal decompression, which are serious cases, didn't make a strong case for early recompression being better. However, the study probably does not contain many examples of divers that presented very early, say less than three hours, because it always takes time to get to a chamber.

So, what about at less an hour or less than 30 minutes? So, we went


MARITIME ARCHAEOLOGY / UNIV OF SOUTHERN DENMARK / FLICKR / CC BY-NC-SA 2.0

Rescue diver training. Full-face masks are one way of protecting the airway, in particular when using open circut. On rebreathers, the mask needs some function that maintains a degree of positive pressure inside of the mask, relative to the pressure outside of the mask.

Recompression

looking for data that answered that question. What if you recompress immediately? The great thing about working with David is that he has access to these big databases of dives, US Navy experimental guys without designing dive tables, and they actually cause decompression sickness in these subjects. But because they are subjects of an experiment, they have a chamber right there. The moment they get symptoms, they go in the chamber—so very early recompression.

We located a data set, but it was in a very obscure publication. It described 166 cases in US Navy experimental dives, with decompression sickness arising in divers after arriving at the surface, and there was little or no delay between symptom occurrence and treatment, as you would expect.

And they showed that 72% of these cases resolved during the compression, not during the entire treatment, but as the chamber was being compressed. So really quickly. Ninety-seven percent resolved during the first recompression, and all of them got better, eventually.

So, does very early recompression improve outcome? I think we can reasonably confidently say, on the basis of hard data, the answer is yes.

Shorter shallower recompression

The second question is, does a shorter shallower recompression work, especially if it is started early?

The standard approach to treating decompression illness in a hyperbaric chamber is the so-called US Navy Table 6 during which 100% oxygen is breathed at the initial depression to 2,8 bar. You cannot do that in the water. It is too dangerous. The risk of oxygen toxicity in the water is way higher than it is in a hyperbaric chamber. The question is, therefore, does something shallower and shorter than that actually work?

I did not know this until David pointed it out, but in the 1960s, when they were developing that table, the US Navy experimented with shallower, shorter recompressions than chambers— but the sort of recompressions you could do in the water.

It is a small data set of just 31 cases of experimental dive decompression sickness that was recompressed to ten metres for 30 minutes and then decompressed over 13 minutes. That was the treatment that divers received. Twenty-five of those recovered completely and two had substantial resolution. And the others needed more treatment. The point is that this very early, short, shallow recompression did work.

Following these findings, the medical community cautiously endorsed in-water recompression, with caveats.

Who to treat in-water

We adopted a grading system for separating our decompression illness into very broad categories and we would treat Tier II- and Tier III-type patients. We would not use in-water recompression for symptoms that are very mild and nonspecific [Tier I]. Someone with Tier II, so-called mild decompression sickness symptoms, or Tier III—the more serious ones with more neurological symptoms are the sort of patients you would consider for in-water recompression.

Chamber proximity

The next question is: Is a recompression chamber close enough that you would not bother with in-water recompression? And somewhat arbitrarily, we chose two hours as the cut-off point. So, if the recompression chamber is more than two hours away you would continue with in-water recompression. If there is a chamber close by, you go to that chamber.

Another question you need to ask: Is the decompression illness stable? If symptoms are progressive, if you follow the rest of these considerations [on the diagram next page], you might default to the end with in-water recompression, even if there is a chamber moderately close by.

Contraindications

Next, consider any contraindications or reasons why in-water recompression cannot be performed.

- **Vertigo.** Severe vertigo is a contraindication. We don't want to treat cases with inner ear decompression, in-water, because the patient is just too unwell to go back into the water.
- **Oxygen toxicity.** If someone was, say, decompressing from a technical dive, had a seizure, came to the surface quickly, and then got decompression sickness, you probably would not want to put them back into the water on oxygen, because they have already had a seizure and their risk might be quite high.
- **Incapacitation.** If they are so sick or physically incapacitated that returning them to the water would be unsafe, clearly you would not do it. Neither would we take anybody who is unconscious or with a deteriorating level of consciousness into the water.
- **Unwilling.** The patient has to be willing and want to do it.

The team

Is the team willing, trained and equipped? This is probably the most important question. If you are going to do in-water recompression the following matter is really important.

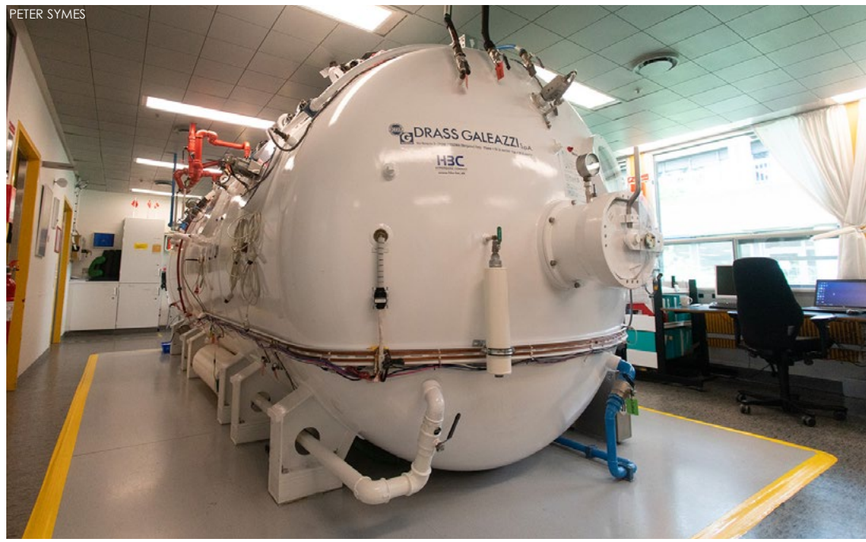
The patient, the buddy who must accompany at all times, and the surface supervisor *must all be trained in decompression procedures or above*.

Why? Because they have been taught how to use oxygen safely and what is required to use oxygen in the water. In other words, the patient is an informed risk acceptant, because they understand the risks of using oxygen in the water. The people treating the patient know how to deal with it safely.

In other words, this is not something that your average divemaster can just put up a sign on the side of their dive boat, saying "In-water recompression offered here." It has to be the right qualified people.

Other requirements

Oxygen. An adequate sup-



PETER SYMES

Hyberbaric chamber at Rigshospitalet in Copenhagen, Denmark


PHILIPPE GUILLAUME / FLICKR / CC BY-NC 2.0

Diver peers through a hole in the ice above. Ice diving deals with an extreme environment.

ply of oxygen is needed. Rebreathers are a very good way of doing that.

Shot line or stage. You should have a shot line or a stage—something that the diver can sit on, be clicked onto, or be supported by. Free swimming during in-water recompression is a big no-no.

Airway protection. And finally, we strongly recommended airway protection of some sort. in case the patient becomes unconscious or has a seizure, one would need to bring them to the surface, but you do not want them to drown while you are doing that. One way of protecting the airway is by using a mouthpiece retainer. It is basically a strap that goes around the back of the head and pulls a flange in around the lips that has the mouthpiece attached to it, and it keeps the mouthpiece in place and helps seal it in the mouth.

Environment

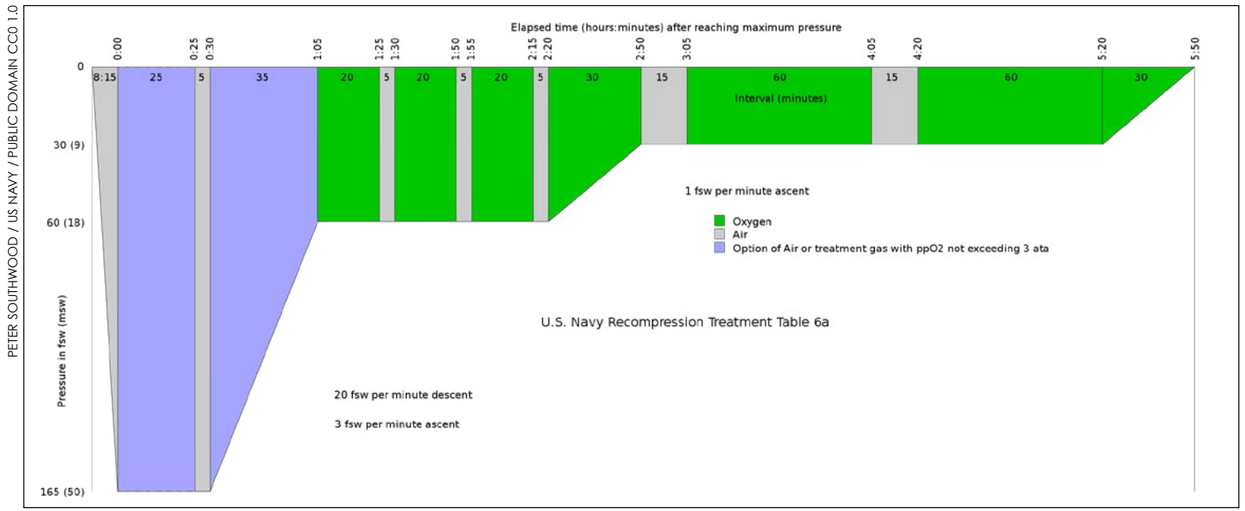
Do you have a suitable environment? What time of day is it? Is the water rough? What is the temperature? Is the diver going to get hypothermia?

Finally, if the answer to [the question] "Do you have a suitable environment?" is yes, then you can go ahead with in-water recompression. I am not going to describe algorithms. There are a bunch of them out there, but look, it can be as simple as what I showed you that the US Navy did in testing for their Table 6: Go down to ten metres, stay there for half an hour, and come back up… go down to ten metres, stay there for an hour, and come back up.

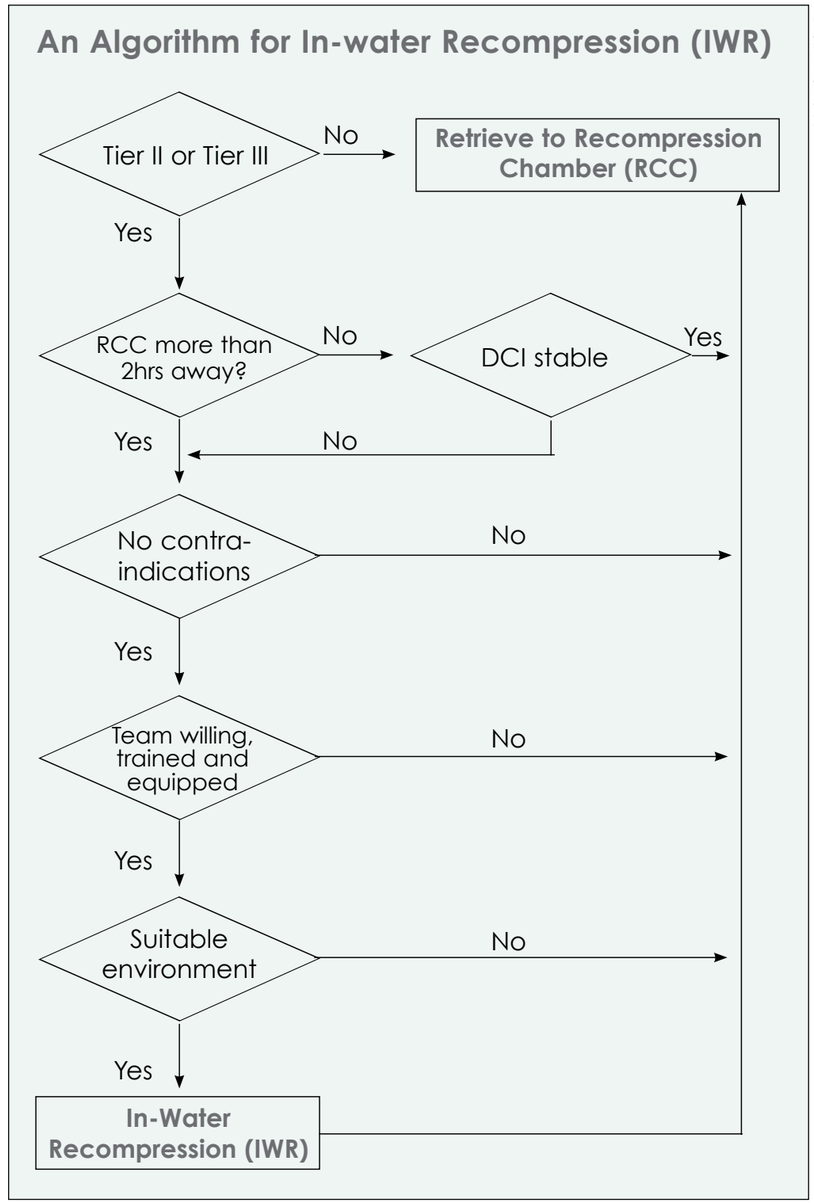
That tends to be what we have done when we have done in-water recompression

We actually codified in-water recompression in a paper, "Decompression sickness and arterial gas embolism," published in the *New England Journal of Medicine*.

It basically says: "However, published evidence of the efficacy of short, shallow recompression (at approximately 10m), administered very early, and experience from the 2018 Thailand cave rescue, showing that careful management and use of a full-face mask can protect the airway if a diver becomes unconscious, have provided the basis for qualified endorsement of in-water recompression with the use of oxygen by dives with appropriate equipment and training."



US Navy Recompression Treatment Table 6a



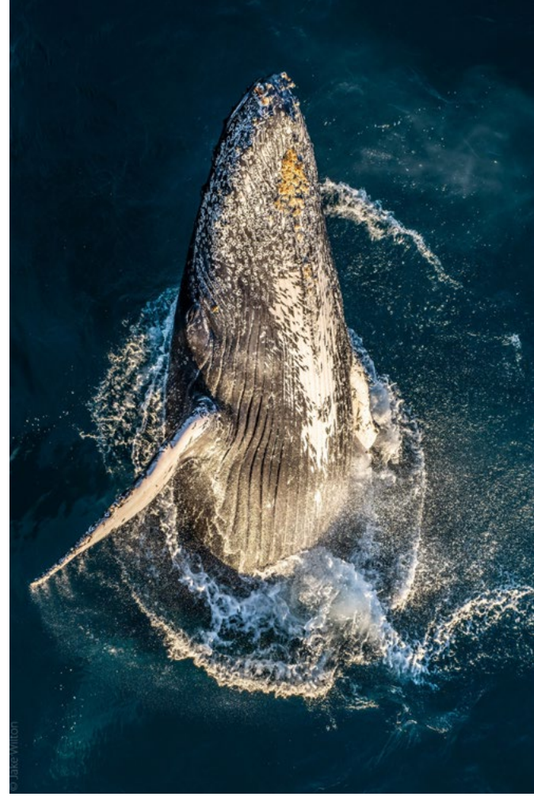
Conclusions

In-water recompression is endorsed. However, It is not for everyone. It is for people like technical divers who know how to use oxygen safely.

- Short delays to recompression seem associated with better outcomes,
- Recompressions shorter and shallower than the US Navy Table 6 do work, and
- In-water recompression is endorsed by the medical community for divers trained in the use of oxygen underwater and equipped properly for in-water recompression. ■

Edited by
G. Symes

UW CHARACTERS WINNER: Jake Wilton, Australia. A curious southern giant petrel investigates my camera dome port during a rare visit to the tropics. Ningaloo Reef, Western Australia (right)



Underwater Tour Awards 2022 Winners

In December 2022, the winners of the third Underwater Tour Awards were announced. This prestigious international competition takes place annually, encouraging and inspiring the passion for underwater photography, while raising awareness of our fragile aquatic and marine ecosystems and their denizens.

The event in 2022 marked the first time that the Underwater Tour Awards partnered with environmental education and action organisation Take 3, introducing a new category for novices called the "Take 3 for the Sea Contest." Proceeds from the contest registration fees and additional donations were given to Take 3.

Judges

Led by Canon Master and six-time winner of the AIPP's Professional Nature Photographer of the Year award, Darren Jew, the international judging panel included Amanda Blanksby, William Tan, Dr Richard Smith, Russell Ord and Brett Lobwein, who judged hundreds of images submitted by photographers from around the world.

"Each year the competition grows, and we are delighted with the high calibre of submissions," said Jew. "The finalists' gallery takes us on a remarkable underwater tour, showcasing the fine work of competing underwater wildlife photographers and celebrating the natural wonders of the underwater world."

The Guru Awards – Photographic Competition

The Underwater Tour Awards is the only international photography competition of its kind to use a systematic Ethical Review for images submitted. The team behind the event is "committed to ensuring the natural world is depicted both creatively and honestly, with due regard shown to the welfare of all marine life and habitats." This meant that before moving to the first round of judging, all shortlisted images entered were subject to the competition's Ethics Review process, which was conducted by renowned marine biologist and author Dr Richard Smith.

And the winners are…

The Guru Grand Prize

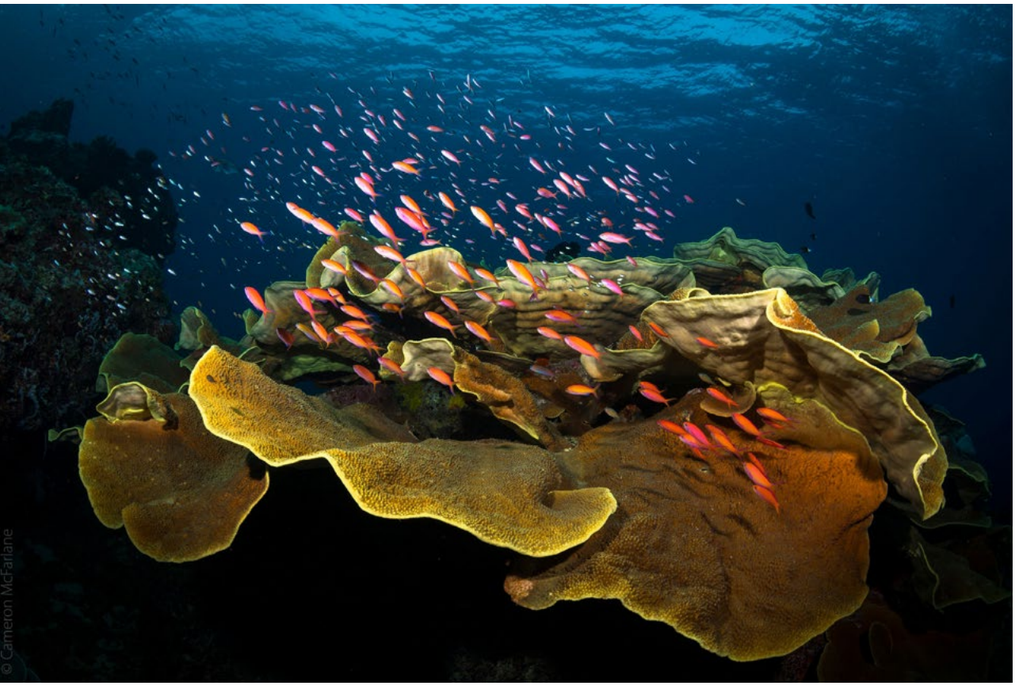
Highlighting the work of a great photographer, rather than just one great photo, the Guru Grand Prize is awarded to the photographer who achieves the highest level of accomplishment with a portfolio of six entries across three or more of the six competition categories.

Winner: Jake Wilton, Australia
Finalists:
Gabriel Guzman, Australia
Joergen Rasmussen, Singapore
Jake Wilton, Australia

GURU GRAND PRIZE WINNER: Jake Wilton, Australia. Topside Scenes – Humpback whale in Indian Ocean, Carnarvon, WA (top right); UW Characters – Manta ray with yellow tail scad fish, Ningaloo Reef, WA (top centre); UW Characters – Southern giant petrel, Ningaloo Reef, WA (top left); UW Characters – Whale shark engulfing baitfish during a rare bait ball feeding frenzy event on Ningaloo Reef, WA (centre left); UW B&W – Manta ray feeds with a barrel roll, Ningaloo Reef, WA (above); Aquatic Abstracts – Whale shark, Ningaloo Reef, WA (right)

Winners

TOPSIDE SCENES WINNER: Anthony Brown, Australia. Humpback whale raises its tail right after another whale breached. Making it look like a very powerful tail slap, Coolangatta, Queensland, Australia (right). This image also won the People's Choice Award.



UW SCENES WINNER: Cameron McFarlane, Australia. A beautiful school of Anthia's use the plate coral as a home and to protect themselves from their prey. Kicha Reef, Solomon Islands (left)

AQUATIC ABSTRACTS WINNER: Wade Hughes, Australia. A natural wall of colour created by sponges and ascidians, Wakatobi National Park, Sulawesi, Indonesia (above).

Guru Image Categories

Underwater Scenes
Winner: Cameron McFarlane
Finalists:
Helen Walne, South Africa
Gabriel Guzman, Australia
Wayne Osborn, Australia
Talia Greis, Australia

Underwater Characters
Winner: Jake Wilton
Finalists:
Gabriel Guzman, Australia
Dave Levasseur, Canada
Josh Blank, Australia
Nicolas Remy, Australia

Aquatic Abstract
Winner: Wade Hughes, Australia
Finalists:
Derek Firman, Australia
Richard Condlyffe, USA
Karen Ho, Papua New Guinea
Walter Drechsler, Germany

Topside Scenes
Winner: Anthony Brown
Finalists:
Joergen Rasmussen, Singapore
Reed Plummer, Australia
Pam Osborn, Australia
Cameron McFarlane, Australia

Underwater Black and White
Winner: Pavlos Evangelidis
Finalists:
Gabriel Guzman, Australia
Katie Clewett, Australia
Ellen Cuylaerts, United Kingdom
Karen Ho, Papua New Guinea

Reportage
Winner: Joergen Rasmussen, Singapore
Finalists:
Sam Glenn-Smith, Australia
Jodi Frediani, USA

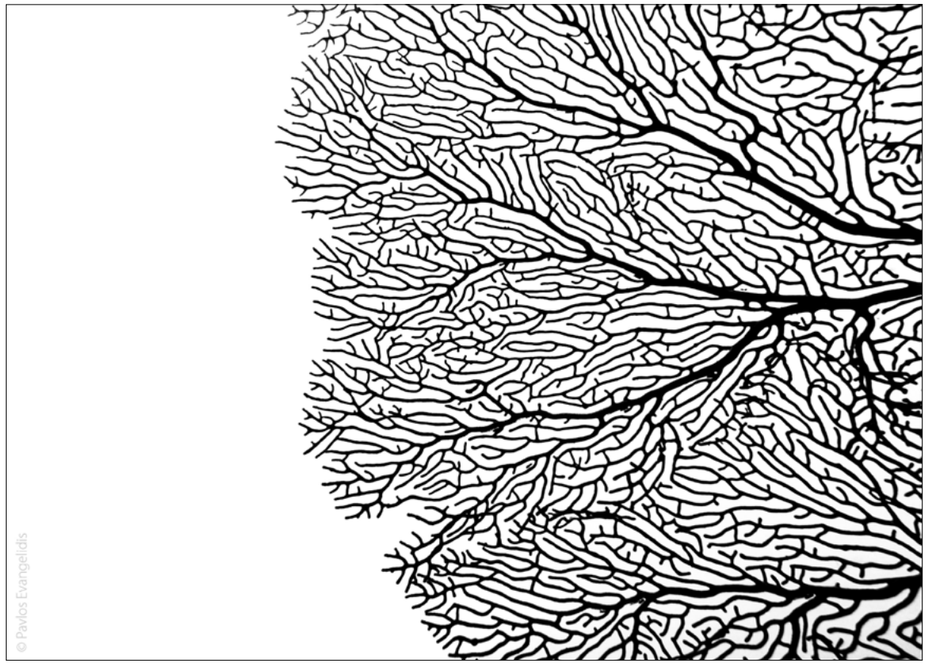
The People's Choice Award
Winner: Anthony Brown, Australia
Runner Up: Mel Wu, Australia

Two new awards introduced

The Packer's Prize
(chosen by the Underwater Tour Team)
Winner:
Helen Walne, Cape Town, South Africa

PACKERS PRIZE: Helen Walne, South Africa. Coraline-encrusted boulders transform this kelp grove into a raspberry-hued delight. A Frame, Cape Town, South Africa (right).

REPORTAGE WINNER: Joergen Rasmussen, Singapore. We found this female paper nautilus riding a piece of plastic over deep water in the open ocean. Plastic is everywhere. Janao Bay, Philippines (far right).



UW BLACK & WHITE WINNER: Pavlos Evangelidis, Benin. A gorgonian fan coral's intricate patterns as a silhouette in the bright South Pacific water—a natural mini-maze. North East Mane Wall, Russell Islands, Solomon Islands (left).

TAKE 3 PHOTO CONTEST WINNER 1: Emma Turner, NSW. Oblivious to the dislocation of a more natural habitat option, a goby makes a discarded plastic bottle its home (above).

TAKE 3 PHOTO CONTEST WINNER 2: Jules Casey, VIC. A discarded plastic cup floating under Blairgowrie Pier with a tiny juvenile seahorse inside (above).

The Take3 Contest
Winner 1: Emma Turner, NSW
Runner Up: Jean-Louis Lebreux, QLD

Winner 2: Jules Casey, VIC
Runner Up: Cathy Finch, QLD

Words from the organisers

"Congratulations to all winners and well done to all entrants," said lead judge Jew. "We'd like to thank all our valued Partners, Take 3 and their fabulous prize partners, and our generous friends at CameraPro, Mike Ball Dive Expeditions, Momento Pro, Heron Island, Walindi Plantation Resort, Lady Elliot Island, Lady Musgrave Experience, QySEA FIFISH, Henderson Greenpreene, Inon and SeaLife.

Co-founder Tim Hochgrebe added, "Thank you to everyone who has taken part and supported the Awards this year. Planning for the Underwater Tour Awards 2023 is already in full swing and we are looking forward to seeing you next year."

About the Underwater Tour and Underwater Tour Awards

An annual collaboration between Juliette Myers of **IlluminOcean** and Tim Hochgrebe of **Underwater.com.au**, the Underwater Tour seeks to celebrate the best of our oceans, promoting inspiration, discovery and adventure. The team was joined in 2020 by creative partners Darren Jew, Jasmine Carey and Greg Crow from **Finslap** and **Photo Competitions**. ■

*For more information about the Underwater Tour, please contact Tim Hochgrebe: **tim@underwater.com.au**.*

*The Underwater Tour Awards recorded announcement video can be found at: **youtu.be/QTRK_dINvjw**. For more information about the Underwater Tour Awards, please contact Darren Jew: **darren@finslap.com***

photo news

Edited by
Rico Besserdich

Sea Dragon 5000+ Professional Photo-Video Light

The Sea Dragon 5000+ photo-video light delivers 5000 lumens in a smooth 120°-wide beam and with a colour rendering index of 90 CRI. The new patent pending SeaLife Color Boost mode combines red and white light frequencies to produce a warming underwater effect that increases brilliance and adds colours to underwater photos and videos. When the SeaLife Color Boost is activated, the colour temperature warms to 3700k, which replenishes lost red for a balanced effect, especially shooting at longer distances. The Sea Dragon 5000+ also has an over-drive feature that allows a brightness output of 6000 lumens for two minutes time, after which the light automatically returns to 5000 lumens to regulate temperature and power consumption. The Sea Dragon 5000+ is depth rated to 100 meters (330 feet). **Sealife-cameras.com**

Marelux Flash tube

Marelux has developed a new gadget for fellow underwater macro photographers—the SOFT-Smart Optical Flash Tube, which can be mounted on a range of popular flashes. This unit has a built-in focus light that automatically turns off when the flash goes off. Light shape can be adjusted by a built-in aperture, which is controlled by an external dial. The focus point is 170mm from the end of the tube and the diameter is 2mm to 60mm. **Marelux.co**

Backscatter MiniFlash 2

Backscatter Mini Flash 2 MF-2 is a light and therefore travel-friendly flash and video light for macro photography. The MF-2 is a major upgrade of the MF-1, according to the manufacturer. The new model has plenty of new features and upgraded performance. These include Olympus TTL, remote flash control, high-speed sync, test mode, emergency signal function, a faster recharge time, and LED light that is twice as powerful as the previous model. All accessories from the Backscatter Mini Flash MF-1 can also be used with the Mini Flash 2. The associated snoot Optical Snoot OS-1 is easy to mount, and the associated masks can be used to shape the cone of light exactly as desired. **Backscatter.com**

Divevolk SeaTouch phone housing

SeaTouch 4 Max underwater housing for smartphones comes with a touchscreen that can be used underwater up to a depth of 60m. According to the manufacturer, it is the world's first underwater full-touchscreen diving housing for smartphones. Its touchscreen offers complete access and contact with the phone's screen, which can then be operated as usual including accessing and using every app also underwater. The housing is compatible with a wide range of both iPhone and Android models. It is also possible to share and upload media without opening the housing and exposing the phone to moisture in wet or humid environments. While made for diving, the housing can also protect the phone while taking videos and pictures when surfing, diving, snorkelling, skiing, kayaking or doing other outdoor activities. Both the back and front cameras can be used. **Divevolkdiving.com**

Easydive 360

The Italian brand has designed this quirky-looking underwater house for the Insta360Pro camera, which, as the name implies, records photos in a 360-degree angle, or all the way around. The camera costs around €4,500 and the housing, with various accessories, is priced at €13,318.63. So, this clearly is a piece of equipment for the dedicated photographer who also has deep pockets. All of that being said, this combination is obviously a high-end professional setup, which can be used to produce high-quality video in 3D, which is best viewed with a VR headset. **360underwater.com**

Nate Wilson

P O R T F O L I O

Nate Wilson

Mandarin Dragonets, 12 x 18in, watercolor on paper (left); *Clown Triggerfish*, 12 x 18in, watercolor on paper (far left); and *Paracheilinus nursalim*, flasher-wrasse, 12 x 16in, watercolor on paper (previous page), by Nate Wilson

Interview by G. Symes
Images by Nate Wilson

American artist Nate Wilson creates beautiful and enchanting watercolor paintings of marine life with great attention to the unique characteristics of each species. *X-Ray Mag* interviewed the artist to find out more about his artwork and creative perspectives.

X-RAY MAG: Tell us about yourself, your background and how you became an artist.

NW: I grew up in the United States, in Central Pennsylvania. My childhood home was located on the banks of the Juniata River. I spent a lot of time in the water as a kid—swimming, canoeing, inner tubing, snorkeling and catching fish, which I kept in small aquariums. My parents were both art teachers, and I grew up with lots of access to art: trips to museums, tons of art supplies, and just spending time making art. One of my earliest memories is sitting with my dad on the floor and drawing together on a big roll of paper in the evenings.

In high school, I spent most of my day in the art room, in art class or on a pass from another subject. After high school, I got a Bachelor of Fine Arts degree in printmaking from Edinboro University in Pennsylvania, and eventually a Master of Fine Arts degree from Tulane in New Orleans. Much later, I went back to Mansfield University and earned my K-12 teaching certificate in art.

I have made different kinds of art over the years, but it was not until about ten years ago that things really clicked. My wife and I were living in a small apartment, and the space was not conducive to the large-scale art I had been making (things like screen printing, large relief prints, or big acrylic paintings).

I think most artists benefit from having a space specifically for making their art—where they can look at it, think about it, and work on it as new ideas arise. At the time, the area where I could make art was also the kitchen table, so I would not be able to make art consistently because there was no way to leave things out when I was done for the day. Everything had to be put away, so we could use the table to make dinner, eat, etc.

Aside from sketching, making art had become something that I only did if I felt I had a lot of time to work on it. Maybe

Ecsenius springeri, blenny, 16 x 12in, watercolor on paper, by Nate Wilson

Nate Wilson

Napoleon, life-size Napoleon wrasse, 6ft x 3ft, watercolor on paper, by Nate Wilson

this is why I did not really feel that I had a lot of connection to the art I was making at that time.

One day, I picked up an old student-grade watercolor set and decided to paint a fish. I had not used watercolor since high school. I had never had actual lessons in watercolor painting or used it more than once or twice. It was a challenge to work with, and I think that made it inviting. As much as it is possible for someone with two art degrees to say they are self-taught in anything, I think that I am self-taught with watercolor.

Because it was also easy to clean up, I found myself painting a lot. I worked in the evenings and nights as a photographer for my local paper. During the day, I would substitute teach. If I did not have a sub job lined up, I would make painting my job for the day, starting when my wife left the apartment and working until just before she came home.

I started painting fish because they seemed suited to the medium, and they were something I connected with because of my continuing interest from childhood. I was also fortunate that I was able to sell a number of my early fish paintings, and that helped challenge and motivate me to continue in this direction.

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

NW: I have always enjoyed being around water and have been fascinated by fish and marine life. I had a bunch of fish tanks growing up. Some of these were tropical, with fish like guppies and mollies. My family kept goldfish in tanks and a pond. I also had river fish in a 29-gallon tank.

My friends and I would catch all kinds of things in the river below the house. I used to walk upstream and snorkel down the river, past our house. Every trip was different. I really liked observing nature and got a lot of joy out of noticing small things.

I think as I have gotten older, the enjoyment of nature has become a central part of the things I choose to do. I feel that painting fish has been successful for me because it is something that I am truly interested in. I think that I am being honest with myself in what I choose to make and that carries through into the artwork.

As far as my style goes, despite the art degrees, I would say that it reflects that I am self-taught when it comes to watercolors and their application. I try to really look at what it is that I am painting and notice the details. I think art is about perception and translation—showing other people what you see and translating that for them. Obviously, what I do is pretty straightforward, but I enjoy noticing the small things and displaying that knowledge as part of each artwork.

X-RAY MAG: Who or what has inspired you and your artwork and why? What mentors, artists, art styles or movements have influenced your artistic vision?

NW: My parents were a huge influence in that they were very supportive of me making art. After a very young age, they were really hands-off, in terms of showing me specifics. They just let me go. There were always art supplies in the house, we went to a lot of museums, and they backed my interests. My mother was first up in the mornings and often found dust-covered crayfish, which had escaped my fish tanks, wandering around downstairs.

I enjoy looking at many kinds of art even if it is not specifically relevant to the kind of work that I make. I like cave

Blue Ribbon Eel, 36 x 24in, watercolor on paper (above)

Nate Wilson

and Nudibranches 1, 12 x 16in, watercolor on paper (right), by Nate Wilson

paintings because it is wonderful to see oneself as part of a tradition of people trying to understand their world through artmaking, which goes back tens of thousands of years. I like to look at street art because I understand that compulsion to make the gray spaces of the world colorful, to make people think, and just that need to make and create.

I like the Japanese woodblock masters like Kuniyoshi and Hokusai, and the skill it took to build their images. I like to think about how the Renaissance masters rediscovered perspective, or how the Impressionists used color. I like the German Expressionists.

As for contemporary artists, I like Okuda San Miguel, Jeff Soto, Skinner, and Swoon. There is so much great and wonderful stuff that has been or is being made. Those are just some examples. I think it is impossible to pick a favorite artist or even a style. In terms of "fish artists working today," I really enjoy Yusei Nagashima, Karen Talbot, Joe Tomelleri, and Teuthis. Just looking at any of these artists' works makes me want to start making my own.

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

NW: How I make art is pretty straightforward. I have an idea of a species I want to paint. It may be a fish or endemic species from a location, which I just saw something about. There are 30,000+ species of fish, and I am always reading, looking at images and learning new things about fish.

I search for images online, in my own photo library or in my shelves of fish books. I try to get at least seven to ten pictures of a species to look at, and then I pick and choose bits from each. A lot of my fish are painted from the side, but I try to maximize their colors and patterns.

I generally start with a light pencil sketch of the basic shape and pattern. I then work from one end of the fish—usually starting with the face—to the other. I like to build layers of color as I go, and take a lot of breaks to let stuff dry. I usually listen to podcasts while I work.

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 favorite experiences?

NW: In high school, I spent a year as an exchange student in Queensland, Australia. I had always wanted to go there, after seeing an article on the Great Barrier Reef in *National Geographic*. David Doubilet's pictures were incredible.

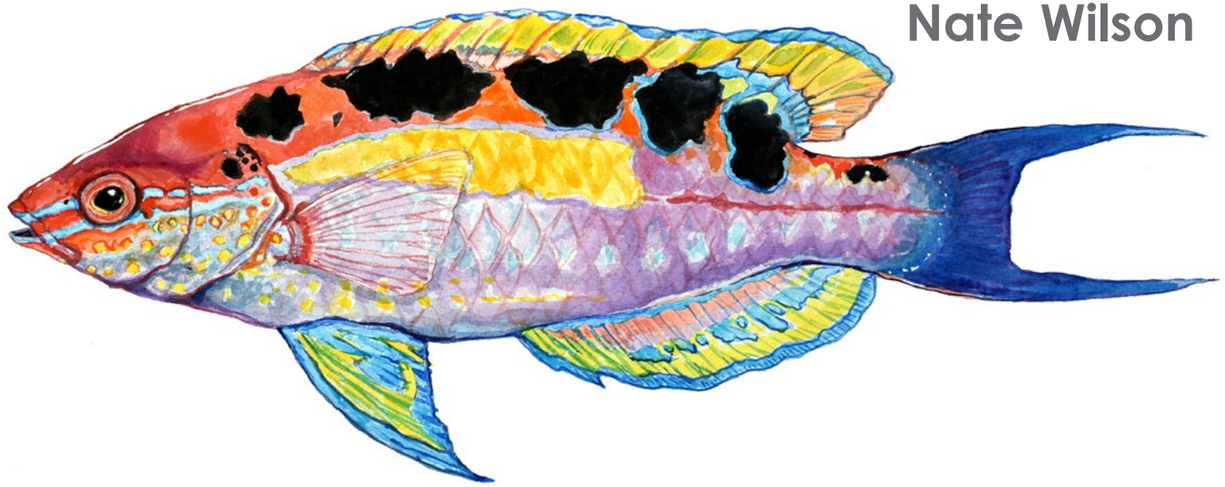
I was able to spend one day on the Great Barrier Reef, off Airlie Beach, as part of a bus trip around half the country with other exchange students. I swam over a wobbegong shark and saw a harlequin tuskfish. Those were animals I had only seen in magazines. That experience blew my mind.

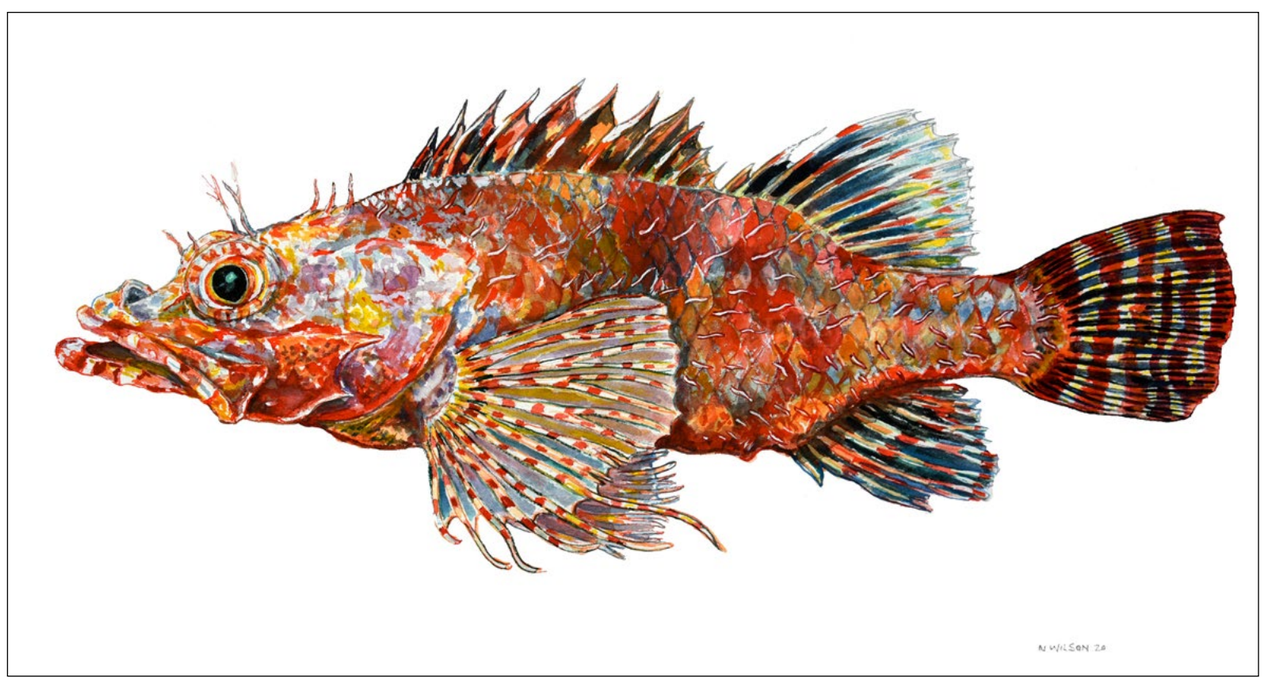
In graduate school, I managed to squeeze a PADI Open Water and Advanced Open Water certification, and a couple of dive trips to the Florida Panhandle, into my school schedule. In 2003, I took a year off and traveled around Australia, New Zealand and Fiji. Since then, my wife and I have been back to the South Pacific six or seven times. I have dived the Great Barrier Reef, Ningaloo Reef (Western Australia), lots of places in Fiji (the Rainbow Reef, between Taveuni and Vanua Levu, being my favorite), Tonga and the Cook Islands.

My top underwater experi-

Red Seahorse, watercolor on paper, 12 x 18in, by Nate Wilson

Nate Wilson





Trimma blematium, pygmy goby, watercolor, 12 x 16in (above); *Cirrhilabrus cenderawasih, wrasse*, watercolor, 12 x 16in (top right); *Scorpaenodes bathycola*, scorpionfish, watercolor, 12 x 16in (bottom right); *Ecsenius taeniatus*, coralblenny, watercolor, 12 x 16in (right), by Nate Wilson

ences include the time when my wife and I went to Vava'u in Tonga in 2014 to see the whales. On our last day, we were watching a mama humpback and her calf. The calf kept swimming up to check us out and would corkscrew past us, playing, over and over again. This lasted a good 30 minutes.

In the end, the mother cruised by us with her baby. Just looking into her eyes was amazing. I don't think I am anthropomorphizing when I say she was looking back, actually considering us and what we were.

Another dive I really enjoyed was at a site called Blizzard Ridge on Ningaloo Reef. We were engulfed in a school of baitfish, stretching along an underwater ledge, for a good 20 minutes. Then there was the summer when we spent about five weeks on Taveuni in Fiji. I spent so many hours snorkeling in the tiny lagoon between the beach and the reef edge that I knew where just about every scorpionfish and blenny hid. Every day brought something new. Being able to spend that amount of time in one spot was phenomenal.

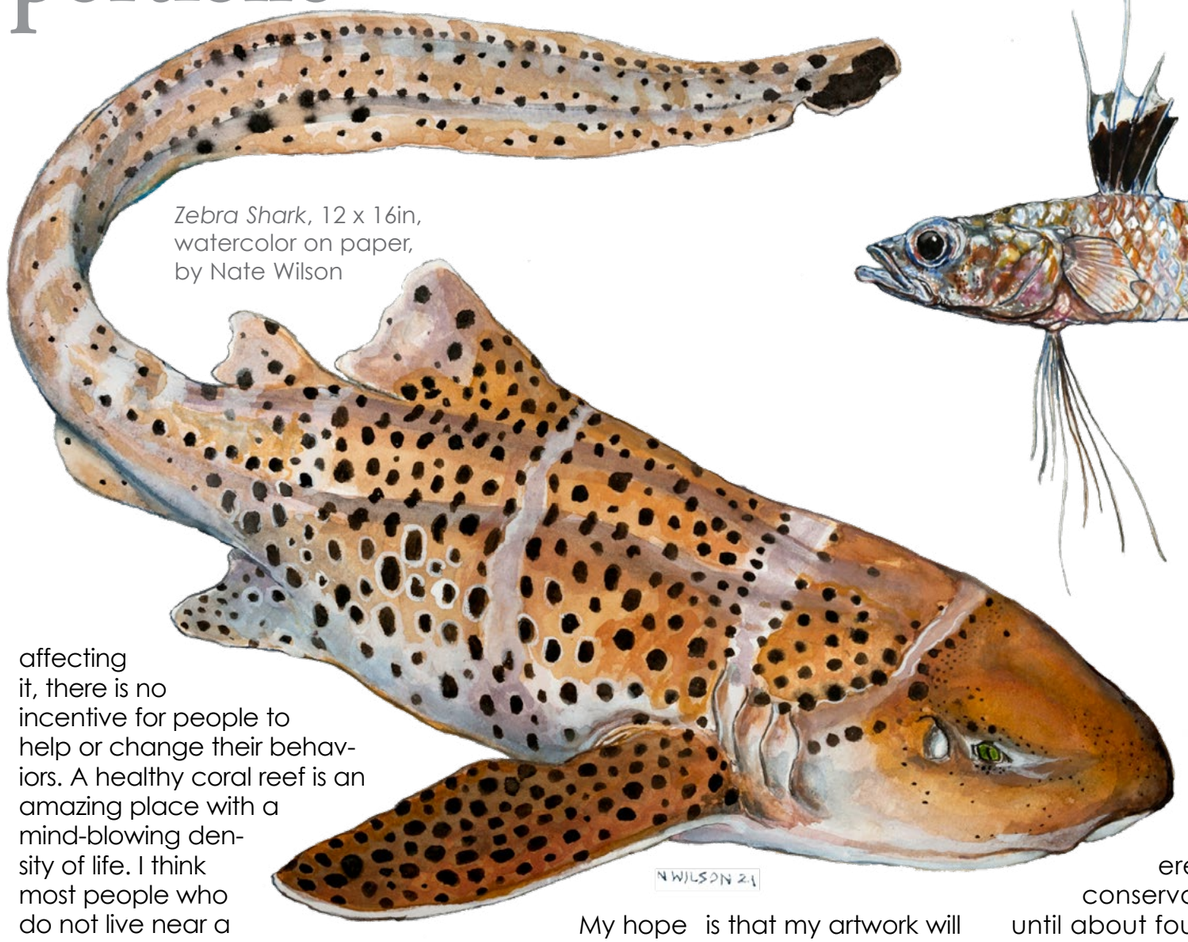
And just this past summer, I was thrilled to find sculpin in a tiny creek in Southern Pennsylvania. Really, you could put me anywhere there is water and fish, and I will be happy.

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

NW: I think ocean conservation and reef management are both extremely important. I also think that tackling the global problem of climate change should be a priority for individuals, who can do small things, and governments, which can do large things. I am no scientist, but I think that without addressing climate change, I am not sure how effective reef conservation will be in the long run.

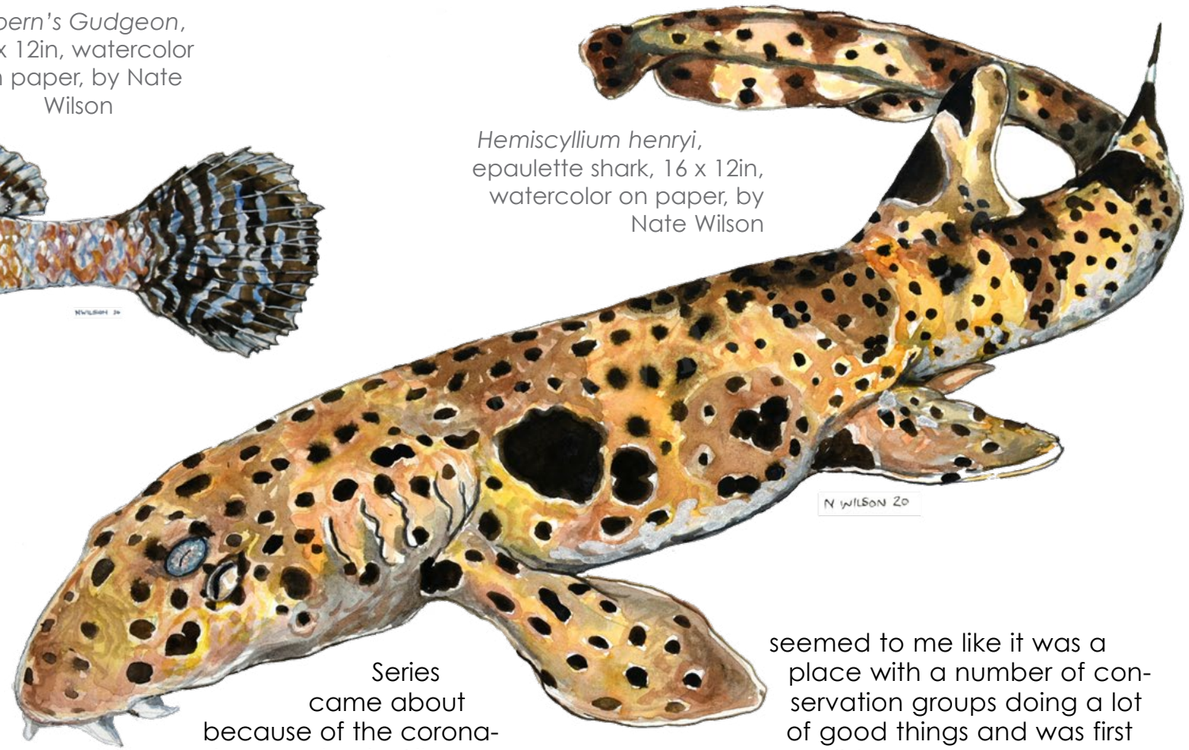
I think that education about the oceans and reefs is very important. People cannot appreciate what they do not know anything about. Without knowledge about an ecosystem, or the problems

Nate Wilson



Zebra Shark, 12 x 16in, watercolor on paper, by Nate Wilson

Eilpern's Gudgeon, 16 x 12in, watercolor on paper, by Nate Wilson



Hemiscyllium henryi, epaulette shark, 16 x 12in, watercolor on paper, by Nate Wilson

affecting it, there is no incentive for people to help or change their behaviors. A healthy coral reef is an amazing place with a mind-blowing density of life. I think most people who do not live near a reef, or have never dived or snorkeled on one, have no idea just how special they are.

Aside from education, I think that getting local communities involved with the conservation of their resources is key. Local communities often need an economic reason to conserve the resources near their homes, so providing opportunities to help them transition into conserving these resources is important. Many local communities have traditions of stewardship that can be reinvigorated or expanded. Marine protected areas, with no-take zones and/or managed subsistence fishing, are great ways to help regenerate a marine area.

My hope is that my artwork will show people the beauty and value of every species. The first time I ever saw a mandarin goby, I was amazed at just how much detail and beauty was packed into this tiny living thing. I think about that moment when I paint.

I want my artwork to represent each species like a jewel being presented on a blank background, where its beauty is emphasized by the empty space around it. I am constantly asked by people, looking at my work, if the fish I have painted is real. Hopefully, the realization that the earth is full of things we do not know about or understand, will cause people to dig into their world a little bit deeper.

I have always considered my art to be about conservation, but it was not until about four years ago that I really started to think about what that actually meant and what I needed to do to make art that might change something.

X-RAY MAG: As avid divers, many of our readers are familiar with Bird's Head Seascape. Please tell us about your Bird's Head endemic series. How did this series come about? What was most interesting to you about Bird's Head and why were you drawn to this location? How did you choose the species to paint?

NW: I have known about Raja Ampat and the Bird's Head Seascape's biodiversity for a while. The Bird's Head Series came about because of the coronavirus pandemic. Like many people, I was in lockdown during Covid. The school district I work for shut down in March of the first year of Covid. We began online learning. Things were very uncertain.

To help out families not working, our district began distributing food parcels twice a week. I volunteered to help with this, because I wanted to do something positive and also get out of the house. The end result was that on days that I helped fill food parcels and distribute them, I felt really good. I decided that since I was doing something on a volunteer basis locally, I should try and do something with a more global scope.

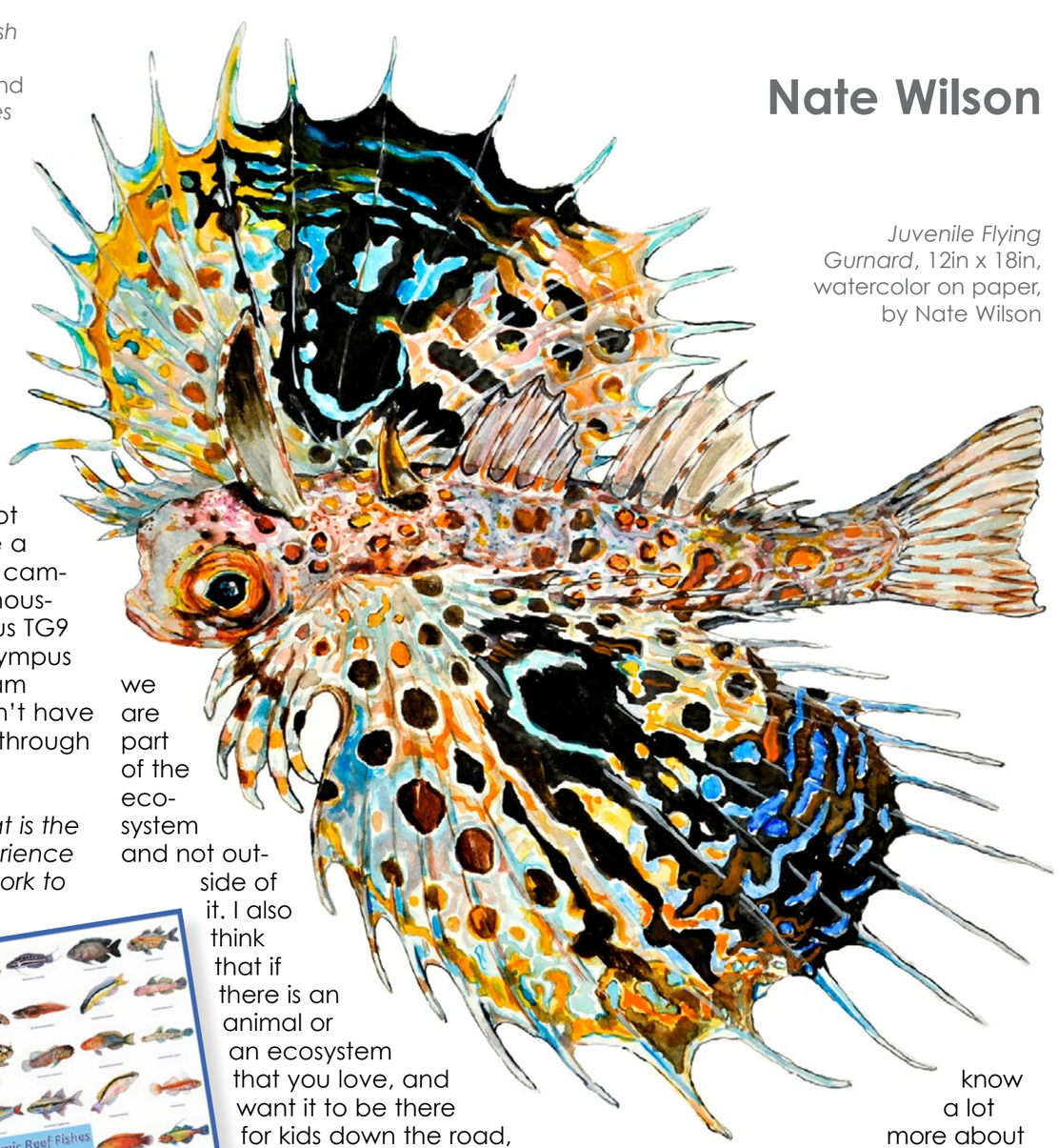
So, I made a list of organizations that I would be interested in working with and started to send out emails describing my work as an artist. I expected this to be a lengthy process. The Bird's Head Seascape seemed to me like it was a place with a number of conservation groups doing a lot of good things and was first on my list.

Burt Jones from the Bird's Head Seascape website got back to me almost immediately to let me know that he had passed my information on to Dr Mark Erdmann at Conservation International. If you are not familiar with Burt and his wife Maureen, they are excellent photographers (**secretseavisions.com**), who have written two guidebooks on Bird's Head and run the Bird's Head Seascape webpage (**birdsheadseascape.com**).

Via a Zoom meeting or two, and numerous emails with Dr Erdmann and Marit Miners from Misool Eco Resort/Misool Foundation, we decided that I would paint the fish species endemic to the Bird's Head Seascape. Images of the paintings have been used by the Misool Foundation to create 52-week planners (calendar booklets), t-shirts and canvas bags. A hundred per-

Banggai Cardinalfish Shoal, 36in x 24in, watercolor (left), and *Endemic Reef Fishes of the Bird's Head Seascape* poster, (below), by Nate Wilson

Nate Wilson



Juvenile Flying Gurnard, 12in x 18in, watercolor on paper, by Nate Wilson

cent of the profits go to the Misool Foundation to pay for patrols and other conservation activities. The items have been on sale since late September, and with the Bird's Head reopening to travelers, it will be exciting to see how they take off.

I took the 57 paintings I did and made them into a poster called the "Endemic Species of the Bird's Head." I also did another poster for the endemic species of Teluk Cenderawasih National Park, most of which are the same as Bird's Head. Both these posters have been printed and distributed in a number of government offices.

I donated my artwork to them because I think that conserving the Bird's Head Seascape is important. Obviously, I would like to see Bird's Head at some point myself. But I also hope that when the kids I teach get older, places like the Bird's Head will still be there for them to see.

X-RAY MAG: Did you work from specimens or underwater photographs of the endemic species, and if so, what camera gear did you use?

NW: I have to say that it is really exciting to be able to work with great photos taken by the experts who oftentimes are discovering new species and describing them. Most of the pictures are provided by Dr. Erdmann, taken either by him or Gerry Allen.

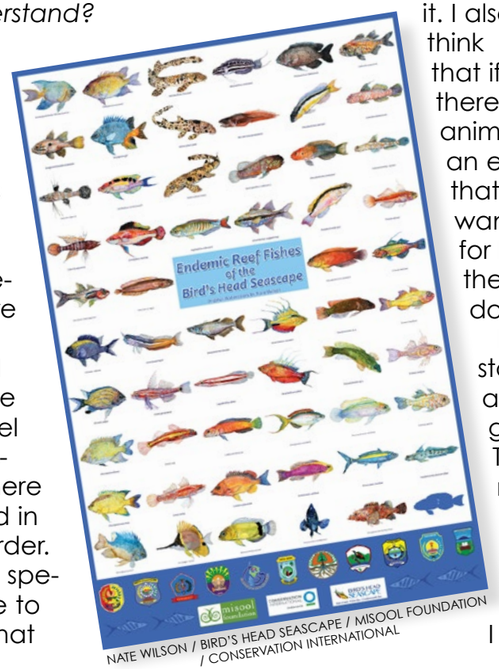
Allen uses a Nikon D7000 DSLR camera in a Nexus housing, with 105mm macro lens, and Dr. Erdmann uses a Sony a7R III mirrorless camera in a Nauticam housing, with a 90mm macro lens. I have yet to shoot any images in Bird's Head… hopefully, next year!

When I do shoot underwater, I use a Nikon D750 DSLR camera in an Ikelite housing or an Olympus TG9 camera in an Olympus housing (for stream shooting, so I don't have to lug the Ikelite through the woods).

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

NW: I want viewers to think about each individual animal as something to be marveled at and appreciated. Nature is amazing in and of itself. I would also like for that marvel to spark a discussion of where humans stand in the natural order.

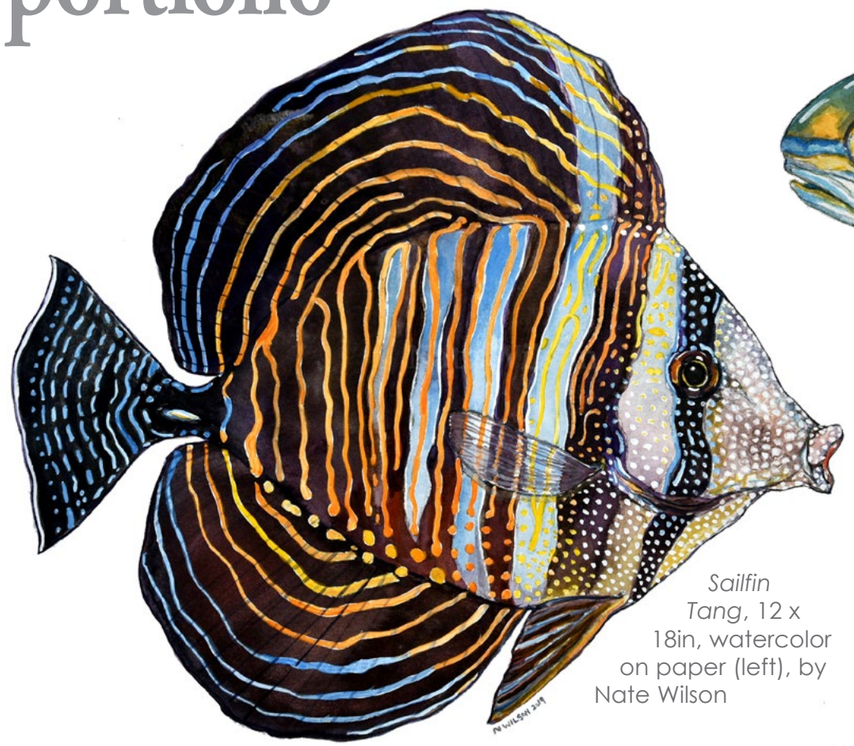
I think, as a species, we have to understand that we are part of the ecosystem and not outside of it. I also think that if there is an animal or an ecosystem that you love, and want it to be there for kids down the road, then you need to try and do something to help it.



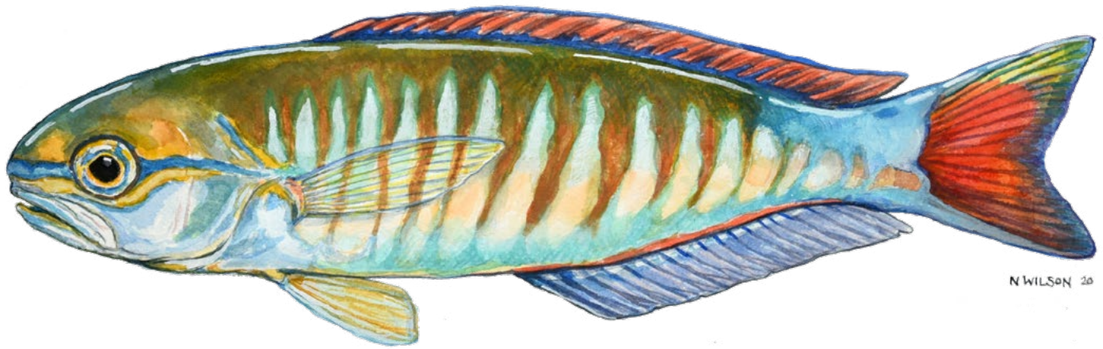
I want people to understand that they can make a difference in what goes on in the world. Three years ago, I had nothing to do with the Bird's Head. It was just a dream destination. But now, because of the creative process that I have been part of, I know a lot more about the endemic species that live there, the reefs, and conservation issues in the region. That has been really enlightening in itself. But I have also gotten to know some very knowledgeable and passionate people through this process.

Today, paintings I made are being used to help fund conservation there. All 57 species I painted are being used on fish ID posters. I hope that it makes at least a small difference. Just being involved is amazing to me, but none

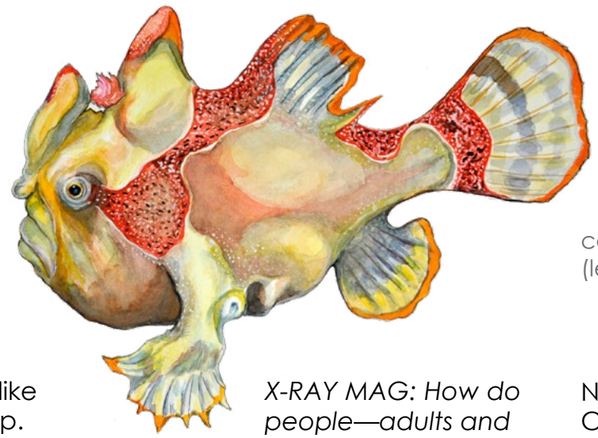
Nate Wilson



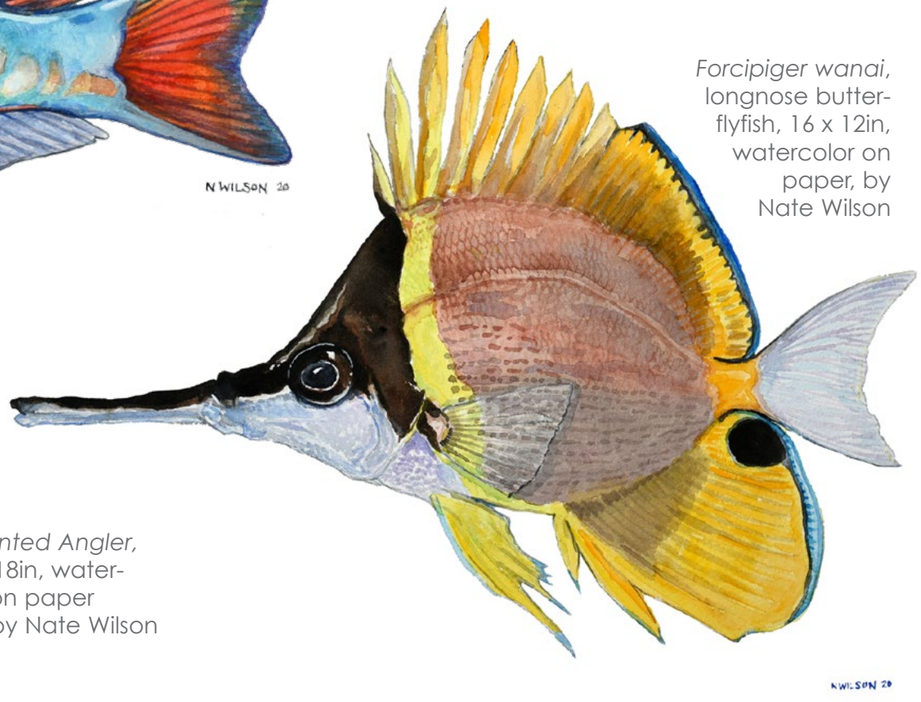
Sailfin Tang, 12 x 18in, watercolor on paper (left), by Nate Wilson



Erdmann's Tilefish, 12 x 16in, watercolor on paper, by Nate Wilson



Painted Angler, 12 x18in, watercolor on paper (left), by Nate Wilson



Forcipiger wanai, longnose butterflyfish, 16 x 12in, watercolor on paper, by Nate Wilson

of it would have happened if I had not sent an email. Take that first step. You never know what can happen.

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

NW: I think the hardest things are: making art that is honest, maintaining a love for something that you loved as a child (making art), and balancing that love and enjoyment of art with everything that goes into making money from it.

Some benefits of making art, among others, are that you develop the ability to be creative, to make something out of nothing, to share your voice in a visual way. I work with students at ages anywhere from 3 to 14 years old (depending on the school year). My advice is, if you like art and enjoy making it, don't stop. Don't listen to people who tell you that "you should not make art," that "it is silly" or "a waste of time." If more people learned to express their feelings regularly, we would be a healthier society. Be comfortable with what you like to do.

If you want to get better at art, then make sure you stop and look at it critically from time to time. Give yourself permission to make mistakes, just make sure that you try and learn from them. I try to learn something from each painting I make.

Try to draw or make something every day. This is essential to developing as an artist. You do not need fancy materials to make art. You can draw with a pencil on scrap paper or cardboard, or build sculptures from trash—just make something!

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

NW: Sometimes, adults do not believe that what I paint actually exists. I have literally had to open a book and show people pictures of some species before they believed that I was not making something up. I never have that problem with kids.

At school, I get a lot of drawings from kids. It's not always related to my artwork. Usually, they are drawings of me. They are generally pretty funny. I have been drawn as a pirate, a bear, and one year, a fifth grader drew me as a centaur. I have that one framed.

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

NW: I am doing some more art for Conservation International. I have finished a poster for them of the endemic fishes of Milne Bay in Papua New Guinea. I have done some paintings that will be used for posters called the Walking Sharks of the World and also the Walking Sharks of Indonesia. I have also done some art for the StAR Project, a program to reintroduce zebra sharks back into the Bird's Head Seascape. See: **birdsheadseascape.com**

There are a couple of other regions in which I have been looking at the endemic species. I have really gotten into looking at the fish that only come from very specific areas. For example, this past summer, I did not go diving but did some snorkeling in Pennsylvania. I thought I knew quite a bit about the local species, but the first creek I got into proved me wrong. I think I am going to be doing a series on the endangered and threatened species in my own state and then maybe a series of freshwater darters.

I have an art show coming up in December that will be over by the time this comes out. It is my first show since pre-Covid times. I would like to get a couple more shows set up. A show of all the Bird's Head species would be really cool.

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

NW: I am always open to discussing new projects or exhibitions, especially if they have a conservation angle. I do commissions as well. You can contact me through my website at: **natewilsonpaints.com**. ■