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Cat Island
**Oceanic Whitetip
Sharks**

Scotland
**Muck
Diving**

Tech
**When Have
We Learnt?**

Ecology
Anemonefish

UW Photo
**The Snoot
Method**

INDONESIA
North Sulawesi

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COVER PHOTO: *Rhinopias scorpionfish*, photo taken with a snoot
by Mike Bartick (Saltwaterphoto.com)

Soft coral squat lobster, Bali, Indonesia. Photo by Lawson Wood



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Be More Bruce

It is time that manufacturers adopt the ethos—"Be more Bruce"—and remember everyday practicality, rather than the Apple model of "this is how we can forcibly bind our customers to us."

What am I talking about?
 A snorkel mouthpiece fitting.

Recently, I covered staff leave at a dive centre when a customer came in to buy a snorkel. I enjoy equipment counselling and explaining the kit, so that customers can make an informed choice about the features and benefits of the gear they want for their current and future diving.

I am a fan of snorkels that have replaceable mouthpieces. Let's face it. We have all done it—got excited, chomped on a mouthpiece and bitten off the silicone stubs. The joy of using a decent quality snorkel is that you can simply replace the mouthpiece and carry on diving.

Or so I thought.

I was happily chatting my way through a pretty good snorkel made by a reputable manufacturer when I got to the mouthpiece. I demonstrated to the diver that this mouthpiece would be very easy to remove and replace, when to my shock, I saw that the manufacturer had redesigned the oval standard 180-degree flange so that it now projected at a strange angle. I then looked at the silicone mouthpiece and saw that the bottom end was also angled.

My mind went black.

I stopped talking. On the face of it, I knew I had a great snorkel in my hand, bar the mouthpiece—and this was a major issue for me. Morally, I felt uncomfortable about selling customers this particular snorkel because I knew that one day they would bite through that mouthpiece. With luck, it might be in the pool just up the road from this dive centre. And then the diver could just pop in and get a replacement.

But because life is what it is, the mouthpiece would most likely be bitten to pieces in a remote location—perhaps when the diver was on honeymoon. No doubt, the local dive centre would be able to provide them with a standard mouthpiece, but would it properly fit this customer's snorkel? Nope. Not a chance. "Sorry your honeymoon is ruined."

So, who is the diver going to get upset with? The manufacturer? Or the poor soul and dive centre who sold it to them. Go on, take a guess.

How can I morally sell this snorkel, knowing it does not come with a bog standard mouthpiece fitting? Personally, I can't.

And would I, in turn, buy in this snorkel for the dive centre? No. Really no.

So designers and manufacturers, start applying some common sense. By all means, research and develop the bit you put

into your mouth. Change it up as much as you like. And by golly, there are some sexy-looking mouthpieces out there. But please don't mess with the end that attaches to the snorkel. Step away from redesigning something that works on pretty much every single snorkel and regulator around the planet.

BE MORE BRUCE.

So, where does the saying, "be more Bruce," come from?

When Bruce Partridge designed the Shearwater Petrel dive computer, he worked on the premise that the most common battery in the world that divers could access was the AA. He also realised the diver would have no tools to hand, but they probably would have a coin in their pocket.

The Petrel was designed so that you just use a coin to open or close the AA battery compartment. Every time I change a battery on my Shearwater, I silently thank Bruce for having the nous and the integrity for designing his Petrel with these handy benefits.

So "be more Bruce." Actively consider your end user. Assume they will be diving your products in a very remote location—with little or no support. So remember to design in convenience. Thanks!

— Rosemary E Lunn



News edited by Peter Symes

from the deep NEWS



SIMONE MARINHO / CC BY-SA 3.0

Trindade and Martin Vaz is an archipelago located in the Southern Atlantic Ocean about 1,100km (680 miles) east of the coast of Espírito Santo, Brazil, of which it constitutes a part.

Brazil plans a mosaic of Marine Protected Areas, covering 900,000 sq km, around two archipelagos in the South Atlantic Ocean. Seychelles announces the creation of two new Marine Protected Areas covering about 210,000 sq km.

Though Brazil has lagged behind other developing countries in Marine Protected Area coverage, with only 1.5 percent of its jurisdictional waters under protection, the addition of the two archipelagos will make Brazil's MPA coverage jump to some 21 percent of its exclusive economic zone, making it a global leader.

One is a group of 15 small islets known as the Saint Peter

and Saint Paul Archipelago. It is located in the central equatorial Atlantic, while the other island group, Trindade and Martin Vaz, are farther south, about 1,100km east of the coast of Espírito Santo, Brazil.

The island groups are biodiversity hotspots and their surrounding waters harbour many vulnerable and endangered species that have been severely depleted by

industrial overfishing. These include whales, sharks, sea turtles, fish and an astounding variety of fish.

World-class diving

In spite of their distance from the continent, both archipelagos have enormous potential for non-extractive wildlife uses. Their rich submarine habitats could provide world class scuba diving, whale watching, bird watching and

other forms of eco-tourism. If protected, the region could give rise to a whole new income generation opportunity with conservation as its umbrella, for as regions of untouched natural beauty become increasingly rare, they will become more and more popular as tourist destinations.

Brazilian president, Michel Temer, is expected to make a decision in early March, after the public consultation period ends. As well as congratulating Brazil for the initiative, the recommendation should be made that the no-take zones should be greatly expanded around both archipelagos in order to provide a gravely-needed refuge from factory fishing, where the populations of many depleted marine animals of the Atlantic Ocean can recover.

MPAs in return for US\$21 million debt relief

Seychelles is to create two huge new marine parks in return for a large amount of its national debt being written off, in the first scheme of its kind in the world.

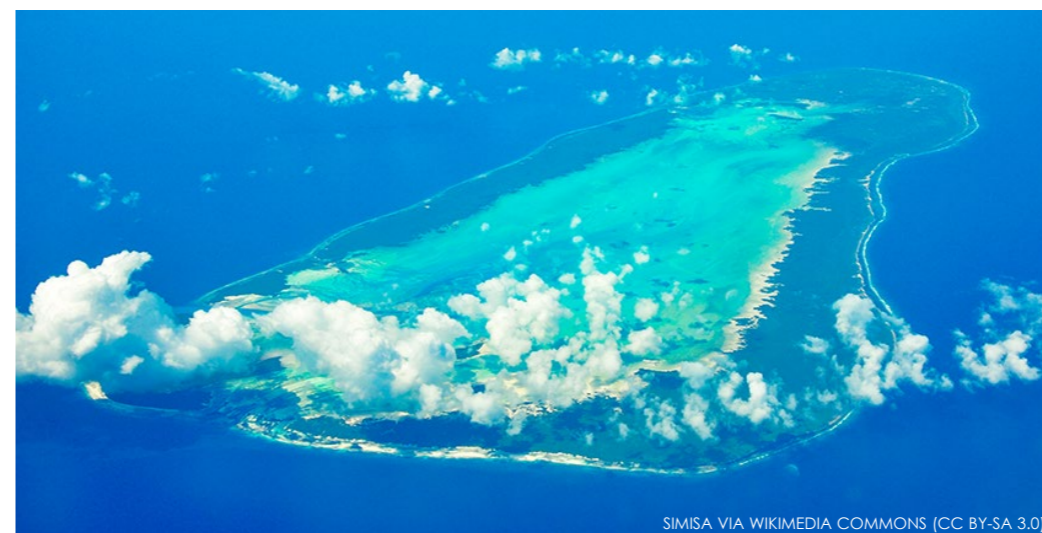
US-based Nature Conservation,

backed by philanthropists such as Leonardo DiCaprio, will buy US\$21 million of Seychelles sovereign debt, and the government will use the money saved to protect its oceans. The deal increases protection for the country's waters from less than one percent to more than 30 percent and supports the creation of the second largest Marine Protected Area in the West Indian Ocean.

The first marine protected area includes 74,400 sq km of waters surrounding the extremely isolated Aldabra Atoll, which is home to the elusive dugong (*Dugong dugon*) and the world's largest population of about 100,000 rare giant tortoises (*Aldabrachelys gigantea*). The islands are also important nesting grounds for hawksbill turtles (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*).

The second marine protected area covers 136,000 sq km of a commercially important stretch of ocean between the Amirantes group of islands and Fortune Bank.

Together, the parks cover 15 percent of the Seychelles ocean and the government will double this by 2021, ■



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The uninhabited Aldabra is the world's second-largest coral atoll.

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Photo: Alex Dawson

More nations create big Marine Protected Areas

Edited by
Catherine
GS Lim



BRANDI MUELLER

Despite the best efforts of concerned divers and organisations, the Great Barrier Reef (GBR) continues to be under threat from coral bleaching, nutrient runoff, and crown-of-thorns starfish.

Race to save the Great Barrier Reef

Australian Government announces a AU\$60 million plan to protect the Great Barrier Reef (GBR), which had large sections decimated by coral bleaching and outbreaks of predatory crown-of-thorns starfish.

In recent months, several projects have been launched to slow down the GBR's degeneration and perhaps even restore it to its former pristine condition.

For instance, in January this year, the Australian government launched a challenge to scientists, business leaders, innovators and entrepreneurs to come up with novel, innovative solutions that can

protect corals and boost the recovery of damaged reefs on the GBR.

Describing it as the "planet's greatest living wonder," Australia's Minister for the Environment and Energy Josh Frydenberg said that the ideas could focus on anything from reducing the corals' exposure to physical stressors to ways to boost coral regeneration rates.

"The scale of the problem is big and big thinking is needed, but it's important to remember that solutions can come from anywhere," he said in a media release.

AU\$60 million plan

The challenge is supported by the Australian government's Reef Trust and the Queensland government's Advance Queensland initiative. The

Advance Queensland Small Business Innovation Research (SBIR) awards contracts to innovators to research, develop and test their solutions to complex challenges. Minister for Jobs and Innovation, Senator Michaelia Cash said the funding showed the federal government's commitment to protecting the reef's future.

At the initial feasibility stage, more than one proposal is expected to be accepted. During this time, for up to six months, researchers can use up to AU\$250,000 to test the technical and commercial viability of their proposals. Then, a further AU\$1 million will be made available to the best solutions at the proof of concept stage, during which applicants can develop and test their ideas for up to a

year. Entries will close on 6 March 2018.

Crown-of-thorns

AU\$10 million has been earmarked to combat crown-of-thorns starfish, with the number of culling vessels increased from three to eight.

Already towards the end of January, the crown-of-thorns starfish problem had been dealt with head-on. In just seven days, 25 volunteer divers killed a record number of the starfish—nearly 47,000—on the southern GBR. Led by Gladstone charter operator Bruce Stobo, the divers operated in groups of 12, injecting the starfish in the shoulder with bile salts, while contending with ocean currents and swells.

Although the aim of the operation was not eradication but containment, what the divers encountered underwater gave them an idea of just how massive the

If you become too pessimistic, you give up, and we are optimistic, but we're backing our optimism with science and great scientists.

— Malcom Turnbull, Prime Minister of Australia

problem was. It was reported that the number of starfish was so massive in some areas that they were layered on top of one another in order to get to the coral.

"Everyone was absolutely surprised," said Stobo in an ABC (Australian Broadcasting Commission) article. "We had professional divers on board who've been working up north, and one in particular who's been doing it for eight months full-time, and he said it was the most that he's seen in one area."

Polluted water

A bulk of the funding, to be rolled out in the next 18 months, will be spent on measures to prevent polluted water entering the reef. These initiatives will work with farmers reducing soil erosion, improving on-farm nutrient, management and restoring coastal and riparian vegetation in the reef catchments. ■



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Crown-of-thorns starfish on coral, right half of which is dead

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ANDREY RYANSKIY

The newly discovered but yet unnamed species of scorpionfish, likely a *Parascorpaena*

New species of scorpionfish found in the Philippines

Like many venomous animals, this fish is bright red—a warning to potential predators—but has some unusual characteristics: extraordinary, long and branching skin appendages above each eye, and smaller appendages between and under the eyes.

Text and photos
Andrey Ryanskiy

That evening in Anilao was like many others. A crazy red sunset. Wonderful company on a boat. High season, warm water. We decided to explore the sites between the Mato Point and the Pierce. In places like Anilao, every dive is an exploration, even if you

dive this site for the fifth time for this trip, not to mention other trips in previous years.

This dive was no exception. Soon our small group of four divers and a guide dispersed on a slope in a depth range of 15 to 20m, and total darkness was occasionally illuminated by flashes of cameras. Nudibranchs, crabs, shrimps played the usual game of hide

and seek with us. After about half an hour, I swam to our guide. He looked around, understood that everyone was busy with work, and nodded to me.

After a couple of minutes, we were already 39m deep. We always checked the deeper part of the sites. Slowly, we were swimming along a steep slope covered with large, rounded

boulders. Covered with sand, overgrown with hydroids, sponges and small algae, they create thousands of places for shelter, so necessary for shy underwater inhabitants. But at night these inhabitants come out of their shelters—to eat or to breed. This time, we did not have to swim far.

Something unusual

A rather large (about 20cm) scorpionfish was resting on the slope, looking at us with calm interest. Scorpaenids have very few natural predators, their spines are exceedingly dangerous. Like many venomous animals, this fish was bright red, an excellent colour warning. Its large mouth was capable of swallowing prey over half its own body length.

But what was most unusual about this fish were the extraordinary, long and branching skin appendages above each eye, with smaller appendages between and under its eyes. They gave the fish an appearance that was somewhat funny, childish and perhaps inappropriate for a night predator. Ambon scorpionfish have very long skin appendages over their eyes too, but this fish was definitely different.

Realisation kicking in

Almost immediately, I understood two things: First, I realised that I had not seen this scorpionfish before—neither underwater nor in the books; secondly, it was most likely I would never see it again. So I gave the guide a sign that I was staying here, and he could ascend. The fish was calm for five to six minutes so that I could spend time with it, trying to find the best camera angle and take a few pictures.

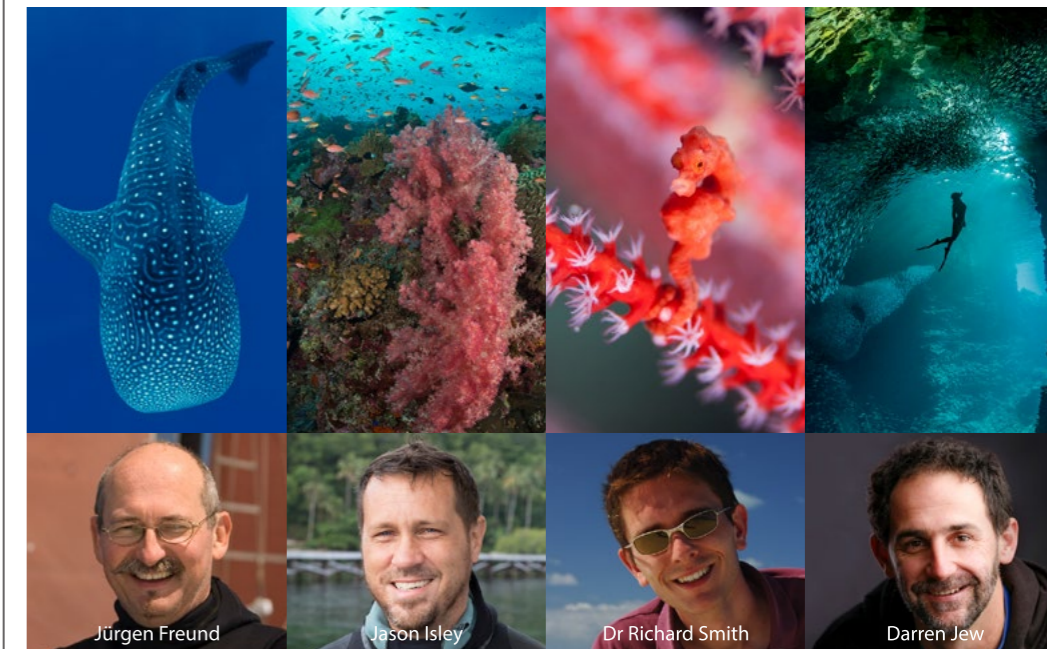


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Scorpaenids like this one are mostly ambush hunters. They can spend hours motionless, waiting for the chance that a fish will approach close enough for a lightning-fast attack. The scorpionfish creates a vacuum by quickly opening its jaws, sucking prey into its wide open mouth in 15 to 25 milliseconds.

Confirmation

Later, Hiroyuki Motomura—one of the world's leading scorpi-

onfish experts—confirmed that it was likely a new species of *Parascorpaena*, not yet known to science. There are currently only seven recognized species in this Indo-Pacific scorpionfish genus. Looks like our filamented beauty is one of the largest. It is a pity that the species is still undescribed.

On the other hand, to describe it, one must first catch a specimen. But it is so cute—with its long, funny eyebrows—it would be a shame to capture one. ■



Diver at propellor on wreck of SMS *Szent István*

Text and photos by Vic Verlinden

During WWI, the mighty warship from the Austrian-Hungarian navy was attacked at an unexpected moment. The brave crew of two Italian torpedo boats did not falter and the *Szent István* was struck twice with deadly force.

It was a quiet night on 9 June 1918 when the two sister ships SMS *Szent István* and Tegetthoff left the port of Pula (now Croatia) and set a course for Dubrovnik.

Both ships' crews did not have much fear of being attacked by the Italian navy as they were accompanied by a destroyer and six torpedo boats. The *Szent István* was still a new ship of 20,000 tons, and up until now, had only used her gigantic 12-inch (30cm) cannons during gunnery practice.

The ship was named after the first Catholic king, Saint Stephen (in Croatian: *Szent István*). The initial plan was for both ships to have a rendezvous with the other

units of the fleet and carry out an attack on the allied sea blockade near Brindisi. The captain and his officers were conducting a final preparatory meeting in the admiral's cabin on the rear deck. He

was issuing the final instructions while the watchkeepers were getting ready. It was a clear night and the lookouts had nothing to report; not one member of the more-than-thousand-strong crew

suspected all hell was about to break loose.

Bold and courageous attack

It was just barely nighttime when the Italian corvette's captain,

Luigi Rizzo, gave the command to return to base. The torpedo boats MAS15 and MAS21 of the Italian navy had experienced a rough night, without much action, and were in a hurry to enter port.

As it was a clear night, they suddenly noticed smoke plumes on the distant horizon. It could only be an enemy ship in these waters. Captain Rizzo gave orders to his captains Gori and Aonzo to

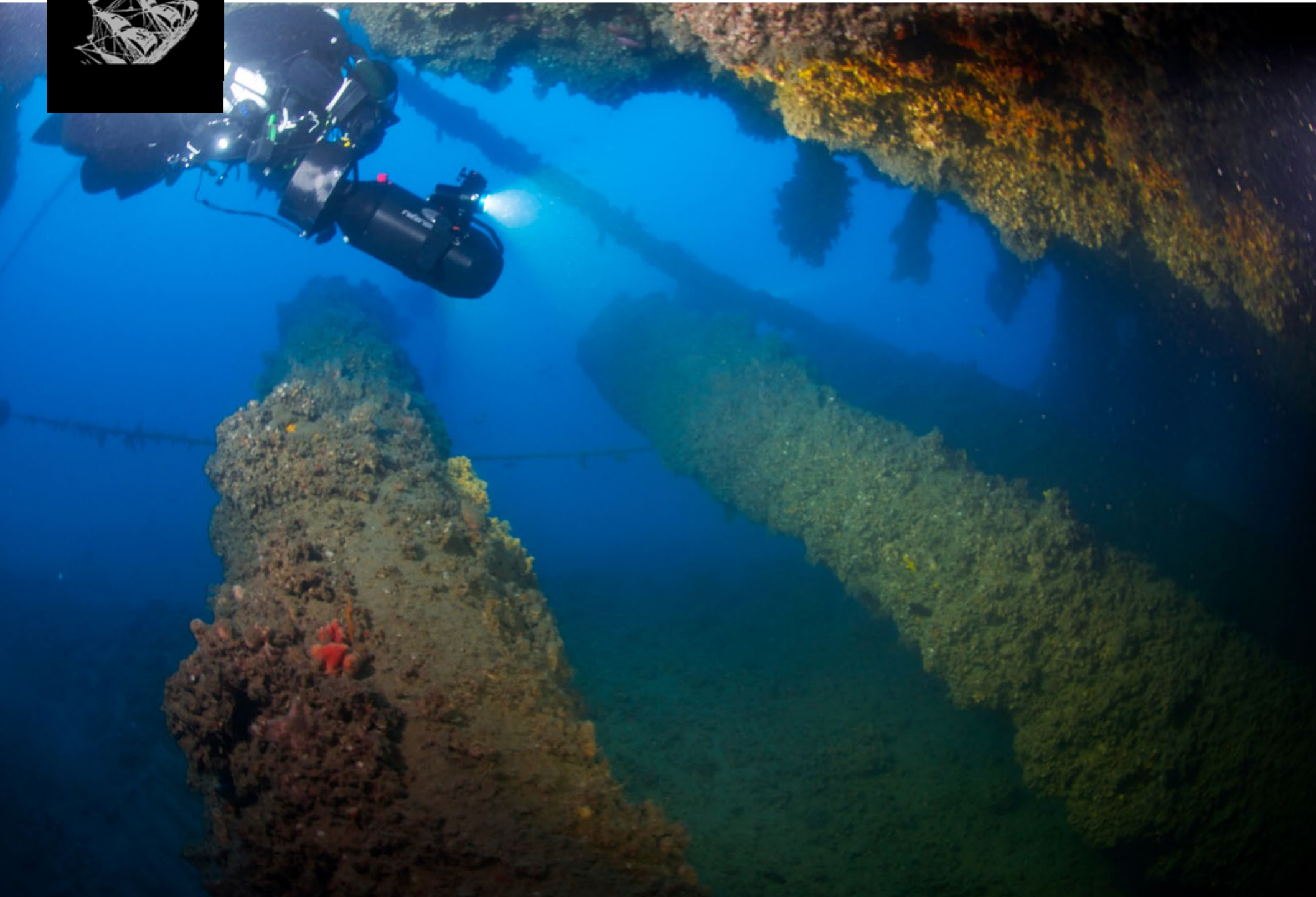


The Demise of **SMS Szent István**





Huge cannons on wreck of SMS *Szent István*



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Dive expedition to a protected war grave

The *Szent István* was discovered by the Yugoslavian navy in the 1970s and is now a protected wreck. You can only dive the wreck site with special permission.

It took my Croatian friend Drazen Goricki a long time to get all the needed permissions. In the end, they were provided by the ministry of culture and the underwater archaeology department.

Many years had passed since

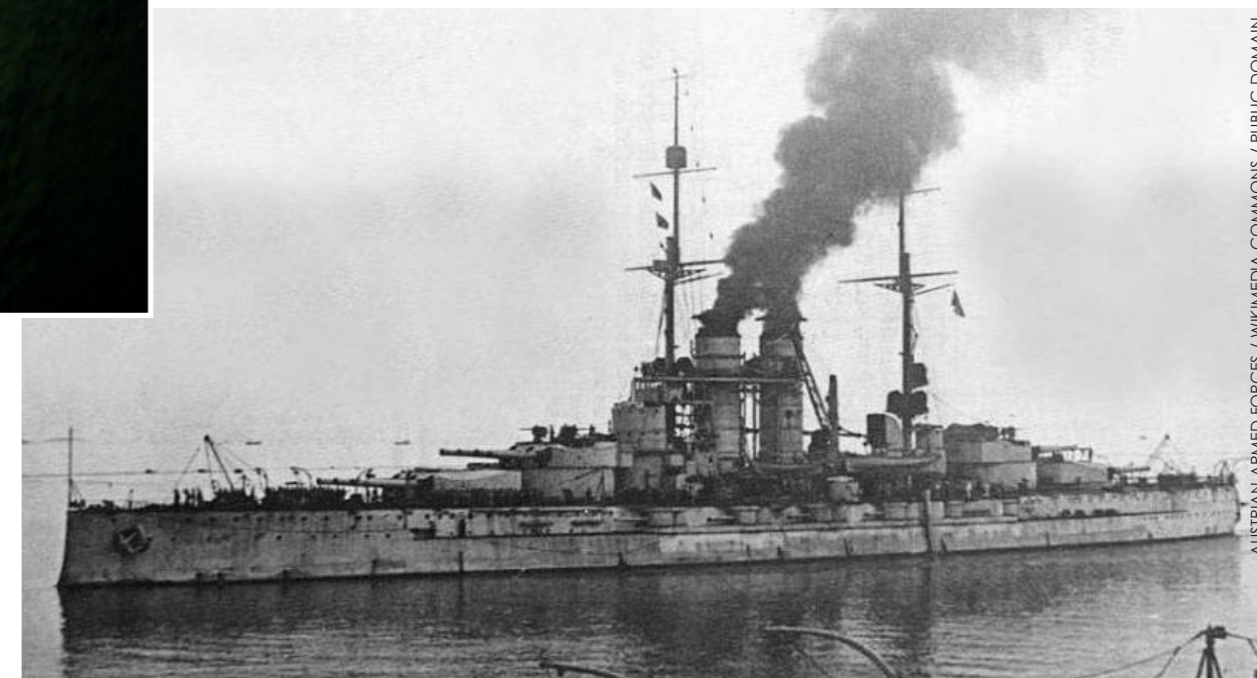
sail straight for the smoke plumes. Even though it was a long distance to sail, both torpedo boats succeeded in breaking through the cordon of escorting vessels and commenced the attack.

When they were in range of the two large battleships, Captain Rizzo decided to let the MAS21 initiate the attack against the

Tegettoff. The torpedoes fired by the MAS21 missed the battleship. At the same time, the MAS15 set a course towards the *Szent István* and fired two torpedoes at her. Both torpedoes hit her in the flank, by way of the boilers. The rear boiler rooms immediately started to flood, giving the ship a 10-degree list to starboard.

Immediately, the captain of the *Szent István* gave the order to turn the heavy guns to port, as a way to counter the listing. However, more and more water poured into the boiler rooms, resulting in a loss of both power and pumping capacity. At 6:05 in the morning, the *Szent István* capsized and sank close to the Island of

Premuda. The demise of the battleship was filmed by an officer of the Tegettoff and is the only film ever made during the First World War of the sinking of a warship. In this disaster, 89 crew members lost their lives.



Historical photo SMS *Szent István*

AUSTRIAN ARMED FORCES / WIKIMEDIA COMMONS / PUBLIC DOMAIN



Historical photo of the sinking of SMS *Szent István* during WWI (right), and rescue of crew members (lower right)



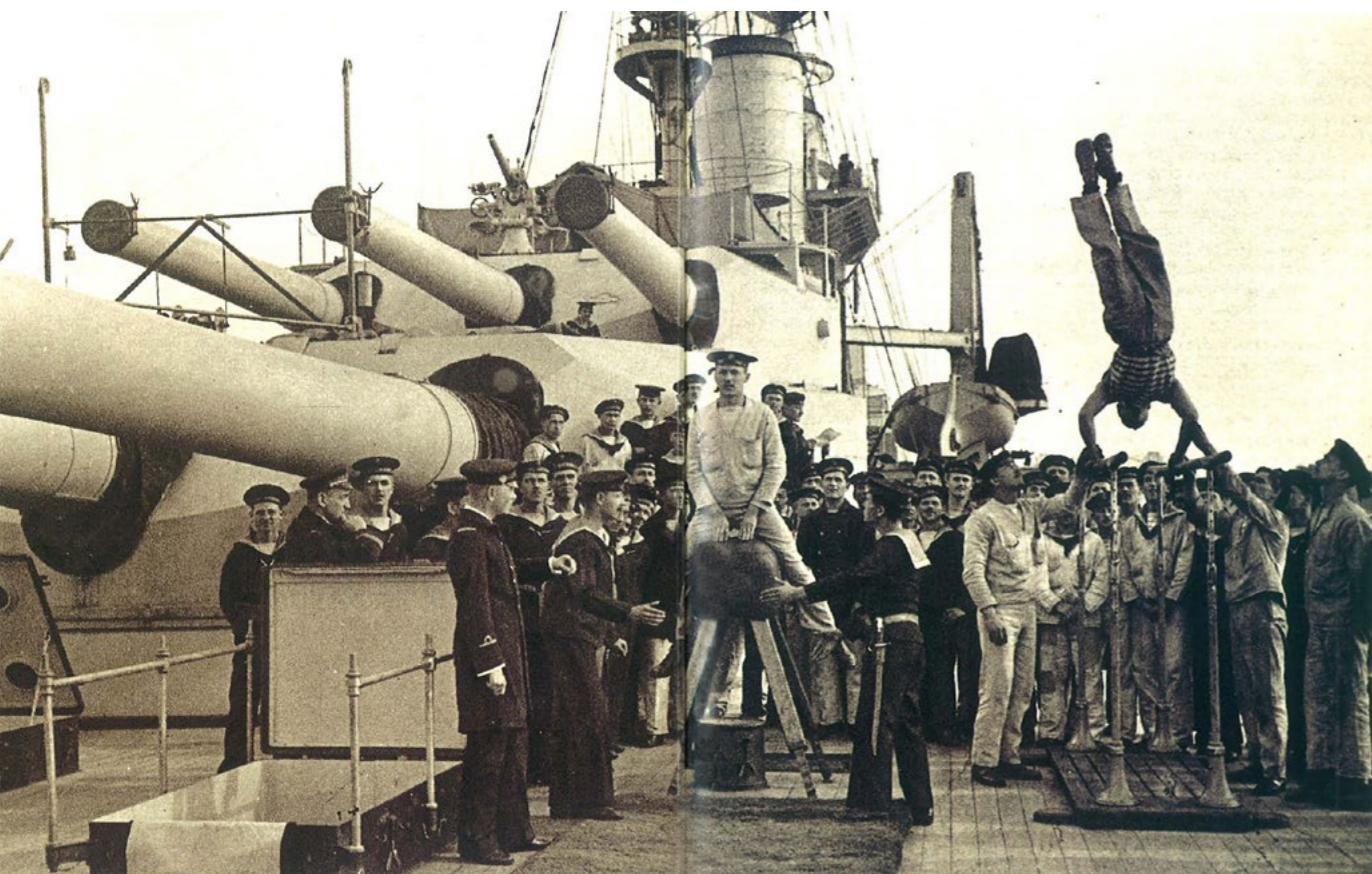
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the last time permission had been granted to a group to dive the wreck. Our team consisted of divers from five different countries, but divers from a special diving unit of the local police force and the Croatian navy would also be joining us.

Our home port during the expedition was the base of the special police diving unit in Mali Lošinj. We would be using their fast boat to go out to the wreck, which was 20 miles away from the base. At

this base, it was also possible to get trimix and prepare our rebreathers.

This expedition was assisted by underwater archaeologist Igor Miholjek of the Croatian Conservation Institute. He was responsible for the retrieval and conservation of artefacts of the wreck. Igor was also an experienced trimix diver. It was also an intent during expedition to take as many film and photo images as possible, in and around the wreckage.



Historical photo showing crew members doing gymnastics on SMS *Szent István*



First reconnaissance with obstacles

It is not often you get the opportunity to dive a wreck that has been closed off to diving activities. Therefore, I wanted to prepare myself and subjected my equip-

ment to a thorough check before leaving for Croatia. Even my camera was tested in every detail.

Preceding the first dive, the dive plan was discussed during the briefing and dive expedition members were divided into teams. My buddy was Phillipe Alfarei from Austria. Shortly before the dive, I tested my camera and noticed my flash was not working. I decided to take pic-

tures with my video light instead.

During the descent to the wreck, it became apparent the visibility was no more than six metres. The downline was connected to one of the two large propellers and just beside these lay the rudders which

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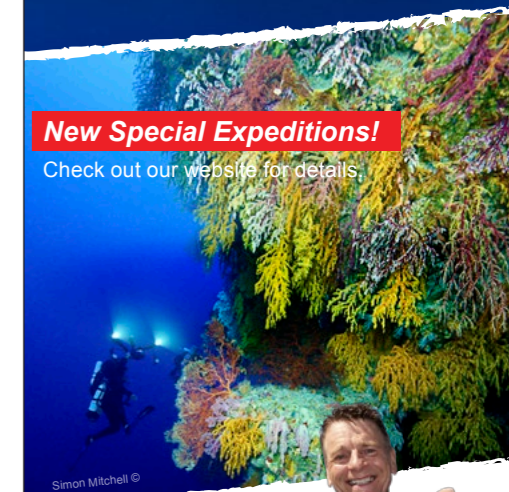
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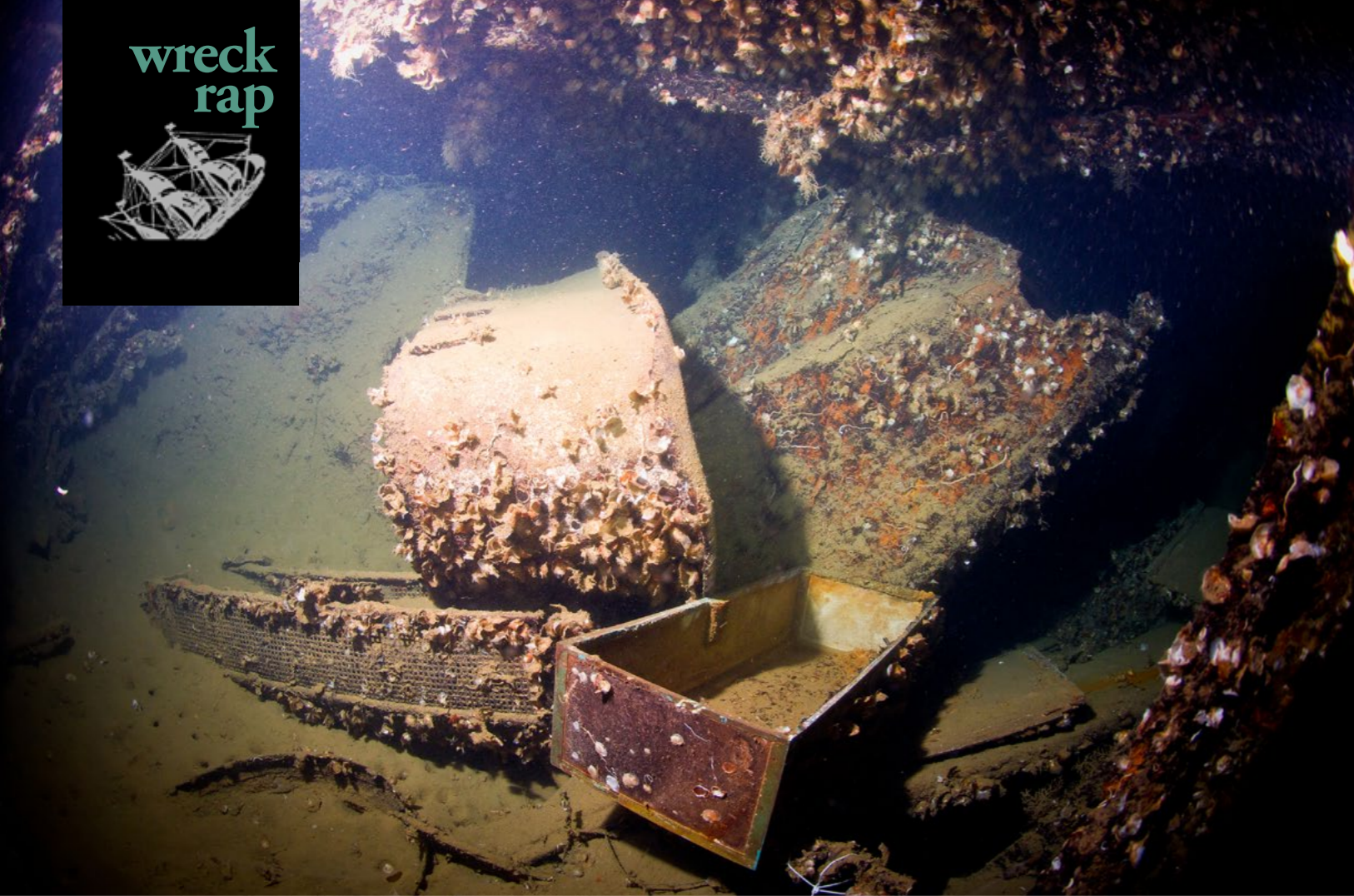
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Artefacts found in the admiral's quarters (above and bottom right); Shoe found on wreck of *Szent István* (top right)

were clearly visible.

After shooting some pictures, we descended farther towards the bottom and found an opening where we could swim underneath the wreck. The space where we were swimming was fairly large, and we found several leather shoes amongst the rubbish on the seafloor.

In the distance, some 15 metres ahead, we could recognise the large cannons, and there was an opening that led out of the wreck. The barrels of the 30cm guns were gigantic and gave a good sense of the scale of this enormous wreck. However, at a depth of 66m, time flies, so we had to swim back to the downline to start our ascent and a long decompression.

Admiral's bathroom

During the following dives, Drazen found a passage to the admiral's cabin. Here, several beautiful bronze lights with cut glass



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were retrieved for conservation, as was the telephone with which the orders were given to the bridge, found during one of the explorations deep into the wreck. It is obvious that, at 66 metres' depth, these explorations were not without danger—more so, as the wreck was inverted on the seabed.

Close to the admiral's cabin was also his bathroom, with a clearly

recognisable bathtub. There was also some silver cutlery and porcelain retrieved from the various cabins.

During one of my dives, I discovered one of the large searchlights mounted on the mast, now partially hidden in the sand. Closer to the bow was the ammunition room, which was also filmed and photographed.

During the whole expedition, the weather was exceptional, with not much wind. More than 70 dives were made, and in the following months, all the recovered artefacts would be conserved and catalogued. Once this is done, the artefacts will be exhibited in a museum. ■

Having dived over 400 wrecks, Vic Verlinden is an avid, pioneering

wreck diver, award-winning underwater photographer and dive guide from Belgium. His work has been published in dive magazines and technical diving publications in the United States, Russia, France, Germany, Belgium, United Kingdom and the Netherlands. He is the organiser of tekDive-Europe technical dive show. See: tekdiver-europe.com.



Bronze lamp found on wreck of *Szent István* (above); Searchlight on wreck of *Szent István* (top left)

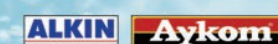
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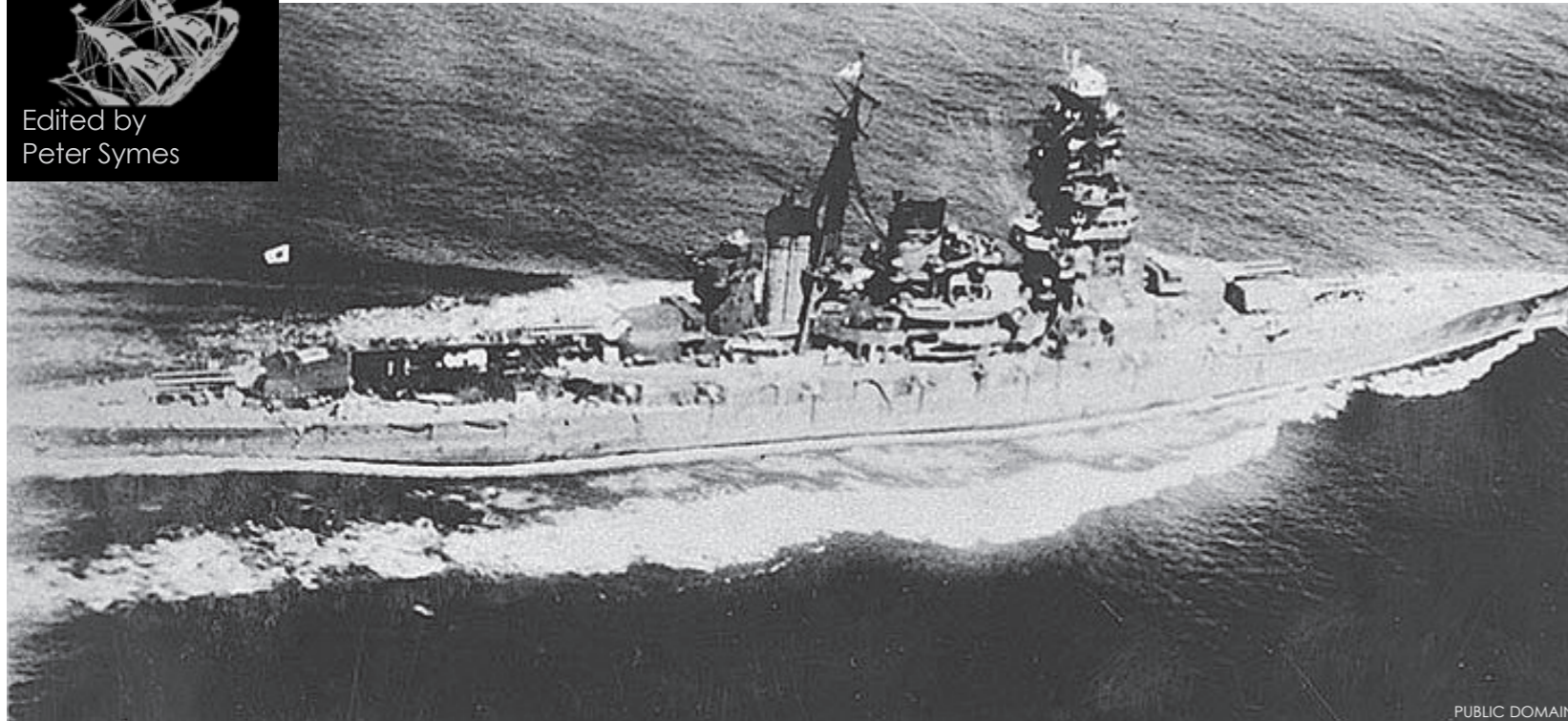
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PUBLIC DOMAIN

The *Hiei* was about 220m long and 30m wide. Its standard displacement was about 32,000 tons. It had 36cm naval guns and usually carried about 1,200 crew members.

WWII Japanese battleship possibly found in the Solomon Islands

In late November, a previously unknown wreck was discovered about seven miles north of Guadalcanal by an Tokyo-based nonprofit organization, which has been searching for the Imperial Japanese Navy battleship *Hiei*.

The *Hiei* was sunk off Guadalcanal Island, one of the fiercest battlefields of the Pacific War and was the first Japanese battleship to be lost in the conflict.

During the Battle of Midway, she sailed in the Invasion Force under Admiral Nobutake Kondo, before being redeployed to the Solomon Islands during the Battle of Guadalcanal. During the Third Battle of the Solomon Sea in November 1942, the *Hiei* was extensively damaged in an exchange of fire with US warships, including cruisers. The *Hiei* was under tow when it was subse-

quently attacked by US bombers and the order was given to abandon ship. Based on last known location of the battleship and tides in the area, it is estimated that the sinking point was in an area about 10km north of Guadalcanal.

490ft-long wreck

A Tokyo-based nonprofit organization, Asian-Pacific Remembrance Honouring Association, had been searching the seabed around the Solomons using sonar to identify anomalies, and in late November, a previously unknown wreck was

discovered about seven miles north of Guadalcanal. The wreckage is at a depth of more than 1,300ft and partly covered in sand and debris, the group said. Sonar images show a vessel approximately 490ft long, 130ft wide and standing 16ft proud of the seabed. Due to the shape, it appears that the ship had sunk with its bridge still upright, and one side of the vessel may be buried under earth and sand.

So many battleships were sunk in the area that it has become known as "Iron Bottom Sound." ■
SOURCE: THE JAPAN NEWS



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Edited by
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& Catherine GS Lim



BRANDI MUELLER

Dive operators such as Blue Force tells X-Ray Mag that its operations are running normally and are unaffected by the state of emergency.

Maldives unrest affects general tourism but dive operators report business as usual

Maldives' current state of emergency has led to a drop in tourism figures as prospective overseas visitors change their travel plans, affecting businesses in the island nation.

The current state of emergency in the Maldives has been extended by another 30 days, as this issue goes to press. It has been in place since 5 February, and alongside the civil unrest in the capital city of Malé, has severely affected its tourism sector.

Security forces are deployed in Malé in response to political

developments. If you are in Malé, you should exercise caution and avoid any protests or rallies. There are, however, no reports that outlying islands, resorts or Malé International Airport are affected.

The Liveaboard Association of Maldives recently issued a press statement expressing deep concern in how the island nation's

state of emergency has affected its tourism sector.

Tour operators and local guest houses have received booking cancellations in significant numbers, which has led to serious loss of income for several businesses. Even a charter flight direct from Europe due to begin operations in May was cancelled.

Travel advisories

In addition, several countries have issued travel advisories cautioning their citizens about travelling to the Maldives and advising travellers to avoid demonstrations and crowds. One of them is China, whose citizens accounted for 22 percent of Maldives' tourism numbers in 2017. While cautioning travellers about the situation

in the capital, the UK's Foreign Service stated that most visits to the Maldives are trouble free. The most common problems faced by visiting British nationals are lost and stolen passports, and swimming and diving-related accidents.

On AVAS Online, an owner of a hospitality business was quoted as saying, "Several bookings from China have been cancelled already, and an investment from a Chinese entrepreneurship has been cancelled as well. No one is willing to fly here because of the state of emergency. Who would want to risk it anyways?"

According to a travel agency owner, cancellations from China hit particularly harder than from those in other countries, as China

bookings usually comprise more than 30 travellers, compared to European bookings of mostly four travellers.

Dive ops run normally

Nevertheless, despite the extended state of emergency, the dive operators and liveaboards we spoke to say that all their operations are running normally and that none of their guests have been affected by the goings-on in the capital.

The same goes for the luxury hotels operating in the island nation, which are located far from the capital of Malé, where the unrest is taking place. All airports in the Maldives, both international and domestic, are operating as usual. ■





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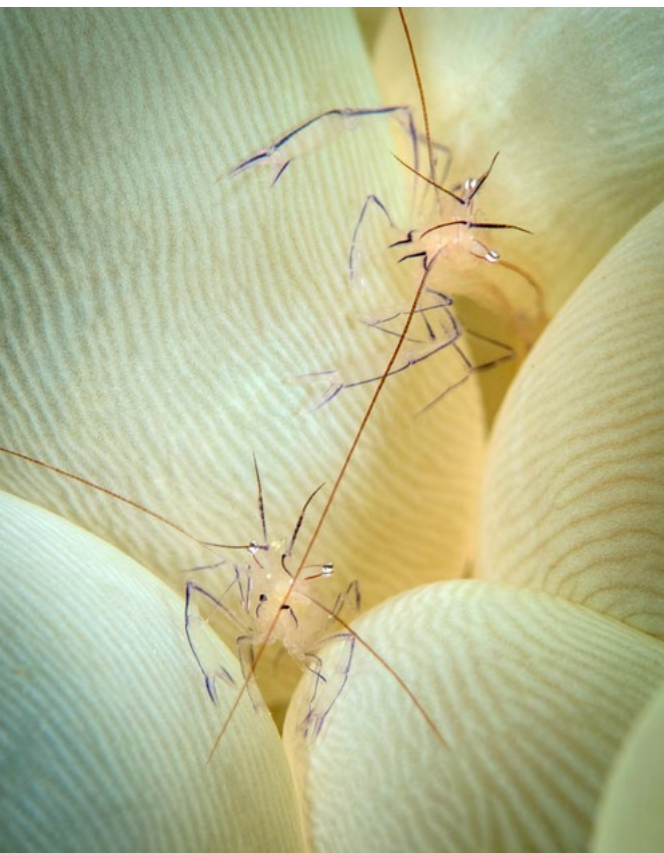
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Indonesia's
North Sulawesi

Text and photos by Brandi Mueller





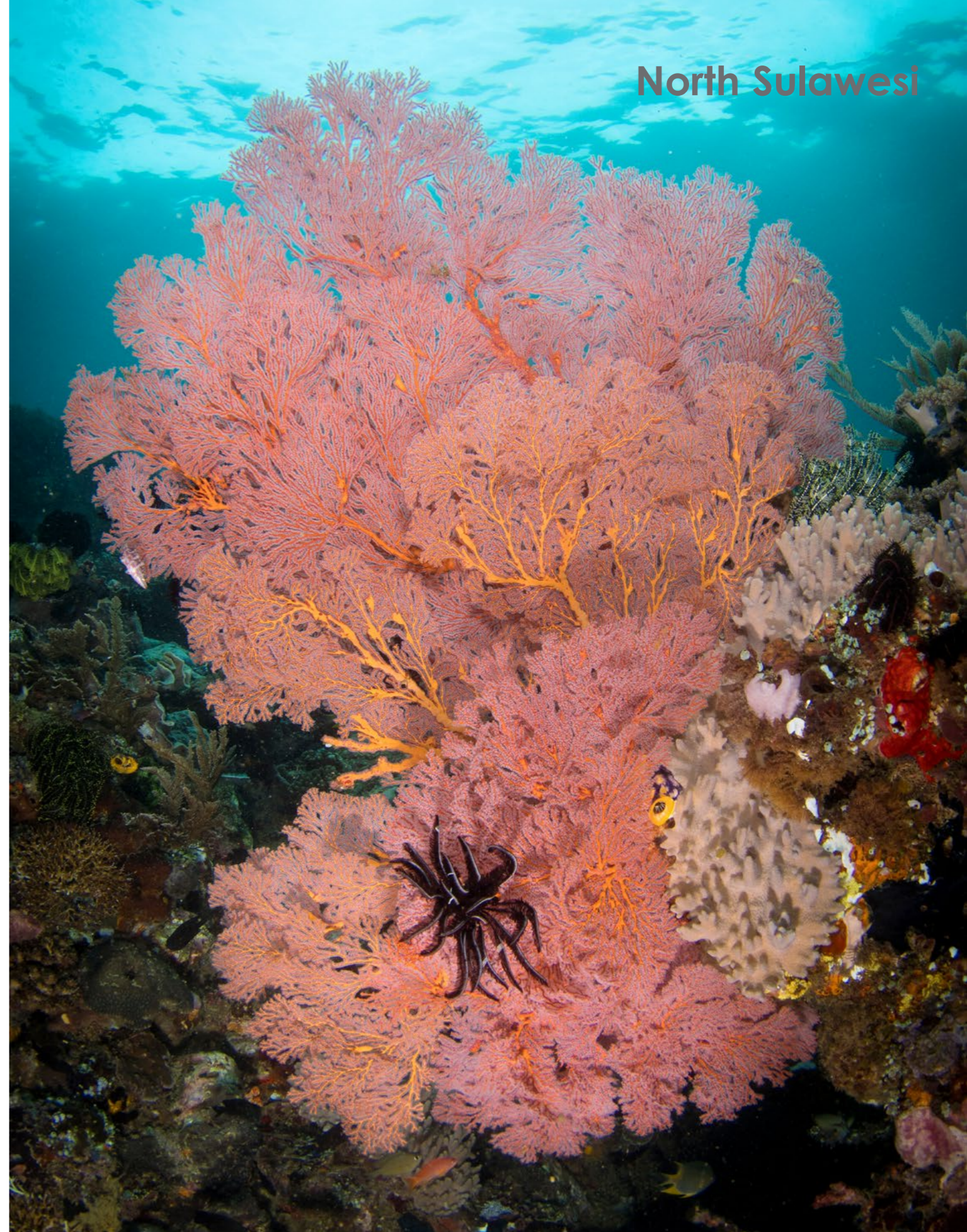
Bubble coral shrimp on bubble coral

The current felt like the wind on a breezy day, and it was blowing me past the coral-covered sheer wall that disappeared over 60m (200ft) below me. Looking directly down, I noticed the color blue fading into slightly darker shades and finally into darkness, at the edge of how far I could see.

To my right was a gorgeous wall of color. Pink and purple soft corals extended fully, reaching out into the current to feed on plankton passing by and numerous giant purple barrel sponges extending away from the wall. Looking to my left into the open water was more blue and thousands of fish. Butterflyfishes, including the largest congregation of pyramid butterflyfishes I have ever seen, fluttered about in the water column, seeming to move in sync with one another.

Turtles clearly dominated this space. I could not go more than a few minutes without seeing one sleeping in a crevasse or on a comfy-looking sponge. When I looked out into the mass of small fish off the wall, sea turtle silhouettes could be seen moving toward the surface for a breath of air.

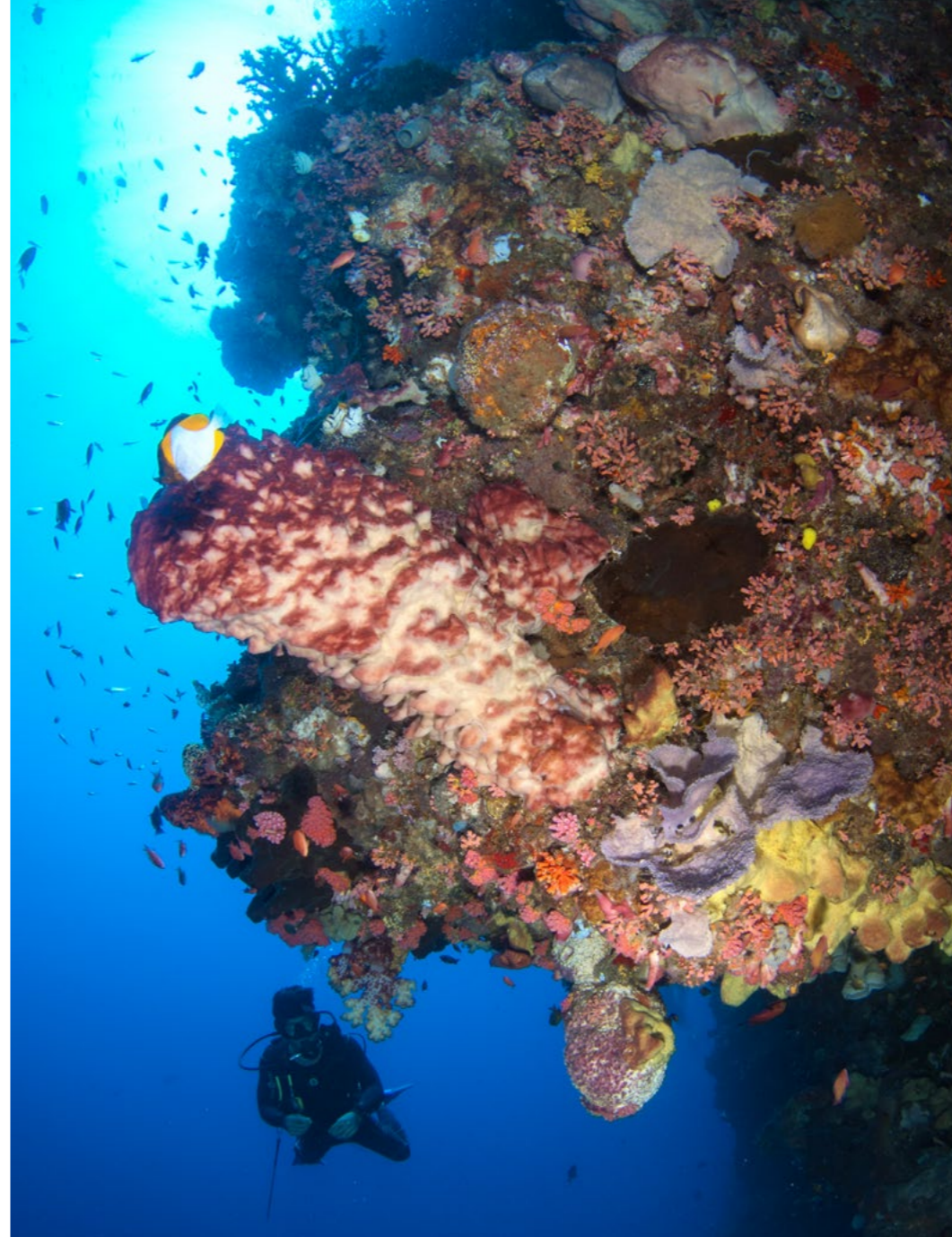
The current continued to carry me along the wall. Suddenly, the wall turned a corner inward, and as I drifted around the slight bend in the reef, the current all



Beautiful coral garden of brilliantly colored sea fans, feather stars, hard corals and sponges at Bunaken National Marine Park; Close-up of juvenile harlequin sweetlips (top left). PREVIOUS PAGE: Green sea turtle on reef



Black saddled toby (above); Diver on wall at Bunaken National Marine Park (right); Banded coral shrimp in barrel sponge (lower right)



Sea pen crab on sea pen

but stopped. Not moving and looking around, it felt like I was flying, and the desire to do a swan dive down into the abyss below me was tempting. It was one of those “wow” moments where I remembered I was so lucky to be here, underwater, surrounded by this beauty. As if on cue, a sea turtle emerged out of the blue, swimming right towards me, then over my head, and slowly settled on the reef for a nap.

Bunaken National Marine Park North Sulawesi is one of those exotic destinations on every diver's list. When someone asks me about the diving in the region, I find myself going on and on about the wonders of Lembeh Strait like a love-sick teenager pining for a high school crush. Lembeh Strait

is known for its extensive collection of weird and wonderful muck critters, from little known nudibranch species to frogfish galore. But I had never been diving on the western coast of Sulawesi and was in awe of what I found in Bunaken National Park.

An established marine park and reserve since 1991, Bunaken National Marine Park covers five islands and the water around them—over 75,000 hectares (346 square miles) in total. Like much of Indonesia, it falls within the Coral Triangle, which is compared to the rainforest of the ocean, containing the most biodiversity of marine life on Earth.

Species counts vary widely in the

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School of catfish with large sponge on reef (above); Tiny frogfish (top left) and juvenile orange frogfish (left) no larger than a pea

national park, but over 1,500 fish species, 70 coral species, as well as dolphins, pilot whales and even the rare dugong have been documented in the park. And there are likely more species to be recorded, given its location. The deep waters and ample ocean currents around the islands of Bunaken, Siladen,

Manado Tua, Mantehang and Nain play a role in the vast amount of marine life in the area as do the varying ecosystems, including sea-grass beds, mangroves and tropical waters.

For photographers, Bunaken offers everything one could want and more, but it does test one's

ability to answer the never-ending question of whether to shoot wide-angle or macro. The walls are covered in life, creating many picture-perfect wide-angle opportunities, with healthy corals and sponges, plenty of fish, and of course, sea turtles everywhere. But upon close inspection, the walls are teeming with tiny stuff, including leaf scorpionfish, anemones with anemonefish and clownfish, tiny frogfish, shrimp, crabs and many species of nudibranchs.

The muck diving

For those who cannot imagine diving North Sulawesi without go-

ing on a black sand treasure hunt for the marvels of muck diving, don't worry, there is plenty of that too. Along the coast of the actively volcanic North Sulawesi, black sand muck diving is abundant.

Our first muck dives were around Poopoh, and the underwater landscape was a slowly sloping sandy bottom with small patches of coral. I am always amazed by how fantastic the dive guides are in spotting tiny critters, and it was not long before my dive buddy and I had been shown to a freckled snake eel, several shrimps in bubble coral, and at least five species of nudibranchs.



Costasiella sp. nudibranch, also called Shaun the Sheep or sheep nudibranch

Hyselodoris sp. nudibranch





North Sulawesi



Freckled snake eel (above); Ornate ghost pipefish (top center); Soft coral cowry (top right); Peacock mantis shrimp (right)

Different colored anemones dotted the underwater landscape with several species of anemonefish and clownfish, as well as crabs and shrimp residents. Just before the end of one dive, our guide mimicked he was boxing underwater and then pointed into the coral to show us a brightly colored peacock mantis shrimp fully out of its burrow, walking along on the sand.

In the shallows were seagrass

beds, and we had heard about the potential to see elusive dugongs, so I tried to keep one eye on the sand, looking for tiny critters and my other out in the water column. No such luck on the dugong, but who knows, one could have gone right over my head while my attention was fully absorbed in trying to get a photo of a single skeleton shrimp on a hydroid.

Other muck dives revealed

many of my favorite muck critters, including seahorses, several species of ghost pipefish, large and small frogfish of many colors, and even a soft coral cowry the size of a lint ball, thanks again to the amazing eye of the dive guide.

Thalassa Resort

So, what is the best way to see both the stunning corals of Bunaken National Marine Park and

the muck diving of Sulawesi? Thalassa Resort is a great place to use as a base to see it all. Located on the main island and only about a 30-minute drive from the



Flabina sp. nudibranchs (above) Skeleton shrimp (left)



Bungalows (above) and dive boat (left and below) at Thalassa Dive Resort; Local fishers, with town of Manado in background (top left); Interior of bungalow room at Thalassa (far lower left)

airport in Manado, this charming resort is set among stunning landscape, with a very cozy feel about it.

The landscaping and greenery around the resort are lovely. From the moment you enter the property, you notice the extensive amount of plant species, including plenty of brightly colored ex-

otic flowers, and unique trees such as the starfruit tree that was right outside my bungalow. The path that takes you from the restaurant and dive center to the bungalows is so dense in flora that part of the path is a tunnel of vegetation. It was fun to walk through, especially at night when soft lights lit up the pathway, casting a lovely

glow on the trees.

The bungalows are built on a hill at different levels, all having gorgeous views, some with partial ocean views, that made you feel like you were in the Indonesian jungle. Each morning, I was awakened to the songs of many birds, and each night crickets filled up the airwaves.

Definitely splurge on the sea view bungalows or cottages, all recently renovated, with spacious living areas, good air conditioning and fully stocked refrigerators so that you can enjoy a local Bintang from your private terrace while watching the sunset turn the sky orange and red. Some rooms have a bit of a blue ocean view, others overlook the beautifully

gardened grounds (go hilltop for more ocean views, although it is a workout

kids and plenty of lounge chairs for sunbathing.

The dining area is large and airy, providing a great place to enjoy conversation with other divers. There is coffee and tea available all day, a bar, and (my favorite) an ice-cream cooler with plenty

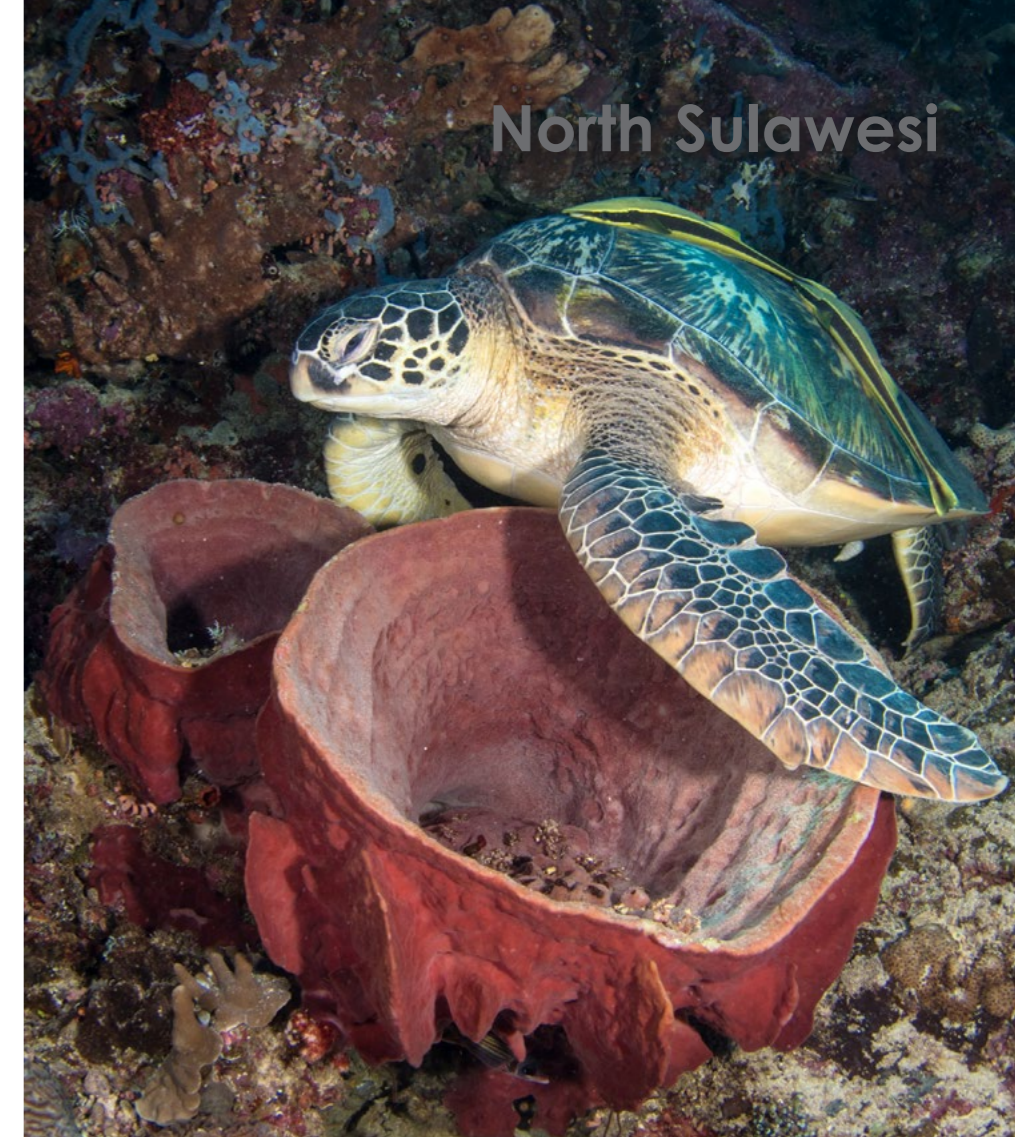
of ice-cream bar options for late-night or after-dive cravings. One night was pizza night, made to order in a wood-fired brick oven and enjoyed out on the terrace surrounding the pool and overlooking the water.

to climb all the stairs.)

The ambience of the resort exudes relaxation. There is no hustle and bustle, and stress levels of everyday life seem to melt upon arrival. On several nights, there was live music during dinner and into the evening. For those wishing to de-stress with a massage, there is a peaceful spa with windows overlooking the mangroves and water. Not to mention, you can take a nice detox from the internet (which we all probably need more than we realize), but if you cannot go without it, it is available in the restaurant for free.

Further relaxing can be done at the large pool (a favorite place to watch the sunset). There is also a small shallow pool next to it for the





CLOCKWISE FROM TOP LEFT: Wall dive at Bunaken National Marine Park; Porcelain crab on anemone; Tiger blenny on golden sea squirt; Green sea turtle on barrel sponges; Moray eel; Napoleon snake eel (left)



those really wanting to get the most out of their trip to North Sulawesi, Thalassa makes it easy to dive all of the famous

Diving

Thalassa Resort is a PADI 5-star resort and instructor development dive center. The staff can teach everything from a Discover Scuba dive to Instructor Development classes. In fact, the resort is one of the main places that local Indonesians go to become dive instructors, and then they go on to work at the resort or at others throughout Indonesia. The owner, Simone Gerritsen, is a PADI Course Director, and the dive center has been teaching instructors since 1996.

Diving from Thalassa could not be easier. They had flexible dive days, allowing divers to pick and choose from an 8am, 10am and 2pm dive (or all of the above) each day. Night and mandarinfish dives were available on request, and divers could enjoy unlimited dives on the house reef. The dive shop had a nice camera room with many electric outlets for charging, and was secured overnight.

Dive boats were spacious, and the crew took care of setting up and taking down gear, so all we divers had to do

was show up with our cameras, ready to go. Plenty of towels were available on the boat (as well as by the pool), and after the dive, there was hot tea and fruit.

Beyond the resort

The diving around Bunaken Island is only a 20-minute boat ride from the resort and exceptional muck diving can be found on the mainland very close to the resort, both of which could keep any diver satisfied for many dives. But for



Sea cucumber crab on sea cucumber





North Sulawesi



CLOCKWISE FROM LEFT. Sunburst anthia; Giant frogfish on sponge; False clownfish; Anemonefish on anemone; *Caloria indica* nudibranch; Robust ghost pipefish (above)

hours, and it was a beautiful, sunny day. The longer boat ride was enjoyable as it was neat to cruise the coastline of North Sulawesi and see the many small islands around it.

Bangka Archipelago

Sahaung Point. At Bangka, our first dive was at a site called Sahaung Point, which had many large boulders covered in soft corals. Visibility was a bit murky, but one could see on a clear day that this site would be amazingly colorful with sea fans, sponges and plenty of fish. On our second dive, we found three giant frog-

fish, one of which was yellow and swimming from sponge to sponge.

Yellow Coco. Our last dive of the day was off the mainland (but close to Bangka) at a site called Yellow Coco. It is a place where volcanic activity can be seen underwater. Sulawesi has active volcanoes and our dive guide took us to an area around 20m (65ft) where hot water was coming up from below (which felt wonderful). The hot water venting into the cold made looking through the water blurry. Not much life was around the vent, but it was very neat to experience, and

the sand around the water vent was also hot to the touch.

Whether diving close to the resort or at more far-off dive sites, the crew went out of their way to make sure guests got to dive where they wanted. On more distant dive trips, lunch was provided on board, and when the boat stayed closer to home, they would return to the resort so we could have lunch, take a quick nap and then, if desired, go back out for the third dive. Diving with Thalassa Resort made it so

easy to make the most out of a dive trip, while also relaxing and fully enjoying a dive vacation.

Tangkoko National Park

A 90-minute drive east from Thalassa takes you to Tangkoko National Park, a reserve that has been a conservation area since 1919. Famous for the possibil-





Between dives, one can enjoy an excursion to Tunan Waterfall near Manado.



Pair of cuscus (above) and a macaque (right) in Tangkoko National Park



ity of seeing tarsiers, the world's smallest primate, visitors also commonly see black crested macaques and bear cuscus. The park has documented 127 mammal species, 233 birds, and 104 reptile and amphibians, many of which are endemic to the island.

We set out to visit the park on our last full day (we could not dive because of morning flights), which made it fit perfectly into our schedule. Once at the park, a local guide and park ranger led us on our hike in hopes of viewing the big three: macaque, cuscus and tarsier. After just minutes on the path, we spotted wild pigs and our guide stopped, alerting us to the different bird calls and identifying what species they were.

I had visited the park several years ago and remembered getting to see all three with very little effort. I had not realized how lucky I was at the time, until this visit; we had been hiking for over two hours through mud, spider webs and

battling biting ants before even getting a glimpse of a monkey.

Macaques. Then, suddenly, we were surrounded by macaques. A mother carrying its baby on her back crossed the path just in front of us, and we spotted a young monkey jumping from tree to tree over our heads. The largest male (likely the alpha) sat in the middle and just looked at us while munching on some leaves. Our discomfort over the long hike was forgotten the instant we saw the monkeys and our cameras were out, snapping away.

Cuscus. After a little while, we left the macaques in peace and continued to hike. Next up in our search was the cuscus. Cuscus (sometimes spelled "kuskus" or called Sulawesi bears) are not ac-

tually bears, but arboreal marsupials endemic to Sulawesi and a few nearby islands. They have long, curled claws and prehensile tails that allow them to climb considerable heights to the tops of the trees where they live and eat leaves and flowers.



NEW RESORT: THALASSA IS NOW ON BOTH SIDES OF NORTH SULAWESI

While Thalassa Manado is located on the west coast of the northern peninsula of "Sulut," the operation's newest resort, Thalassa Lembeh, is located on Lembeh Island off the east coast of the peninsula. At Thalassa Lembeh, divers can enjoy muck diving at its best.



A multi-resort stay at Thalassa is now possible in which you can dive Bunaken National Marine Park and Bangka Archipelago at Thalassa Manado as well as the incredible, rich muck diving in Lembeh Strait at Thalassa Lembeh. The new resort on a peaceful cove with beautiful views of Lembeh Strait has nine comfortable bungalows, each with its own private terrace overlooking the sea. There is a swimming pool for both dive courses and relaxation. Cappuccinos can be enjoyed at the Sabar Lounge and Santai Restaurant, led by Chef Arifin, offers delicious meals in the Minahas tradition. Between dives, guests can enjoy a traditional massage or go on one of the excursions offered by the resort. You can explore the lush, green island of Lembeh on guided hiking trips or get a glimpse of island life with a visit to the local village. Learn more at: Thalassamanado.com/lembeh



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

SOURCES:
INDONESIA-TOURISM.COM
SCIENCEFOCUS.COM

SULAWESI-INFO.COM
THALASSAMANADO.COM
WIKITRAVEL.ORG

CLOCKWISE FROM LEFT: Lavendar kingfisher, macaque, tarsier and flying lizard in Tangkoko National Park

Our guide stopped us, his gaze directed to the tops of the trees. "Do you see that black dot in the tree?" We looked, and looked some more. I took

monkeys seem to be so ugly that they are cute. Tarsiers are nocturnal, so we had to wait until just before sunset before we might get a glimpse.

Our guide led us to the tree in which the tarsiers are usually found, and we waited. And waited. The sun had set and the sky had turned a blood orange, giving us a warning that it would be dark soon. We had to start hiking out so we would not be walking too long in the dark.

Two out of three isn't so bad, I was thinking, as we tried not to trip over tree roots or hit our heads on low branches in the dark. Then, off in the distance, we saw a light signaling us. (It was like we were on a night dive and someone was flashing their light to us to say they had found something good.) Another guide and his group had found a single tarsier on a tree while they were hiking out. We stopped for a few minutes for a glimpse

of these amazingly strange animals that are genetically our not-so-distant cousins. It was no larger than a person's hand and seemed to be all eyes and ears.

With the biting ants returning and mosquitoes swarming, we were satisfied with the brief encounter and continued our way out of the jungle, feeling quite lucky to have seen all three amazing animals of which we had hoped to catch a glimpse.

Thalassa Resort can arrange day tours to Tangkoko among other local highlights like village tours, volcano hikes, waterfalls, cooking classes and more—once again, making it an ideal place from which to explore North Sulawesi. The next day was time to depart, and after heartfelt goodbyes from the staff, it was just as their motto said, "Where guests leave as friends." ■



out my telephoto lens and aimed for the spot he described. Snapping a photo and then zooming in on the photo, there it was, an adorable cuscus looking down at us.

Tarsier. Last up was the tarsier. Said to have inspired the design of the gremlins and some even say was the inspiration for Yoda in Star Wars, these large-eyed, large-eared, large-fingered, but tiny

fact file

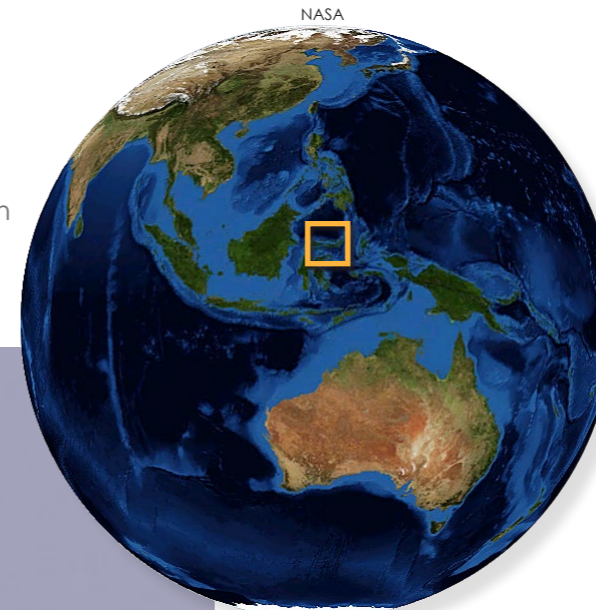


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North Sulawesi, Indonesia



Location of North Sulawesi on global map (right), and on map of Indonesia (below)



History Archeological research in caves in North Sulawesi has found evidence of human habitation dating as far back as 30,000 years ago. In the latter part of the 16th century, this land of gold, spices and rice drew the Portuguese, the Spanish and the Dutch to North Sulawesi, leading to political and military conflicts. It was also an east-west trade route, which saw the spread of Christianity, Islam and religions brought to its shores by Chinese merchants. In the 17th century, the area fell under Dutch control, whose rule spanned three centuries until WWII, when the Japanese forced out the Dutch. In 1945, the Japanese surrendered and the Dutch regained possession of the area briefly until they recognized the newly created United States of Indonesia in 1949. North Sulawesi became a territory of the State of East Indonesia, which was later dissolved and merged into the Republic of Indonesia (RIS). In 1950, the RIS was reformed into the Unitary State of the Republic of Indonesia, in which the island of Sulawesi was governed by one province. In 1959, this province was divided into several, one of which became North Sulawesi. Government: presidential republic. Capital: Jakarta

Geography Located in Southeastern Asia, Indonesia is an archipelago situated between the Indian and Pacific Oceans. It is made up of about 13,500 islands, 6,000 of which are inhabited and sit on either side of the equator. Indonesia is made up of about 13500 islands, 6000 of which are inhabited and sit on either side of the equator. Bunaken National Marine Park was established in 1991 as one of Indonesia's first marine parks. Five islands sit within the park including Bunaken, Siladen, Manado Tue, Mantehage, and Nain. Three percent of the park is land and the other 97 percent is water. Bunaken National Park is 896 sq km and has extremely deep waters and oceanic currents. Mangrove, seagrass beds, coral reef, deep water, and coastal ecosystems exist within the park. North Sulawesi is considered to be a young island (5-24 million years old) and is still actively volcanic. Coastline: 54,716km. Terrain consists primarily of coastal lowlands, with interior mountains on larger islands.

Climate North Sulawesi climate is affected by monsoon winds. November-April tend to be windy and rainy, and May-October tends to be drier. Water temperatures vary from 26-29°C (78-84°F) with January-March being the coolest. Air temperatures average 28°C (82°F) year-round. Diving occurs year round but the drier and less windy season is May-October.

Environmental issues Over half of Indonesia falls within the Coral Triangle. Rainforests cover over 57% of the land and 20% of the world's coral reefs are in Indonesian waters. Studies have shown there are over 3,000 species of fish, over 600 species of corals in the area and reef surveys have shown the Raja Ampat Islands to have the most bio diverse on Earth and the northern tip of Sulawesi having more than

70 percent of all known species to be found in the Indo-Western Pacific.

Economy A vast polyglot nation, Indonesia has experienced modest economic growth in recent years. Economic advances were made with significant financial reforms. In 2009, when the global financial crisis hit, Indonesia fared well compared to its regional neighbors. It was one of the only G20 members posting growth in 2009, alongside China and India. However, the government still faces ongoing challenges of improving the country's insufficient infrastructure, labor unrest over wages, and high oil prices affecting fuel subsidy programs.

Currency Indonesian rupiah (IDR). US dollars and Euros are often accepted in resorts and onboard liveaboards. MasterCard

and Visa are widely accepted in cities and tourist areas. Major airports and cities have ample ATMs but they can be scare (and possibly not working) on the smaller islands. Currency exchange rates will be better in large cities. Thalassa accepts credit cards, Rupia, US dollar,

and Euros. Currency exchange rates will be better in large cities. Exchange rates: 1USD=13,539 IDR; 1EUR =16,895 IDR; 1GBP=19,051 IDR; 1AUD=10,697 IDR; 1SGD=10,319 IDR

Population 260,580,739 (July 2017 est.). The island of Bali is 4.2 million as of 2014. Ethnic groups: Javanese 40.1%, Sundanese 15.5%, Malay 3.7%, Batak 3.6%, Madurese 3%, Betawi 2.9%, Minangkabau 2.7%, Buginese 2.7%, Bantenese 2%, Banjarese 1.7%, Balinese 1.7%, Acehnese 1.4%, Dayak 1.4%, Sasak 1.3%, Chinese 1.2% (2010 est.) Religions: Muslim 87.2%, Protestant 7%, Roman Catholic 2.9%, Hindu 1.7%, (2010 est.). Note: Indonesia is the largest Muslim country in the world. Visitors are encouraged to respect local tradition and dress modestly. Internet users: 65,525,226 (2016 est.)

Language Bahasa Indonesian is the official language with over 700 regional languages on different islands. English is often spoken in tourist areas including resorts and liveaboards. German, Spanish, and Russian are also common in the tourist areas. Thalassa Resort's staff is fluent in English, Dutch, and German.

Health Mosquito-borne illnesses are a problem and there are cases of malaria, dengue, Zika, and other. Avoid mosquito bites by using mosquito repellent and covering up during times when mosquitos are out. Water and food-borne illness can also be a problem so be sure to drink only bottled or filtered water and that food is cooked thoroughly.

Decompression chamber There is a hyperbaric chamber in Manado.

Travel/Visa Indonesia's visas requirements are ever changing so check with your countries State Department before traveling. Currently there is no visa required for tourists for up to 30 days. Passport must be valid for six months beyond expected stay.

Security Indonesia has had recent incidences of terrorism and travelers should be aware of their surroundings, avoid public demonstrations, and be cautious or avoid traveling at night. Petty crime is a problem especially in cities and credit card and ATM fraud are on the rise. Use only reputable and marked taxis preferably arranged by hotels or shopping centers.

Web sites Indonesia Tourism www.indonesia.travel



Scotland

Text and photos by Lawson Wood

— *Muck Diving at Home*



Snake pipefish, *Entelurus aequoroides*, Scotland (left); Pipefish, Sulawesi, Indonesia (below); Burrowing sea cucumber, *Neopendactyla mixta*, Scotland (far left); Burrowing sea cucumber, *Cucumina sp.*, Lembeh Strait, North Sulawesi, Indonesia (lower left)

PREVIOUS PAGE: Squat lobster, Scotland

Do we really need to go underwater at the other end of the world (and its challenges)? Lawson Wood poses this question while comparing the muck diving found in his home country of Scotland to that found in exotic locations in Asia and other regions of the world, renowned for their muck diving sites.

"Muck diving" is now a recognised, broad term for (generally) close-up and macro or micro photography, often in terrible visibility, resulting in low light



and backscatter problems in photographs; and some disorientation with depth, resulting in finding deep-water critters in much shallower water due to the cut in natural light.

As the name implies, you are searching in a "mucky" or "murky" environment, moving slowly with additional lights to try and spot all of the weird and wonderful creatures that we tend to miss in the search for larger, weird and wonderful creatures. Do not let the term "muck diving" fool you; it is one of the best and most rewarding diving and underwater photography trips that you can do to obtain quite unique photographs in probably the most unhurried dive profile style you will ever have. This form of scuba diving and underwater photography encompasses all of your skills, particularly buoyancy, as you will be working close to the seabed, if not on it. By its very nature, the muck does get everywhere, and special care must be taken

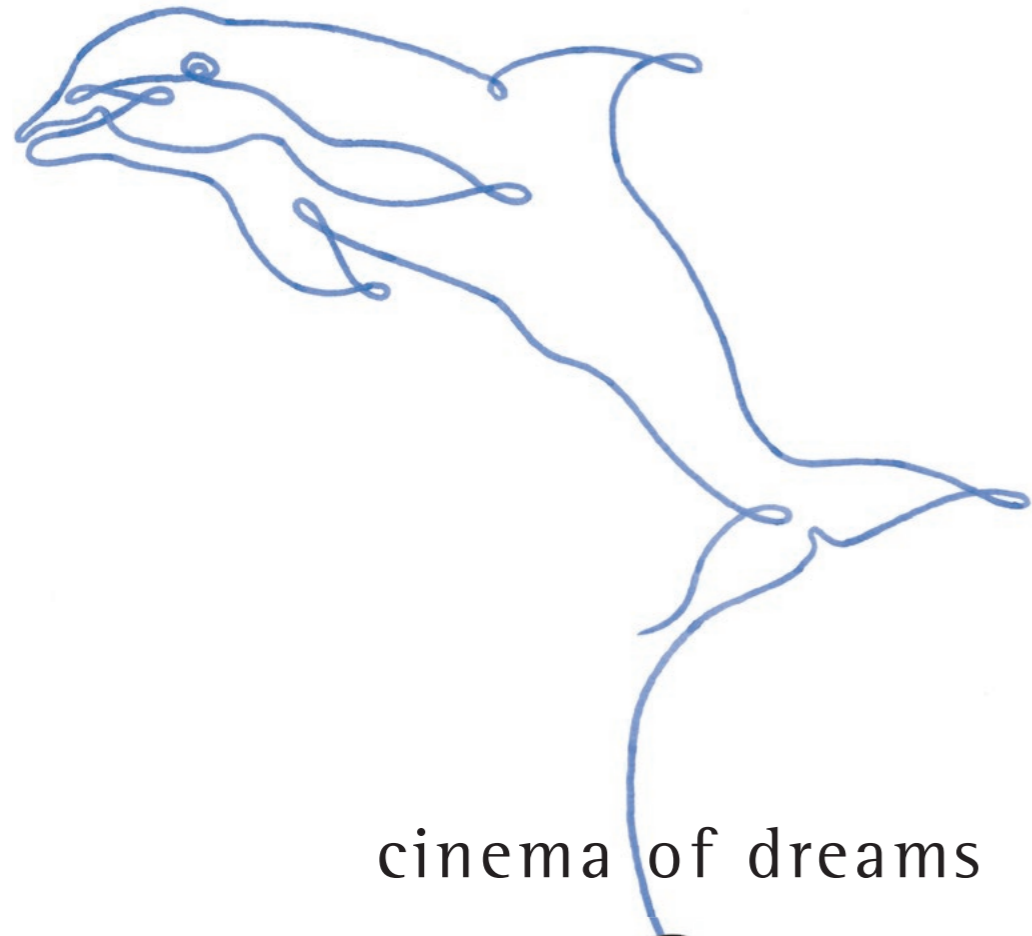
with cleaning all of your equipment after every dive.

Diving protocol

Consideration must also be taken with all of the critters that inhabit this environment, particularly if you are settling on the seabed. Always make sure that the area beneath you is clear and critter-less. Always remember that your diving buddy may be following in your fin strokes, so you may actually make the visibility worse and spoil the experience for your buddy for your own selfish gain. Also check which way the current is flowing, as you may actually spoil your own photographs. So, try and orient yourself facing into the current.

It is only in the last ten years or so that the term was first coined in the Lembeh Strait of Indonesia, and more specifically with the original staff of Kungkungan Bay Resort who discovered a wealth of hith-

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Scotland



Flame shell, *Limaria hians*, Scotland (above); Neon file clam, Lembeh Strait, North Sulawesi, Indonesia (left)

erto rarely seen or unheard-of species in staggering numbers, hidden in the garbage-strewn seabed near a major seaport in northern Sulawesi, Indonesia. Deciding to do an “eco” clean-up of the seabed, the developers discovered that the trash that they wanted to remove was already inhabited by all manner of weird and wonderful beasts.

However, many of us had already experienced forms of muck diving in places such as underneath the Town Pier and Salt Pier in Bonaire, Frederiksted Pier in St. Croix, Dodd Narrows off Vancouver Island, Tulamben Beach in north-

ern Bali, Blue Heron Bridge in Florida, Papua New Guinea, and especially Loch Fyne in Scotland. Now, new and exciting areas such as Tasmania, Raja Ampat in Irian Jaya, Mabul Island in Malaysia, and many other exotic locations in the South China Sea have become popular.

Many would argue that muck diving was actually invented in Scotland, and now, as we have discovered and fully appreciate, muck diving need not be confined to tropical waters. I personally enjoy exploring the muddy depths of Loch Long, Loch Fyne and Oban in Scotland where I





Scotland

TOP TO BOTTOM: Long-clawed squat lobster, *Munida rugosa*, in Scotland; Squat lobster in Bali, Indonesia; Hermit crab, *Dardanus pedunculatus*, in Gangga Island, North Sulawesi, Indonesia; Cloak anemone, *Adamsia carciniopados*, on hermit crab in Scotland

am able to find weird and exoticly coloured dragonets, gobies, shrimps, starfish, sea cucumbers, molluscs and anemones (one of which I found to be the first ever record of the beast in British inshore waters).

Now, with many years of diving and underwater photography in all of the world's oceans and over 50



books published on the topic, it is very apparent that there are massive similarities in marine species in all of our seas. So much so, in fact, that the parallels in critters being found at almost opposite ends of the globe give us an insight into

the marvellous spread of marine life from the ancient Gondwanaland millions of years ago, to the land masses and far-reaching oceans that we have now.

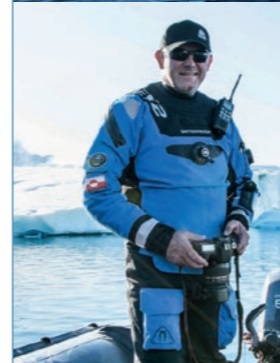


Undoubtedly, the area of this original golden triangle is the centre of Indonesia—now referred

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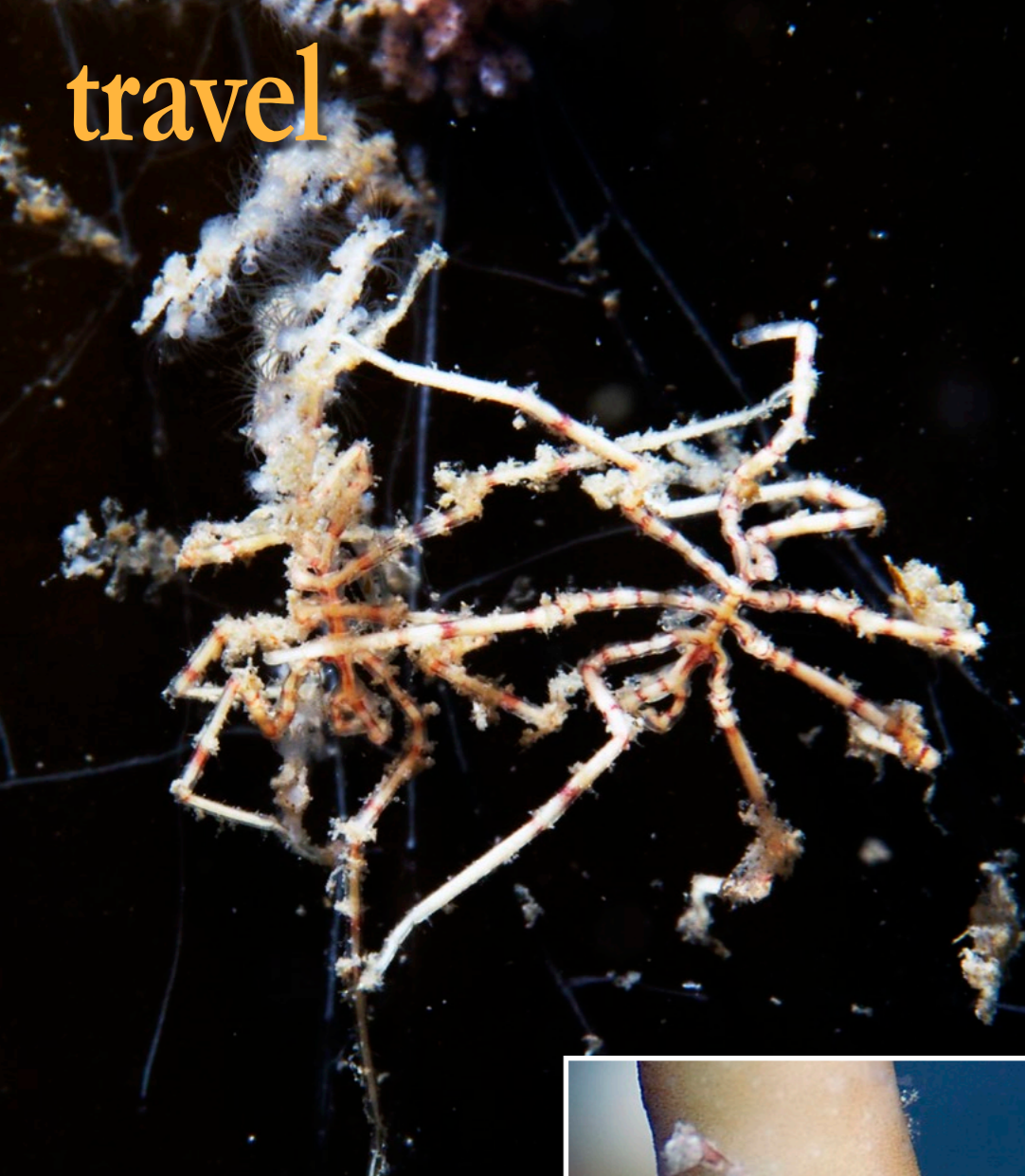
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- Goran Ehlme Underwater photographer and head of Waterproof R&D

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Sea spider at St. Abbs in Scotland (left); Sea spider in the Red Sea (bottom left); Queen scallop, *Aequipecten opercularis*, in Scotland (lower right); Rock scallop at Sipadan in Malaysia (bottom right)

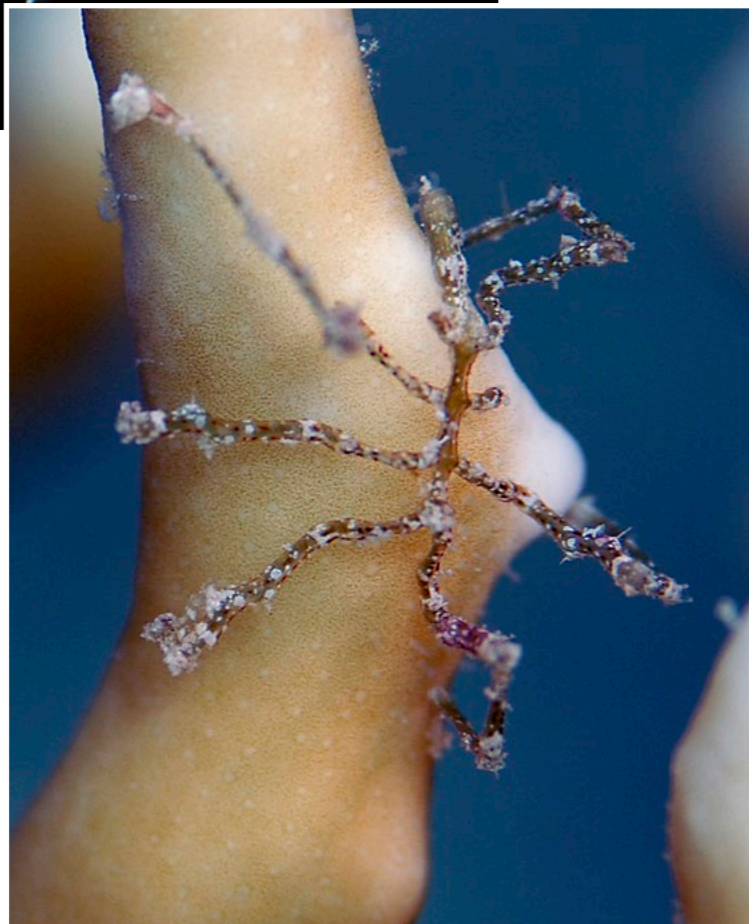
Scottish challenges

I, and many others, know that there are weird and colourful critters in colder waters, but the finding and photographing of these creatures is also one of the main problems with which we have to deal. The Scottish sea lochs in the winter and spring have a lot of freshwater runoff, which lies as a thick layer of dark-stained, peaty water, cutting out virtually all available light into the depths, similar to the fjords in southern New Zealand or southwestern Tasmania. Every dive can be a night dive, and additional lights are always necessary to make life a bit easier. Unlike the oftentimes poor visibility in tropical waters muck diving, the Scottish sea lochs in winter are usually crystal clear once you

get below the peat-stained, freshwater halocline.

Loch Long.

The Scottish sea lochs are known for their steeply sloping muddy inclines, which drop well below the safe scuba diving limit. The eastern shore of Loch Long is fairly featureless, except for a couple of places where the bare rock strata juts into the loch, creating small caves and crevices



to as Wallacea, after Alfred Wallace, the Scotsman whose work on natural selection was used by Darwin for his now world-famous treatise. Wallace discovered that there was a massive divide in distribution between the species of the Indian Ocean and Australasia, even when the waters were only a short distance apart. Yet, many of the species were actually distributed in most of the rest of the world's tropical waters. Since the opening of both the Suez Canal and the Panama Canal, fostering the transmigration of species in the holds and on the hulls of the world's supertankers, this big, wide world seems so much smaller nowadays.

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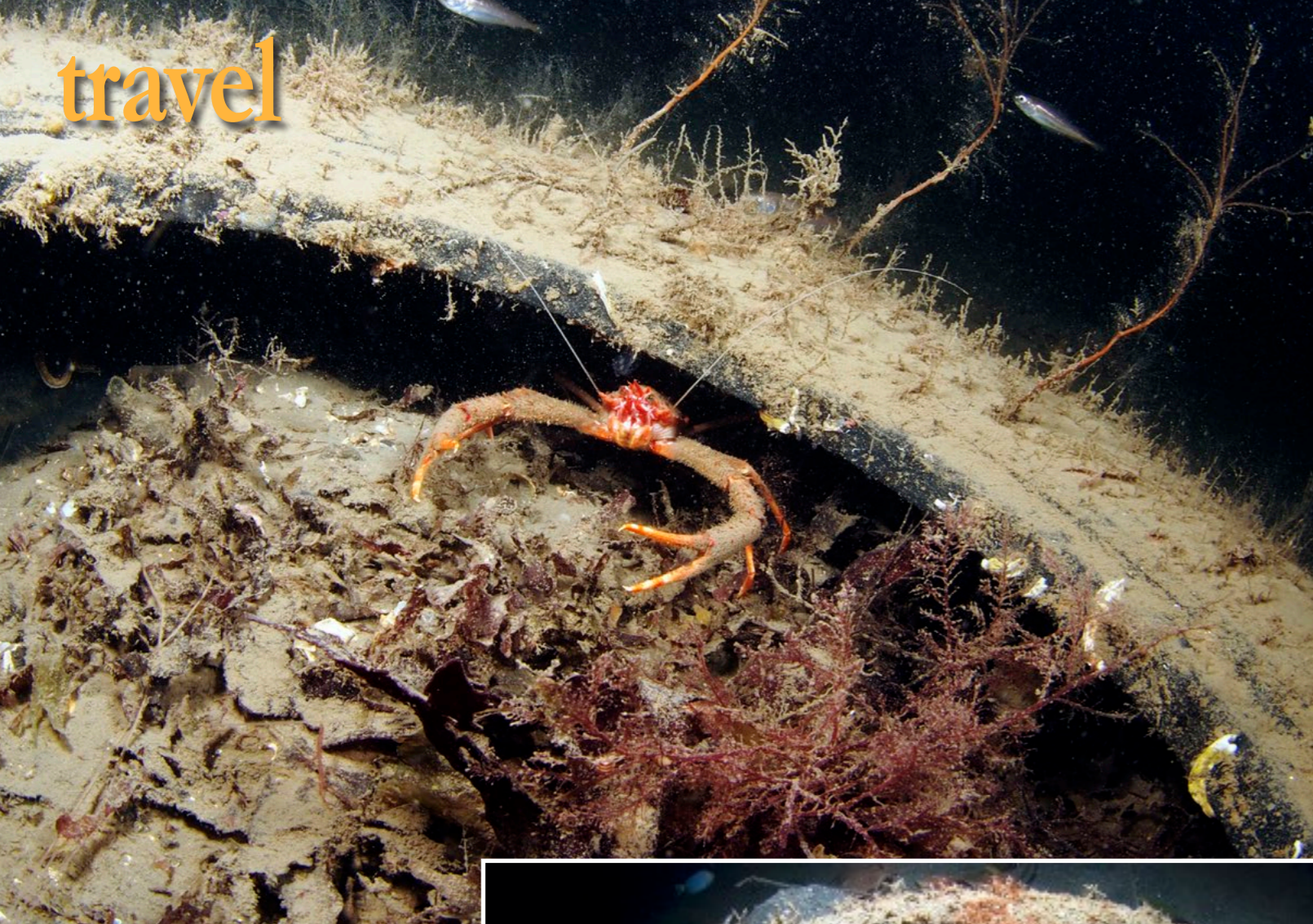
Oban. Down the small slipway opposite Puffin Dive Centre in Oban is another great mucky, rummage dive, usually dived by newbie trainee divers. Spider crabs, various snails, small queen scallops, camouflaged spider crabs, burrowing anemones and sea cucumbers—which are very similar, in fact, to an almost identical species found in Indonesia or the Caribbean.

Isle of Skye. Farther north, into the sea lochs around the Isle of Skye,

for squat lobsters, conger eels and small blennies. The uniform muddy slope has sea cucumbers, scallops, various species of crab, squat lobsters, dragonets and burrowing anemones.

Loch Fyne. The next sea loch over to the west is Loch Fyne, which has very similar topography. It also has Inverary Pier, where a night dive amidst the old harbour trash is essential. Pipefish, nudibranchs, brilliant anemones, octopuses, starfish and various shrimps are all evident. As the dive depth is only around 7m (23ft) at high tide, you

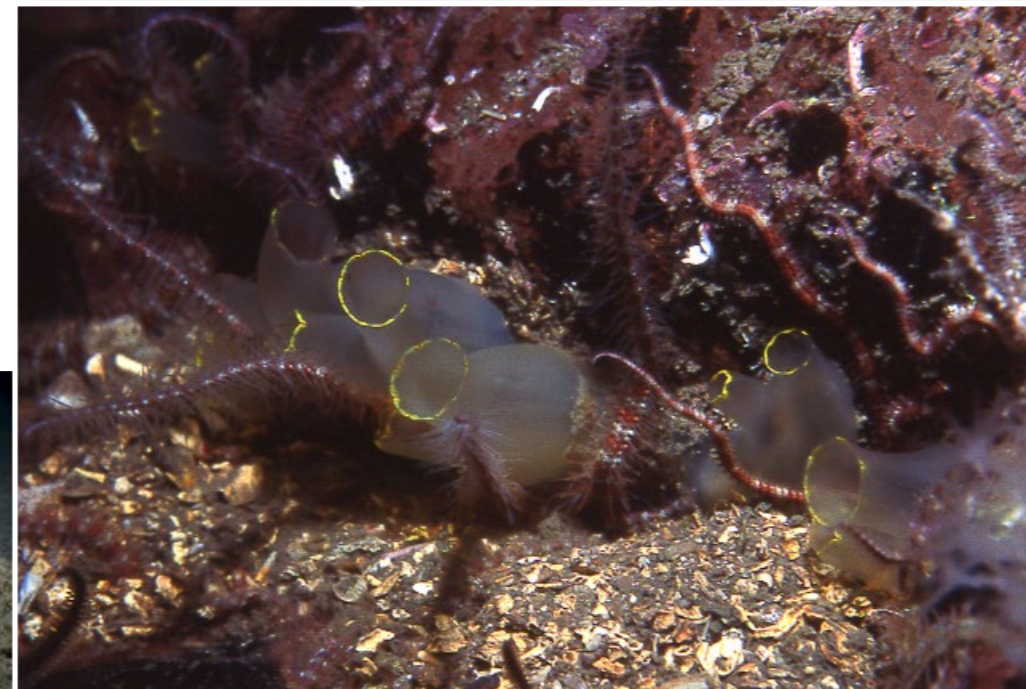




there are huge fireworks anemones, langoustine (scampi prawns), three different species of sea pen, individual coral polyps, small sea fans, fire clams and colonial zoanthids, and amazingly—huge fields of an incredible, hard, calcareous algae called maerl (*Phymatolithon calcareum*) or “Scottish coral,” which creates a unique habitat for dozens of other marine species. This is absolutely unique in British waters, yet very similar to species and habitats found in tropical seas; most obvious are the true coral reefs.

Backscatter

Muck diving can, as the name suggests, be rather mucky and, as mentioned earlier, backscatter can be a problem, both in your own efforts as well as stirring up trouble for any other photogra-

life, but new ones are equally as exciting, as the seabed under them is always strewn with rubbish and builders' trash, which make perfect homes for little critters and fish. I once found a beautiful, little sea spider on a piece of old shopping basket under the new pier at the port on Cayman Brac in the Caribbean, virtually similar to that found off St. Abb's Head in Scotland and Shag Rock in the Red Sea.

On these type of dives, what you are doing is a slowed-down version of macro photography,

phers following you. Backscatter is the major problem we all face in low visibility conditions. We either try to avoid it by getting in ultra-close, with skillful positioning of flash and extended arms, or do as I do—I like to use it as part of the photograph, and accept backscatter as a necessary element in the composition. In fact, in many instances, the addition of backscatter can enhance the composition.

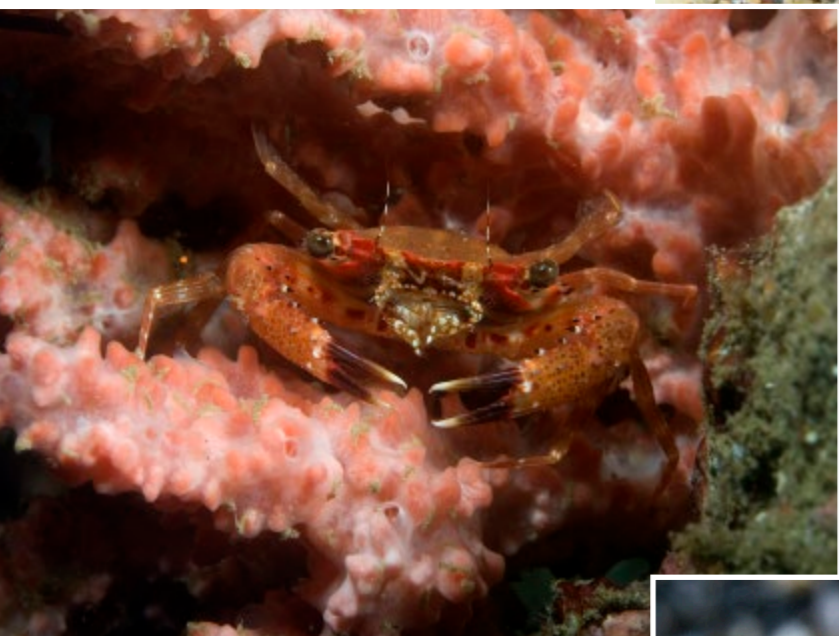
Where to muck dive

You can really go muck diving anywhere. One of the best locations is under piers, new or old. Old ones are always well encrusted with marine



LEFT TO RIGHT: Marine life is found living in the trash at Oban in Scotland and living in the trash at Lembeh Straits in Indonesia; Common sea squirt, in Scotland; Tunicates at Lembeh Strait in North Sulawesi, Indonesia

but with the option for seeing and photographing larger critters, should they come along. A friend of mine, Max Hillier, always used to say to students: "Stop and smell the roses." Well, we are doing the equivalent under-



diving with you may also have spent a fair amount of money and time to reach their desired destination, and many can be quite aggressively eager to get

as much—if not more—from the trip than anyone else. These same rules apply even if the dive site is just a short drive away from your home.

1. Do not monopolise a subject. The subject may be light sensitive and other divers may well be waiting in the sidelines to photograph the same subject, particularly if a guide has discovered this critter in the first place.

water: Stop, slow down, and examine every single tiny little bit of sea floor, as something may well be hiding under it; eating something on top of it; hopping, crawling or walking over it; or swimming by, just minding their own business!

Muck diving, by far, is one of the most rewarding styles of diving and opportunities for underwater photography. The potential for discovering weird and wonderful critters is certainly higher than average. By slowing down, you will get so much more out of the dive experience. Thankfully, you do not need to travel to the other ends of the earth to experience all of these wonders. But should you do so, then the same rules apply in the search for those weird and wonderful critters, which are almost identical, no matter where you travel.

Muck diving etiquette

Remember that other photographers



Sea pen in Bali, Indonesia (above); Sea pens in Scotland (right); Brown swimming crab in Scotland (top right); and at Gangga Island, North Sulawesi, Indonesia (upper left)



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Lesser octopus hiding in a shell in Scotland (left); Common reef octopus, *Octopus cyanea*, hiding in a bottle at Lembeh Strait in North Sulawesi, Indonesia (below); Common cuttlefish in Scotland (right); Cuttlefish at Lembeh Strait in North Sulawesi, Indonesia (bottom right)

many have fine sand, or mud, which acts like waterborne talcum powder and gets absolutely everywhere. Treat your exit from a photo opportunity the same way you enter the scene—with great care, awareness and empathy of the critter and your fellow photographers.

4. Do not feed or handle critters.

Many favourite locations for muck diving are also keen conservation areas and have strict rules of conduct, particularly about feeding or handling subjects. Unsurprisingly, you may find that some guides may be less than scrupulously subtle about inducing behavioural responses from subjects in the quest for greater kudos and gratuities.



Please do not encourage this behaviour, as it totally makes a mockery of any conservation logic in place and should leave a rather sour taste when viewing your so-called hard-won photographs.

5. Never “over-shoot” the subject.

Many species found in low-light zones are particularly sensitive to strong light. Flash photography, by its very nature, is very intrusive and often alarming for these subjects, which may be forced to leave their safe habitat and increase the threat of being eaten. Perhaps three or four photographs of any subject



should be enough, as opposed to dozens where quantity will just never outshine quality. Every subject is special and sacred, and should never be stressed by a photographer's zeal. ■

Lawson Wood is a widely published underwater photographer and author of many dive guides and books. For more information, visit: lawsonwood.com.

2. Do not intrude. If you find another photographer in the midst of a “shoot”, do not intrude on the scene. This is not only extremely bad manners, you may also spook the subject, and therefore, really annoy the other photographer. So, stay well away, have patience, and wait your turn—better still, find another subject nearby to be more individually productive

rather than just copying someone else's shot.

3. Be careful of your buoyancy at all times. Kicked-up particulates may drift away from you and can spoil someone else's shot. Some areas have heavy sand or rocky substrates, but



Oceanic Whitetip Sharks

Text and photos by Don Silcock

of Cat Island, Bahamas





Greenwood Beach on Cat Island—classic Bahamas

Until quite recently, the Red Sea was generally considered as the best place to see and photograph oceanic whitetip sharks—typically in remote locations such as the Brother Islands and Elphinstone Reef in Egypt or the isolated reefs of southern Sudan. Significantly though, these sightings are generally of lone individuals or very small groups and little is known about the overall population of oceanics in the Red Sea or their migration patterns.

Oceanic whitetip sharks are formidable animals that can reach almost 4m in length when fully mature and have a reputation to match their size, with Jacques Cousteau once describing them as “the most dangerous of all sharks.” That said, they do not feature highly on the common shark-attack registers, and it seems it was the sinking of the USS *Indianapolis*, plus that of the steamship *Nova Scotia* by a German submarine in WWII, that got them their reputation.

When encountered underwater, they have an intimidating presence and are very inquisitive, seeming to have no fear whatsoever, a combination that comes over as naked aggression when first experienced. They will come in very close and even bump you—often repeatedly, which is obvi-

ously quite disconcerting to the uninitiated. But it seems that this is simply their way of checking you out.

Divers who have been in the water a lot with oceanics say that once they work out that you are not easy prey, they leave you alone, which in many ways mirrors what the survivors of the USS *Indianapolis* said about them.

Cat Island

Once a common sight in the deep offshore waters around the Bahamas, from around the early 1980s, oceanic whitetip sharks became increasingly rare. It was generally assumed they had been completely cleared out by longlining. Although it seemed much too late for the oceanics, as part of their overall conservation program, the Bahamian government



View of the southeastern coast of Cat Island (above) shows the shallows close to shore, then the deep waters of the Atlantic; An oceanic whitetip shark patrols near the surface (top right). PREVIOUS PAGE: The formidable oceanic whitetip shark—confident, inquisitive and without fear!





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Whitetips



Yachts at anchor (left) at Hawk's Nest Marina (above) on Cat Island, Bahamas



mian archipelago, on the eastern boundary of the main limestone carbonate platform called the Great Bahama Bank. Its eastern and southern

appear again after their enforced absence.

Quite who made the discovery they were back is not clear, as it seems both a BBC film crew and National Geographic photographer Brian Skerry were there about the same time, both following up on the same lead. The significance of the discovery though is incredibly important, because there on the southeastern tip of Cat Island was what appeared to be a healthy population of oceanic whitetip sharks—almost completely opposite to what was happening everywhere else in the world, where declines of 80 to 90 percent had become the norm.

It also provided the first opportunity anywhere for scientists to tag oceanic whitetip sharks and track their movement patterns to try and understand why they were

banned longlining completely in the early 1990s.

Then, around 2005, the fishing community at Cat Island started to complain about sharks stealing their catches—behavior that oceanic sharks are renowned for. But it was another year before it became clear that something quite special was happening.

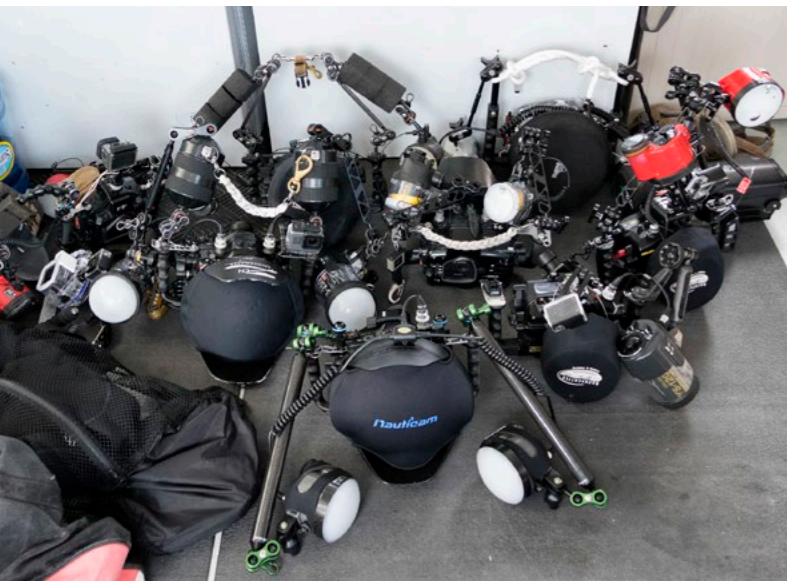
Cat Island is a long, thin island that is in the middle of the Baha-

shores sit right on the edge of that bank, and just offshore are the deep blue waters of the western Atlantic Ocean Basin and the rich Antilles Current that sweeps up the coast as it heads north.

It is literally the perfect location to fish for large ocean-open pelagic fish like marlin and tuna, which is exactly what the fishermen were doing. But it is also the perfect spot for oceanic whitetip sharks to re-



Incoming tourists at New Bright Airport on Cat Island (above); Camera gear (left) ready to go on Epic Diving's boat, the MV *Thresher* (top right), at Hawk's Nest; Sharkey's Bar at Hawk's Nest Marina—the name says it all! (right)



roamed far and wide in the Atlantic—in some cases, up to 2,000km away from Cat Island—overall, they spent most of the year in the protected waters of the Bahamas. All the sharks spent 99 percent of their time shallower than 200m, but they also all made short 10-

recovering. Because if those lessons could be learned at Cat Island, they could be applied elsewhere. Serious research began in 2010, and since then, some 100 oceanic whitetip sharks have been tagged with satellite tracking devices, so their movement patterns and a variety of other data such as depth and temperature could be established.

Several important results have come to light so far, starting with the fact that while the tagged sharks

to 15-minute dives down to around 1,000m—usually at night, where they stayed briefly and then made a slow ascent back to the surface, which the scientists believe is the oceanic sharks foraging for alternate prey.

Probably the two most significant results, however, are that over time it has become apparent from the large number of sharks being recaptured and retagged, that the overall population of oceanic whitetip sharks at Cat Island may be as low

as 300. And secondly, while many of the sharks are pregnant females, there are no indications that they give birth at Cat Island. So, the challenge now is to find the birthing grounds and establish a full cycle of protection. There are indications that the northern coast of Cuba may hold the secret to this, as government scientists there have reported significant numbers of juvenile oceanic whitetip sharks off the small village of Cojímar, but that topic will have to be saved for a future story.

Diving

Over the last five to six years, the Bahamas has firmly established itself as the “shark diving capital of the world”, largely because of the tiger and lemon shark encounters at Tiger Beach on Grand Bahama, and

dives with the great hammerheads at Bimini. Those encounters are what I would describe as two-dimensional experiences in which you are typically kneeling on a sandy area in shallow water and the sharks usually (but not always) approach you from the front. So, it is all reasonably predictable and relatively easy for the support divers to literally “watch your back.”

Cat Island, however, is very much a three-dimensional experience, because you are in blue water and your only point of reference is the white bait crate that is suspended at about 10m. The oceanic sharks are attracted by the scent of the bait in that crate, but are not actually fed, as the mere scent seems to be enough to keep them engaged. And engaged they truly are,



Whitetips



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Suspended from a buoy, the bait box (above) provides the only point of reference; Seen from above, the white fin markings are very distinctive (top right); Whitetip shark checks out its reflection in my dome port (far right)

exhibiting no apparent fear and approaching extremely close—often to the point of bumping your dome port!

They also sneak up from behind, above and below, often coming so close that they touch you with those long fins. As exciting as all that is, I never really felt in any real danger, as it all seems part of their pattern of testing to see if you are the weakest link and worthy of further investigation.

How it works

Options to dive with the oceanic whitetip sharks at Cat Island are somewhat limited, as the season is short, from the end of March to mid-June, and the island lacks much of the tourism infrastructure of the more popular locations in the Bahamas. That said, the locals are extremely keen to attract tour-

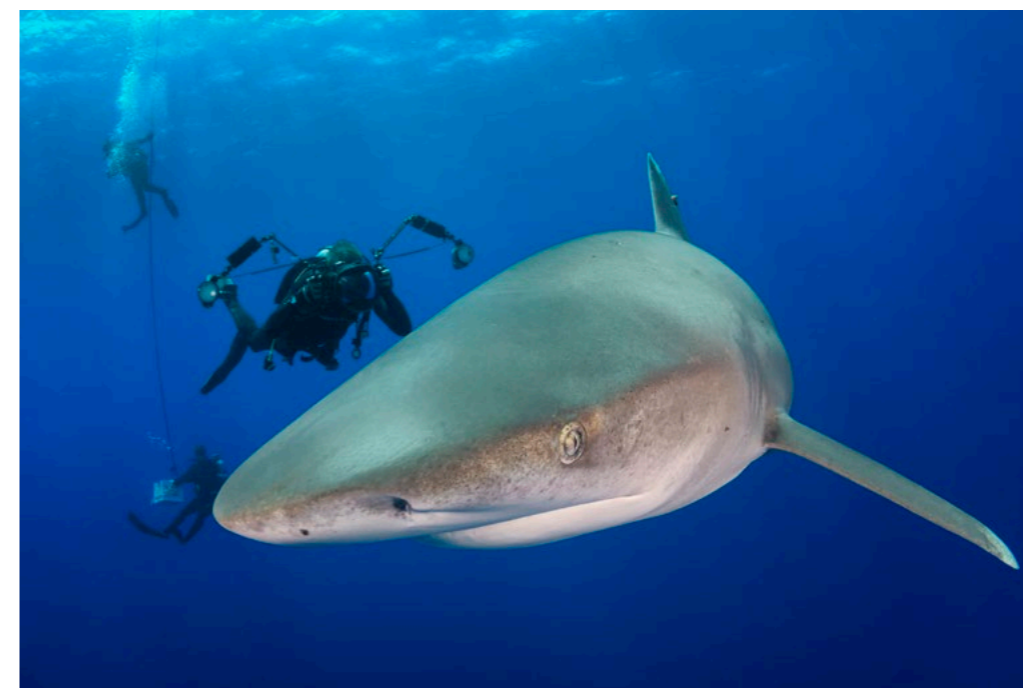
ists in any way they can, so you can be sure of a warm welcome.

I booked my trip with Andy Murch of Big Fish Expeditions (I paid full price out of my own pocket) and he worked with Epic Diving, who base themselves and their boat *MW Thresher* at Cat Island during the oceanic season. The arrangement worked well for me, as Andy is extremely knowledgeable about anything with fins attached, and Epic were well organized and very capable in the water.

Run by husband-and-wife team Vincent and Debra Canabal, Epic's story is worth telling, as the couple put their professional careers on hold in order to pursue their passion for sharks, shark



diving and shark conservation. In Vinnie's case, that was being a hospital emergency-room physician in New Jersey, something he still does in the off-season, while



Debra worked as an animal nutritionist, after completing a Ph.D. in biomedical science.

It is very much a family business. While Vinnie and Deb are running the boat and diving, Deb's mother homeschools the couple's two

children at Cat Island, and Vinnie's sister runs the reservation and booking systems.

Bahamas marine protection

The Bahamas was one of the first countries to understand the impor-

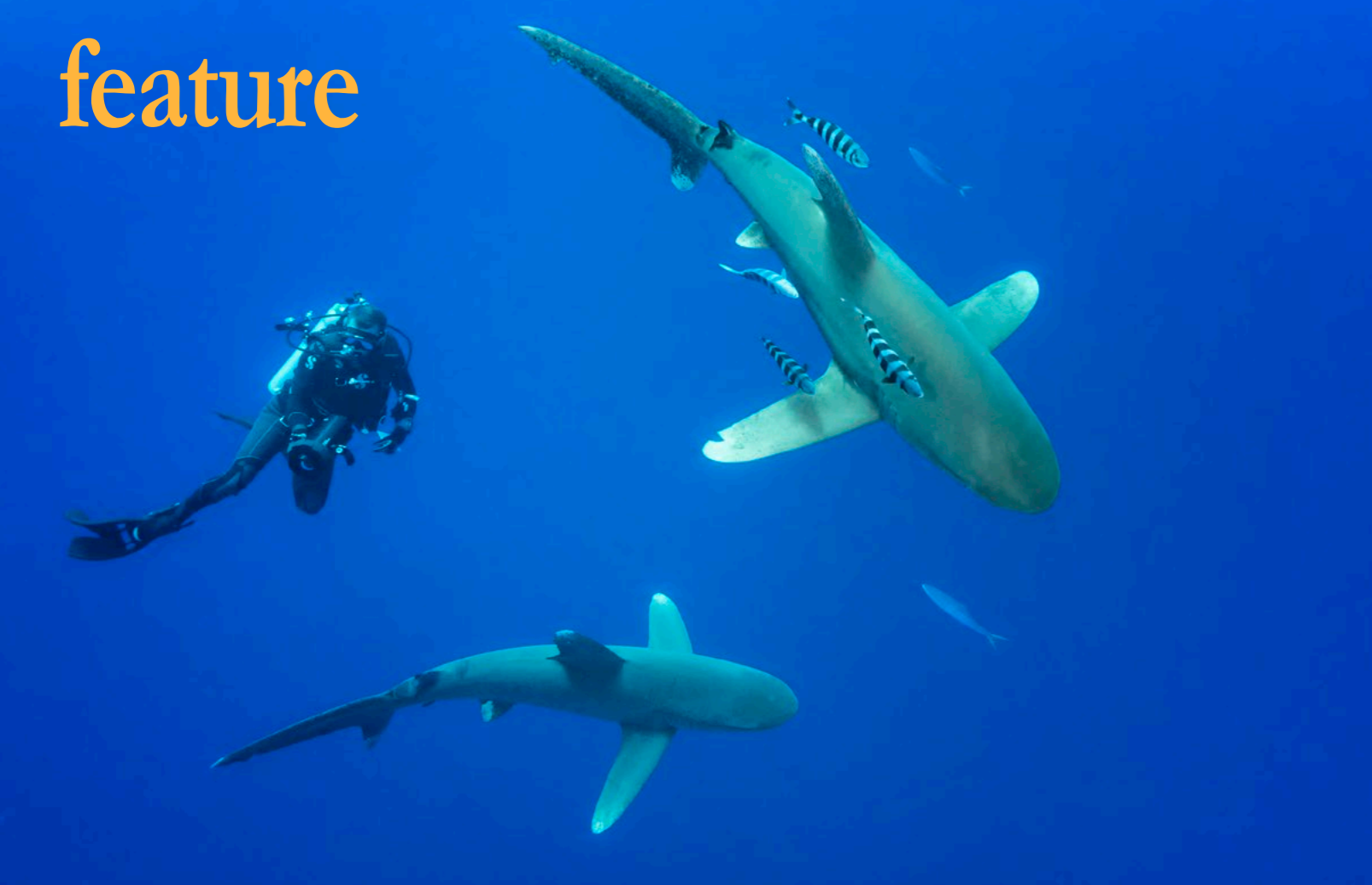


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Oceanic whitetip sharks check out a diver (above and right) showing just how inquisitive they can be, as well as how they seem to be basking in the attention (far right)

tance of sharks to their seas and fish stocks. The growth of shark tourism has proven that live sharks are much more valuable than the dead and de-finned variety—plus, they generate a recurring source of revenue.

That said, the country was never at the leading edge of the conservation movement. It has suffered from over-exploitation of its fish stocks over the years and periodic over-development of tourist resorts in ecologically sensitive areas. But there is no major industry in the country, and its people generally have a deep and visceral understanding of the importance the health of their surrounding waters is to their long-term prosperity.

Therefore, the establishment of the Bahamas National Trust in

1959 to manage the world's first marine protected area—the 112,640-acre Exuma Cays Land and Sea Park—can now be viewed as an incredible piece of foresight. The Bahamas have since added another 26 national parks covering over one million acres of land and sea, together with enacting substantial supporting environmental legislation, including making Exuma Cays a no-take marine reserve.

Then, in 2011, the government went one step further and became the fourth country in the



world to establish a shark sanctuary by formally protecting all sharks in Bahamian waters. It

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seems clear that the reappearance of a small but healthy population of oceanic whitetip sharks at Cat Island would never have happened if the government had not taken those measures. Nature is amazing and can produce astonishing things if we humans can only give it the chance to do so.

History of shark finning

It seems almost unbelievable that as recently as the mid-1960s, the oceanic whitetip shark (*Carcharhinus longimanus*), was widely considered to be one of the most abundant large animals in the world. And now, just over 50 years later, these sharks are on

the IUCN Red List, categorized as "Vulnerable" globally and "Critically Endangered" in the northern and central western areas of the Atlantic Ocean.

As for when the decline of shark populations started, some point to the moment when Deng Xiaoping came into power in China and



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Deng Xiaoping in 1979 (left); Shark fins drying on sidewalk in Hong Kong (above)

pensive concoction called shark fin soup.

While there is much to admire about Deng Xiaoping and the incredible economic growth he enabled, there have been very visibly dark sides to letting the Chinese entrepreneurial genie out of its bottle, including pollution which plagues the nation's cities. Less obvious though is the appalling impact that the conspicuous consumption of the Chinese middle class is having on the world's oceans. While the general public hears about the shark fin trade and periodically sees the hideous images of row upon row of fins drying on the roofs of Hong Kong warehouses, divers know firsthand the impact shark finning has had on the seas: We rarely see sharks underwater.

Roaming free

In so many ways, the oceanic whitetip shark personifies this hidden impact. It is an open-water pelagic animal, near the top of the marine food chain, which has

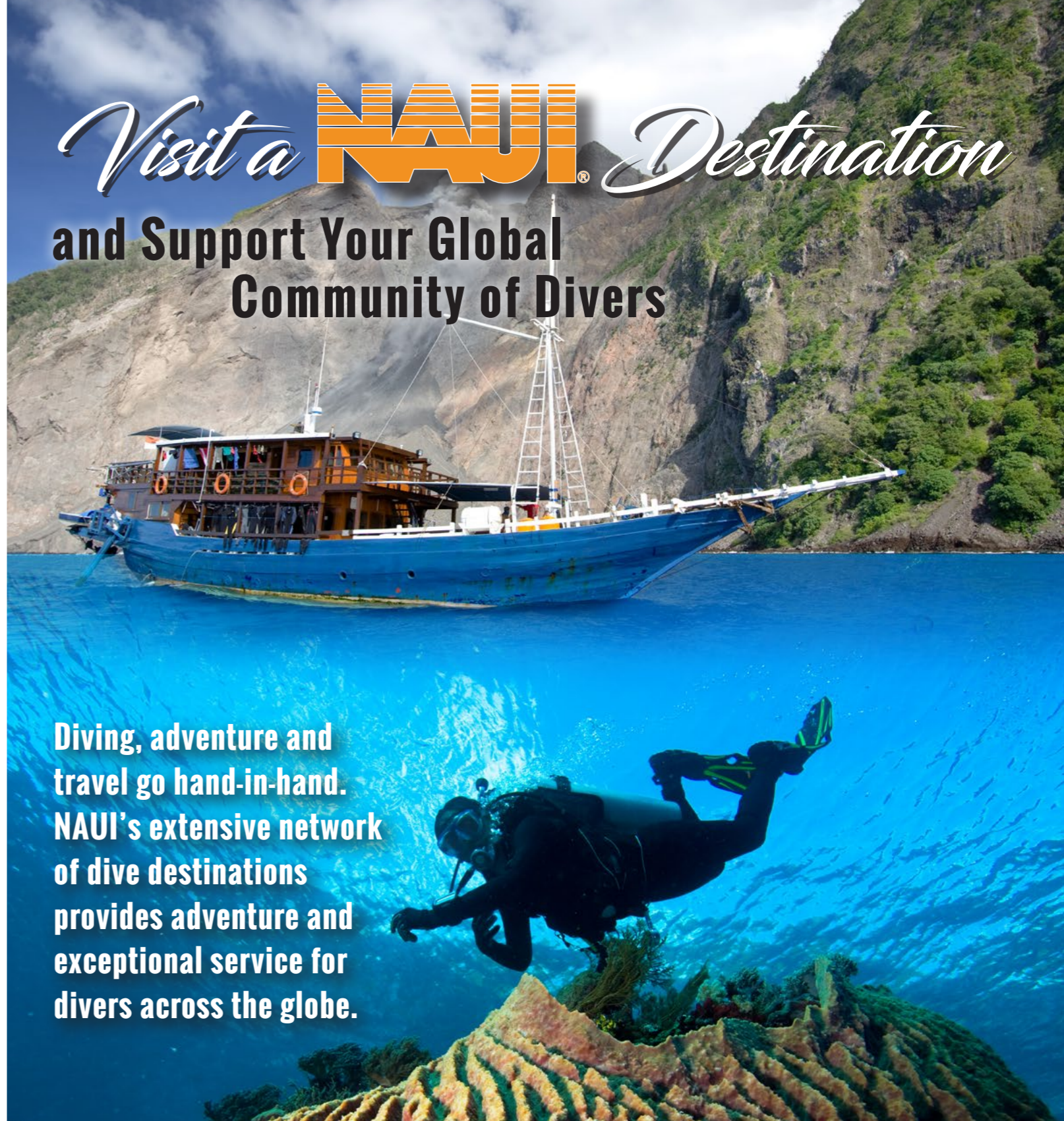
evolved superbly to wander the upper water column of the world's oceans. Found in all tropical and sub-tropical waters across the Atlantic, Pacific and Indian Oceans, but rarely seen in coastal waters, oceanic whitetip sharks roamed free in a never-ending search for food and, with few predators and limited industrial-scale fishing, the sheer bounty of the oceans had



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Shark fin soup in Hong Kong

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When viewed from this angle (above and top right), oceanic whitetip sharks appear to be cold and calculating predators; Diver (right) gives a sense of scale

allowed it to become such a populous species.

But as the market for shark fins expanded almost exponentially in China, so did the demand for large, open-ocean fish such as tuna, mackerel, mahi-mahi and swordfish, leading to the development of the deadly fishing methodology referred to as “longline.” Despite the rather innocuous sounding name, longlining is designed to catch those apex open-ocean fish and does so with devastating efficiency using a thick main line, which is laid out and suspended from buoys every 100m or so. Connected to those main lines are many shorter lines that have baited hooks attached to them and a single longline can be up to 50km long with over 12,000 baited hooks!

While the ethics of longline fishing can be debated—with proponents arguing it is simply meeting a demand for the highly prized open-ocean fish—what cannot be defended is the devastating

“bycatch” that it produces. Yet another innocent-sounding term, bycatch refers to the creatures that are not the object of the overall mission and are simply caught by accident.

Seabirds, for example, are especially vulnerable to longlining because they are attracted to the scent of bait in the water, which they follow only to become victims on the “line of death.” The exact number of seabirds lost to bycatching is impossible to measure accurately, but credible scientific estimates put the number killed each year at between 150,000 and 300,000!

Oceanic whitetips as bycatch
Oceanic whitetip sharks spend the vast



majority of their time roaming in what scientists call the “surface mixed layer” of the water column, which in layman’s terms means from the surface down to about 150m. This is basically their domain and where they are the apex predators,

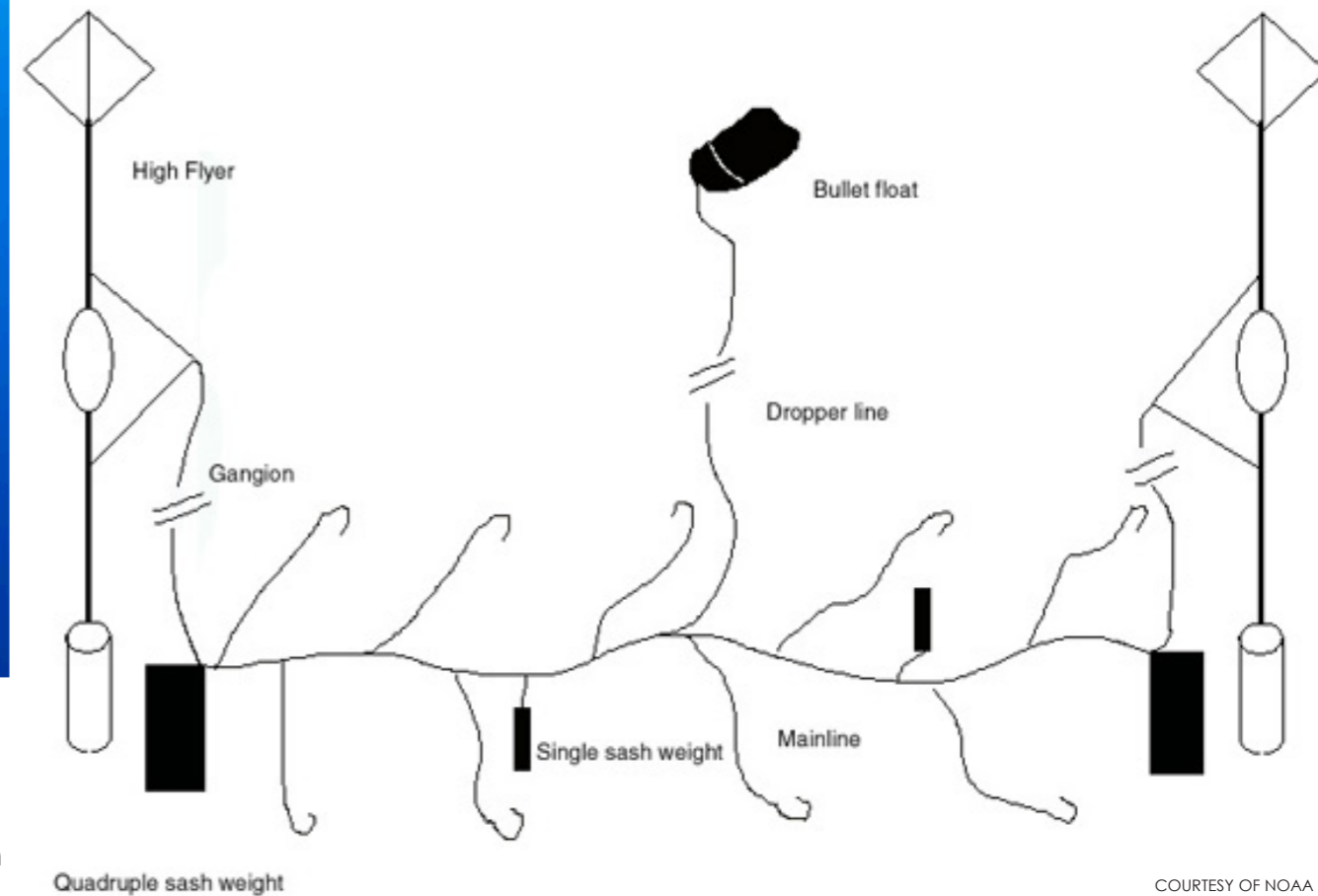


Diagram of longline fishing

COURTESY OF NOAA



Oceanic whitetip sharks are not the target of longliners, but a lucrative sideline, as their fins are highly prized in Asian markets

traveling slowly but efficiently over great distances with their large, almost winglike, pectoral fins—or longimanus, roughly translated as “long hands”.

In that mixed layer are the tuna, barracuda, swordfish and white marlin, which are the oceanic whitetip shark’s principal source of food. But it is also where the longlining fishing boats concentrate much of their efforts.

As they are such opportunistic feeders, oceanic whitetip sharks are drawn onto the line of death in astonishing numbers, with very clear indications that it has caused population declines of at least 70 to 80 percent in all three ocean basins—Pacific, Atlantic and Indian. While oceanic whitetip sharks are not specifically targeted by the longliners, they provide a lucrative sideline, because their large and distinct fins are highly prized in the international fin trade.

Size matters to the Chinese, and the fact that the key ingredient in the trophy soup served at banquets and weddings comes from an apex predator carries a very special cachet to the increasingly status-conscious middle class.

The really appalling aspect of oceanic whitetip bycatch though, is that because their meat is considered low in value, the sharks are usually separated from their prized appendages and then thrown back into the water alive to drown! This hideous practice has gone on for many years, and while there are signs it is now changing in regulated areas such as the US Northwest Atlantic, there is little doubt that it continues unabated in less controlled areas.

Then there is the really dark side known as “IUU” (Illegal, Unreported, and Unregulated) fishing. With IUU fishing, there is no doubt at all about what happens to oceanic

whitetip sharks when they are caught as bycatch.

Hope springs eternal

While it is far too early to declare, or even consider declaring, any kind of victory in the journey to reverse the population decline of oceanic whitetip sharks, there is cause for a degree of optimism. Two main things have brought this about.

Firstly, there was the recruitment of prominent Chinese celebrities, such as former Houston Rockets basketball star Yao Ming, to the WildAid campaign of raising awareness of the impact of eating shark fin soup. The fame that the 7.5-foot-tall Yao Ming gained in the United States has made him an absolute mega-star in China, so the credibility he brings to the campaign is simply immense.

When WildAid began its campaign in 2006, their research



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of Dive Equipment

VIDEO SHOWCASE
of The Ocean Documentary

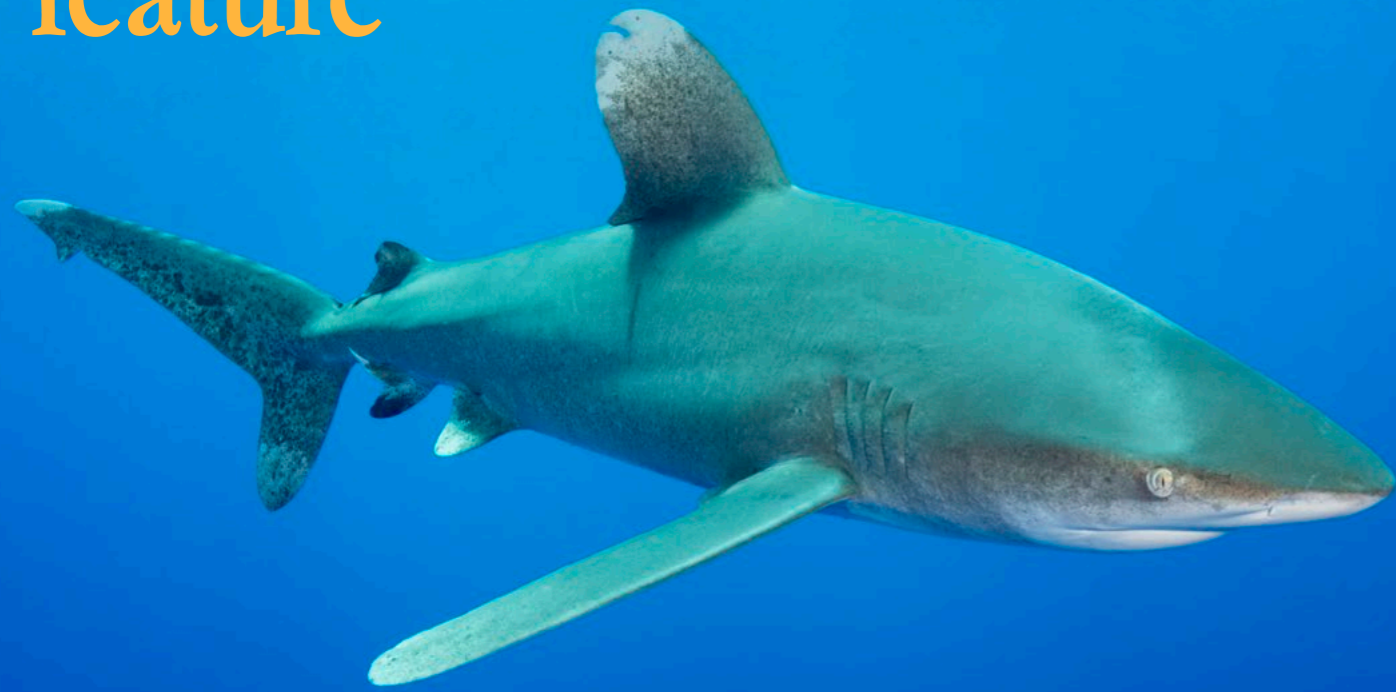
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Photo by: Larry Cohen



The almost wing-like pectoral fins of oceanic whitetip sharks are very distinctive (left); An oceanic whitetip shark cruises past, near the surface (below); Many oceanic whitetip sharks have their own retinue of pilot fish (bottom right)

Whitetips



tic and Indian Ocean. Plus, there are indications of improvement with the situation in the Northwest Atlantic and Hawaii areas. So, scientists do not want to be accused of over-reacting. Then, there is the concern about the wide range that oceanic whitetip sharks roam, which could mean that either they are not being accounted for in the population estimates and bycatch numbers, or are being counted twice.

The most recent assessment of the current status of oceanic whitetip sharks globally is a comprehensive 25-page review by the American scientific agency NOAA (National Oceanic and Atmospheric Administration), which was



KEITH ALLISON / WIKIMEDIA COMMONS / GFDL

Basketball star Yao Ming

showed that 75 percent of the Chinese surveyed were unaware that shark fin soup actually involved sharks because the literal Mandarin translation is “fish wing soup.” Furthermore, about 19 percent of those surveyed believed that the fins actually grew back again!

Yao Ming's commitment to the campaign has had a huge impact, and it is said that eating shark fin soup is now almost shameful for young middle-class people, which is an incredibly positive development. But in a country of 1.3 billion people and a middle-class of 100 million, it is obviously just a drop in the ocean.

Secondly, and more significantly perhaps, is the way the Chinese government is getting behind certain aspects of conservation, and specifically, the anti-shark-fin campaign. The actions taken so far are very positive—such as

closing shark fin speciality restaurants in major cities like Shanghai and Beijing, plus making it illegal to consume the soup at all official banquets.

Recent studies of the global shark fin trade indicate that the market is in fact declining. So, while there remains much to do, it would appear that the lowest point may be behind us.

Conservation status

While the oceanic whitetip shark has been placed on the IUCN Red List as “Vulnerable” globally and “Critically Endangered” in the northern and central western areas of the Atlantic Ocean, there appears to be much discussion in the scientific community about the data used for those assessments and the overall status of oceanic whitetip sharks globally.

Specifically, there is a lack of robust data for the South Atlan-





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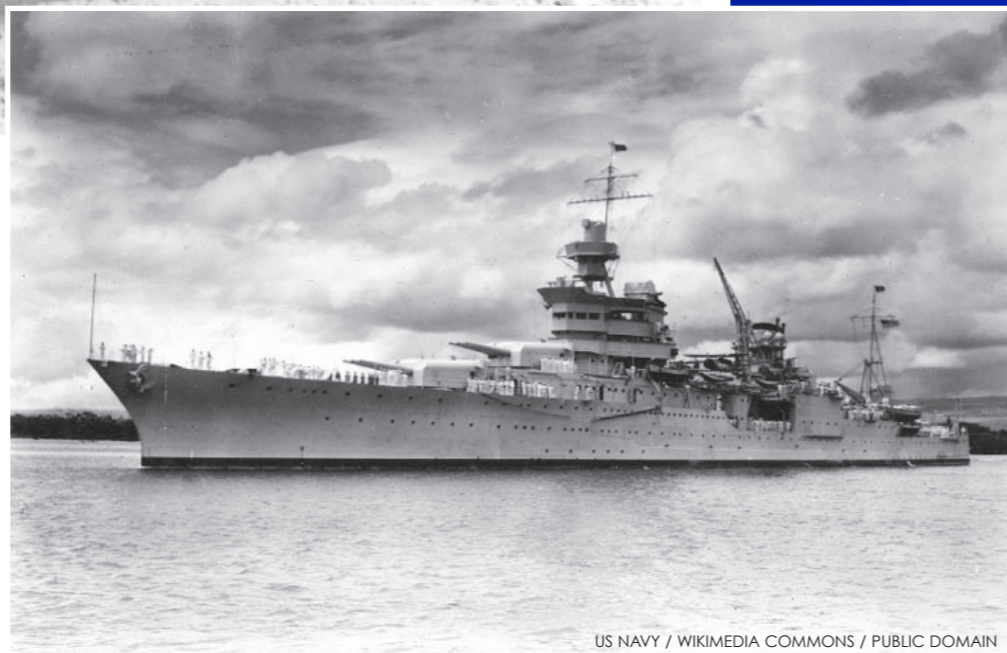
released at the end of 2016.¹

It is a long and complex read, but NOAA basically drew the following principal conclusions:

- “Given the species’ significant historical and ongoing abundance declines of varying magnitudes in all three ocean basins, slow growth, low fecundity, and low genetic diversity, combined with ongoing threats of overutilization and largely inadequate regulatory mechanisms, the ERA (Extinction Risk Analysis) team concluded that the oceanic whitetip shark currently has a moderate risk of extinction throughout its global range.”

- “In other words, due to significant and ongoing threats of overutilization and largely inadequate regulatory mecha-

¹ [HTTP://WWW.FPIR.NOAA.GOV/LIBRARY/PRD/OCEANIC-WHITETIP/OCEANIC-WHITETIP-STATUS-REVIEW-REPORT-2016.PDF](http://www.fpir.noaa.gov/library/prd/oceanic-whitetip/oceanic-whitetip-status-review-report-2016.pdf)



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nisms, current trends in the species’ abundance, productivity and genetic diversity place the species on a trajectory towards a high risk of extinction in the foreseeable future of ~30 years.”

This basically means that there is still time to reverse the situation. But if things do not change, the probability is that this animal that

was so recently extremely abundant could be extinct within the next 30 years.

The Indianapolis

No story about oceanic whitetip sharks would be quite complete without a reference to the sinking of the heavy cruiser USS *Indianapolis* in the final months of WWII. Torpedoed during the early hours of 30 July 1945 by the Japanese

submarine *I58*, the attack was devastatingly successful and involved just two torpedoes. The first struck the bow and the second hit the midship, sinking the *Indianapolis* within 12 minutes—so fast was the overall attack that about 300 of the nearly 1,200 crew went down with the ship.

Many of those who managed to scramble off the stricken ship did so without lifeboats or life-jackets, and were forced to cling to debris in the open sea. Bad as that was, the worst was yet to come, because in a series of almost unbelievable administrative blunders, the ship was not reported missing.

For 3.5 days, the poor sailors were left to the mercy of the sea until a passing plane spotted the wreckage and alerted the US Navy, which immediately dispatched rescue ships. But, by the time they arrived a day later, only 316 were still alive.

Most of the victims died from exposure to the elements and lack

of water, but enough had succumbed to predatory shark attacks—later attributed to oceanic whitetip sharks—that the animal has permeated into the modern psyche as a ruthless and deadly killer. Nobody knows how many shark attack victims there actually were, but a recent *National Geographic* article paints a more balanced story as a result of talking to actual survivors, many of them now in their nineties.

By far, the biggest problem the survivors said they faced was the lack of fresh water, and many of the sailors that died did so after succumbing to horrendous thirst and drinking seawater. They all said that the prowling sharks were a concern and would approach closely, often bumping them, but

could be easily kicked or pushed away.

Overall, it would seem that the oceanic whitetip sharks went for the dead or nearly dead sailors. As horrendous as that must have been, it is a significantly different story than the urban myth about oceanic whitetip sharks systematically attacking the seamen, one by one. ■

Asia correspondent Don Silcock is based in Bali, Indonesia. For extensive location guides, articles and images on dive locations in the Indo-Pacific region, visit his website at: Indopacificimages.com.



Whitetips

A diver (left) contemplates a particularly large oceanic whitetip shark—once one of the most abundant creatures in the sea; USS *Indianapolis* (center inset) was torpedoed and sunk on 30 July 1945 by Japanese submarine *I58* in the last months of WWII; Survivors of *Indianapolis* (far left) in August 1945, on Guam. Many were originally thought to be victims of ocean whitetip shark attacks, which was later refuted by survivors.

shark tales



Edited by
Peter Symes

PETER SYMES

Female tiger shark, known as "Smiley" after its signature injury to its jaw, appears to be pregnant.

Tiger sharks are monogamous

Tiger sharks differ from many other sharks in that they do not use multiple paternity as a reproductive strategy.

Multiple paternity occurs when a single brood of offspring is fertilized by multiple males. Multiple mating by females is referred to as *polyandry* and is one mating strategy widely documented to increase the genetic quality of offspring. In theory, certain genes or genetic combinations will raise the mean offspring fitness of polyandrous females, compared with that obtained from a single mating.

Jumping to conclusions

This phenomenon has been documented among many species of elasmobranchs—the subclass of cartilaginous fishes, which include sharks, rays, skates and sawfish—leading to the assumption that multiple mating may be ubiquitous in these fishes.

But at least when it comes to tiger sharks that does not seem to be the case.

Skewed data

The majority of studies of elasmobranch paternity have been conducted on coastal and nearshore species, with a lack of research on pelagic sharks. In the case of large oceanic species, obtaining pups from females of reproductive age remains challenging, particularly when aborting of pups is commonplace during capture. In addition, species that do not aggregate are all the more difficult to observe during mating events.

Tiger sharks breed by internal fertilization and females only mate once every three years. The tiger shark is the only species in its family that is ovoviviparous; its eggs hatch internally, and the young develop inside the mother's body up to 16 months and are born live when fully developed.

Single-sired

Tissue samples were obtained from 112 embryos from four litters (63 female, 49 male) captured in the Queensland Shark Control Program (QSCP) between 2008 and 2012. Genetic analysis indicated that only one father contributed to each litter. Three litters were identified as being fathered by a single male. In the fourth litter, a single pup, out of a litter of 34, was assigned to a second father.

Other monogamic sharks

Genetic monogamy has been reported in only one other elasmobranch, the bonnethead shark (*Sphyrna tiburo*), with 22 litters sampled from the Gulf of Mexico revealing over 80 percent as being single-sired. ■

SOURCE: ROYAL SOCIETY OPEN SCIENCE

Are skates using black smokers as egg incubators?

Deep-sea skates have been found to be laying their eggs at hydrothermal vents, perhaps in a bid to accelerate embryonic development.

Using a remotely operated vehicle (ROV), a team of researchers surveyed an active hydrothermal field in the Galapagos archipelago, 28 miles south of Darwin Island. As they panned the camera down, they discovered several layers of mermaid purses (egg cases).

Shared behaviour

According to Charles Fisher, Professor and Distinguished Senior Scholar of Biology at Pennsylvania State University, the multiple layers indicated that "whatever was laying these eggs had been coming back to this spot for many years to lay them. As the dive progressed, we saw more and more of these egg cases and realised that this was not the result of a single animal, but rather a behaviour shared by many individuals."

The animal that laid the eggs turned out to be the Pacific white skate (*Bathyraja spinosissima*), one of the deepest-living skate species not typically thought to occur near the vents.

According to the university's press release, "The majority—58 percent—of the observed egg cases were found within about 65 feet of the chimney-like black smokers, the hottest kind of hydrothermal vents, and over 89 percent had been laid in places

where the water was hotter than average."

Years of incubation

Deep-sea skates have rather long incubation periods, as long as four years. Thus,

the researchers concluded that the warmer temperatures in the area could reduce the typically incubation time of the eggs.

"Hydrothermal vents are extreme environments, and most animals that live there are highly evolved to live in this environment," said Fisher. "This study

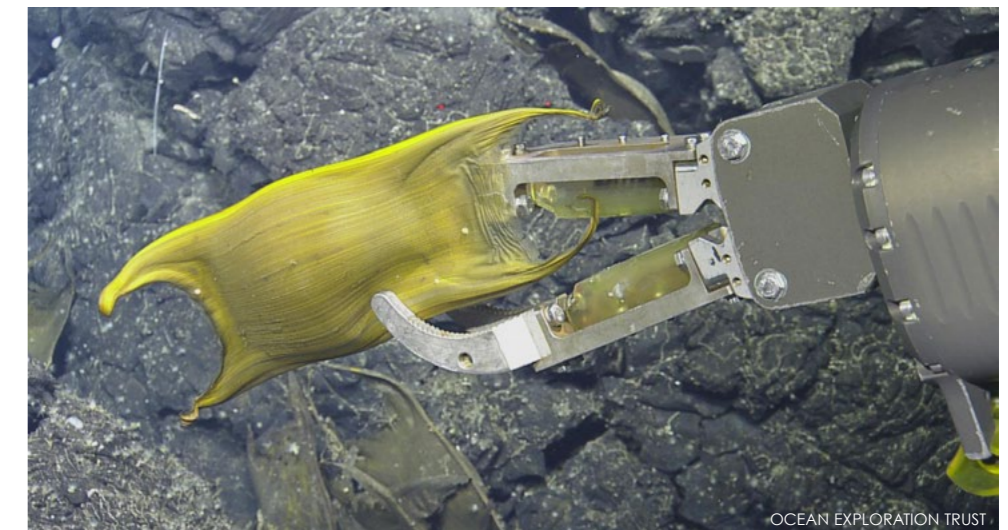
is one of the few that demonstrates a direct link between the vent environment and animals that live most of their life elsewhere."

The findings of the study was published in the journal *Scientific Reports*. ■



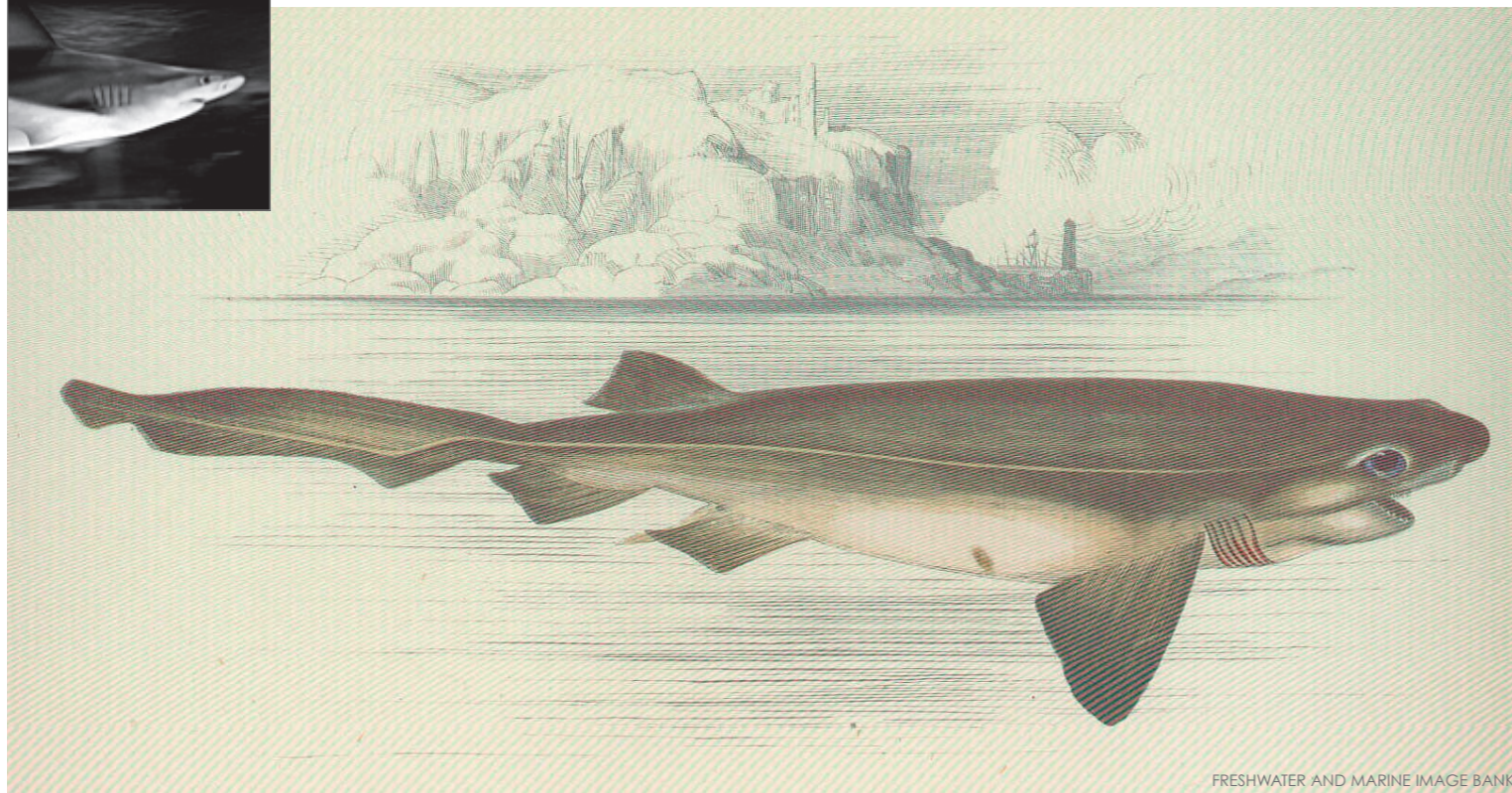
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The Pacific white skate (*Bathyraja spinosissima*) is one of the deepest-living of all skates.



OCEAN EXPLORATION TRUST

Skate egg case being recovered by ROV for analysis.



Depiction of a six-gilled shark by Jonathan Couch (1877) from *History of the Fishes of the British Islands*

New species discovered: Atlantic sixgill shark

Genetic testing confirms that sixgill sharks residing in the Atlantic Ocean are a different species than their counterparts in the Indian and Pacific oceans.

The sixgill sharks are a genus, *Hexanchus*, of deepwater sharks characterized by a broad, pointed head, six pairs of gill slits, comb-like, yellow lower teeth, and a long tail.

Though only two extant species—the Bluntnose sixgill shark (*Hexanchus griseus*) and the bigeyed sixgill shark (*Hexanchus nakamurai*)—were originally known, a third has now been found to exist also.

By analysing mitochondrial genes, a team of scientists led by assistant professor of biological sciences at the Florida Institute of Technology,

Toby Daly-Engel, determined that there are enough genetic differences between what had long been considered a single species of bigeyed sixgill shark to rename the Atlantic variety *Hexanchus vitulus*, or the Atlantic sixgill shark.

We showed that the sixgills in the Atlantic are actually very different from the ones in the Indian and Pacific Oceans on a molecular level, to the point where it is obvious that they're a different species even though they look very similar to the naked eye.

Significant differences

These differences found are of the same magnitude—about seven percent—as the genetic distance between both Atlantic and Indo-Pacific bigeye sixgill sharks and the bluntnose sixgill shark. Such variation far exceeds previous measures of species-level genetic divergence in elasmobranchs, even among slowly-evolving deep-water taxa.

Measuring up to six feet in length, Atlantic sixgill sharks are far smaller than their Indo-Pacific relatives, which can grow to 15ft or longer.

■ SOURCE: FLORIDA INSTITUTE OF TECHNOLOGY

Great white shark population in Australian waters determined

Thanks to a breakthrough in genetic and statistical methods, CSIRO has been able to determine there are more than 1,000 great white sharks in waters off South Australia.

Currently, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) believes that there are two main populations of white shark in the Australasian region: the “Eastern” population, which is basically everything to the east of Bass Strait (including New Zealand); and the “Southern-Western” population, which appears to range from west of Bass Strait, around the South Australia and West Australia coasts as far north as Ningaloo Reef.

The revised estimates of the Eastern adult population size were around 750 (with a range of 470-1,030), with annual survival probabilities of 93 percent. Revised estimates of total population size in the Eastern region were around 5,460 (with a range of 2,909-12,802).

CSIRO's initial estimates of the Southern-Western adult population were around 1,460 (with a range of 760-2,250), and that survival probabilities were very high (in the 90-percent-and-above range, as for the East). So these estimates suggest that there are almost twice as many adult white sharks in the Southern-Western population relative to the Eastern.

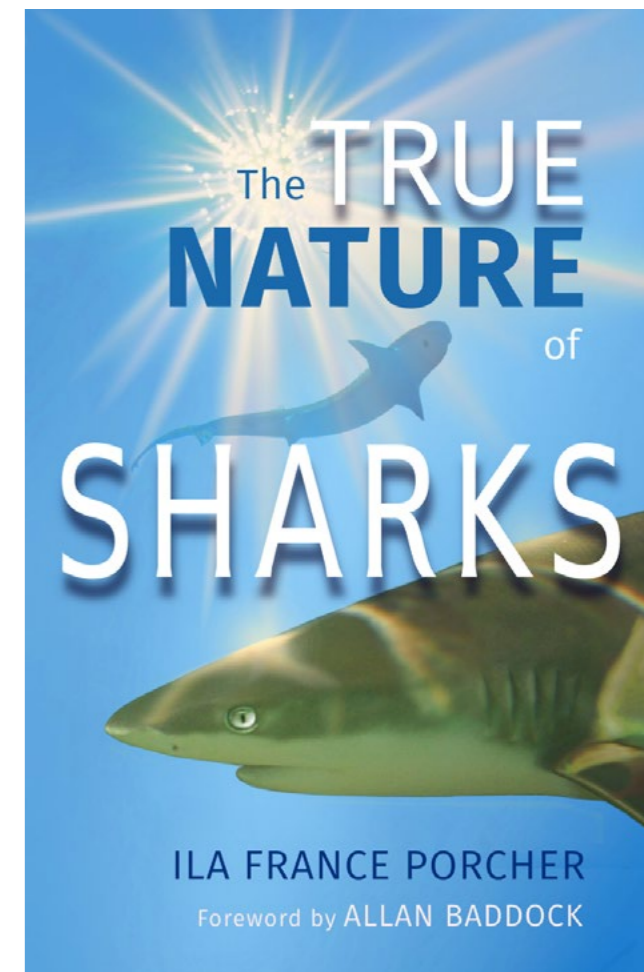
Numbers steady

The study shows the number of great whites has not changed significantly in the 20 years since the species was first protected, findings which have given environmentalists cause to fight against calls to remove the great white from the protected species list.

CSIRO found that in both populations the adult population trend since protection has been essentially flat, with no evidence for a substantial increase or decrease. However, the picture is more uncertain when it comes to estimating population changes for younger white sharks.

White sharks take 12-15 years to mature. Assuming protection of the species reduced the juvenile mortality rate, then any such effect will not be apparent in the adult population until the next 5-10 years. ■

SOURCE: CSIRO



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Edited by
Rosemary E. Lunn

Equipment



SI Tech Orust

Once it was impossible to get a latex or silicone seal instantly changed in the field. In the mid 2000s, this changed. Waterproof worked with SI TECH, and the Neck Tite System was developed.

The Neck Tite system worked; it just was not that comfy to dive with. SI TECH took note. Now the Swedish manufacturer has launched the ORUST neck seal system.

This version offers better flexibility because it is made from a more malleable material. SI

TECH has also considered field practicality. Clips have

been added to keep the ring seal in place, and the latex or silicone seal and Lock Ring can be mounted into the PU-Ring by hand (no tools required). The system can also be fitted to amphibious drysuits, rescue suits and water sports garments. SITech.se



Monitor

British manufacturer C and R Testing unveiled a virtual compressor engineer at DEMA.2017. "The Monitor" constantly checks your compressor and lets you know if something is amiss. It monitors carbon monoxide, carbon dioxide, oxygen, moisture levels and oil vapour (in the outgoing air) and oil pressure in the compressor. It even tells you when the filter needs changing. In the event that the Monitor is not happy, it stops the compressor and sends you an email stating the problem. The Monitor can also be retro-fitted to pretty much any other compressor, provided you have a separate power source and connection to the internet (either hard-wired in, or via wireless). As the monitoring is done in real time, you have peace of mind that the gas you are pumping is safe. candrtesting.co.uk



Miflex hybrid

Miflex has launched what could be termed a black "hybrid" hose. It behaves like a rubber hose—it is not positively buoyant—yet it is lighter and more flexible than a rubber hose. The XT-Tech hose has been designed for techies, particularly those who dive a Hogarthian set-up and loop a long hose around their necks. Understandably these divers asked for a smooth outer layer (thermoplastic), which is kinder on the neck. In addition, divers wanted an inner braiding that was reinforced with kevlar. The XT-Tech hose (like all Miflex diving hoses) has fittings made of sea water-resistant, electroless nickel-plated brass and a polyether-based PU thermoplastic inner liner (not all braided hoses do). This new range is initially available in a limited range of lengths for regulators and inflators. Miflexhoses.co.uk

FE Expedition Series

Fourth Element's new "Expedition Series" duffel bags should put pay to the Where's Wally game. Each duffel bag is bright orange, inside and out. The distinctive colour makes the bag simple to spot on a baggage carousel. And the practical inner fabric is bright enough that divers no longer have to hunt for black gear, in a black bag, whilst in a black cave. The trio of bags—60-litre (1.2kg), 90-litre (1.5kg) and 120-litre (1.5kg)—are manufactured from tough, heavy-duty mesh PVC, and the base is double-lined for durability. Each bag benefits from grab handles, a large u-shaped zippable flap, compression straps, and adjustable, removable, padded rucksack-style carry straps.

Fourthelement.com

TUSA Liberator

TUSA's latest iteration of its Liberator buoyancy control device is due to hit dive centres this spring. The "BC0103B" is a jacket-style, wrap-around BCD constructed from black 500 Denier Cordura. It has been designed to be a workhorse—something that you will dive for many years. Complicated cylinder straps that make changing cylinders an unnecessary ordeal are irritating. TUSA has fitted its RiteTite Buckle to the Liberator. This system makes changing cylinders a breeze and, in fact, TUSA fit this system to all its BCDs. The Liberator comes in five sizes (XS, S, M, L, XL) and benefits from a weight integration system, four resin D-Rings, three dumps, two zipped pockets and a stainless steel D-ring on the right shoulder. Tusa.com





Text by Simon Pridmore
Photos by Andrey Bizyukin

Albert Einstein is quoted as saying, “as our circle of knowledge expands, so does the circumference of darkness surrounding it.” In other words, in expanding our awareness, we just expose our ignorance. The more we come to know, the more we realise we do not know.

This makes a lot of people uncomfortable. Astrophysicist and cosmologist Neil Tyson has described what many people do in response; instead of searching further, they build a wall around what they know so they do not have to see the darkness beyond. He refers to this wall as “the perimeter of ignorance”.

How is this relevant in the world of scuba diving? Let me begin with a story.

A story

Robert was sitting quietly at home one afternoon, when he received a call from a woman who introduced herself as a friend of a friend. She asked him if he



Scuba Confidential:

The Perimeter of Ignorance

could recommend an operator to take her and her husband to dive off Nusa Penida, which is an island off the south coast of Bali, famous for big fish, cool water and strong, unpredictable currents that make it a notorious accident black

spot, especially for new divers.

Robert asked about their experience and the woman told him that she and her husband were “advanced divers”. He pressed a little more and found out that they had only learned to dive a few

weeks earlier and had done nine dives, all during their training (when I had my dive centre on Guam, the reception staff used to refer to such folk as “AD 9s”).

On hearing this, Robert suggested that, as diving around Nusa Penida could be

tricky, they might prefer to try some of the wonderful diving in easier conditions off the village of Tulamben on Bali’s north east coast. The woman was highly indignant at Robert’s implication that she and her husband were “not excellent divers-

PIXABAY



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Ignorance

praise and insincere enthusiasm to blind them to their limitations. They were "advanced divers". There was nothing they could not do. Next stop, a little rescue training, and then the path towards instructor. Yes, scuba diving really is that easy: there is nothing to it.

Instructors & experience

You cannot really blame the dive instructors. As the industry today is structured, they themselves may not know much beyond the materials and skills they have been taught in their own (often short) diving lives. No instructors can widen the scope of a student's knowledge beyond what they, the instructors, know themselves.

This was one of the factors that drove me to write my *Scuba* series of books. My aim was to enable people at various stages in their diving lives to see "behind the wall." *Scuba Fundamental* tells non-divers how to prepare for a scuba course, explains what will be involved and offers them a guide to what their first 20 dives should look like. *Scuba Confidential* imparts knowledge that veteran and technical divers acquire from intensive training and/or years of experience. *Scuba Professional* shows prospective career divers what to expect from the industry and shares some of the secrets of success, while *Scuba Physiological* aims to give all divers

which we are" and hung up on him.

Two days later, she gratuitously called Robert back to tell him that she and her husband had gone to Nusa Penida and that they had had a perfectly wonderful day's diving. "So there, everything you were telling me was wrong," she said. He did not even know where to start explaining the various issues involved, so he just told her he was glad they had enjoyed their dives.

The couple had evidently graduated from their courses with no idea of their limitations. Nobody had told them that, as new divers, they should ease themselves gently into the sport and that, no matter how intuitively talented someone may be, it takes a lot of practice to become an "excellent diver". They were also unaware that many dive sites around the world, even

popular ones, are genuinely dangerous for beginners

Misplaced confidence

Instead, all the high-fives and "great jobs" they had received during their training had encouraged them to believe that, having completed the courses and obtained their certification cards, they were now ready to dive anywhere. Indeed, their misplaced confidence was so deeply entrenched that it even induced them to over-ride common sense and dismiss the well-meaning advice of someone who had been introduced to them as a knowledgeable diver.

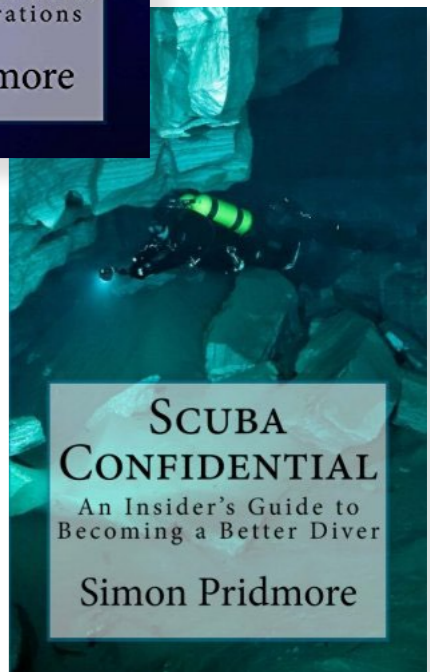
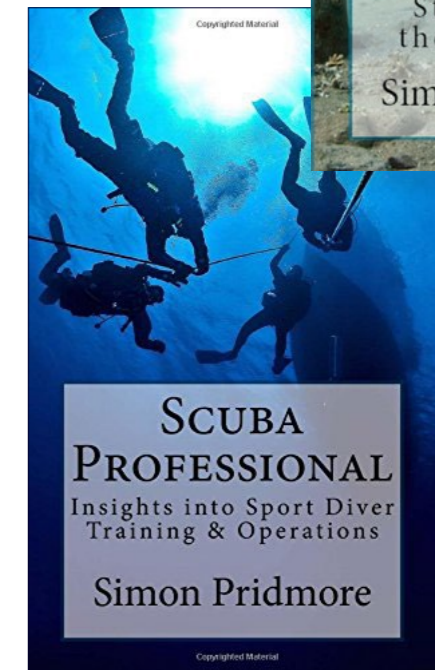
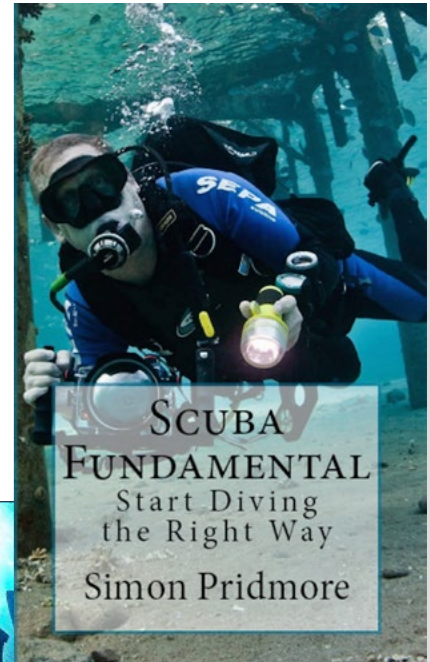
Their instructor and the agency that provided them with their training materials had conspired to build a perimeter of ignorance around them, using carefully chosen information, over-cooked



ANDREY BIZYUKIN

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opinion

access to the cutting edge of decompression research without blinding them with too much science.

Technical diving

The advent of technical diving broke down the wall for many divers, revealing as it did the secrets of the military and scientific diving communities and applying them to sport diving. Technical diving pioneer Richard Pyle was reflecting Einstein's concept of the "circle of knowledge" and "circumference of darkness," when he wrote about his early days on rebreathers. He said:

"After my first 10 hours on a rebreather, I was a real expert. Another 40 hours of dive time later, I considered myself a novice. When I had completed about 100 hours of rebreather diving, I realized I was only just a beginner. Now that I have spent more than 200 hours diving with a closed-circuit system, it is clear that I am still a rebreather weenie . . . it takes a fair amount of rebreather experience just to comprehend what your true limitations are."

Pyle was not only tearing down the perimeter of ignorance but actively embracing the idea that the more you know, the more you find there is to know. This should not be surprising-after all, he is first and foremost a scientist himself.

Sport to technical diving

However, for divers coming into technical diving from mainstream



ANDREY BIZYUKIN

sport diving, the perimeter is still in place. I remember having lunch with a group of technical divers where we were swapping stories of deep dives on CCRs. During the afternoon, a friend who had been listening in-a veteran diver who used to do single cylinder deep dives on air in his youth (as we all did) but has no technical diving experience- asked me what it would take for him to get to do dives like the ones we were discussing.

I thought about it for a couple of minutes, plotting the route from single cylinder air diver to CCR Trimix diver in my mind and factor-

ing in the cost of gear, dives and training. I told him, "Two years and US\$20,000."

His face registered shock, and I watched as his surprise turned into something else. Like the woman in Robert's story, my friend took offence at what he saw as my suggestion that he was not a capable diver. I mollified him, explaining my answer in more detail and eventually he understood. In turn, I apologised for my lack of tact in having torn down his perimeter of ignorance a little too brutally.

Early days

In the very early days of sport



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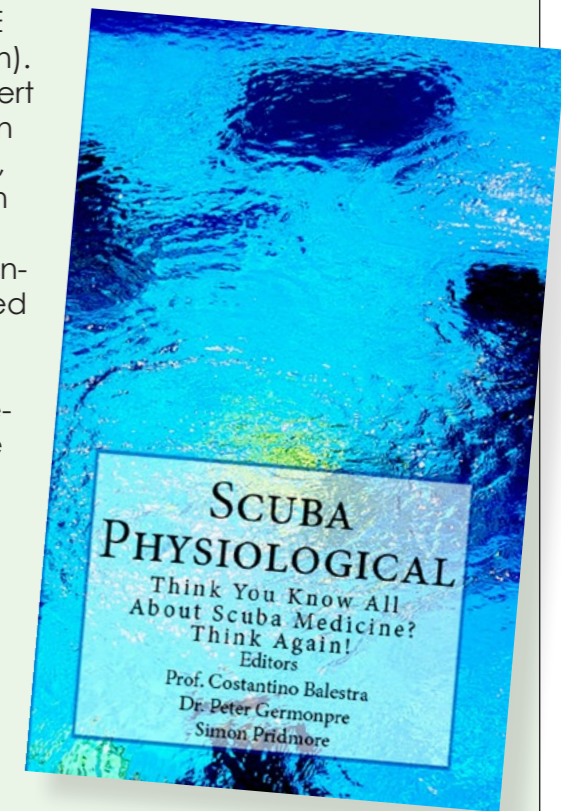
A New Book for Scuba Divers!

If you are a diver, much of what you learnt about topics such as decompression sickness and narcosis in your scuba diving class is over-simplified and some of it is just plain wrong, as diver training agency texts have not kept pace with the science. Despite 170 years of research, the nature of decompression sickness and decompression stress remains unknown. Great advances have been made to make diving safer, but there are still glaring gaps in our knowledge. *Scuba Physiological* provides us with a good summary of what we know, a glimpse of where current science is taking us, and some good tips to make us all safer divers now.

The chapters in *Scuba Physiological* were originally written by scientists in the field of decompression research as part of a three-

year project called PHYPODE (Physiology of Decompression). Simon Pridmore is not an expert on diving medicine but, when he came across the material, he knew that many people in scuba diving beyond the scientific community would be interested in it. So, he contacted the original authors and proposed an abridged, edited, simplified and re-formatted e-book, which would make the information more accessible to the general population of divers. They thought it was a great idea and *Scuba Physiological* is the result.

Scuba Physiological: Think You Know all About Scuba Medicine? Think Again! by Simon Pridmore is available on: **Amazon.com**.



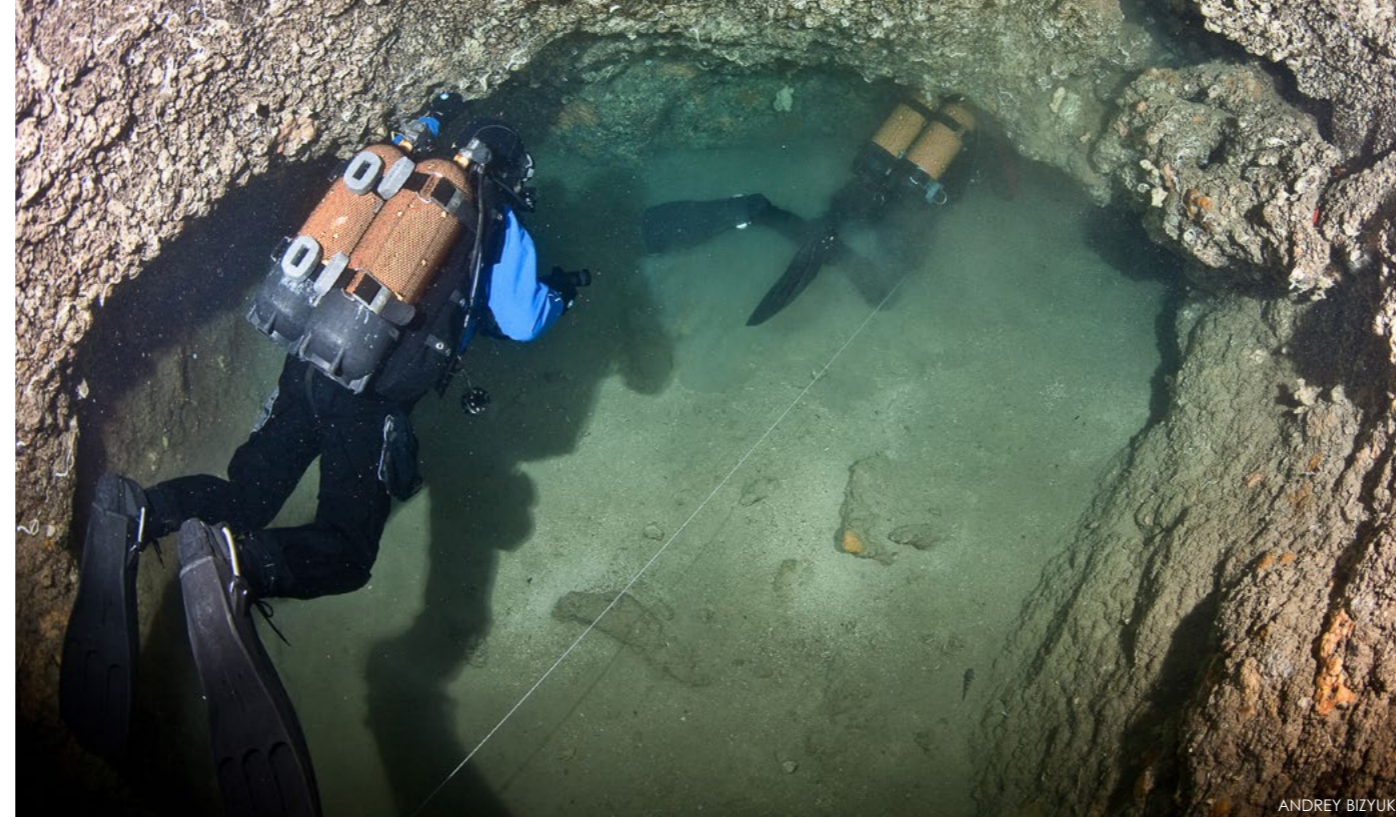


opinion

rebreather diving, before Richard Pyle had done his first 200 CCR dives and reminded us all about the "circle of knowledge," very few people in sport diving had any idea how to dive rebreathers. It was really a case of the "one-eyed folk in the land of the blind." Many very experienced divers jumped onto the newly available technology and immediately took it deep. This was why they had invested in it, after all. They thought they knew every-

thing about diving, but this was a completely different type of diving, one that lay beyond their perimeter of ignorance. Some survived and learned; others died using the new machines.

Today, we know much more about the mindset, skills and tools required to dive rebreathers safely within a sport diving framework. Magazines like *X-Ray Mag* and regular conferences like Oztek, Eurotek and Tekdive USA help divers keep



ANDREY BIZYUKIN

abreast of new ideas and new technology, and the accepted wisdom continues to be questioned as the sport evolves.

Comprehending limitations

Having said this, the circumstances surrounding a number of recent rebreather accidents are an indicator that the lessons tragically learned by the first generation of sport rebreather divers are in danger of fading into history, and Richard Pyle's words of warning are not being heeded. There are signs that new CCR divers do not adequately comprehend their limitations and are coming to harm as a result.

With the blurring of the lines between regular sport diving and technical diving, it is important that the circle-of-light concept is kept well in view and that training agencies do not start fencing in the knowledge in order to try to broaden the technical diving market and generate more business, thereby building similar

illusions around technical diving to those that exist in mainstream sport diving. From time to time, one hears recruitment messages along the lines of "dive with us, become an XXX diver and everything will be OK". These sound to me suspiciously like attempts to build a perimeter of ignorance. ■


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


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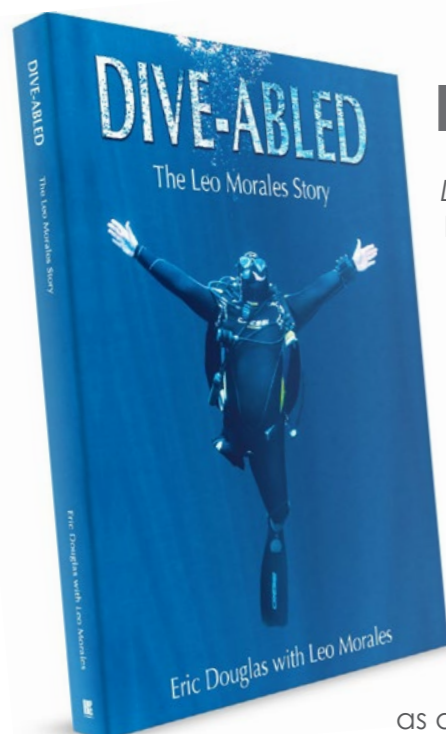



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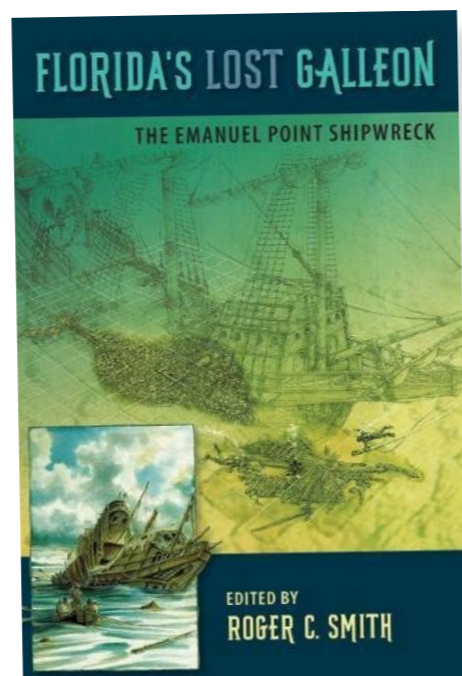
Dive-Abled

Dive-Abled, by Eric Douglas with Leo Morales

In 2008, Leo Morales lost his right leg to cancer, and he plunged into depression. After learning to scuba dive as part of his physical therapy, his life changed forever. He swiftly progressed to becoming an instructor and technical diver—and he set two world records

as a disabled diver. In addition to this, he travels the world as a motivational speaker. This book tells his inspirational story.

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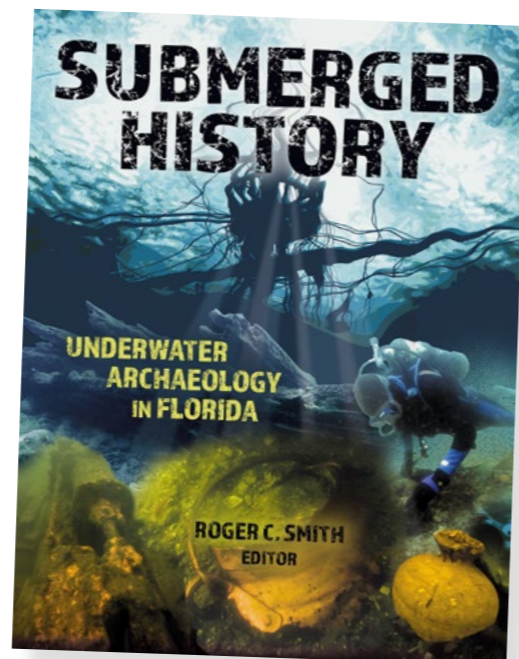


16th Century Shipwreck

Florida's Lost Galleon: The Emanuel Point Shipwreck, edited by Roger C. Smith

Relive the ground-breaking discovery of the earliest shipwreck found in Florida, the result of a hurricane that destroyed a small colony and six ships led by Spanish explorer Tristán de Luna in 1559. Follow underwater archaeologists as they dive the ship's hull, and then in the lab as they analyse the well-preserved but waterlogged Spanish colonial artefacts and prepare them for public display. The excavation of this shipwreck was fuelled by the enthusiasm and support of local volunteers, highlighting the importance of such public archaeology projects.

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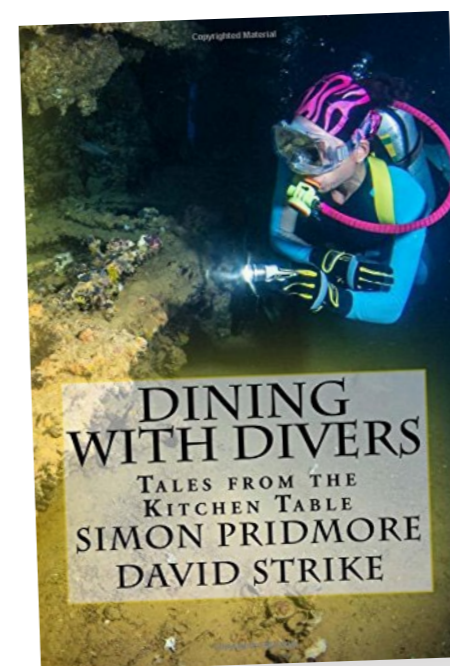


Underwater Archaeology

Submerged History: Underwater Archaeology in Florida, edited by Roger C. Smith

Discover Florida's sunken heritage in unique underwater sites and learn more about the people that came before us. Over 14 chapters written by archaeologists, this heavily illustrated book takes readers to the bottom of springs and rivers, to visit prehistoric waterfront neighbourhoods, dive wrecked Spanish galleons, slave ships and a Civil War troop transport, and study waterlogged artefacts in the lab.

Paperback: 256 pages
Publisher: Pineapple Press
Date: 7 March 2018
ISBN-10: 1561649929
ISBN-13: 978-1561649921



Divers' Tales & Recipes

Dining with Divers: Tales from the Kitchen Table, by Simon Pridmore and David Strike

This book extends an invitation to the reader to partake in dishes served up by some of the great and the good of the scuba diving world. Besides diving into delectable and varied dishes like Thai salad, Flemish stew, jellied eels and vegan cupcakes, this is also an opportunity to eavesdrop on fascinating dinner conversation, ranging from discovering shipwrecks, exploration in iceberg alley to encounters with large animals.

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ISBN-13: 978-1981262021





The Moon, Tides & Your Dive Trip

Text and photos by Brent Durand



The Passage in Raja Ampat, Indonesia, dived on outgoing tide



Porcelain crab with eggs (above). PREVIOUS PAGE: Reef in Raja Ampat, Indonesia, during optimal current

There are many factors to consider when planning your dive trip, including the marine life, travel logistics, seasonal weather, ocean conditions and distance between dive sites. This is a lot to think about, and likely the reason so many of us, especially photographers, forget to consider one of the ocean's most important processes when planning a trip—the tides.

We all know that tides are primarily created by the moon's gravity, raising and lowering the water level at the beach in daily fluctuations as the earth spins. The tides move in a pattern, making them

predictable each day and in each season. The moon phase also corresponds with this pattern; full and new moon phases create the greatest differences between low and high tide.

So, what does this have to do with our dive trip? Simply put, almost every ocean dive destination has unique local conditions that change depending on the tide and currents.

Cast spawning. First, many critters on the reef reproduce through cast spawning. These cast spawners often choose to release their contributions during the new moon phase, when there is no moonlight to illuminate the eggs floating through the water column. The new moon coincides with larger tide swings, and eggs and larvae are often released during a strong outgoing tide. This car-

ries them farther from the reef and predators, ensuring a greater chance of survival. Naturally, incoming tides help carry the eggs and larvae back into the reef to settle.

Pelagics. An incoming tide will also bring in some interesting pelagic invertebrates celebrated by black water divers and photographers.

Visibility. Tides can also control visibility. Consider diving near the edge of a small group of islands, a bay or even in mangroves. An incoming tide will bring in clear ocean water while the outgoing tide will bring brackish water with more particulate. As a wide-angle photographer, this is really important to understand. I plan most of my California beach dives for the top of high tide



Moon Tides

Anthias on a reef that is often undiveable due to current, Anilao, Philippines; Harbor seal in kelp forest during a beach dive at high tide (top right); Butterflyfish feeding on coral eggs in water column (right)

since the outgoing tide will start pulling sand into the water column.

Strong currents. In many dive destinations, you simply cannot dive during large tide swings. Strong currents might whisk you away into the ocean, while down and diagonal currents can present a serious hazard. If the #1 dive site on your list is subject to strong currents, it is best to plan your trip during a week with slack tides in order to have the best opportunities to dive the site.

That said, we also need to consider the benefits of tidal currents on dive sites. We know that the current brings nutrients, which means that when the current picks up along a

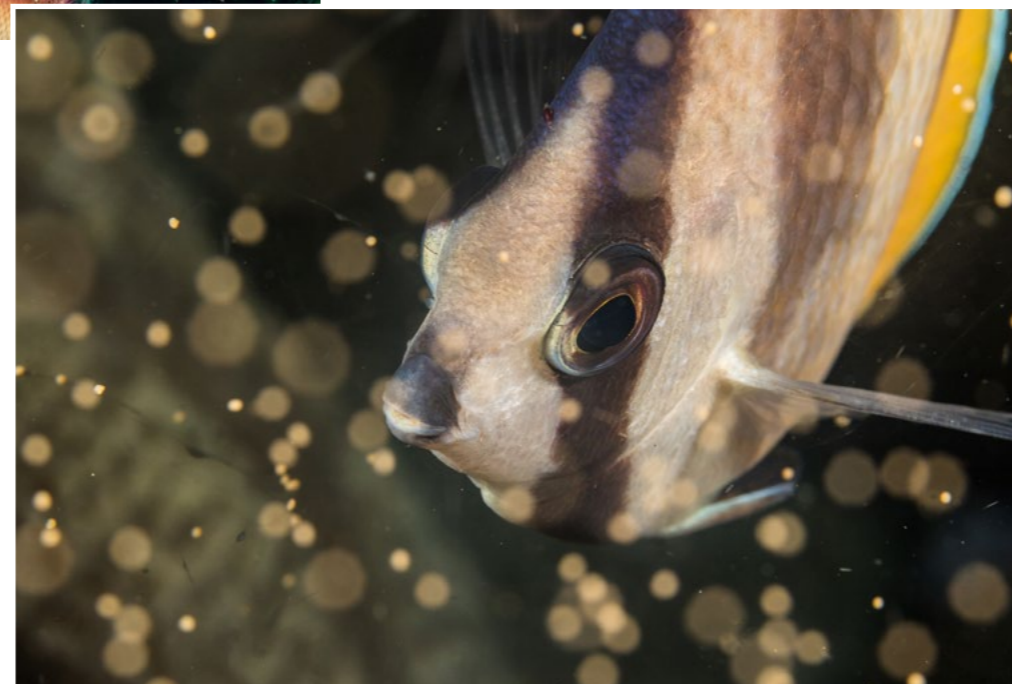
reef, the schools of fish appear. With the reef fish come larger predators like sharks and big pelagics! The key here is to make sure that the currents during your dive trip will be moving enough to bring the fish, but not so strong that reef hooks become a challenge to use. A good dive guide will be able to time the dive for optimal current.

Final thoughts

These are all important things to keep in mind and a big incentive to really look into your dive destination prior to booking a trip. Consult a travel agent, a seasoned dive traveler and/or the Internet to ensure you consider all of these factors. One thing is cer-

tain—regardless of when we time our dive trip, the Earth will keep rotating, the tides will keep moving, and the currents will keep flowing to support ecosystems around the world. ■

Brent Durand is a digital media content producer and publisher. His work covers adventure from the snow to the oceans and the marine life we find there. His photography has been published in print worldwide, in advertising and across the web in a variety of outdoor industries. He has a reputation for writing insightful yet simple camera gear reviews and speaks regularly



on photography technique, dive adventures and trends in the photo industry. He has led underwater photo workshops in the Bahamas, California, Indonesia, Mexico, the Philippines and Sri Lanka, and

has a popular monthly newsletter full of photo tips and tricks. He is also a dedicated brand ambassador for BARE Sports, Stahlsac and Kraken Sports. For more information, visit: BrentDurand.com.

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WAYNE HOGGARD NOAA/NMFS/SEFSC

Risso's dolphins

Dolphins plan deep foraging dives ahead of time

Marine mammals remember where their food sources are located and develop strategies to find and catch their meals as efficiently as possible.

Working with Risso's dolphins (*Grampus griseus*) researchers from University of Western Australia has demonstrated that the dolphins remember where their prey is, and change the depth and location of subsequent squid-seeking dives accordingly.

Like other dolphins, Risso's dolphins find prey using echolocation. They prefer to feed near coasts, but not in the shallow waters. Rather, they like the deeper offshore water where their favourite food—squid—tends to hang out most.

Fitting recorders

The scientists equipped some of the mammals with sound-and-

motion recording tags to reveal where they focus their attention through their externally observable echolocation and how they fine tune search strategies in response to expected and observed prey distribution. When they analysed the dolphins' behaviour, they noticed that the dolphins seemed to pull information about previous dives into their next.

Planning ahead

At the start of the dives, whales adjusted their echolocation inspection ranges in ways that suggest planning to forage at a particular depth. Once entering a productive prey layer, dolphins reduced their search range comparable to the scale of patches

within the layer, suggesting that they were using echolocation to select prey within the patch.

As soon as they started swimming down, the animals started echolocating at a frequency corresponding to the depth at which they encountered most squid during the dive prior. Then as they swam back to the surface for another breath, the dolphins kept up their clicking, even though they were not hunting.

It was as if they were seeing what prey might be out there and the dolphins then adjusted their strategy on the next dive to accommodate any information they had gathered. ■ SOURCE: JOURNAL OF EXPERIMENTAL BIOLOGY

Climate change forces beluga whales to dive deeper and longer to find food

The Arctic has warmed two to three times faster than the global average, and unprecedented reductions in sea ice in the Arctic have a clear impact on animals such as polar bears that rely on frozen surfaces for feeding, mating and migrating. The loss of sea ice also has a profound effect on population-specific habitat and behaviour of a migratory Arctic cetacean—the beluga whale.



A pod of beluga whales in the Chukchi Sea

According to a new analysis led by University of Washington researchers, beluga whales that spend summers feeding in the Arctic are diving deeper and longer to find food than in earlier years, when sea ice covered more of the ocean for longer periods.

Climate change is fundamentally altering habitats

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Two periods

The researchers analyzed migration data collected intermittently from two different periods—referred to in the paper as “early” and “late”—for two be-

Effect on dives

Sea ice loss appears to affect how the Chukchi belugas dove for their food. During the later period, when there was less sea ice, the whales dove significantly longer and deeper than in the earlier period—presumably in search of prey as the animals, in turn, changed their habits because of different ocean conditions brought on by sea ice loss.

Specifically, during the earlier period belugas dove for 20 minutes or longer only once per day, compared to nearly three times a day during the later period. Similarly, their average daily dive depth increased from about 50 meters (164 feet) to 64 meters (210 feet) between the two periods.

The belugas might be diving longer and deeper to follow prey that has dispersed or been driven deeper itself from changing ocean conditions. It's also possible that feeding opportunities are actually better for belugas in an ocean with less sea ice. ■ SOURCES: BIODIVERSITY RESEARCH AND UNIVERSITY OF WASHINGTON





Yellow clownfish perches in a fold in its host anemone.

Text and photos
by Steve Rosenberg

Anemonefish are aptly referred to as “clownfish” because of their swimming behavior. It is interesting to note that the different varieties of clownfish exhibit very different characteristics. Some are shy homebodies, some can be very aggressive, and some even share their host anemones with other species. My observations of anemonefish have taken me to dive destinations all over the Indo-Pacific, including Australia, the Philippines, Indonesia, Micronesia and Fiji. In these areas, there are a wide variety of anemonefish to observe and photograph.

The entire Indo-Pacific region abounds in unique and beautiful varieties of vertebrate marine

life. Scuba divers from all over the world are drawn to the Indo-Pacific by the excitement and diversity found beneath the surface of the ocean. However, the diminutive anemonefish are identified with

this area perhaps more than any other species of fish, and are perhaps most often the photographic subject used to stimulate an interest in diving there.

In nature, anemonefishes, or

clownfishes, are always found in close association with large sea anemones, which in turn are found on relatively shallow coral reefs. It is the symbiotic relationship between the fish and anemo-

nes that has made this species of fish of particular interest to the scientific community.

Characteristics & behaviors
In all, there are approximately 27

different species of anemonefishes, which are found living with some 13 different types of anemones. In the wild, adult clownfishes are never found without an anemone. They spend most of their time

The Clowns of the Ocean

— *Anemonefishes of the Indo-Pacific*





swimming in and around the tentacles of the anemones, laying their eggs beside the anemones and rarely venturing far afield. When alarmed, anemonefish will take shelter amongst the anemone's tentacles. These fishes develop a special mucous layer over their bodies that protects them from the dangerous stinging nematocysts that are contained in the tentacles. In exchange for this protective shelter, anemonefishes feed, oxygenate and remove waste material from their host anemone. It is believed that some of these anemonefishes will also protect the anemones from natural predators such as butterflyfishes.

The anemonefishes are small brightly colored fishes. Their colors range from hues of brown, orange, pink and red with one or more bars or stripes of black,

white or light blue for each individual species. These fish swim with a distinctive rising and falling tilting motion, which has earned them their common nickname, "clownfish."

A few of the most common species of anemonefishes, which are found in the Indo-Pacific areas, are the red and black anemonefish, *Amphiprion melanopus*; the orangefin anemonefish, *Amphiprion chrysopterus*; the pink anemonefish, *Amphiprion perideraion*; the yellowtail clownfish, *Amphiprion clarkii*; and the ocellaris clownfish, *Amphiprion ocellaris*.

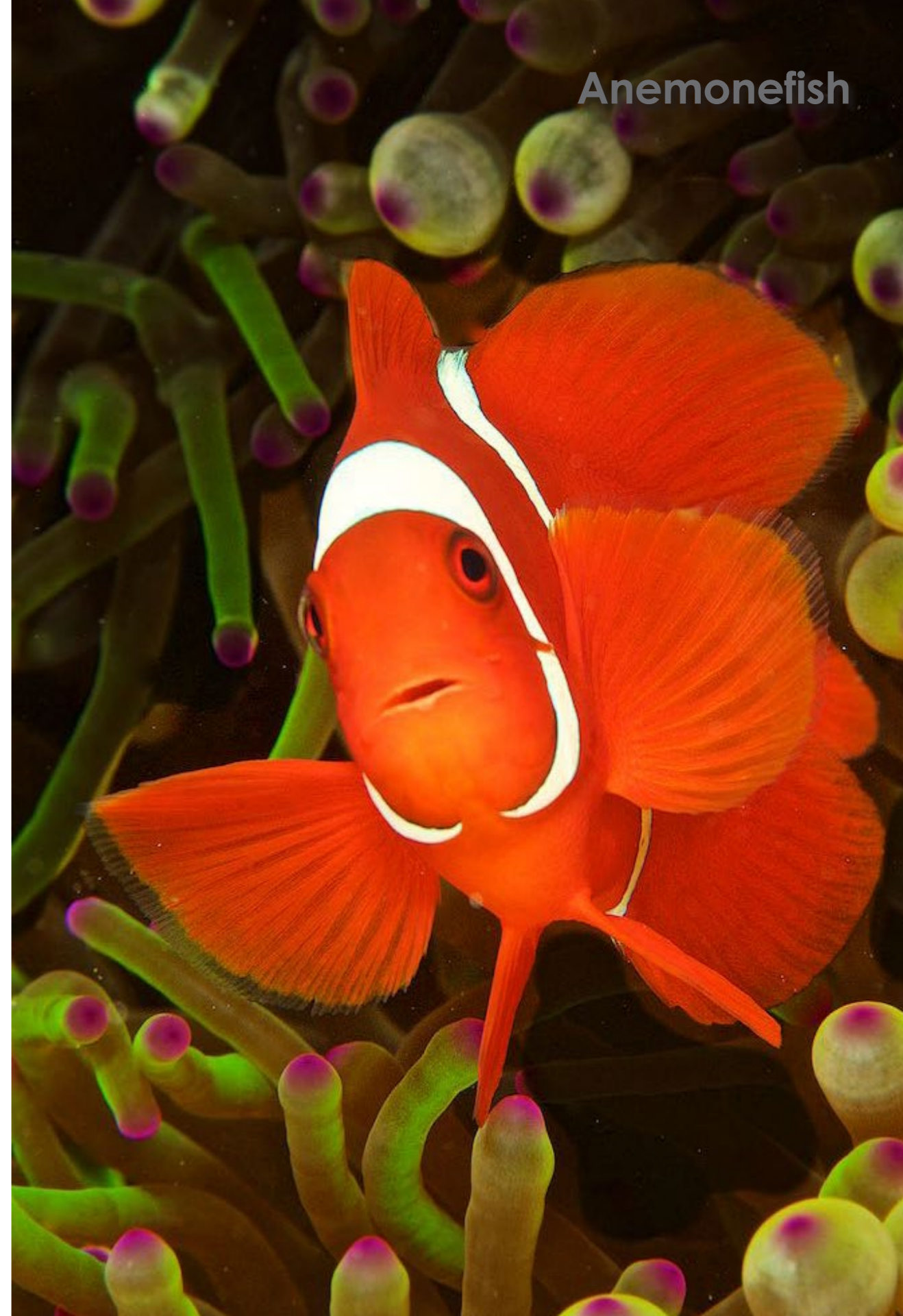
Symbiosis

Except for a brief larval period, during which it simply drifts among plankton in the water column, anemonefishes are rarely found without a host anemone.

Such a relationship between two very different types of animals is known as symbiosis, or "the situation where two species of organisms live together in a union that is beneficial or necessary to both." It is this fascinating relationship between fish and anemone that attracts the most interest.

Sea anemones are members of the phylum referred to as Cnidaria or Coelenterata, which include a large and varied group of relatively simple, yet versatile, marine animals, armed with microscopic harpoon-like stinging capsules known as nematocysts or stinging cells. Sea anemones possess hundreds of tentacles, and they can sting prey by releasing venom through these tentacles.

Divers who have come in contact with burning fire coral or stinging hydroids are certainly aware that the nematocysts



Juvenile spinecheek anemonefish (above) have two vertical white stripes and a visible spine that extends into the middle of the forward stripe; Family of ocellaris clownfish (top left) nestle into the tentacles of their host anemone.



Pink anemonefish (left) is easily recognizable by its vertical white lines as well as a horizontal white line; Red and black anemonefish closely resemble tomato clownfish except that their sides are mostly black (above)



Yellowtail clownfish, or Clark's anemonefish, are one of two species of clownfish that will swim in the water column sometimes six feet over their host anemones

are discharged when stimulated by the contact of other organisms. The nematocysts are especially dense on the surface of the anemone's tentacles. The sea anemone, which is carnivorous, seizes and immobilizes its prey with these stinging tentacles and then uses the tentacles to pass the victim to its mouth. It is very interesting that the anemonefishes flourish in this inhospitable environment that is so deadly to other fishes.

Anemonefishes, like all other fishes, have a layer of mucus covering their skin that prevents the anemones from stinging them. The mucus layer of the anemonefish is thicker and chemically different than the mucus covering of other closely related fishes, which do not live with an anemone. It is believed that this covering is acquired by the anemonefish during its initial contact with its host anemone. Presumably, the anemone alters the

mucus covering of the fish, or adds to it in some way, so that it serves as a type of cloaking device for the fish. It is believed that mechanical stimulation alone is not enough to trigger the firing of the nematocysts, but that it has to be a combination of contact together with a certain chemical stimulation. Thus, the anemonefish avoids being stung because the anemone, chemically speaking, does not know it is there.

Biology and breeding

Anemonefish begin their lives as males and then undergo a complete physiological change in their reproductive organs, thereby becoming females. Although the change is physiological, it is brought about by social signals within the family of anemonefish living in a single anemone. Anemonefish are monogamous, with each anemone inhabited by

only one adult spawning pair of a given species. The female is usually somewhat larger than the male.

Usually, there is only one species of anemonefish inhabiting a single anemone, although pink anemonefish are occasionally observed living with a variety of other anemonefish. On numerous occasions, I have observed yellowtail clownfish, *Amphiprion clarkii*, sharing their anemone with an adult pair of pink anemonefish, *Amphiprion perideraion*. The pink anemonefish are smaller and appear much less aggressive than the yellowtail clownfish. The pink anemonefish tend to hide behind the anemone when threatened with danger, whereas the yellowtail clownfish will aggressively protect their host anemone. This is also true of other species of anemonefish such as the saddle-back anemonefish, which will often boldly confront and nip at divers.

Dive and Travel Galapagos



The Complete Guide to Dive Sites, Land Tours, Wildlife & Travel Basics Throughout the Archipelago

By Steve Rosenberg and Greg Bassett



Dive and Travel Galapagos is the latest in a series of informative dive guides by Steve Rosenberg. The 2017 NATJA Gold Medal award-winning e-book provides detailed descriptions of 47 of the most popular dive sites and dozens of land tours throughout the archipelago. The guide also contains practical information on travel basics and some of the fascinating wildlife that visitors will encounter. This electronic interactive guide has many useful features and can be used as a travel log, allowing you to add your own comments and notes. It contains hundreds of high resolution images and several videos of what you will experience on land and in the sea. Available on iTunes, Google Play and Amazon. Download it today!

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The saddleback clownfish (above) is the most aggressive clownfish toward divers; Pink anemonefish (right) tucks in close to the protective tentacles of its host anemone; Tomato clownfish (left) have an oval body with a vertical white stripe just behind their eyes.

When juvenile anemonefish reach maturity, they search for an unoccupied anemone. If, however, something happens to the female, the breeding male undergoes a physiological sex change by becoming the breeding female, and the largest juvenile quickly becomes the breeding male.

It is easy to see the benefits of the anemonefish having both male and female sex organs. They are confined to their protective anemone

of breeding female if something happens to one of the adult pair. Thus, there is always one female and a dominant male, and this maintains a stable social structure among the fish living in one anemone.

Nesting

Anemonefish are nest builders. The pair of spawning adults selects a nest site on the substrate, next to the base of their host anemone. The fish will actually nip at the bottom edges

and tentacles of the anemone to get it to retract so that the nest site may be exposed and cleaned. The eggs in the nest are mouthed and fanned by the adult male during the incubation period.

In Fiji, I recently observed a pair of orange-fin anemonefish tending to the nest site laid on the substrate next to the host anemone. There were four fish in the one anemone: two adults and two smaller juveniles. The anemone itself was approximately 20 inches in diameter. The female, measuring approximately four or five inches in length, confronted divers three to four feet from the anemone and made loud clucking noises. On numerous occasions,

both adult fish left the vicinity of the anemone to try to drive the divers off.

Once, I observed the larger fish actually biting air bubbles. Even when the divers swam away from the anemone, the adult fish patrolled an area, which was much larger than the actual size of the anemone, sometimes swimming as far as six to eight feet from its protection. The second largest of the pair, which I presume was the male, was most attentive to the nest site, guarding it against intruders and keeping it cleaned. He seemed reluctant to stray far from the nest and the protection of the tentacles of the host anemone. Each time the male



Orangefin anemonefish can frequently be seen high in the water column, well away from their host anemone



away from their host anemone to chase or confront divers. It is not unusual to have them nip at the tips of your fingers to the point of drawing blood. Saddleback clownfish usually inhabit anemones that can be found on flat sandy areas, away from the main reef structures.

reached the area of the nest, he would appear to either nip at the substrate around the nest or mouth one or more of the eggs.

One of the most aggressive species is the saddleback anemonefish, *Amphiprion polymnus*. When they are protecting their eggs, they will swim up to 10ft

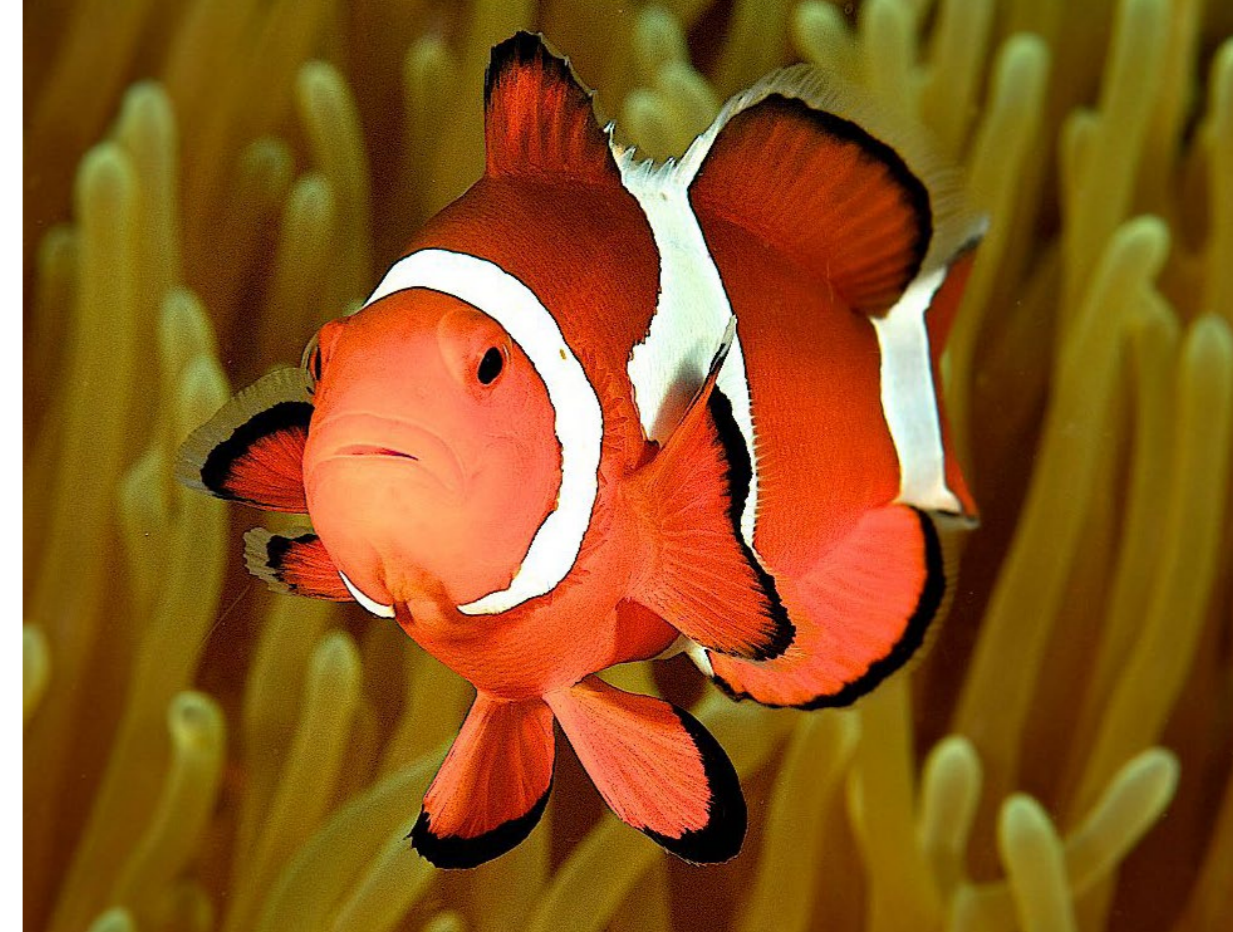
anemonefish derive many benefits from their association with the host anemone. They are generally poor swimmers, and would probably not do well outside the protection of the anemone's tentacles. In addition to enjoying protection from its enemies, the anemonefish also feeds on leftover portions of

the anemone's meals and waste material. The alterations to its mucus covering brought about by its interaction with the anemone may also make it more resistant to skin diseases and parasites. What is not so apparent is what benefits are derived from the relationship by the anemone. In most cases, however, while the anemone's association with the clownfish may be of some help, it is certainly not necessary to their existence.

Photographing anemonefish often poses problems because the fish often appear to be constantly moving and hiding. However, if you take your time to observe a family of anemonefish, you will often notice that they swim in patterns. Also, as they get used to your presence, they will eventually no longer perceive you as a threat and let you get closer.

While diving in the Indo-Pacific, I have observed numerous marvelous species of anemonefishes and casually observed many

Ocellaris clownfish (right and left) will often repeat their swimming patterns around the anemone, making it possible to photograph them by anticipating their movements; Saddleback clownfish (lower left) exposes rows of sharp teeth; Diver with pink anemonefish (lower right)



of their idiosyncrasies. Nature once again has outdone herself in creating such a truly beautiful and interesting animal. Marine biologists have only scratched the surface in learning about these fishes. I look forward to seeing more varieties of these special animals and watching their antics, which clearly give rise to their reputation and appellation as the clownfish of the oceans. ■

A professional underwater photographer and photojournalist since 1980, Steve Rosenberg has produced over 20 destination guide books in print for international publishers including Lonely Planet, Cruising Guides and Aqua Quest Publications; as well as hundreds of articles for US and international publications. With thousands of his images appearing in books and magazines worldwide, Rosenberg has won 250 awards for his imagery in international competitions. He is an active member of the Society of American Travel Writers (SATW) and the North American Travel Journalists Association (NATJA). In 2013, Rosenberg assembled a new team of professionals for the purpose of producing interactive e-books to be used as scuba and travel guides, as well as powerful



marketing tools for destinations, resorts and liveaboard operations. The most recent guide is Dive and

Travel Galapagos, which was released in August of 2017. Visit: Rosenbergebooks.com.





squid tales

Edited by Peter Symes

How octopus and cuttlefish change their skin tone and texture

The colour and pattern changing abilities of octopus, squid and cuttlefish via chromatophore neuromuscular organs are unparalleled. When this system is expressed, dermal bumps called papillae disrupt body shape and imitate the fine texture of surrounding objects. But how do they do it?

Cephalopods can swiftly and reversibly morph their skin into a textured, 3D surface, giving the animal a ragged outline that mimics seaweed, coral or other objects it detects and uses for camouflage.

Scientists have puzzled over this extraordinary ability for years, but marine biologists are now a step closer to understanding the neural and muscular mechanisms that enable octopus and cuttlefish to erect 3D spikes out of their skin, hold them for an hour, then quickly retract them and swim away.

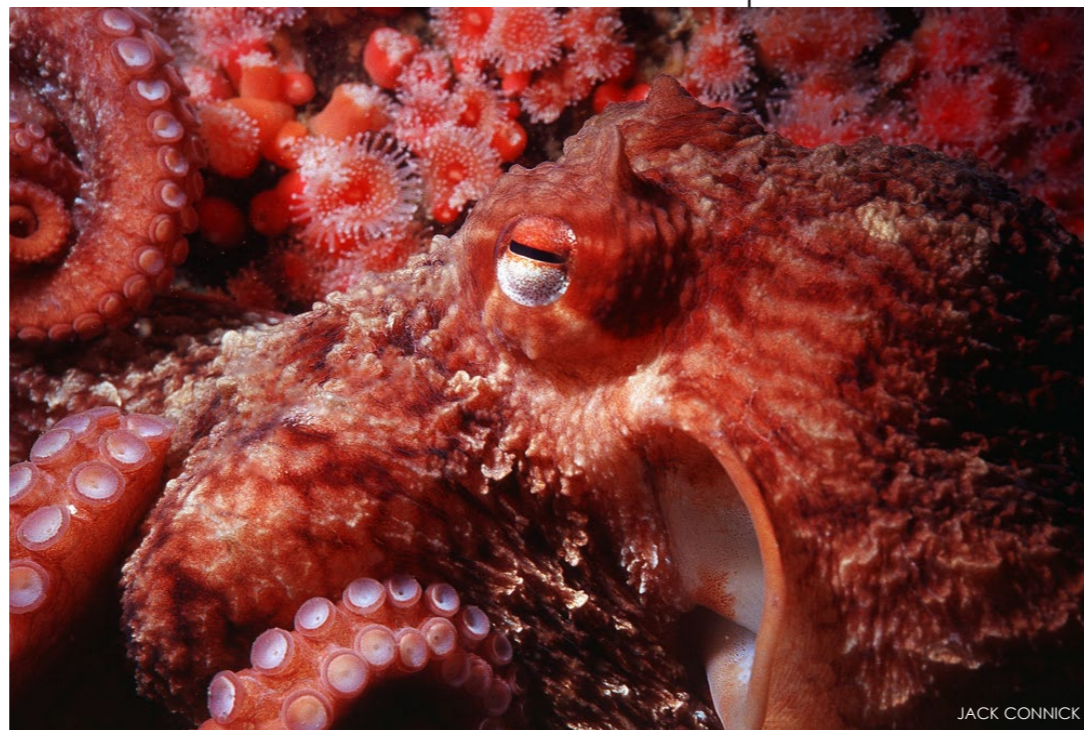
Researchers observed that cuttlefish can hold their papillae in the extended position for more

than an hour—and without the use of neural signals to hold them in place.

Tension without energy

This sustained tension, a team of researchers found, arises from specialized musculature in papillae that is similar to the “catch” mechanism in clams and other bivalves.

“The catch mechanism allows a bivalve to snap its shell shut and keep it shut, should a predator come along and try to nudge it open,” said corresponding author Trevor Wardill, a research fellow at the University of Cambridge and a former staff scientist at the University of Chicago’s Marine Biological Laboratory. Rather than using energy to keep the shell shut, the tension is maintained by smooth muscles that fit



JACK CONNICK

Giant Pacific octopus is widely distributed across North Pacific, ranging from California to Alaska to Russia and Japan.

like a lock-and-key, until a chemical signal (neurotransmitter) releases them. A similar mechanism may be at work in cuttlefish papillae, the scientists found. This means that energy and mental effort is not required by the cuttlefish to keep these spikes erect.

■ SOURCE: UNIVERSITY OF CHICAGO

New species of giant octopus discovered

New research indicates the world’s largest octopus—the giant Pacific octopus—is actually at least two species. The new species is called the frilled giant Pacific octopus.

This discovery is not a total surprise. Scientists have suspected for decades

that giant Pacific octopus might be an “umbrella name” covering more than one species. The newly documented frilled giant Pacific octopus was found by marine biologists from Alaska Pacific University, who noted that some of live octopuses that were snared as bycatch in shrimp pots looked quite

different. They had frills all over their mantles, strange eyelash-like protuberances, and two white spots on the front of their heads, whereas the typical giant Pacific octopus has only one.

Genetic tests confirmed that, indeed, these cephalopods were genetically distinct from the giant Pacific octopus in the scientific literature. ■ SOURCES: AMERICAN MALACOLOGICAL BULLETIN, ALASKA OCTOPUS PROJECTS

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Edited by
Catherine
GS Lim



The cockeyed squid

KATE THOMAS

Histioteuthis heteropsis or "strawberry squid"

When it comes to looking for prey, the cockeyed squid (*Histioteuthis heteropsis*) pretty much has the best of both worlds. With one normally sized eye and the other eye that is much larger and bulges out of its socket, the squid admittedly looks rather strange.

Also known as the strawberry squid, they live in the mesopelagic or twilight zone of the ocean, some 200 to 1,000 metres below the surface. They drift through the sea in a near-vertical orientation, with its head "pointed" downwards, with its larger eye directed slightly upwards and its smaller eye directed slightly downwards.

Hunting strategy

It turns out that their mismatched eyes are actually an ingenious hunting strategy.

This was what Duke University biologist Kate Thomas discovered when she started investigating the purpose of the mismatched eyes. So she reviewed more than 150 videos of cockney squids collected by the Monterey Bay Aquarium Research Institute. It was then she realised that the squid's eyes had evolved to its present state so as to take advantage of the two different sources of light available in the deep sea, where the squid lives: The large eye is adapted for gazing upwards, looking for the shadows of animals against the sunlight. The small eye, on the other hand, gazes slightly downwards looking for flashes of bioluminescence.

A paper about the discovery

was published in the recent issue of *Philosophical Transactions B* journal.

Eye design

"The deep sea is an amazing natural laboratory for eye design, because the kinds of eyes you need to see bioluminescence are different from the kinds of eyes you need to see the basic ambient light," said senior author Sönke Johnsen, Professor of Biology at the university.

"The eye looking down really only can look for bioluminescence. There is no way it is able to pick out shapes against the ambient light. And once it is looking for bioluminescence, it doesn't really need to be particularly big, so it can actually shrivel up a little bit over generations. But the eye looking up actually does benefit from getting a bit bigger," he added. ■ SOURCE: DUKE UNIVERSITY

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opinion

Text by Mike Ange

Is diving safe? This is a question as old as the sport itself and the potentially accurate answers fill an entire spectrum of responses. Over the past 17 years, I have studied this question intently, publishing numerous case studies and articles in addition to several books. In the last third of that period, this study was for the purposes of an academic paper in a degree program. Here is the definitive answer: It depends.

Diving is no doubt one of the safest of the adventure sports in terms of the occurrence rate of injury. Diving is also deadly. When we isolate incidents resulting in injury as compared to other sports, you are more likely to die from a serious diving injury than you are from most other injuries occurring in many other sports. The funny thing about statistics is that they are like a wetsuit: What they cover up can be just as interesting as what they reveal.

Perhaps a better question is: What can be done to make the sport safer? Regardless of how safe our sport is today,



Analyzing the Obvious:

It's About Anticipation

few would argue that reduced rates of injury or death would be a good thing. Many proponents of more regimented or more rigorous training will say that training is the key. Training agencies struggling to stay afloat in an increasingly competi-

tive marketplace strive to balance the ease of access to the sport with some ever-shifting perception of safety. Neither party is correct; they are merely somewhat opposing viewpoints.

Examining the facts

Tracking two groups of over 100 divers over two separate 10-year periods of diving supports the theory that accidents are statistically insignificant in our sport. Roughly half of these divers were trained

using an older, more regimented and most would argue more rigorous training regimen. The other half were trained after a significant shift in training standards that occurred in the 1990s, resulting from an effort to lower the bar to allow more

PETER SYMES





Anticipation

diving. The dropouts in the short training group averaged less than 10 dives, with many never completing a fifth dive in their short diving careers.

Lack of comfort zone

The reasons for the lack of comfort zone are much more difficult to ascertain, and in fact, come down to only educated opinions that are hard to validate reliably. In my opinion, divers are uncomfortable diving because they lack an ability to anticipate.

Human beings are comfortable doing what they know. We are comfortable responding to situations with known outcomes. If we drive, we are comfortable in our ability to create cause and effect in our control of the automobile. If

we hit the brake, we stop before striking the car that stops in front of us; if we accelerate, we move out of the path of an oncoming vehicle; and if we turn the wheel, we can follow a safe course with our vehicle. We may become overconfident, or too comfortable, and certainly that creates a risk of accident and injury. But overconfidence will almost never stop a driver from sitting behind the wheel.

Now imagine taking the wheel but not knowing what each pedal will do, which one stops you and which one makes you go. Imagine a world where every country used a different standard for automobile manufacturing. Some placed the clutch in the middle, some on the right. Some placed

divers to come into our sport.

The number of divers involved in accidents from the study is insignificant in each population and none of those accidents were fatal. In fact, over the two 10-year periods tracked, more divers were removed from the study as a result of cancer, heart disease and automobile accidents than diving—by far. However, an interesting fact resulted from the research that was not an anticipated outcome, and this result does in fact relate to the health of diving—not the individual health of the diver, but the health of the sport itself.

In this limited study, there was a direct correlation between the dropout rate of divers and the type of training received. Follow-up interviews linked the reason for diver drop out to the diver's comfort zone.

Instructors from nearly every training agency use materials that discuss the diver's comfort zone and the importance of diving within that comfort zone. However, it seems that in at least some cases, we may not be creating a comfort zone large enough to allow some divers to participate at any meaningful level in our sport.

Indications are that divers in compressed training programs with fewer skills required are 30 percent more likely to leave the sport than those in the longer more traditional programs of old. While it is tempting to link this dropout rate to other issues—like competing sports, economic indicators and more nebulous indicators like the “mindset of the millennial” diver—in truth, the divers themselves linked their own exodus from the sport to “being uncomfortable”, feeling “threatened by the environment”, or as one said, being “afraid I would die during every

minute of my dives.”

These responses do not engender a vision of competently-trained divers operating within an established comfort zone. The dropouts from the earlier training group cited a number of other reasons, including the requirements of marriage and family, jobs, economics and proximity to good diving as they aged. Not one person from this group cited a belief in his or her capabilities as a diver among the causes for dropping out, except for those that had a significant medical event that left them medically unfit for



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opinion

the throttle control on the left and others in the center. Some brakes are foot brakes and others are on the wheel. All of the controls are shaped differently and it is up to you to determine which one is which and how it works. In short, you have no ability to anticipate the outcome of activating any control. Would you feel safe hop-

ping onto a high-speed motorway directly out of the rental car lot, or would you require some time to get accustomed to how the car will respond?

To a much lesser extent, many of us experience a similar situation when traveling between countries that drive on the right and those that drive on the left of the

motorway. Even though the function and orientation of the controls is the same, this seemingly minor change shakes our ability to anticipate the outcome of our actions, even though we have a solid frame of reference for those same actions—just on the other side of the road and perhaps the other side of the car.



The new diver

Now as experienced divers, let us step back and examine how we all started in the sport. Our new diver: is encapsulated in bulky unfamiliar equipment; her head is filled with her parents' warnings about falling into the pool as a child; his memories include news reports of drownings, perhaps recent drownings, perhaps a diver drowned. That first breath underwater is—AMAZING—and over 90 percent of them will love it.

Then they try to interact with those new and alien surroundings, but nothing works, as it should. Gravity is now a fickle mistress that cannot be relied upon. Your feet do not propel you as they did in your comfortable surface world, and the very process of breathing—something you do about 1,000 times an hour in your world—now feels alien.

Every single diver experiences

these sensations the first time they breathe underwater, and every single one responds to it differently. The athlete, the swimmer, those that have experiences like military training, will immediately embrace the differences and they will adapt quickly. Others may have a fear of the water, perhaps even an irrational fear. I have had students enroll in dive classes as a way to overcome those fears. In between these two groups, there is an entire spectrum of potential divers, and they all have one thing in common: To feel comfortable in the water, they need time to adapt, and positive reinforcement from a competent coach.

The amount of time and coaching required will vary dramatically, but it is still required. In short, these divers need practice, and the more time we allow for practice, the more comfortable they will become in a pool-like environment.

Transition to open water

The transition to open water also opens the mental images of great wonders, and for many new divers, a fear of astounding horrors. Take away the diver's sight with poor visibility, and we increase the feelings of the unknown. Add a limited background knowledge of the environment, and we expand the fears again.

Most instructors have seen divers that are extremely competent in confined water drills but revert immediately to bad habits and lose control in the open water. If you think about it in these terms, this is understandable. Stress degrades even the most practiced skills, much less those that may be rushed and compressed into a three-day open water class. The diver once again has no ability to anticipate the outcomes of his or her actions, and this can make the transition



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Anticipation

should be fun, so take your time to enjoy it.

- And never hesitate to let your instructor know if you need more time.

- You should plan a minimum of about 8 hours of your time to complete the academic modules whether home study, classic instruction or a mix.

The next article in this series will address how the ability to anticipate aids in problem solving, even if the problems cannot possibly be anticipated. We will discuss what drills can be used within the restrictions of modern training to improve problem solving ability and therefore expand the diver's comfort zone. ■

- Planning about 12 hours for water sessions (including deck time) is a good start point, but be prepared to extend if you need the time.

Mike Ange is an American author and photojournalist, lecturer, instructor trainer, advanced diver medic (International Board of Undersea Medicine), and USCG Licensed Master. He has served as contributing author and technical editor for Scuba Diving Magazine, Diver Down and SEAduction.com.

both a challenge for the instructor and an absolute horror for some divers.

The good instructor will be patient, will positively reinforce and most importantly will be willing and able to invest the time to allow this transition to occur as naturally as possible. This is how we expand the comfort zone.

Many of us have seen student divers passed through courses where they met the skills standards, but it was apparent that they were terrified though the entire process. Statistics in the real world verify what the best instructors have always known: A student who passes a dive course in this manner is not really a diver at all and is very unlikely to ever be a diver.

It is a long-held tenant in business that it is easier and cheaper

to keep a customer than it is to recruit a new one. So, not only are these minimum practices bad for the prospective diver, they are also bad for the instructor, the facility and the sport itself.

Pre-planning fixes

Fortunately, these are easy issues to address with a little pre-planning.

As a facility owner or instructor:

- Never plan courses to the minimums, in terms of time and instructor resources. In 80 to 90 percent of all classes, you will need to extend this time to address the needs of every student.
- Allow for a little one-on-one time for students who need special attention.

- Be observant and never depend on the student to tell you when he or she is struggling.

- Be proactive and step in to provide the assistance needed. An uncomfortable diver may not be statistically a higher safety risk, but they will never be a loyal customer, so invest the time and effort in our sports greatest asset!

As a potential student diver:

- Avoid facilities that focus on how "quickly" you can be certified. It may sound good in terms of balancing the pursuit of diving with your other activities but planned "quick" classes are in reality ineffective if that is the sole focus.
- Additionally, remember this is a sport and even the training



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Oxygen Toxicity for Divers

Sponsored content by DAN

Oxygen toxicity is a serious topic, but one that many divers struggle to understand. We know that calculating oxygen exposure is important to our safety, but we may not know why or what happens if we exceed the safe exposure limits.

Following training guidelines and conservatively planning our dives can reduce our risk somewhat, but learning how oxygen toxicity affects us and how we can prevent it can mean the difference between a fun dive and one that ends in injury. Push back against complacency and unquestioning acceptance of common practices—understand the effect of oxygen on your body before you plan your next dive.

What is oxygen toxicity?

Inappropriate oxygen exposure can have many negative effects on the body, but there are two primary types of toxicity that affect divers. The first is pulmonary oxygen toxicity. This type of toxicity is of concern only to divers doing very long technical dives (in the range of six to 12 hours) and divers doing repetitive technical dives over a period of days or weeks. Pulmonary oxygen toxicity typically begins with

inflammation of the upper airways that then spreads to the lungs. Manifestations of pulmonary oxygen toxicity include alveolar collapse and damage, decline in lung function and acute respiratory distress syndrome (ARDS).

Central nervous system (CNS) oxygen toxicity is a more pressing concern for most divers because it can arise suddenly and cause seizures. CNS oxygen toxicity can occur with very short exposures to significantly elevated partial pressures of oxygen, and divers should be careful to calculate

and respect both their depth and exposure time with a chosen breathing gas. Extreme exposures to oxygen can have various other effects including hyperoxia-induced myopia, a condition which affects vision, but these are less common and rarely life-threatening.

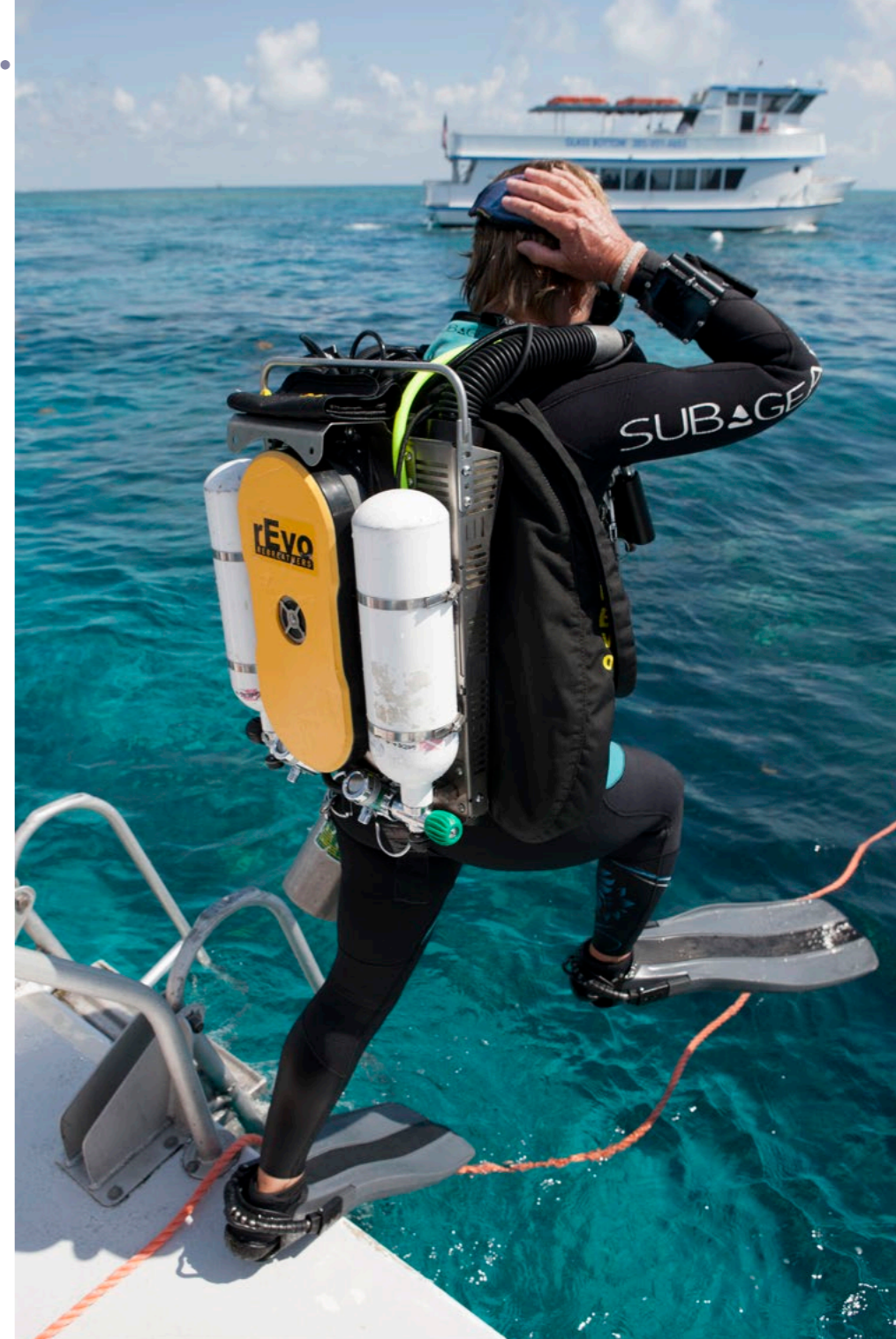
Understanding how oxygen acts in the body to cause these problems requires an understanding of the human nervous system. The nervous system comprises two opposing sides, the sympathetic and parasympathetic. Every

organ in the body is controlled by one of these sides or a facet of their interaction. As a rule, the sympathetic nervous system activates the body and prepares it for action, while the parasympathetic nervous system calms it down to promote recovery. In the central nervous system, the complex of tissues that makes up the brain and spinal cord, nitric oxide (NO) is used to decrease the activity of the sympathetic nervous system and widen the blood vessels. Normally, some but not all of these

NO molecules bind with reactive oxygen species (ROS), which are byproducts of metabolism. The remaining NO molecules are available to control the sympathetic nervous system. When the body is exposed to too high a partial pressure of oxygen, all NO molecules can be occupied by ROS, with none left to control the sympathetic nervous system. Sympathetic activity becomes extreme, and the body releases enormous quantities of adrenaline and noradrenaline in a reaction called an adrenergic storm. This storm can cause seizures, narrowing of arteries and spiking of blood pressure and heart rate and may lead to capillary damage and compromised gas exchange.

Who is at risk?

Divers using nitrox, rebreathers and oxygen as a diving gas are at risk for oxygen toxicity. Exceeding depth limits while diving on oxygen or nitrox, failing to correct a rebreather failure and making an inappropriate gas switch that results in a high partial pressure of inspired oxygen can each quickly put a diver at risk of CNS oxygen toxicity. Mitigating these risks is not difficult but takes some preparation. Understanding—and complying with—training guidelines for switching gases at depth, calculating breathing-gas maximum operating depths (MODs), and



responding to rebreather failures can effectively minimize your risk of an incident. It is critical to accurately plan your oxygen exposure for both your primary and backup dive plans, and to practice responding to rebreather failures. Also keep in mind that in the event of an injury requiring recompression, you will require additional oxygen exposure. Fortunately, CNS oxygen toxic-

ity in a hyperbaric chamber is not particularly dangerous since there is no risk of drowning, but planning your oxygen exposure to include a recompression treatment is a worthwhile way to mitigate a potential hazard to your health.

For more information on oxygen toxicity, visit DAN.org/Health





Text by Mark Powell
Photos by Andrey Bizyukin

In a previous article, I discussed some of the various definitions of learning, and focused on the following definition: Learning is a permanent, observable change in behaviour. Specifically, the article explored the second part of the definition and the learning outcomes that can be used to pin down the observable change in behaviour, which we are looking for. In this article, we will switch back to the first part of the definition: “a permanent change.”

If our definition of learning assumes that learning involves a permanent change in behaviour, then how long is permanent? If a change occurs, but it disappears as soon as the student leaves the class, then did they learn? I think most people would say no. If they retain that change for four hours, would we say that was “permanent” and they have learnt? What about four days, or four weeks, or four months?

This is a fundamental problem with most scuba training. We do not look for permanent change. If the student can

perform the skill right now, then we tick off that skill on a checklist and move on to the next. There is no consideration as to whether they will be able to perform the skill in a week or a month or under stressful situations.

In addition, many scuba classes are structured to be taught in convenient four-day blocks. The instructor dutifully presents the materials, and then tests that the student has understood it. The instructor gives the students a chance to prac-

tise the skills or knowledge, and at the end of the course, the instructor checks that they have retained the knowledge and can perform the skills. After all this, the student and instructor are confident that the instructor has done a good job

and the student has learnt. However, we can now see that if it is a permanent change we are looking for, then we are wrong to say that the student has learnt. It is only if the student retains this information permanently that we can say they



Permanent Change *When Have We Learnt?*



have learnt.

This means that a scuba course, whether it is an initial open water course or a more advanced technical diving course, is just one part of the learning process. Both instructors and students must realise that the end of the course is just one step on the way to total learning.

The forgetting curve

This may be revolutionary for some parts of the diver training industry, but it should not be a surprise. Teaching theory has recognised this for many years. In 1885, German psychologist Hermann Ebbinghaus described what he referred to as the forgetting curve. This refers to the fact that information is lost over time when there is no attempt to retain it.

The forgetting curve is shown in the diagram below. This shows

that even if the student has 100 percent retention after being taught a topic, that retention will rapidly fall over time before levelling off at a much lower level. Most instructors will be familiar with the experience of teaching students and getting them to retain an idea or a concept, only to find that when they return to it the next day, the students have forgotten the concept.

You can see that over time, only 20 percent of the information or skills are retained. This is a frightening statistic when you consider that most of the topics in any diving course are in there because they are considered essential. If only 20 percent of the information or skills are retained, that means that 80 percent of that essential information and skills has been lost.

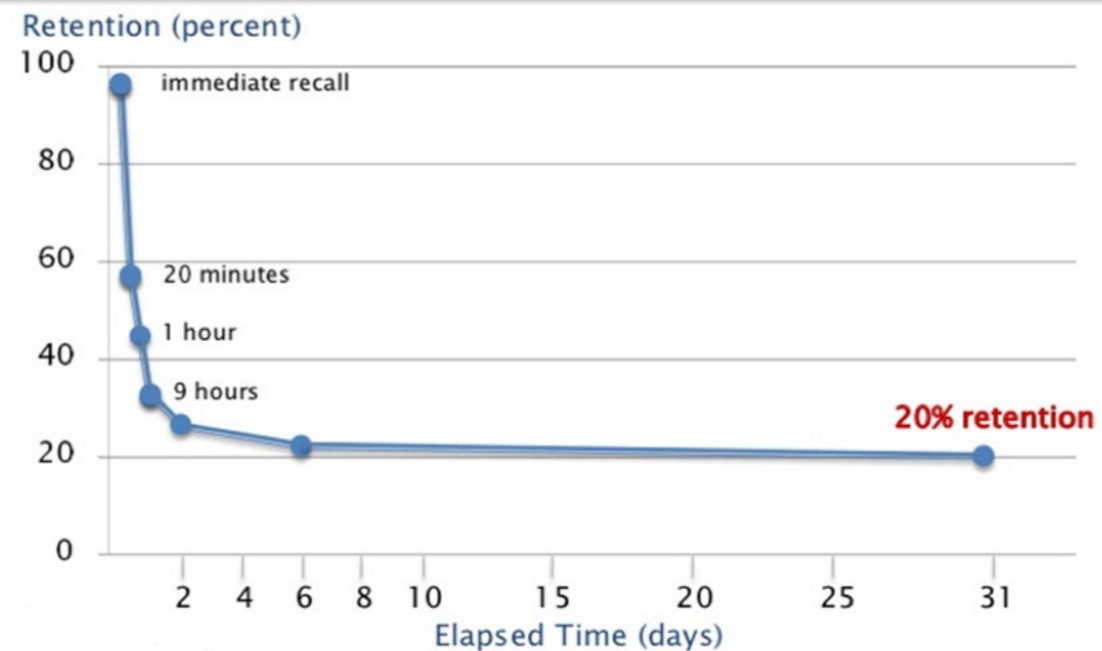
An example of the forgetting

curve in practice was demonstrated by a 1988 study.¹ A number of university students were split into two groups. The first group attended an introductory psychology course, successfully completing the whole course and passing the final exam. The second group did not have any involvement in the course. Four months after the course, both groups were given a test on the material covered in the course. The first group, who had studied and passed the course, scored on average 8 percent better on the test than the second group who had never studied the material.

We see this again and again in the diving world. Instructors are covering all the material, but students are not retaining it. This results in students who have forgot-

¹ RICKARD, H. C., ROGERS, R., ELLIS, N. R., & BEIDLEMAN, W. B. (1988). SOME RETENTION, BUT NOT ENOUGH. *TEACHING OF PSYCHOLOGY*, 15(3), 151-152

The Ebbinghaus 'Forgetting Curve'



SOURCE: HERMANN EBBINGHOUSE, MEMORY: A CONTRIBUTION TO EXPERIMENTAL PSYCHOLOGY, 1885 / 1913

Change

In the Forgetting Curve (left), described by German psychologist Hermann Ebbinghaus in 1885, one can see that only 20 percent of information or skills are retained over time. This is cause for concern when one considers that most dive course topics are included in a course because they are considered critical. If only 20 percent of the information or skills are retained, that means that 80 percent of critical information and skills has been lost.

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2% Non-Fatal Drowning	2%
2% Pulmonary Edema - IPE	2%
2% Fatality	2%
2% Arterial Gas Embolism (AGE)	2%

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Typical Forgetting Curve for Newly Learned Information

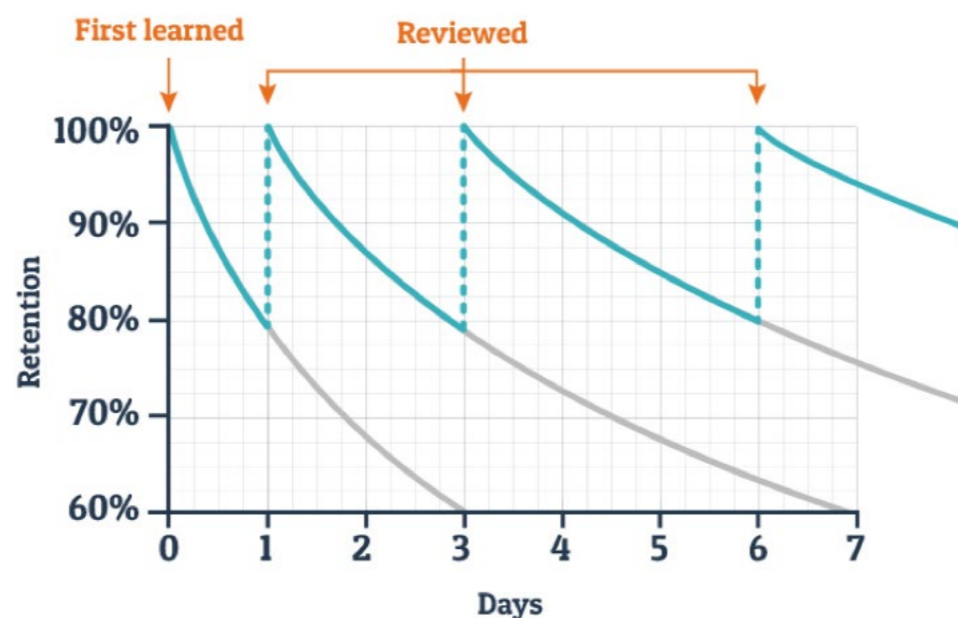


ILLUSTRATION COURTESY OF MARK POWELL

In this diagram, one can see that concept retention still drops to 70 percent after eight days, even with a review one day after first learning the concept and another review three days after first learning the concept.

ten most of what they were taught and are at a level not much above someone who was never taught the information in the first place.

Improving retention by reviewing

This situation can be improved by reviewing the information or practising the skills. This is why good instructors give students a chance to practise skills and review knowledge. Each review or practice gives a boost to the level of retention, and even though the retention will still drop off, it will be slower and will drop to a lower level than if no review had been carried out.

However, you can see in the diagram below that with a review one day after first learning the concept and another review three days after first learning the concept, retention still drops to 70 percent after eight days. Each subsequent review will improve the situation but for a four-day course, the first few reviews can be included by

the instructor as part of the course but any subsequent review will have to be done after the end of the course and is beyond the control of the instructor.

This means that whether the student permanently retains that information—in other words, whether the student learns—is not determined by what happened during the course but by what happens in the weeks and months following the course. It is essential for the student to continue to review the information and practise the skills they were taught after the end of the course.

This is particularly relevant for skills that are only normally used in an emergency situation, such as mask clearing, rescue techniques or CCR manual control. These may be taught and practised on a course, but as they are not a routine part of diving procedures, they may not be practised after the course. Then, when they are needed, the forgetting curve means that the re-

tention of those skills has dropped to such a level that the diver cannot perform the skill when required.

This means that one of the most important skills an instructor can pass on to a student is how to ensure their skills and knowledge continue to grow rather than drop off over time.

Practical vs theoretical

With diving, the situation is more complicated in that we are primarily concerned with practical skills rather than theoretical knowledge. When learning skills, there are a number of stages of learning that students go through.

Cognitive stage. The first is known as the cognitive stage. This is where the students learn the various steps involved in performing the skill so that they “know” how to perform the skill even if they cannot actually “perform” the skill. For example, it is relatively easy to explain to someone the steps involved in



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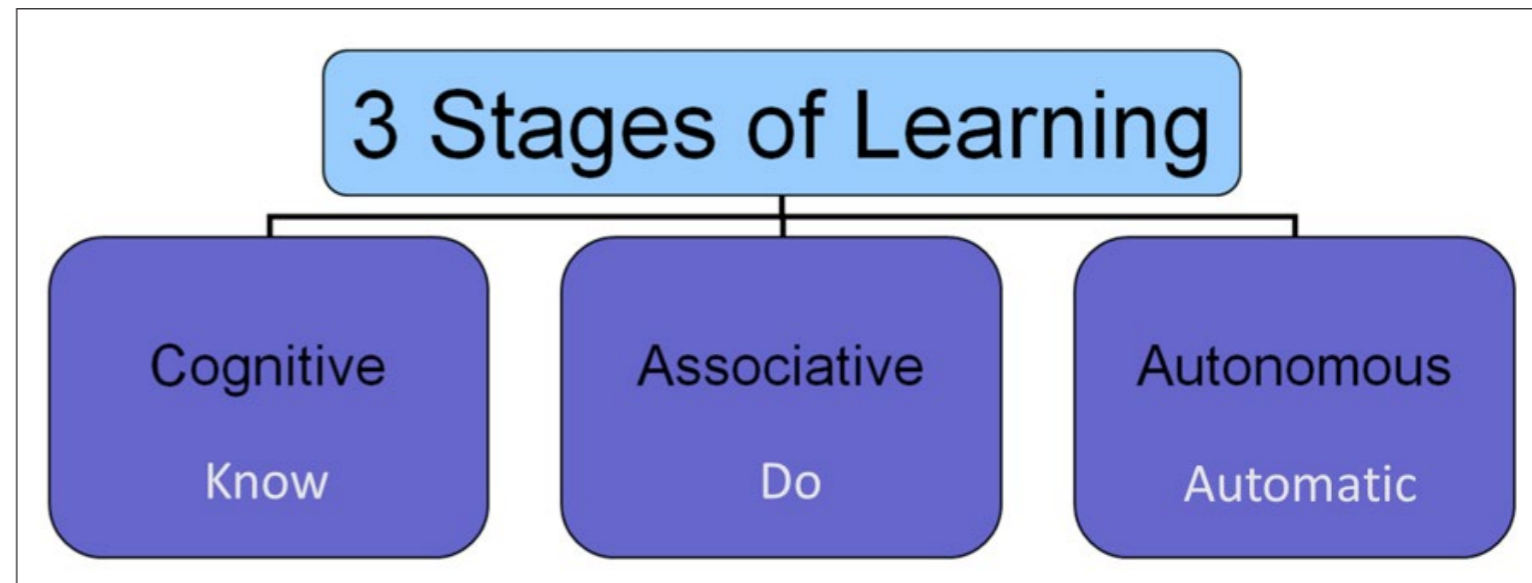


ILLUSTRATION COURTESY OF MARK POWELL



juggling three balls, and they may be able to repeat the steps back to you, but that does not mean they know how to juggle.

Associative stage. The next step is known as the associative stage and is where the student actually starts to “perform” the skill. In our example, they might start to try juggling and may well be able to briefly keep three balls going. However, at this stage, it will require all of their concentration, and any interruption is likely to throw them off.

Autonomous stage. The third stage is known as the autonomous stage, and this is where the student can maintain their juggling,

possibly while talking or moving around.

Mastery. Some researchers define a fourth stage known as mastery. For example, if you are juggling chain saws or knives, there is no room for error, and doing this—especially while balancing on a tightrope or unicycle—would definitely display mastery.

Expectations in scuba training

Obviously, mastery requires a huge amount of practice, so what stage of learning is it reasonable to expect students to achieve with regard to, say, buoyancy or mask clearing during a four-day open water course?

Would we expect them to achieve the cognitive stage during their open water course? Yes, I think anyone would agree, they certainly need to “know” the principles of buoyancy control or mask clearing.

Would we expect them to achieve associative learning? Again, yes, I think everyone would agree that all students should be able to “do” a mask clear or demonstrate buoyancy control.

What about the autonomous stage? Is it reasonable for us to expect them to do it “automatically” after a four-day open water course? In this case, I think the answer is no. They need to be able to do it, but it is just not reasonable to expect them to achieve



the automatic behaviour required for this third stage.

If they are not going to achieve this level during an open water course, then when will they achieve it? The sad truth is that many divers do not achieve this third stage of learning. Not only that, they may even drop back to a previous stage. The hours of practice required to maintain their skills, let alone move from the associative stage to the autonomous stage must come with further practice that can only be achieved after the initial training has occurred.

This further practice can be achieved independently, with the diver practising with a buddy, or it can be achieved with an instruc-

Don't practise until you get it right; practise until you can't get it wrong.

tor. This is one of the main benefits of continuing education; it allows new divers to continue practising and progressing towards the autonomous level under the supervision of an instructor while adding on further skills and knowledge.

Just the beginning

Either way, it is essential that instructors are honest with their students and make it clear that completion of a course will not make them an expert. A course is just the first part of the learning process and must be followed up by ongoing practice. Equally, students must be honest with themselves and ensure they commit to practising the skills they have learnt on the course

in order to firstly maintain and secondly improve those skills, exemplifying the words: "Don't practise until you get it right; practise until you can't get it wrong." ■

Mark Powell is one of the leading technical diving instructors in the field. He has been diving since 1987 and instructing since 1994, and is a full-time technical diving instructor for several leading agencies. He teaches all levels up to and including Advanced Trimix. In addition, he has led a number of expeditions to various parts of the world, including the Middle East, Costa Rica, Malta and the Red Sea, but is usually found diving the wrecks around the coast of the United Kingdom. For more information on any aspect of technical diving, visit: Dive-tech.co.uk.

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Photo: Ernie Brooks



photo & video

Using the optical snoot without any sliders will allow you to shoot bigger subjects, to direct the strobe flash and to deliver intensity when its needed. This animated dancing wunderpus was surrounded by sand and scrubby algae. I used a standard strobe flash at first, which initially left me with a very flat image of a very special subject. Shot in the shallows on a sunny afternoon, I used a low ISO to eliminate the ambient sunlight, strong strobe flash and a fast shutter speed. The *f*-stop controlled the colors of the subject with great accuracy when illuminated.

Text and photos by Mike Bartick

There are several ways to create dramatic images when you are shooting photos underwater: strong compositions, compelling behavior, exotic subject matter and of course lighting.

When I considered buying my first snoot, I was searching for a way to up my photo game a little bit and to broaden the scope of my portfolio. Something that would help me to create stronger compositions and create better frame presence of my subjects—a way to help me assert more control over the image and a way to gain ground on new skills.

For years, I had been swimming over the sandy-sloped dive sites in places like Lembeh, Bali, and Anilao, to name a

few, and shooting photos of the whimsical critters that can be found there. After reviewing my images from a trip, though, the photos felt flat—even when shooting something really exotic, like a blue-ringed

octopus or a hairy frogfish.

I experimented at length with *f*-stops, strobe angles, single strobe, dual strobe, lenses and anything else I could find. Then I saw a few images from a shooter

that completely blew my mind, inspiring me to try something new. He was using a snoot at a time when no one else was using them, and after seeing those incredible images, I was hooked. The

next step was teaching myself how to use one.

Using a snoot has become quite popular over the last few years. Some shooters have become so well adapted to

The Snoot Method





photo & video



My guide pointed out this interesting and pre-historic-looking shrimp (below), which seemed to match the green coral it was living on perfectly. Using a longer fiber optic cord for my strobes allows me to set my strobe up off-camera and to give me the freedom of movement around my subject. I simply removed the strobe and adjusted the snoot tip to the desired position. The coral was nearly surrounding the subject, making it nearly impossible to photograph without causing damage to it or without casting a shadow using my optical snoot. The FO snoot works perfectly for this situation.



Emperor shrimps on a nudibranch are so much fun to photograph, I love it! Making something special out of it, though, can be a challenge. In this image, I wanted the gill of the nudibranch to frame the subject softly but remain bright. Again, using the FO style snoot, I was able to set up the shot and then to move myself around the slug, gaining different angles of view to shoot from. As long as the nudibranch or the shrimp are not disturbed, both will remain calm and natural.

using them that it becomes an exclusive way for them to shoot. While I love using a snoot in my own work, it is important to keep in mind that a strong portfolio should allow for many different methods of shooting, and that a snoot is not the answer for everything.

What is a snoot?

A snoot is a device that is used to control strobe flash in an image. Snoots do not produce light but help to channel the light for dramatic placement

and effect. Oftentimes it is not what is in the image with snooting, but what is not in the image. In other words, using a snoot also helps to eliminate a fussy background or confusing substrate by illuminating just your target while the rest of the frame remains dark.

The first things to consider when buying a snoot is not the cost. In fact, if you are worried about dollars spent on camera gear, you have picked up the wrong habit, I mean hobby. Yes, there is a ceiling of return per



Hairy shrimps respond really well to backlighting. Using a torch works, but oftentimes, it is hard to control the torch power with the finesse that a strobe can have. Strobes also freeze the action, but when using a torch to backlight can also create soft edges. Simple placement of the FO tip behind the hairy shrimp off-camera allowed me to concentrate on the subject and to control the settings until I achieved the acceptable outcome. Oftentimes with a from flash, the delicate features, such as the eggs hidden behind its tail, would be lost. Backlighting allows the light to pass through your subject's transparent properties while adding an interesting result to the image, overall.

Snoots



cinema of dreams



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Snake eels are a subject that are calm and easy to work with as long as you do not touch them. For this shot, I used two Kraken Hydra video lights to rim light the subject from behind. After the backlighting was just right, I then applied a little light on the eye of the eels using my optical snoot with the medium-sized slider. This method is something I like to call "The Works," or two-point lighting. It can be used with a wide variety of subjects; adding colored light also adds yet another dimension.

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The hairy frogfish (above) has to be my all-time favorite subject to experiment with. They are calm, photogenic and respond really well to backlighting. I also use a snoot fashioned from a length of PVC pipe over my hydra 1k video torch. When using a torch exclusively, you will not need to worry about synch speeds. Angle the light so it rakes across the subject from behind, then position yourself to exclude the torch from the frame. The secret to good backlighting is to trap the light behind your subject without too much of the light escaping from around the edges. The PVC pipe helps to create a tight column of light and allows me to assert better control over the light beam.

This tiger-striped cardinal fish (right) caught my eye when I saw the fresh orange eggs in its mouth. I found this guy sheltering under an iron beam of a wreck and in a silty environment, making the strobes nearly impossible to use accurately. Angling my optical snoot with the large slider, I was able to capture the head of the cardinal fish and eliminate the rest of the mess surrounding it.



dollars spent, but do not be shy about spending a few bucks on a device that will actually add chapters to your portfolio. Think of your snoot as you would a new lens. It will actually have that

much of an effect on the way you shoot and over your portfolio.
Types of snoots
There are basically two types of snoots on the market: fiber optic

snoots, where the base fits over the strobe head and the flash is carried through fiber optic cables; or the optical snoot, which fits over the strobe head, with only a slight diffuser between the strobe



Costasiella sp. or
Shaun the Sheep
nudibranch

Snoots

ple phrase: "controlling the light."
For the best results, use the following
settings.

Jump Settings for using a Snoot:

- **ISO-100/Low ISO** to control ambient light

- **Shutter speed: 1/200** further eliminates ambient light and keeps the image sharp.

- **f-stop: f18 and higher** controls the color and depth of field, and ultimately, the light quality and light pool.

- **Strobe power: 3/4 power.** If the strobe power is not strong enough, open the aperture slightly. For super-macro images, increase the ISO from 100 to 360. I do not recommend using your snooted strobe on full power as the strobe head becomes quite hot. Taking a break for a few minutes during intense use will also help the strobe to perform better.

TIP: Use the snoot on the left strobe so that you can make adjustments with your left hand while looking through the viewfinder and adjusting your camera settings with your right hand.

Yes, using the snoot off camera with



Marrionia nudibranchs are highly textured, with some of them displaying some very subtle colorations. Using the optical snoot high above the subject to allow for its larger size gave me a wider pool of light to work with. Remember that your LCD oftentimes lies, so after shooting and adjusting, be sure to review the image. Look for shadows in the foreground, and if present, adjust and shoot again. If the exposures are too hot, roll your *f*-stop a little higher to tame the highlights.

flash and the subject.

A few questions I would ask prior to making the buys are:

- Ease of use—is the device easy to put on and take off?
- What is the scope of use—can I shoot with a wider angle of view and super macro?
- Will I be able to operate the device on my own?
- Do I like the quality of light?

Using a snoot is so much more than casting a ring of light around your subject. Using a snoot helps to eliminate a fussy background while delivering light to precisely where you want it.

The challenge of using a fiber optic snoot (or FO snoot), is the inability to see where the snoot will fire prior to releasing the shutter. More recently, some other products have emerged on the market that eliminated this problem by allowing the shooter to use the pilot light on their strobe to aim with. The light-shaping device also makes it possible to change the size and shape of the light pool by using a set of various masks or sliders.

Each of these types of devices are useful in their own right; it just depends on the user's creativity.

There are also different ways of using a snoot that is not just about creating a ring of light around your slug. Once you begin to master the basics of using a snoot, you will find that its use becomes limitless and could provide you with that creative edge you have been looking for.

Mastering the basics

The basics for using a snoot can be broken down to a single sim-



Sponge goby (right); The blue-striped goby (far right) and fringed-head blenny (below) are common subjects found off Southern California on the US West Coast.



Swimming over the reefs of Southern California, you can see gobies by the dozen; however, once you try to settle down and shoot one, they all but completely vanish. In these cases, I like to plan a sneak attack by finding one in its little hiding place and to position my snoot flash just outside of it. Once I have gained the correct focus point and exposure, I turn off the pilot light of my optical snoot and wait. When the goby or subject peeks out, I release the shutter. This usually scares the goby right back into its hole, so be patient and wait. Gratefully, a fish only has a memory of a few seconds, so this could actually continue for the entire day or until you get the shot. I also use the same sneak attack method for shooting blennies. In fact, the blennies and gobies can often be found living in the same areas as each other. The gobies hide under the rocks and the blennies hide in little holes on top or on the sides. Very convenient for macro shooters that do not like to swim and search.

fiber optic cords is also do-able but will add another dimension of difficulty to a simple shoot.

Nearness to your subject with the snoot tip (FO or Optical) will shrink the pool of light, and as you pull the snoot tip back or away from the subject, the light cast will broaden or get wider. The intensity of the contrast will also change. The optical snoot has a working distance just like a camera lens and is approximately six inches from your subject for the best light quality.

The FO snoot can be used

with very close proximity and offers very good light quality. For super-macro shots, I actually prefer to use the FO snoot rather than the optical snoot as it is easier to control after the initial setup is complete.

Final thoughts

The bottom line is that, without a doubt, lighting is everything, when you are trying to create an image that pops or stands above. Using a snoot could be the next step for expanding your portfolio, broadening your skill set and teaching you

much about how to control light in ways you never thought possible. Your patience will surely be tried along this challenging path, as is mine. It is a journey of learning and not a destination. Have fun!

Mike Bartick is a widely published underwater photographer and dive writer based in Anilao, Philippines. A small animal expert, he leads groups of photographers into Asia's underwater realm to seek out that special critter. Please visit: Saltwaterphoto.com.





photo & video

Last year, Yen-Yi Lee of Taiwan won first place in the Wide-Angle category of the Lens Beyond Ocean International Underwater Photo Contest 2017, with her shot of a manta ray.



Call for Entries and Sponsors: Lens Beyond Ocean International Photo Competition 2018

This year's categories include: Macro, Wide-Angle, Compact Camera, Portfolio, 3-Minute Video, Creative, Freediving and Young Talent. Deadline for submissions is 31 March 2018.

Now in its eighth year, the annual international underwater photography competition, Lens Beyond Ocean, is accepting entries from 1 December 2017. Winners in each category will be chosen by an international panel of judges, with the winning photographs and videos to be displayed at the Malaysia International Dive Expo (MIDE) in Kuala Lumpur, 4-6 May 2018. **Deadline for submissions is March 31.**

Prizes

Since the competition's humble beginnings in 2011, it has grown each year, with over 600 underwater photographers from around the world participating for a chance to win US\$15,000 worth of prizes ranging from travel packages to dive resort destinations, liveboards, underwater photography equipment and more.

One winner will be selected in each of the eight categories. Other images selected by the panel of judges will be awarded honorable mention as "Memorable Pictures." Winning videos will be showcased on the big screen on the main stage at MIDE.

This year's elite panel of judges include widely-published, international award-winning, professional under-

water photographers Dr Alex Mustard (UK), Amanda Cotton (USA), and Nurul Yazid (Malaysia).

Encouraging new artists

Every year or so, new aspects are incorporated into the competition to entice, encourage and motivate more underwater photographers and videographers around the world to

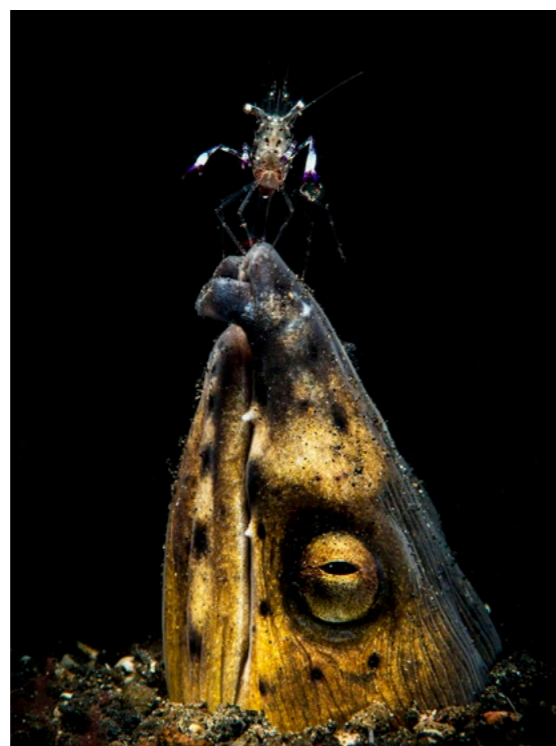
capture in images, the nature and wonder of the underwater world. Through the years, with the exhibition open to the public, imagery by these artists have created greater awareness of the fragile beauty of the underwater realm among divers and non-divers alike.

The Young Talent category was added for young photographers, 10 to 18 years of age, to showcase their images. The aim of this category is to encourage youths to go diving, learn about marine environments and understand and appreciate the underwater world.

Call for sponsors

Businesses and organizations keen to sponsor the event or donate prizes will benefit from intensive international exposure. Your organization's logo will be posted on all print and online promotional materials. This includes a classification as Sponsor on the Lens Beyond Ocean website with a link to your organization's website, logo promotion on social media, the Lens Beyond Ocean gallery banner and venue banner panel during MIDE 2018.

For more information, please visit: **Lensbeyondocean.com.**



First place, Macro category, by Marchione Giacomo, Italy, Lens Beyond Ocean 2017



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photo & video



Compact drone

If you fancy getting a bird's eye view, DJI has just released the Mavic Air drone, which is quite small and compact and therefore a practical option for dive travellers wishing to add some new perspectives to their photography. Take-off weight is just about a pound (430 grams), and dimensions folded together just 168×83×49mm (L×W×H). The drone is capable of 21-minute flight times and able to shoot 4K video. The camera has a 12 MP sensor. Dji.com/mavic-air



Variable red filter

STC Aqua-Red Underwater Fader is like a polarizing filter except the purpose is to create a variable red filter for underwater videographers. By rotating the outer filter, the spectrum of light passing through is adjusted to restore rendition of colours at different depths just like normal red filters except this is variable. Tiny holes along the rim allow for entry and drainage of water between the glass layers, and the filter can also be taken completely apart for rinsing. Made by German Schott—a glassmaker owned by Carl Zeiss, the maker of high-end photographic lenses—it is made in crown glass, with a double-sided anti-reflection coating to reduce lens flare. Available in two diameters: 67mm and 77mm. Stcoptics.com

Nauticam WACP

Nauticam Wide Angle Conversion Port (WACP) gives image makers the opportunity to use true water contact optics. Water contact optics correct for the corner softness most domes suffer from, allowing the photographer to shoot at wider *f*-stops. The WACP is much more than a port.

It is really a lens, or more correctly, the front half of a very elaborate lens.

The lenses that we use with the 0.36x Wide Angle Conversion Port act as the internal components of the lens, performing auto focus and electronic aperture. In addition the 0.36x Wide Angle Conversion Port increases the angle of view of any lens used behind it up to a maximum of 130 degrees. This is a field of view that sits between the popular full frame fisheye lenses (180 degrees diagonal) and ultra wide rectilinear zooms (approximately 110 degrees). Whether there is a market for the US\$3,950 asking price remains to be seen. Nauticam.com



Inon Z-330

Inon's long awaited Z-330 strobe—which replaces its immensely popular Z-240, which was discontinued last summer—was released on 24 December 2017. The new model has a built-in optically-designed dome lens, offering the combination of both high power and wide coverage without a power sacrificing diffuser. Inon stated that unlike a conventional translucent diffuser, which can widen coverage but sacrifices power and stores heat internally, this specially-designed dome lens diffuses light, thanks to the refraction ratios of air, acrylic and water to attain an underwater coverage of 110 degrees, without any power loss. Inon.jp



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Barb Roy



I N M E M O R I A M



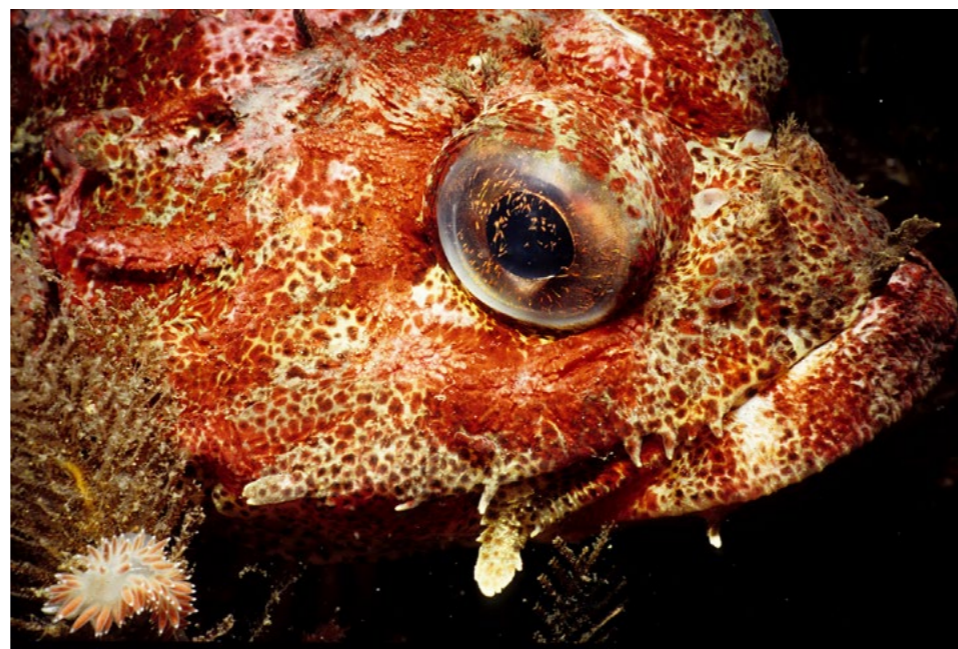
Anemones at Dodd Narrows, near Nanaimo, Vancouver Island, British Columbia

Text by Rosemary E. Lunn and Gunild Symes
Photos by Barb Roy

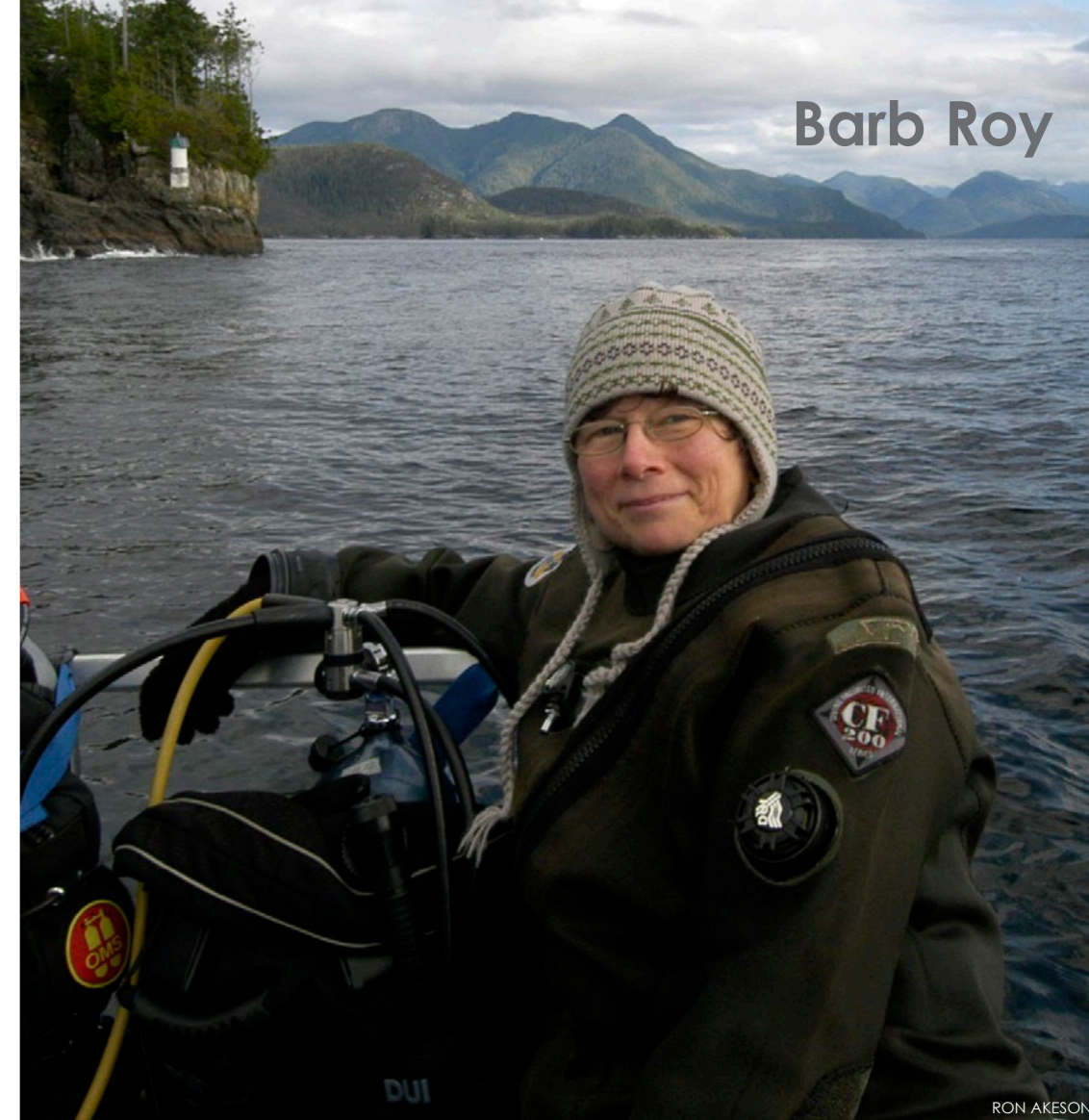
In January 2018, Barb Roy, our long-time associate editor and regular contributor, passed away after a long battle with illness. We celebrate her inspiring life and imagery in this memorial portfolio, highlighting some of the many beautiful and vivid underwater photographs Barb took during her frequent forays under the waves.

Barb was an avid technical and wreck diver, underwater photographer and instructor, having learned to dive in Anchorage, Alaska, in 1979. She was a PADI Master Instructor and held instruc-

tor ratings with DAN, IANTD and NAUI. She became a NAUI Wreck and Archaeology Instructor to explore wrecks and an IANTD Trimix diver to photograph giant gorgonian sea fans at 200 feet.



Red Irish lord eyeing a nudibranch (in the lower left-hand corner of the frame), British Columbia



Barb Roy

RON AKESON



Barb Roy, on her way to a dive in Nootka Sound (top right); Frosted nudibranch (above). PREVIOUS PAGE: Crimson anemones, San Juan Islands, Washington, USA





In 1980, she opened a dive business in Anchorage called Orca Oceanic Research & Salvage, where she taught hundreds of people how to scuba dive, organized local and international dive travel and sold diving equipment. After almost ten years, Barb took on a business partner, Ron Akeson, and changed the company name to Alaskan Underwater Adventures.

In 1991, they moved the business down to Washington State and again the name was changed to Adventures Down Under (ADU). It is no surprise that Barb was certified to repair regulators, drysuit seals and inspect cylinders. In 1997, Barb sold her half of the company to Ron but continued to work, teach and provide the marketing for ADU.

In 1995, Barb also began a part-

Red Flabellina nudibranch
at West Race Wall

What I remember most about Barb, beyond her deep passion for cold water diving and her journalistic and creative gifts, was Barb was a consummate human who reveled in being alive. She was insatiably curious about the world around her; was humble and deeply grounded. And she was always kind, always smiling, always looking at you with a twinkle in her eye that made you want to follow her journey to see what treasure in life it would shine upon. Barb's passing darkens a vast knowledge of the undersea realms, but the memory of her relentless and egoless passion for life will stay with, and inspire, those that knew her, and I am exceptionally grateful and lucky to have crossed paths with her during my life. I will celebrate her memory in my heart on my next dive (sorry, Barb, it may be in warm water)."

— Ty Sawyer
Skin Diver Magazine



Barb Roy

time career as an outdoor adventure photojournalist, specializing in dive travel stories. Since then, her written work and photography have appeared in various international and local print magazines, books and digital publications, including *Diver UK*, *Scuba & H2O Adventure Magazine*, *Skin Diver Magazine*, *Wreck Diving*, and *X-Ray Mag*; as well as for dive businesses such as Tahtsa Dive Charters.

After the passing of her good friend and business partner, Ron Akeson, in April of 2014 and the closing of ADU, Barb and her daughter, Tallen Patrick, opened a dive travel business in the same Bellingham location

As an outdoor adventure writer, dive travel photographer, friend and colleague, I will miss her greatly, as indeed will all of her fellow writers at X-Ray Mag. She was a consummate professional who enjoyed giving presentations about her many adventures to various dive clubs, museums and schools.

— Peter Symes
Publisher and Editor-in-Chief
X-Ray Mag

called Orca Oceanic Diving & Photography. It specialized in underwater photography and videography.

Barb had also served as a board member with the Dive Industry Association of British Columbia, the Maritime Documentation Society, and the Technical Dive Training Facility at ADU. She also assist-



Basket star on soft coral (above); Anemonefish on USS *Arkansas*, Bikini Atoll (left)





Barb had a love for diving and the dive industry. You could see it in her photography as well as in her articles. She put time into helping promote the industry and saw the benefits of the industry working as a whole to promote a passion that is shared by so many. She was very social and always put her heart into all she did. She shared her activity with so many of her friends, both in the industry and outside. She will be missed, but remembered, and that smile will keep smiling on.

— Ed Singer, Owner
Sunset Diving, Nanaimo, BC



Nutrient-rich water feeds this wall of life at Race Rocks near Victoria, British Columbia (above); A cluster of anemones paint the terrain of the Skook (top left)

ed the Washington Scuba Alliance (WSA) in collecting donations.

Diving advocate

Barb was a big advocate of diving in Canada and the Pacific Northwest. It was one of her great loves. Her images

were widely used to promote ecofriendly diving in British Columbia, and she spoke at the Vancouver Aquarium Diver's Weekend and at the dive show in Tacoma. Last March, she gave four photography seminars on diving in BC at the Tacoma Show.

Barb Roy made an indelible mark on this sport we love so much and will always be remembered for her passion and years of remarkable work in photo journalism, telling the story so well with her artistic eye to divers and non-divers alike around the world of why our emerald waters in British Columbia and Washington are so uniquely special. She will be forever remembered and has left a legacy of work that will live on for years to come.

— Deirdre Forbes McCracken
Owner and PADI Master Instructor
Ocean Quest Dive Centre, Burnaby, BC



A wolf eel peeks out from its den in the Victoria area, British Columbia

Shared adventures

With over 30 years of experience in the dive industry, with special interests in marine life, science, photography and shipwrecks, Barb offered presentations to the public about her various dive journeys to places like Tasma-

nia, Egypt, Churchill (Manitoba), Alaska and Guadalupe (Mexico). Barb enjoyed sharing stories of her adventures but also liked to hear about everyone else's too. She often traveled with family members, including her husband, Wayne Grant, children





Wayne Grant with octopus at Browning Pass Wall, British Columbia

It is very difficult to put into words how Barb was a gift to all of us, particularly in the dive community. Her constant upbeat nature, and enthusiasm for our sport is irreplaceable. Thanks for the memories.

— Virginia and Andy Lamb
Marine Naturalist, Author, Educator

The dive community has lost a great underwater explorer. May she rest in peace.

— Diane Reid
Underwater Photographer



ington State's Hood Canal, Churchill: Trekking Canada's Sub-Arctic Region in Manitoba, San Juan Islands, BC's Southern Gulf Islands, BC's Critter Connection, Red Sea Safari: Journey from Cairo to El Quseir, BC's Port Hardy: Aboard the Nautilus Swell,

Guadaloupe's Great White Sharks, Diving the Hot Spots of Vancouver Island, Socorro, Technical Diving Paradise in the Pacific Northwest, Journey to Bikini Atoll, Choosing a Technical Instructor, Thetis Island, Hawaii, New Zealand, Skookumchuck: Challenging

and grandchildren, so she could offer refreshing new perspectives in her stories and photography.

For X-Ray Mag, Barb was one of our most prolific and popular contributors, writing a long list of in-depth articles and news stories, often together with her husband, Wayne, over the past decade— with each article accumulating tens of thousands of reads from divers around the world.

Her stories included topics such

as Diving Coastal British Columbia, BC's Wreck Trek, Underwater Nanaimo, Diving Canada's Freshwater Interior, Vancouver's First Major Artificial Reef: HMCS Annapolis, Pavillion Lake, Wash-

Thanks to Barb for all the many years of support for the dive industry.

— Jan Breckman, Director
Dive Industry Association
of British Columbia



Mosshead warbonnet (above); Gorgonians (left) at Socorro, Revillagigedo Islands, Mexico

I first met Barb as she arrived on the dock in 1996, with her mischievous grin, while I was managing Ex-HMCS Columbia Artificial Reef project. In quick order (“somehow”) she was riding the ship on its tow to Campbell River. Barb had an ability to know when something was going to happen, OR she made it happen. Maybe the word is tenacity. Barb was always nearby. Maybe it has something to do with her relationship with my best friend and associate Wayne Grant (eventually her husband). She later joined us in Portimao, Portugal, to report on the four-ship “Ocean Revival” project. With Barb things were always interesting. She will be missed.

— Wes Roots
Canadian Artificial Reef Consultants





Dodd Narrows (above) near Nanaimo, BC; Barb Roy at the X-Ray Mag staff dinner, DEMA 2016 (top center); Male scalyhead sculpin likely guarding eggs in an empty barnacle shell (right)

the Rapids, and BC's Reefs of Steel.

One of Barb's favorite quotes (originated by E.J. Stieglitz, but often attributed to Abraham Lincoln) was: "In the end, it's not the years in your life that count, it's the life in your years." Barb certainly

fully lived life in her years, and was an inspiration to us all. ■

Special thanks to Wayne Grant and Deirdre Forbes McCracken for their kind assistance and dedication in compiling this memorial article.



PETER SYMES

"The entire BC Dive Industry was deeply saddened by the news of Barb Roy's passing. Barb was a friend to diving and the whole diving community. She will always be remembered for her passion and devotion to the emerald waters of the Pacific Northwest. We are a little less of a community without Barb here amongst us, lighting up our days with her images and stories."

— Donnie Reid, Dive Safety Officer and Photographer
Pavilion Lake Research Project
NASA Moon Mars Analog Mission Activities



Wayne Grant on wreck of Saskatchewan, Nanaimo, British Columbia

Barb was an enthusiastic and engaging reporter whose photography and writing reflected her pure love of diving. She will be sorely missed.

— Jeremy Heywood
Diving and Boating Safety Officer
Vancouver Aquarium

Barb, thank you for all your efforts on behalf of the dive community. It was a privilege knowing you.

— Bernie Hanby
Conservation and Education
Committee
Vancouver Aquarium Marine SeaLife
Science Centre

