



GLOBAL EDITION
November 2017
Number 82

Macro Life
Great Barrier Reef

Indonesia
Northwest Bali

Training
Teaching Objectives

Australia's
Giant Cuttlefish

Wrecks
B-29

UW Photo
Divers

VICTORIA • SOUTH AUSTRALIA

Australia

COVER PHOTO BY DON SILCOCK



DIRECTORY

X-RAY MAG is published by AquaScope Media ApS
Copenhagen, Denmark

www.xray-mag.com

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

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

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

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

ASSISTANT EDITORS
Rosemary E Lunn, London
Roz@xray-mag.com
Barb Roy, Vancouver
Barb@xray-mag.com
Don Silcock, Sydney
Don@xray-mag.com

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

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

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

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

Contacts page: Xray-Mag.com

SENIOR EDITOR
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SECTION EDITORS
Scott Bennett - *Travel, Sharks*
Andrey Bizyukin, Ph.D. - *Features*
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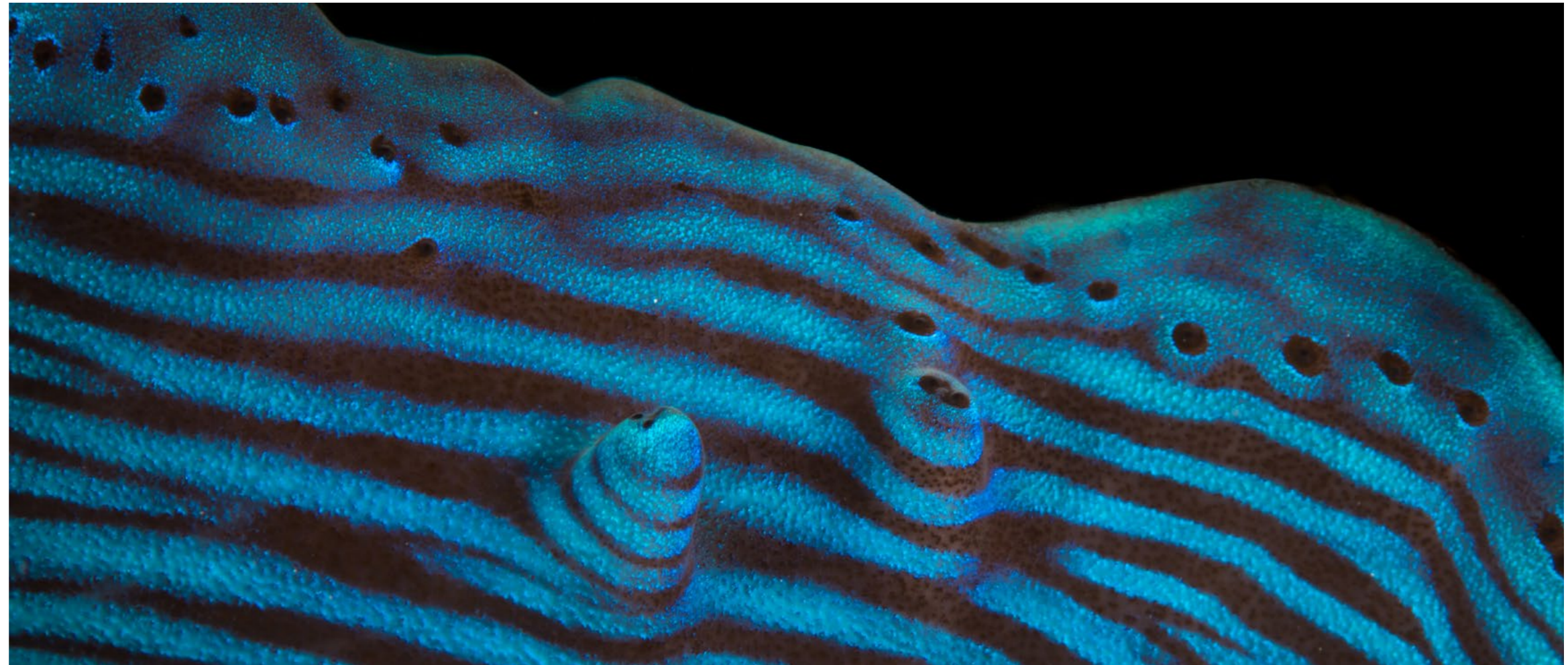
CONTRIBUTORS THIS ISSUE
Scott Bennett
Andrey Bizyukin
Matt Jevon
Kate Jonker
Catherine GS Lim
Rosemary E. Lunn
Jay Maclean
Nigel Marsh
Michael Menduno
Brandi Mueller
Mark Powell
Simon Pridmore
Don Silcock
Joel Silverstein
Gunild Symes
Peter Symes

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Photo by Don Silcock

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Mind & Body

I just got a new bike. Not a very fancy one—just a decent quality bike, which I now use for errands around the city. Riding it, I am all smiles, as I pass through the park on a beautiful sunny autumn day. The air is still warm, the smells are pleasant, and it feels really good to get a wee bit of exercise, which my body seems to crave after long days of editing at my desk.

Now standing by a swimming pool, I can see the water is clear. I jump straight in, head first. I stretch, and streamlined, I can feel how the cool water flows around my face and body, as I glide through the water, before I take my first stroke or start finning.

What do these apparently unrelated and rather inconspicuous daily activities have in common?

Well, first off, I am now in late 50s. I did exactly the same activities 50 years ago, and I still get the same basic joy out of both, and probably always will, as long as I can move my legs.

Granted, there is perhaps not quite as much play involved today as when I was a kid, bicycling around with friends in the yards and alleys of the city, or out in the country side where I spent many summers; or when I went with classmates to either the swimming pool after school or spent long summer days at the

beach. The pleasures of being in nature and using your body remains the same. It still feels good, and I feel relaxed and at peace after such a day out.

What does that have to do with diving, you may ask?

Being divers, we wear equipment, and those of us who progress to advanced diving, such as technical diving, wear a lot of gear that requires still more attention and discipline. If you are a rebreather diver and also a underwater photographer, you end up with checklists to go through before immersion, like those of an airline pilot.

Equipment is great; it enables us to venture where we could not otherwise go. But let us never forget that it is just a means to an end.

Being encased in all that gear tends to separate us from the experience of being one with nature around us. That is why I still enjoy snorkelling too—say, in the evenings, after a day of diving and taking pictures, when I can just swim about with a calm mind.

I often reflect on some of the entry-level technical training I undertook many years ago. One of the exercises and performance requirements for the course was to swim underwater

for the length of a pool (25m) in full technical gear—twin tanks and all—without a mask and with the regulators out of one's mouth, in order to simulate an out-of-air scenario in which one's buddy was not immediately close by.

The issue I had and still have with this exercise is that, in real life, you do not get a chance to get your pulse down and take some deep breaths first. Malfunctions—however rare, thankfully—tend to happen without any prior warning. But I suppose it was still a sobering lesson about what it required of both one's mind and physique, to swim any length underwater in an out-of-air scenario, whatever the cause. I surely never forgot, and always keep it in mind.

In this regard, I can only warmly recommend that one learn and practice a little freediving. It is not only great training for both mind and body—making you both fitter and safer by making you more comfortable with not having to regularly clench your jaws—but it also takes you back to the simple and pure form of submersion.

— Peter Symes,
Publisher and
Editor-in-Chief



News edited
by Peter Symes &
Catherine GS Lim

from the deep
NEWS



PIXABAY

Some fish "farm" their food

EOMES / WIKIMEDIA COMMONS / CC BY-SA 4.0



Parrotfish strategically harvest their favourite food by rotating through algae patches, waiting for each patch to regrow before dining on it again. The fish also defend their feeding territory while the food patches recuperate sufficiently, a new study finds.

Working on Palmyra Atoll, around 1,000 miles south of the US state of Hawaii, a team of researchers from the University of California Santa Barbara became aware of the fish's farming habit when they noticed many bite marks in specific areas of algae growing on dead coral.

They followed these patches through time and found parrotfish were feeding heavily in each patch for a short period of time. Then, the fish would allow that exact location to recover before returning to harvest the algae again.

In doing so parrotfishes are keeping coral reefs healthy. Turf algae have been shown to be harmful, even lethal, to juvenile corals. When the parrotfish bites

scrape the coral, they create pockets of space without the algae, which may enable tiny coral larvae to settle and grow.

Defending their "farms"

"The fish would come back to the same area and defend it against other individuals of the same species," said Peter Carlson, lead author of the paper published in the journal *Marine Ecology Progress Series*. "Essentially, they're farming by using their environment very strategically."

In areas where resources were less abundant and recovered more slowly, parrotfish movements and foraging areas were significantly larger and bites were distributed sparsely across food patches.

Safeguarded helpers

Because herbivores support coral reef health, many are safeguarded in marine protected areas. But to properly create and manage adequate space for these fish, managers need to know the range of their movements. A second paper took a multiscale approach to tracking parrotfish movements, which is important information for conservation purposes. ■

SOURCE: MARINE ECOLOGY PROGRESS SERIES

A species of parrotfish (*Chlorurus microrhinos*) rotationally harvest their favorite food and then defend their feeding territory.

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The Pacific triton sea snail (*Charonia tritonis*) seen here eating a crown-of-thorns starfish, is an endangered species due to demand for its shell.

not, and this is the first real attempt to breed them," AIMS marine chemical ecologist Dr Cherie Motti told Agence France-Presse.

In addition to increasing the sea snail population, this project also builds on previous AIMS research, which found that crown-of-thorns starfish exposed to triton secretomes (or chemical scent) will try to flee the area to escape the perceived threat.

To this end, the research team will try to identify the chemical responsible for inducing fear in the starfish, to explore the possibility of placing alarm-inducing baits in the ocean.

"If successful, this research will allow scientists to closely look at the impact of giant tritons on crown-of-thorns behaviour and test their potential as a management tool to help reduce coral lost to outbreaks," said Queensland federal MP Warren Entsch. ■

Snails to rescue the Great Barrier Reef

An unlikely animal has been recruited to battle the destructive crown-of-thorns starfish that is invading the Great Barrier Reef.

A giant sea snail may turn out to be another line of defence against the destructive crown-of-thorn starfish that is currently plaguing Australia's Great Barrier Reef.

Called the Pacific triton sea snail (*Charonia tritonis*), it can grow up to about 50 to 60cm and is indigenous to Australian waters. More importantly, the crown-of-thorn starfish happens to be part of its natural diet. However, the sea snail is currently endangered due to the consumer demand for their shells.

Since June 2017, the Australian Federal government has been funding a two-year study to find out how to breed these sea snails with the aim of seeding the wild population, thereby providing the Great Barrier Reef with another line of defence against the destructive starfish.

"The idea is that we have high-risk reefs, and you could basically use tritons as a special forces team," said Dr Mike Hall from the Australian Institute of Marine Science (AIMS) in a *Newsweek* article.

However, because the sea snails are endangered, there are only eight adult triton sea snails in the lab. Very little is known about their life cycle. "We really don't know anything about them, what they eat, whether they're nocturnal or



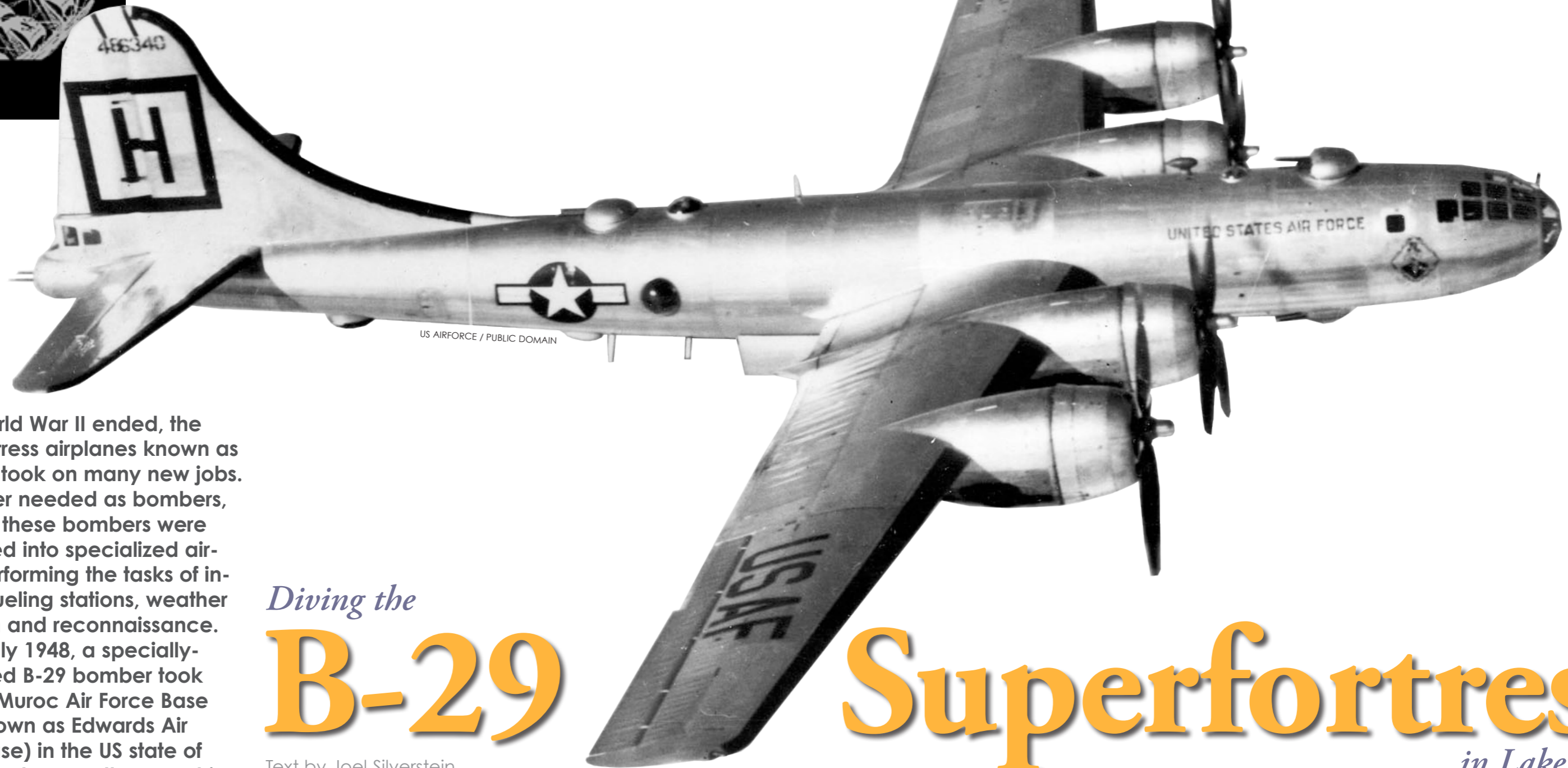
PHOTO COURTESY OF THE AUSTRALIAN INSTITUTE OF MARINE SCIENCE

AIMS' Dr Cherie Motti, beside a tank housing a Pacific triton sea snail

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After World War II ended, the Superfortress airplanes known as the B-29 took on many new jobs. No longer needed as bombers, many of these bombers were converted into specialized aircraft, performing the tasks of in-flight refueling stations, weather research and reconnaissance. On 21 July 1948, a specially-converted B-29 bomber took off from Muroc Air Force Base (now known as Edwards Air Force Base) in the US state of California, to cross the scorching Mohave Desert to Lake Mead in Nevada. Its mission was a top-secret project, conducting high-altitude flights while testing a new intercontinental ballistic missile guidance system named "Sun Tracker."

Diving the

B-29

Text by Joel Silverstein
Wreck photos by Cindy Shaw

Captain Robert Madison and his four crew members flew the Superfortress 270 miles east to Lake Mead. Once there, the pilot repeatedly climbed to altitudes as great as 35,000ft and immediately plunged back down towards the lake's surface before leveling out at a 100-300ft elevation. These were incredibly risky

and challenging maneuvers, but it was the only way to test the missile guidance system developed at the Applied Physics Laboratory at Johns Hopkins University.

On the last descent, the wind had picked up a little, and with the bright sun gleaming off the mirror surface of the lake, the captain lost his depth per-

ception. The B-29 skipped and hopped across the lake's surface at more than 230 miles per hour, ripping off three large engines. This harrowing crash landing had the plane traveling for more than three-quarters of a mile up the lake, before coming to its final stop. While the plane floated on the surface for a few

minutes, the five-man crew escaped into two small life rafts, before B-29 Serial No. 45-21847 sank to the black and cold bottom of Lake Mead.

Secrecy of the crash

Due to the secrecy of the mission, there were no emergency support services

Superfortress

in Lake Mead



wreck rap

Boeing B-29s of the 468th US Bombardment Group in action over Rangoon, Burma (Yangon, Myanmar), during WWII, 1945



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available in the event of a crash. The entire crew was picked up some six hours later by National Park Service (NPS) employees. Because this was a secret mission, Captain Madison and his team were instructed to keep the mission, the crash, and the general location of the sinking secret.

For more than half a century, the B-29 bomber rested quietly, more than 260ft below the surface in a remote location of the lake. No efforts were made to recover the plane or the technology it was carrying. In 1948, the deep-sea technology did not exist for salvage dives necessary to retrieve the aircraft. As with all vessels that sink in a national park, the B-29 became a cultural asset of the

United States even though they had no idea where its precise location was.

Quiet discovery

During the next half century, the little town to the west, known as Las Vegas, boomed from under 30,000 people to over 600,000 residents, with more than 39 million annual visitors. Behind the glitter and glamor of Las Vegas, the lost B-29 remained on the minds of the budding technical diving community of the city. Quietly, and without much disclosure to

other than a private team, diver and underwater researcher Gregg Mikolasek located the B-29 bomber using side-scan sonar equipment in 2001.

The details of the first dives on the plane have remained something of a deep secret, as well as the names of the divers who have dived it. Embroiled in litigation, the location and ultimate ownership of the B-29 bomber remained with the NPS, which is the steward of this historic site.

Government survey

In 2003, the National Park Service Submerged Cultural Resources (SCR) underwater archaeological team conducted an extensive dive operation on the B-29. Their activity mapped, photographed and detailed every aspect of the sunken Superfortress, which now lay in 180ft of water. This formidable task required setting out a four-point mooring system, so the dive platform barge could suspend an underwater "chandelier" to light up the site, and to manage the small ROV that was used to recover video from inside the tiny compartments of the plane.

The agency's work produced an extensive management and educational document to aid in the conservation and preservation of this historic site. During the operations, my wreck diving colleagues,

Richie Kohler and John Chatterton, produced an episode for the Discovery Channel's *Deep Sea Detectives* program. This B-29 is the only B-29 in existence that is underwater.

After the NPS documented the site and developed a management plan, the next step was to develop a method for the general public to visit the site. Unlike some other resources in a park, underwater sites present a host of challenges for both the park and the public. For the B-29, some of the problems included its remote location, which was far from any services; the depth of the water, which was beyond established recreational dive limits; and the fragile state of the plane itself.

To open the site with unrestricted access would inevitably destroy the thin fuselage and risk removal of artifacts. The development of a management process took several years with additional research dives to further evaluate the plane's condition. Finally, in late 2006, the NPS approved a system that would allow for "Technical Guided Dives" on the B-29. But who in the southwestern region could or would take this on?



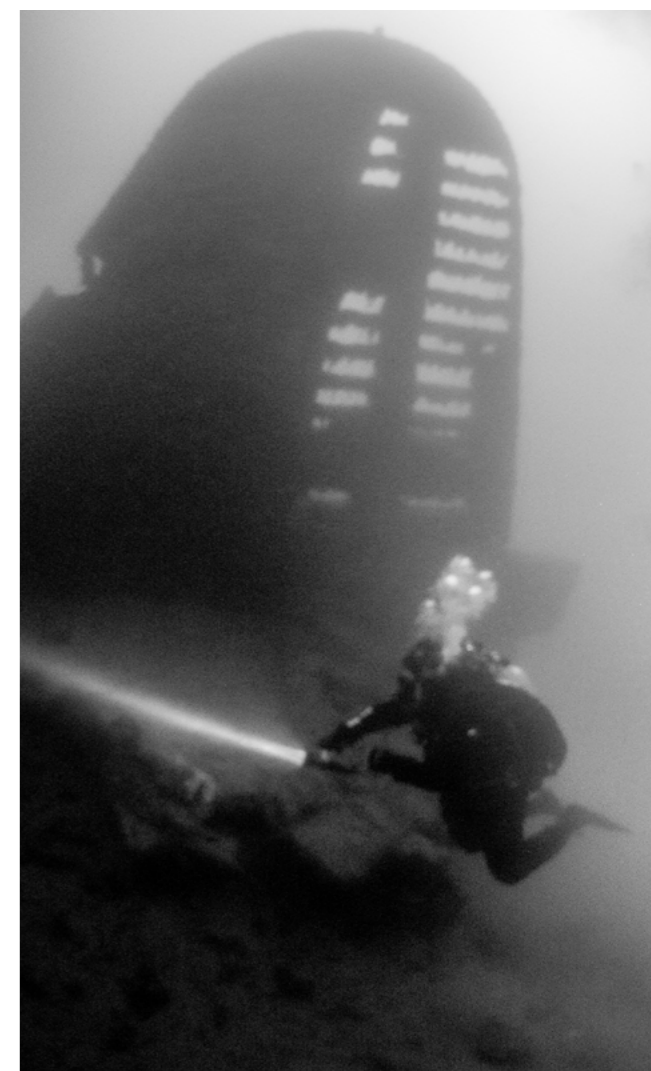
Aerial view of the 247 square miles of Lake Mead National Recreation Area straddling Arizona and Nevada, USA

B-29

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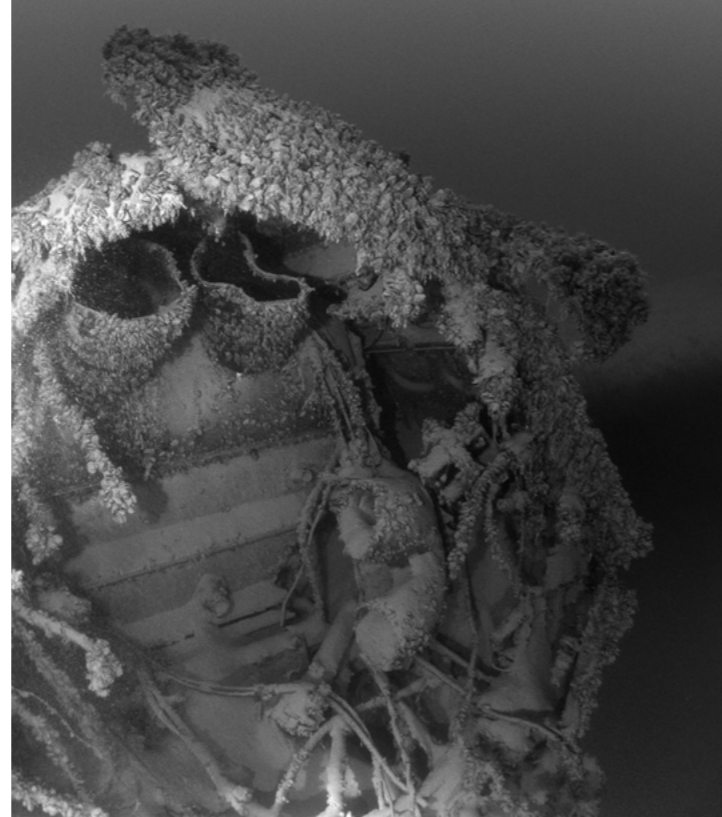
Silverstein examining the tail gunners outlet



Silverstein exploring the port side of the tail wing



No. 3 engine nacelle (right), with its labyrinth of wires and hoses exposed; Divers Patrick Smith and Joel Silverstein examine the remaining No. 1 engine and propeller (far right); Silverstein illuminates the No. 3 engine on the starboard side of the plane (center).



Taking on the challenge

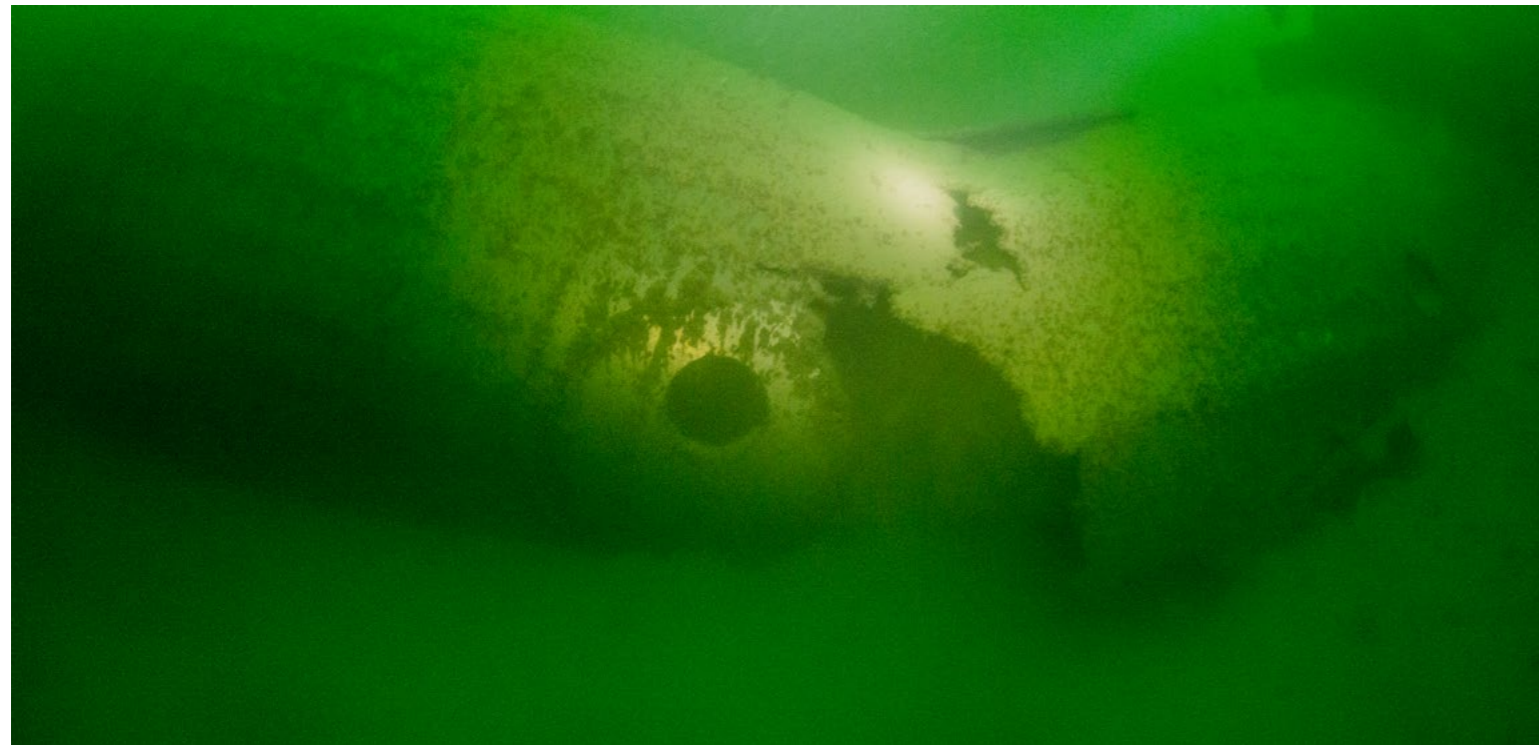
Through our company, Scuba Training and Technology Inc. based in Lake Havasu City, Arizona, Captain Kathy Weydig and I took on the challenge. We have extensive experience with managing shipwreck dives in remote locations as well as working on protected wreck sites. For almost two decades, we have run technical diving expeditions to the wrecks of the *Andrea Doria*, *USS Monitor* and other wrecks that require safety and precision operations. With a nearly 80-page document detailing our experience and activities plan, we were awarded the first Commercial Use Authorization (CUA) to conduct guided technical dives on the bomber.

The first year had operational complexities that were not only stressful, but costly. The initial CUA limited access to no more than four single dives in a week, and 50 dives in total over six months. After the initial trial, the NPS would either extend or suspend operations for the following year.

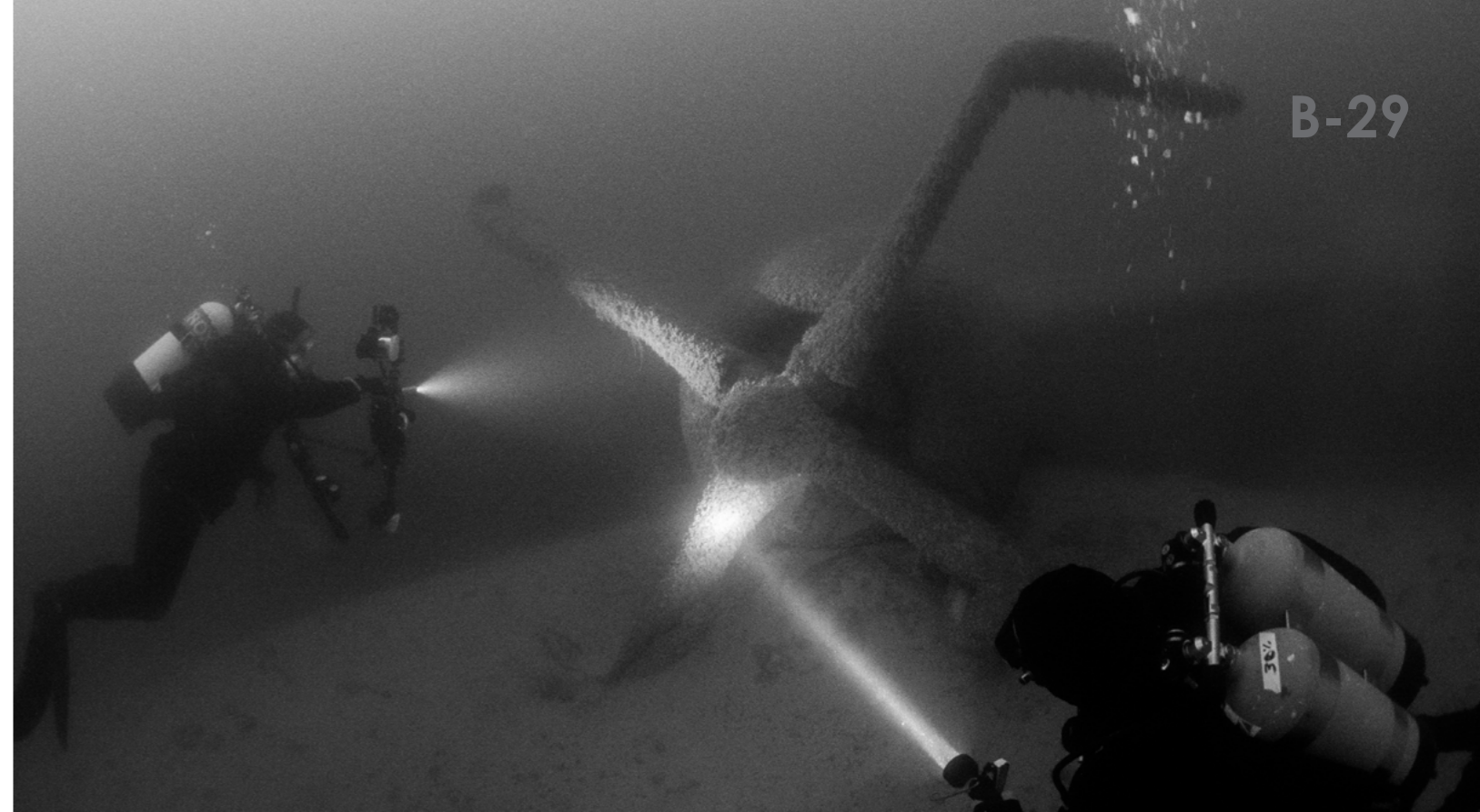
Diving conditions

In 2007, due to the drought in the southwestern region, the B-29 was resting in approximately 165ft of water. These depths required the use of trimix to eliminate inert gas

narcosis. Divers would be at a 1,100ft elevation; water temperatures on the lake bottom were in the low 50s F; and the lake had a moon-dust bottom that could easily silt up, not dissipating for days. Some other challenges included the fact that the site was 35 miles from the nearest marina and winds could reach up to 20 knots!



Port side of cracked fuselage where the B-29 settled on the lake bottom



B-29



Diving the wreck

A typical dive consisted of a well-trained guide and two dive clients. Divers descended on the mooring line to the bottom of the lake where they met the 12,000lb mooring block. From here, divers traversed approximately 85ft along a line to the second moor-

ing block at the stern of the B-29.

The tour followed around the port side of the fuselage, then around the port wing, examining the engines, propeller and landing gear. Next came the nose and the pilot's areas. This brought one around to the starboard side of the plane.

The starboard wing was buried in silt, so exploring this area was not necessary. But divers could continue along the starboard fuselage, examining the dome of the "Sun Tracker" on the way to the tail section, which rose over 30ft. After the tail section and tail gunners port were viewed, divers jumped back onto the guide line and back to the mooring cable to make their ascent, resulting in a total run-time of about an hour.

Economic downturn and waning interest

While the first year on the bomber was successful, the economy in 2008 took a serious downturn, and it was exceedingly difficult to get divers to travel to Las Vegas to dive this special site. Over the next

few years, the B-29 rested on the lake bottom without any activity, other than some inspection dives by the NPS. As the B-29 receded into its secret location, with few seeking to dive it, so did the water level of Lake Mead. As a quagga mussel infestation quietly covered the B-29, the extreme drought pushed the water level of Lake Mead to an all-time low, dropping it another 40ft.

Re-opening the site

During the eight years since our team dived the B-29, the economy recovered. Divers were now traveling to extreme and remote sites again. But what about the B-29?

It was mid-December 2015 when a text message came from FOX10 news anchor Troy Hayden. His message: "We're doing this, right?" With a puzzled look, I saw an email from the NPS simultaneously appear on my screen. The NPS wanted to reinstate dives on the B-29 again!

Without hesitation, I called our CUA coordinator at the NPS, and they were thrilled that we would



Historical photo of B-29 during take-off



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be crazy enough to conduct dives to the site again. However, we still needed to go through the entire application process again. In another call to Troy, he said he wanted to be the first to do a feature story on the secret B-29 bomber in Lake Mead. But now we needed a permit, so we submitted our paperwork, and we waited. Because the NPS was seeking two operators, the deadline for applications was extended. And so, the wait continued. It was now February 2015, and we continued to wait. Then finally, towards the end of March, we were notified that we were issued

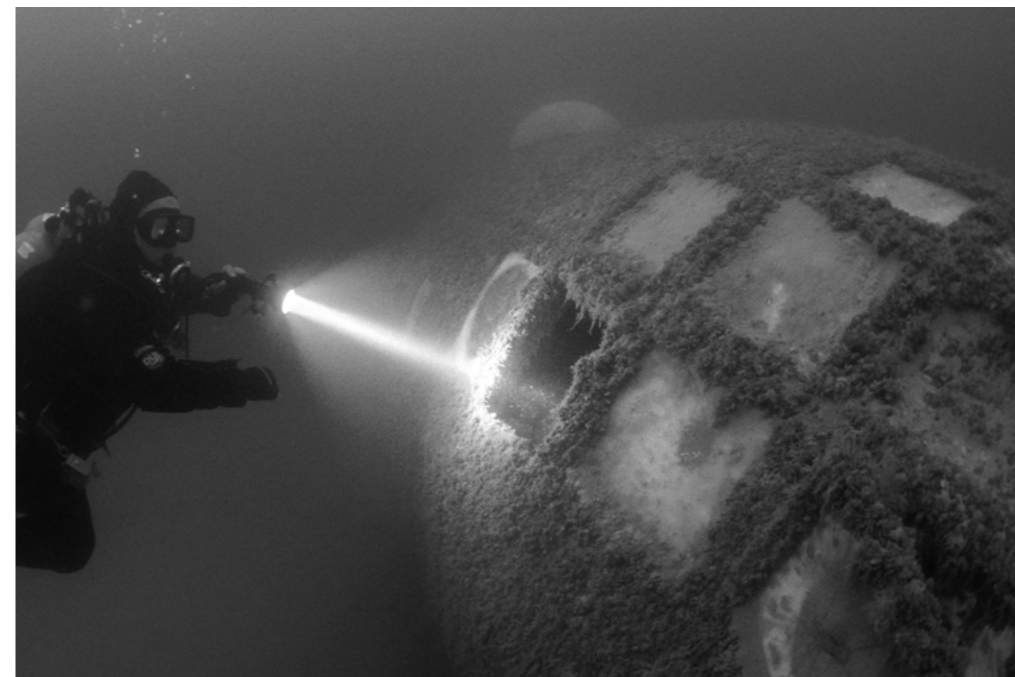
the exclusive permit for conducting dives on the B-29 for 2016. On 14 April, we met with the NPS and SCR team. A permit was handed to us. Meanwhile, our boat was out in the parking lot, and we hightailed it up to our launch area far up in the north end of Lake Mead, some 70 miles from where we are.

Return to the wreck

We needed to conduct a reconnaissance dive, because Troy and his camera people were due first thing the next morning to shoot the story. However, the weather was not our friend in April; the wind was blowing, and the seas were building. Captain John Fuller and I made our way to the site. I splashed in and spent an hour



Interior of the cockpit (above); Diver illuminates the cockpit, with the Sun Tracker dome in the distance (left).



the next 30 minutes. This time, however, she was at a much shallower depth than ever before, 120ft from the surface. Surely, this would be an easy decompression dive, I thought.

Remembering my tour path, I hovered around the tail cone, lighting up the engraved panels with my dive light and inspecting the latest quagga mussel growth. Much of the wing fabric had torn away from the combination of the weight of the mussels and the hydraulic action of the lake.

Moving down the port side, I could clearly see the twisted metal where the fuselage cracked as the B-29 fell into a gully on the bottom. And as I swung around to the port wing, I could see over the top to the Number 1 engine, with its propeller still intact.

As I made my way around the wing tip, I saw that the aileron on the back side of the wing

getting our sub-surface mooring line re-established. Then, it was time to dive the wreck. I have not been on the B-29 since 2008. What was I going to find on the wreck? What condition was she in? What new piece of history would I uncover?

On my descent down the steel mooring cable to the twin 12,000lbs blocks, the clear black-

ness of the water was a familiar sight. I made my way across the 87ft traverse, when a huge shadow in the distance came into view. I exhaled a smooth "there-she-is" as the huge dark area morphed into the still magnificent tail rudder of the Overton B-29 Superfortress bomber on its final landing pad.

I had the B-29 all to myself for



The quagga mussel-covered nose of the B29 with the pilot's wheel in the exact position it was in when the pilot escaped.



had new indentations where the quaggas pressed through the dope-covered fabric. As I swam around the propeller, it looked as though it was encased in a fuzzy sweater. The slick metal I had last seen on the propeller was now covered in quagga mussels.

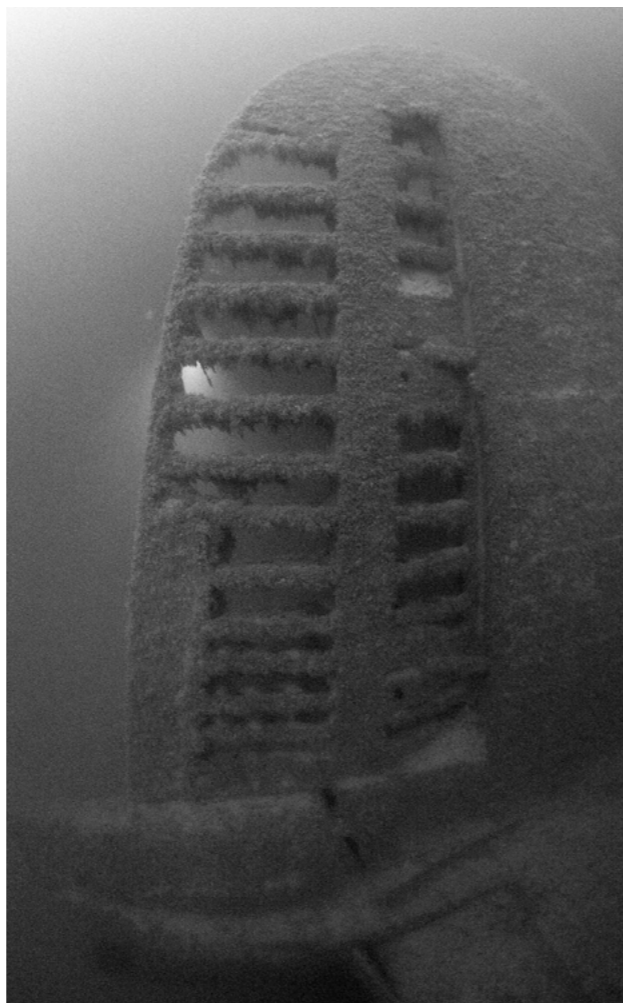
With time running out, I headed to the cockpit to ensure that all was how I had left it years ago. Atop the fuselage was the "Sun Tracker" dome, intact, as was the starboard wing. My mind raced ahead to the next day when I was to take Troy on his dive for the news story. Blocking out shots in my head, I wondered how we could get it all done in two dives. Twenty minutes later, on the surface, the seas had turned, and three-foot rollers were splashing over our boat deck. It was time to get back to the launch ramp.

The next day, the seas had calmed a little, but were still too rough to get out to the site in the morning. We caught a break about three hours later, and made a run for the site. On board was Troy, Captain Weydig,

Captain Fuller, Joe Coccozza and myself. We got Troy rigged in full-face mask gear, with underwater communications, and we hit the water. Joe, Troy and I got all the underwater images and sound recordings to make a great story.

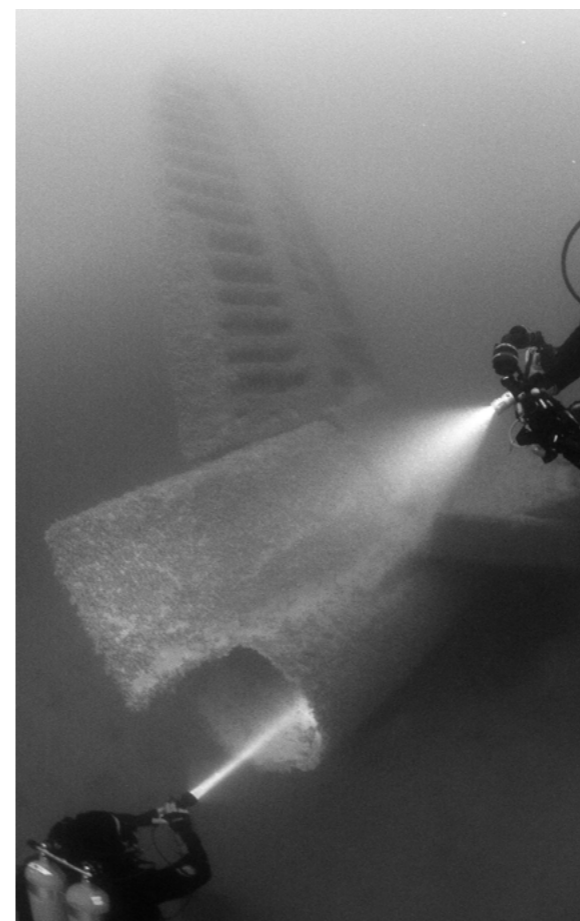
Increased interest

The next few months were filled with divers and news media wanting to dive the famed B-29 bomber. The B-29 and our team became the press darlings of the NPS. We did television, radio and print stories with CBS, NBC, PBS and NPR. In addition to that impressive list was coverage by *The New York Times* and the *Los Angeles Times*, as well as all the syndicated news wires. All told, we garnered close to eight million views nationwide. Despite all the press and



Starboard side of tail wing (above)—the openings appeared after the cloth covering deteriorated over time.

No. 2 engine nacelle (far left); View of the massive tail wing and tail gunners port (left); View of the co-pilot's station through the starboard window (below)



all the people wanting to dive the site, we maintained our small inventory of dives, due to the fragility of the site.

While our dive requirements were stringent, the NPS did have us relax them a little to accommodate single tank recreational divers and give access to the site to more of the general public.

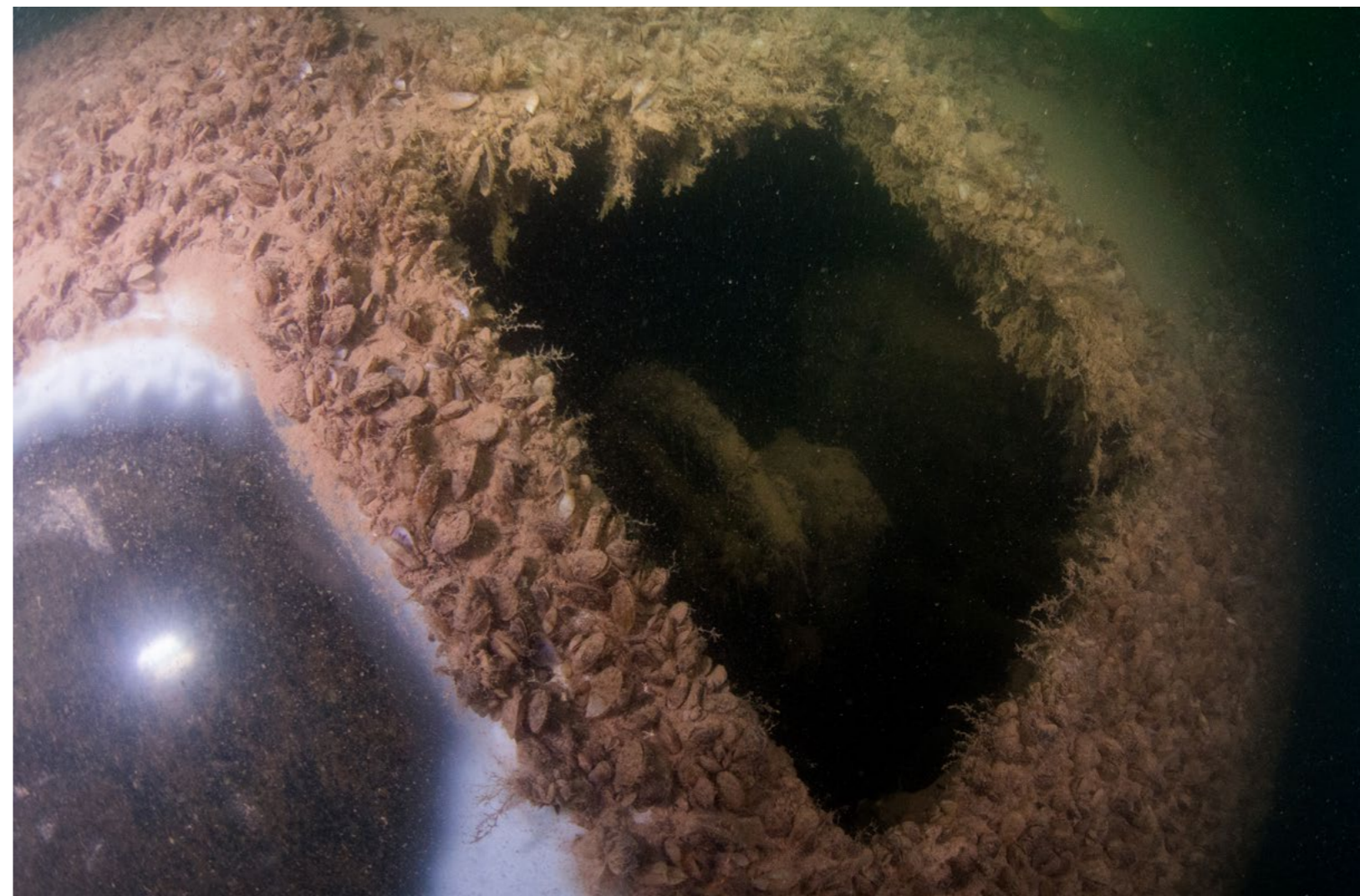
We learned a lot during the first year back on the site. Mostly, we learned that divers who were not highly experienced had no business diving the B-29. The site was too fragile and too deep for the average diver, despite our having highly

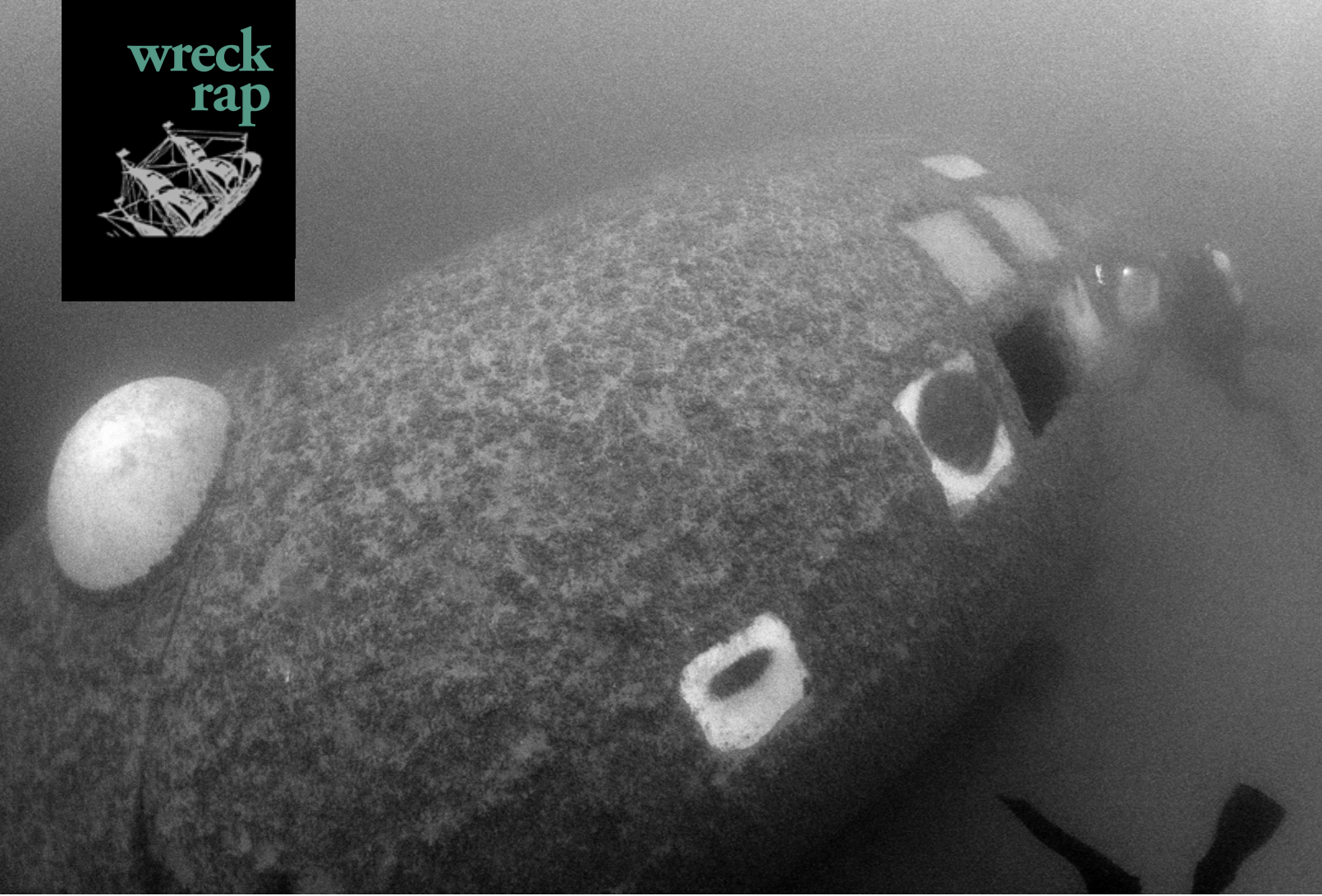
experienced guides and crew. The 2015 season came to an end, and we were already booking for 2016.

Troubling times

Although 2016 proved promising, it was a year wrought with problems. About a month after starting the season, the NPS temporarily suspended our CUA permit, claiming that an agency's inspection revealed damage to the port wing aileron. This suspension caused us to cancel almost three months of diver activity with a significant financial impact.

Yet, when our permit was reinstated, it was because there was, in fact, no damage to any part of the B-29. It had been an error

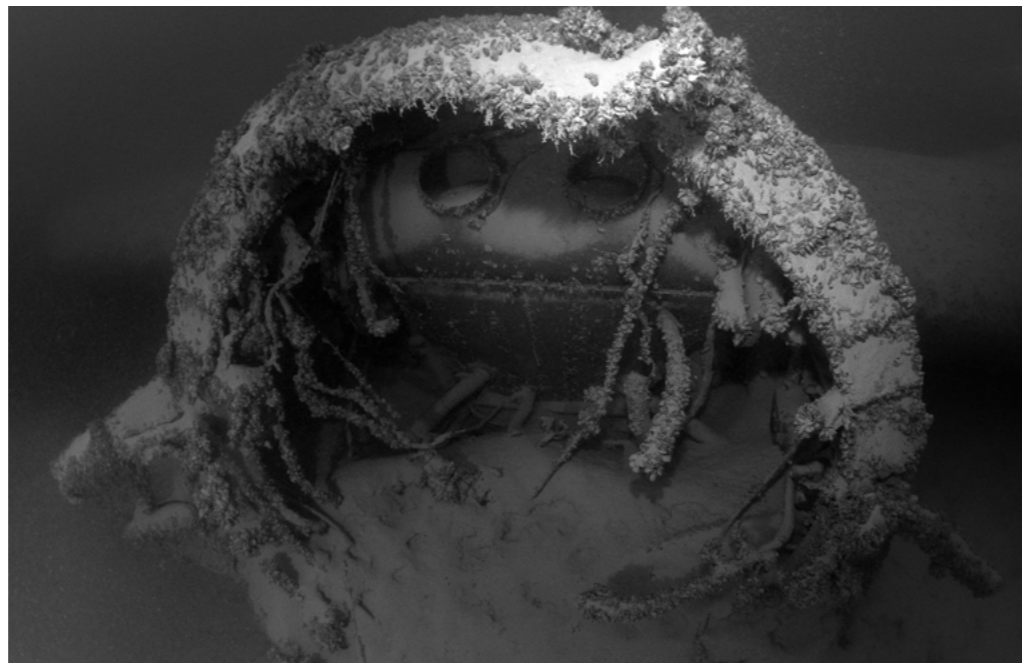




in the evaluation of the site by the Park Service. Now midway through the season, we were faced not only with a shorter season, but lowering lake levels, putting the B-29 at just under 105ft deep. The shallower water meant poorer visibility, and at times, more trying topside conditions. Having lost a few months of operation, we moved clients to dive tour slots later in the year, and operations resumed as normal... until, one day, our world turned upside down.

Emergency incident

We did not dive the site in July and early August, due to air and water temperatures. It was too uncomfortable for most people when the air temperature was above 110°F. So, we pushed our trips to the end of August, with a four-day run of four divers each day.



Friday was a perfect day, the visibility was a reasonable 25ft, and the lake was relatively calm. Saturday was proving to be just as good. We had a group of divers in from Florida: a course director,

No. 2 engine nacelle (above); Overview of the quagga mussel encrusted fuselage (top left); The only remaining engine (No. 1) and propeller that are still intact (right)



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an instructor and two divers with many years of experience. These guys had been diving together for a while, both in the States and abroad.

Due to a minor equipment issue, one diver did not do the first dive with his guide and partner. He opted to go in a little later with

one of our guides, one-on-one.

After the first dives, all the divers were just thrilled with their visits to the B-29 and the detailed tours of the wreck site. After a surface interval, tank change and some snacks, the teams started to roll in again. Time separation between teams was about 45 minutes. As I

was the last diver in the second team to submerge, I saw the third team pass me on the way down. Back on deck, I noted the time and had the divers begin putting away gear, so that when the third team came up, we could be on our way without much delay.

While the divers were recollecting their dives and putting away gear, I noticed bubbles coming across the traverse line from underwater and knew the divers were making their way back to the mooring line for their ascent. A few minutes later, one of our dive guides shouted, "Diver up!" and dived into the water, followed by one

of the clients.

Not more than 15ft off the bow, the divers saw it was their friend. They rolled him over and got him back on the deck. Two other divers assisted getting the victim on board, while I notified NPS that we had an emergency, needed a rescue boat and emergency medical services activated. As CPR and first aid were being rendered, I set up a triage area on the vessel and got everything in order.

Fortunately, a Ranger boat with a paramedic on board had picked up our radio call a few minutes earlier. We helped transfer the diver to the Ranger boat and off they went. Just as they left, the last dive guide surfaced. We got him on board, released the mooring and sped back to the launch ramp.

Tragic outcome

As an extreme diving expedition leader for almost three decades, I have managed more than my share of incidents. Everything from a broken foot from a dropped tank, to oxygen toxicity underwater, decompression illness, arterial gas embolisms, and more than a few airlifts. However, for this one, I did not have a good feeling about its outcome.

About 25 minutes later, we

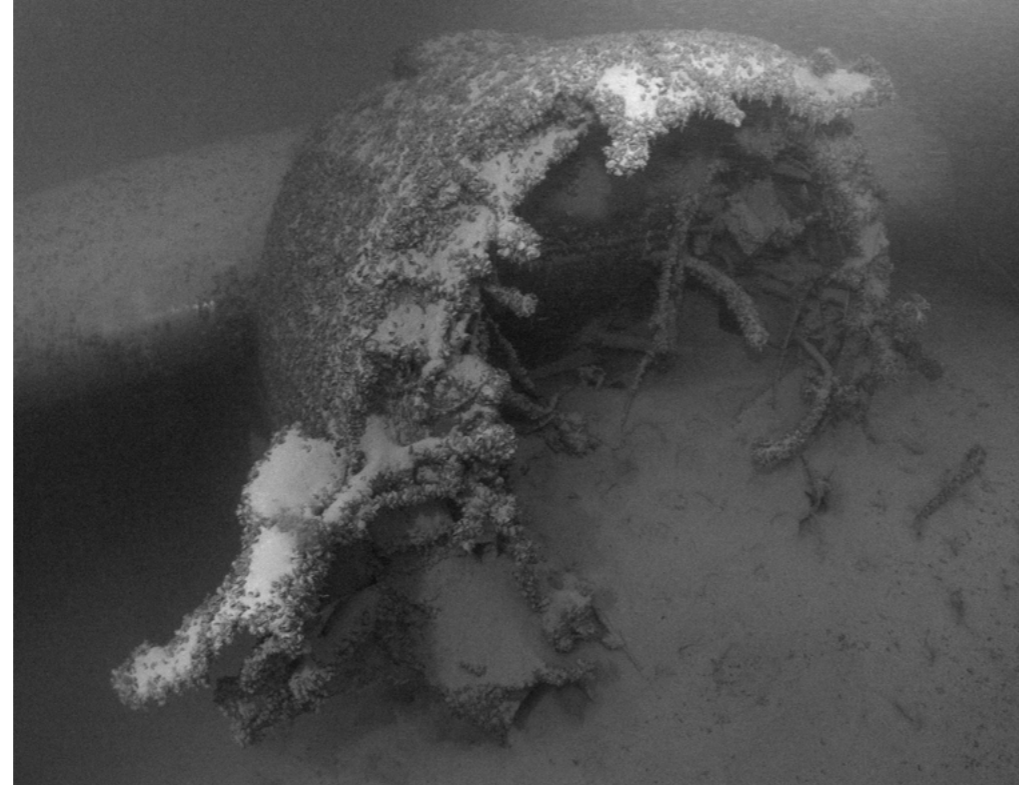




One of the engines on the B-29 wreck (right); Silverstein's son, Jona (age 15), dives the wreck with his dad (far right)

approached the dock, and it was filled with emergency personnel. Amazingly, even in this remote location, there were enough services nearby in the park that a full paramedical team was on site when the Ranger boat arrived. For the next 25 minutes, we watched as the paramedics did everything they could to revive the diver. Unfortunately, they were not successful.

Amidst the tragedy, our entire crew and passengers were

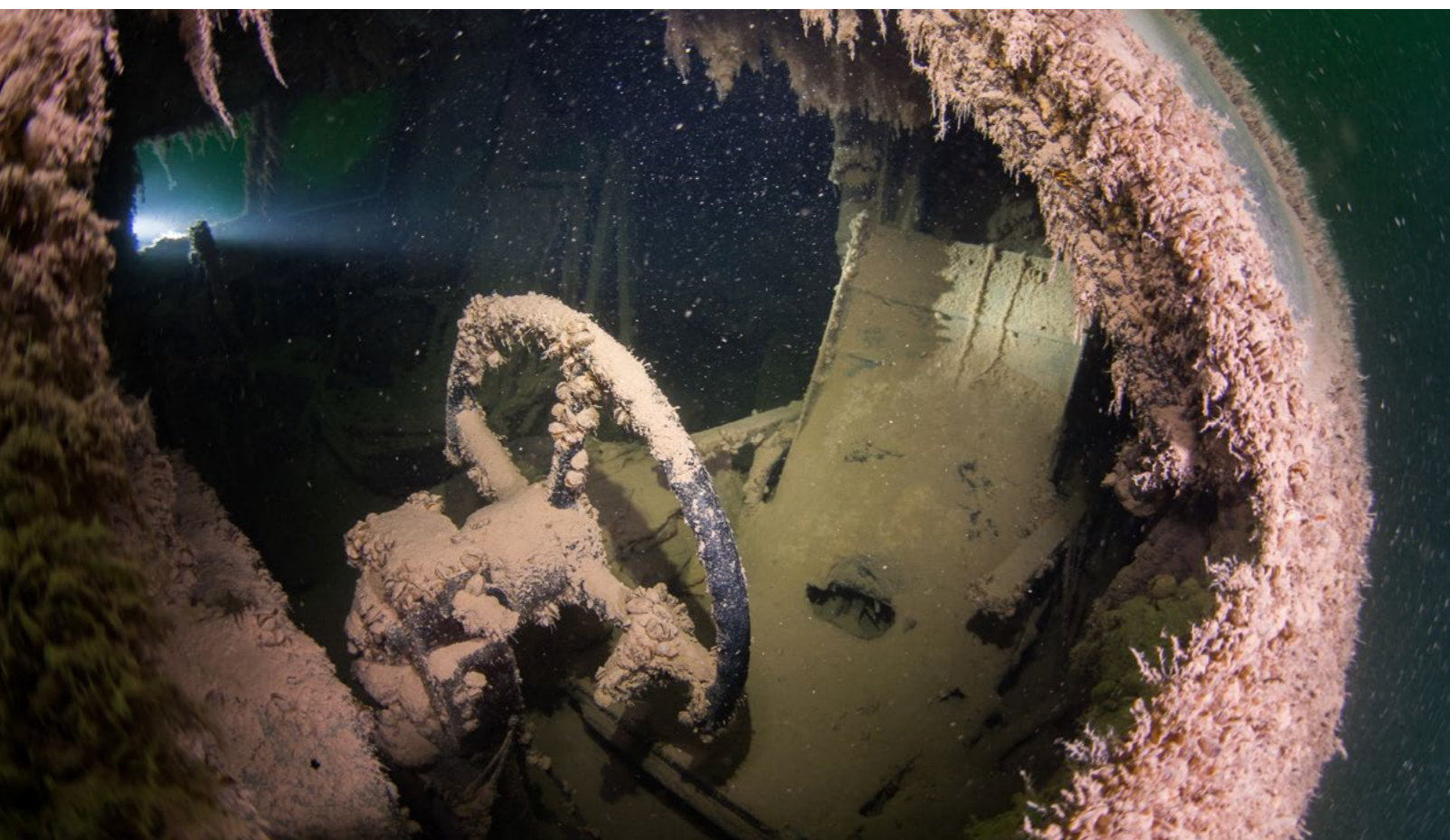


required to be interviewed about the incident and equipment collected for the medical examiner. Within a few hours, it was clear that we would not be diving the B-29 anytime soon. As per park procedure, whenever there is a

fatality, the CUA permit is temporarily suspended, pending an investigation.

Consequences

Following the suspension, divers who had traveled from distant



Interior view of the cockpit of the wreck of the B-29 Superfortress

places to dive the B-29 the next few days had to be called and informed. While it was disappointing, a moment of pause was in order. We hoped we would be back on the plane within a few weeks. Once we saw the investigation continuing for three weeks, we were forced to cancel the rest of our season.

The medical examiners finished their report at the end of December. They stated that the diver perished due to rapid ascent from a scuba dive with significant prior contributing medical history. We were cleared of the incident, and NPS granted us an extension on our CUA into 2017. But would it be worth going back?

Green light

Once given the green light, we re-booked divers whose tours had been canceled in 2016, and made our way back to the B-29.

It was a bittersweet season, back on the bomber. But my first dive to the wreck was like it had been every time I visit her. She was a huge plane resting on the bottom of the dark lake, exposing her gleaming skin to those divers who wanted to see the rare relics that survived the sea. While I made my first dive, I paused and said a little prayer for Fred Arnold, the diver from Florida who perished, and his family—as the last thing he saw underwater was the B-29.

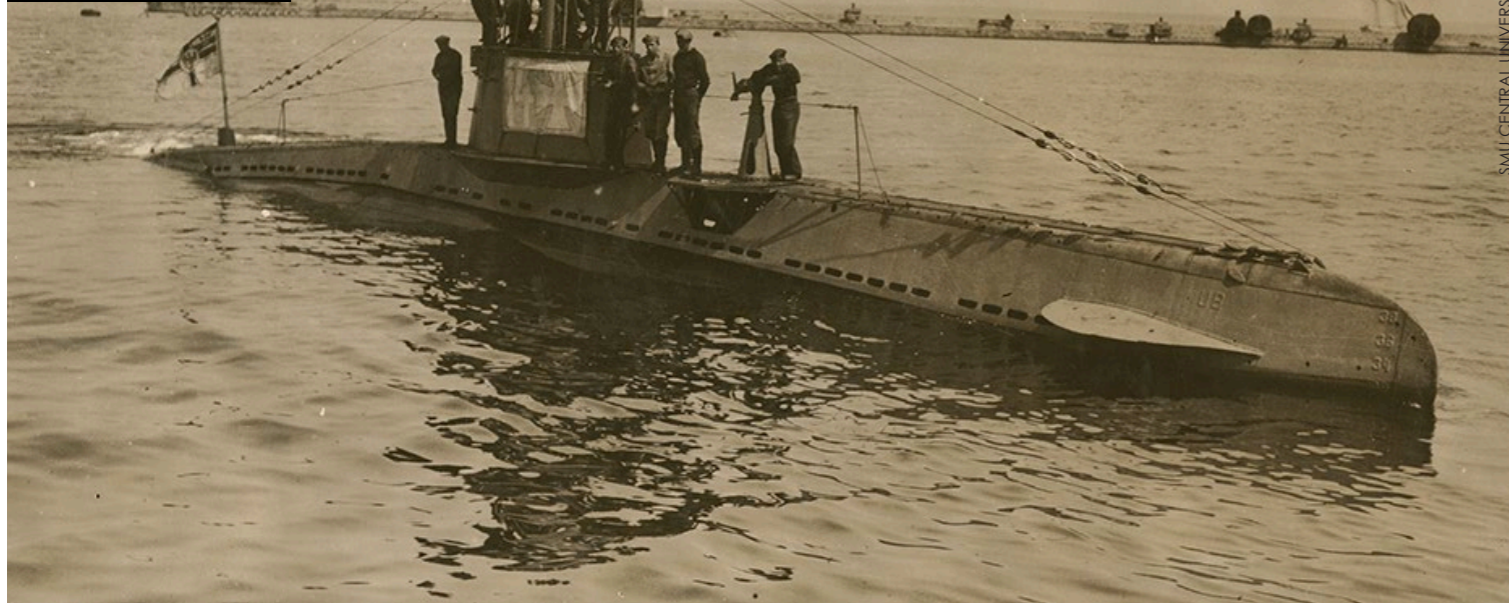
While Fred's death affected us all, there have been some happier moments on the B-29 since his passing. Remember that story we did with Troy Hayden at Fox News on the first day of our new permit in 2015? That story garnered us an Emmy Award for best feature story. Another special moment took place on 25 June. My son, Jona (age 15), did his first dive on the B-29 with me. It was a special

father-and-son moment, which few get to experience.

But now, as our season on the B-29 comes to a close, we hope we will be back on the B-29 in 2018. A new permit process begins soon, and we look forward to taking divers to the B-29 again next year. ■

Information about diving the B-29 can be found at: DivetheB29.com/b29.

Joel Silverstein is the vice president and chief operating officer of Scuba Training and Technology Inc. / Tech Diving Limited, and has been exploring shipwrecks and training technical divers since 1988. He is known for asking the hard questions as well as collaborating to develop viable solutions to complex problems.



Historical photo of German U-boat, circa 1918

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German U-boat from WWI found in good condition off Belgian coast

Belgian authorities announced on Tuesday that they had discovered the remarkably well-preserved wreck of a World War I German submarine off the coast of West Flanders.

The UB II-type submarine was found 25-30m (82-98ft) below the surface on the floor of the North Sea. About 18 such vessels were stationed with the Flanders Flotilla in Bruges between 1915 and 1918 in order to disrupt British trade

routes in the English Channel and the North Sea.

Almost intact

Footage of the wreck shows the submarine almost perfectly intact. However, the vessel did sustain some damage at the front end where researchers believe it struck a mine. The conning tower is described as intact, and the periscopes are still visible. Two torpedo tubes were found lying apart from the wreck.

"The submarine is in such good condition that we reckon all the bodies are still on board," said

West Flanders Governor Carl Decaluwé who contacted the German ambassador to make arrangements for bodies of the deceased left aboard the boat. Eleven German submarines from the World War One period have been found in Belgian waters, but this vessel is reported to be the best preserved of all.

Mr Decaluwé told reporters on Tuesday that the location of the wreck was being kept under wraps to prevent people going near it and to stop the submarine from being looted or damaged.

■ SOURCES: LIVESCIENCE, BBC

Remains of Tulsamerican's crew found?

In 2010, the wreckage of the plane was discovered under 130ft of water. The plane had broken into two, and the front section was upside down, with its landing gear locked into place for a landing.

Human bones were near the wreckage, in addition to a life vest, boot and military equipment. If DNA analysis identifies the bones as belonging to the crew members who had perished, they will be recovered and given a proper burial.

In addition, pieces of the Tulsamerican will be recovered and given a permanent home at the Tulsa Air and Space Museum.

History

The B-24 Liberator bomber is a four-engine heavy bomber, one of the main aircraft types used during World War II. The Tulsamerican was the last B-24 Liberator bomber built at the assembly line of the Douglas aircraft plant in Tulsa, Oklahoma in summer 1944.

In all, about 962 B-24s were built at the plant (some people say that the number is actually 952.) Because this was the last one, the workers at the plant took pride in this plane, to the extent of buying war bonds to pay for its construction. They dubbed it *Tulsamerican*, painted its nose art and signed their names on it.

On 17 December 1944, following a bombing run over Poland (then occupied by Germany), the *Tulsamerican* crashed into the Adriatic Sea after it was hit by



B-24 aircraft in flight, circa 1943

enemy fire. It attempted to make an emergency landing but eventually crashed into the sea off the

coast of Croatia. Of the ten crew members on board, only seven survived. ■ SOURCE: NYPOST.COM

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Wooden steamer *J.M. Allmendinger* ran aground near Mequon in 1895.

Lake Michigan sanctuary to preserve shipwrecks

Local divers know Lake Michigan as a haven for wreck diving, with its seafloor literally littered with wrecks along the shoreline of the US state of Wisconsin. Now, there are plans to establish the first national marine sanctuary in Lake Michigan.

"These shipwrecks really tell us the history of how shipping was the engine of the American economy," said NOAA regional coordinator Russ Green. "There's a huge legacy of risk, sometimes

tragedy, personal stories of innovation, entrepreneurship—all locked into this proposed area."

The proposed site, covering 1,075 square miles, is the final resting place of 37 known shipwrecks that sank from the 1830s to the early 1900s. Researchers believe that there are as many as 80 other wrecks yet to be discovered.

Many of the wrecks in Lake Michigan are intact, thanks to the water within it. "Cold, fresh water. The fact that it's salt-free helps preserve iron and wood, and the cold water is like a big freezer that acts against deterioration," said Green. ■
SOURCE: CHICAGO TRIBUNE

Artificial reef trends around the world

In a bid to generate new dive attractions, encourage coral growth and restore marine life in barren areas of the sea floor, artificial reefs are a growing trend, creating new or rejuvenating existing dive locations around the world. Below are just a few of the recent developments.

Alabama, USA

The Alabama Marine Resources Division is sinking a 250ft surveying vessel, *New Venture*, just 20mi south of Orange Beach, at a depth of 120ft, along the Gulf of Mexico coastline, in the latter part of this year. At 60ft, divers will be

able to see the top of the superstructure. Technical divers will find opportunities for safe, limited penetration of the wreck via holes cut into the vessel.

Florida, USA

In Florida, the South Walton Artificial Reef Association has completed 12 new dive locations with 30 artificial reef structures at each location, plus 12 superreefs designed for snorkelers, off Mirimar Beach in the Florida Panhandle, along the Gulf of Mexico coast. The structures include grouper boxes and snapper pyramids to attract fish.

Thailand

On the east coast of Thailand, 1,000 concrete frames were sunk to the seabed along the shores of Sathing Phra district in the southern province of Songkhla, to create an artificial reef, which will attract fish and marine life, thus combatting the detrimental ef-

fects of overfishing. Another 1,500 concrete frames will be sunk this year in the districts of Sathing and Ranot in Songkhla, and Pattani and Panare.

Australia

Researchers will suspend a modular artificial reef alongside the Sydney Opera House. A partnership between the opera house, the New South Wales Government and two local universities, the three-year project aims to increase native species and bolster marine biodiversity. ■
SOURCES: 30A, BANGKOK POST, COURIER JOURNAL, ENVIRONMENT.NSW.GOV.AU, SCIENCE ALERT

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The 250ft surveying ship, *New Venture*, will become an artificial reef



Edited by
Scott Bennett

The reef around the island country of Niue in the South Pacific, as seen from space



NASA / PUBLIC DOMAIN

Niue plans huge marine reserve

The Niue government has announced plans to create a large marine protected area covering 40 percent of its exclusive economic zone, and called on New Zealand to do more to protect the ocean.

The marine protected area will protect the ocean around the tiny island nation and nearby Beveridge Reef, an uninhabited atoll which is home to the world's highest density of gray reef sharks. Once established, the marine protected area will be the 28th largest in the world.

Along with Palau and Chile, Niue will be one of just three nations protecting over 30 percent of their ocean territories, which is what scientists recommend to keep oceans healthy and resilient to climate change. The ocean around Niue is a breeding ground for humpback whales—the same whales that pass through New Zealand's Kermadec region each spring.

Huge opportunity

"There's a huge opportunity for New

Zealand to keep this momentum going by establishing the Kermadec Rangitahua Ocean Sanctuary now," said WWF-New Zealand Chief Executive Officer Livia Esterhazy. "We Kiwis love our oceans, and we want to protect them," she added. Earlier this year, a Colmar Brunton poll revealed 93 percent of New Zealanders want the Sanctuary established. Let's make it happen!"

University of Auckland scientist Dr Rochelle Constantine has visited the Kermadec region several times to study the humpback whales that gather there each spring en route from the tropics to their sub-Antarctic summer feeding grounds.

Supported by The Pew Charitable Trusts, her research has confirmed that humpback whales from Niue travel to the Kermadecs, along with others from across the Pacific and beyond. The Kermadec Campaign partners, Forest and Bird, the Pew Charitable Trusts and WWF-New Zealand have been advocating the establishment of an ocean sanctuary to fully protect its internationally important wildlife. ■ SOURCE: WWF NEW ZEALAND

Canadian lake features underwater ghost town

Ghost towns are popular above water attractions, but how about an underwater version? Look no further than Canada's Lake Minnewanka. Located within Alberta's Banff National Park, this seemingly ordinary lake conceals a secret: a completely submerged ghost town.

Established in 1888, the resort village of Lake Minnewanka was a summer resort-of-sorts for people living near Calgary. After construction of the first hotel called the Beach House, the small lodging grew into bustling hamlet of Minnewanka Landing, complete with cottages, hotels, restaurants and lake tours aboard cruise boats.

Unfortunately, the good times didn't last. In 1912, a portion of Minnewanka Landing was flooded due to the construction of a new dam for a nearby hydroelectric plant. When a new dam was constructed in 1941, water levels rose by 98 feet, completely submerging Minnewanka Landing.

Well preserved

Today, the remnants of Minnewanka Landing can be explored beneath the lake. The old town's buildings have been well preserved by the

frigid waters and with scuba gear, one can literally swim into the hotels and houses. Each year, some, 8,000 scuba divers visit the lake to do just that.

Visibility fluctuates depending on the time of year and the number of divers at the site. Dives vary in depth from 12m to more than 25m and varies according to the time of year. Although no local operators provide scuba tours, several Calgary dive shops offer organized trips to Lake Minnewanka, as well as providing equipment rentals.

A comprehensive guide to the various dive sites can be found at the Parks Canada website at <https://www.pc.gc.ca/en/pn-np/ab/banff/active-plunge-diving/sites-minnewanka>. ■

SOURCE: MONTREAL BLOG, PARKS CANADA



Lake Minnewanka, Banff National Park

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Northwest Bali

Underwater Gods & Conservation

Text and photos by Brandi Mueller





Chromodoris coi nudibranch

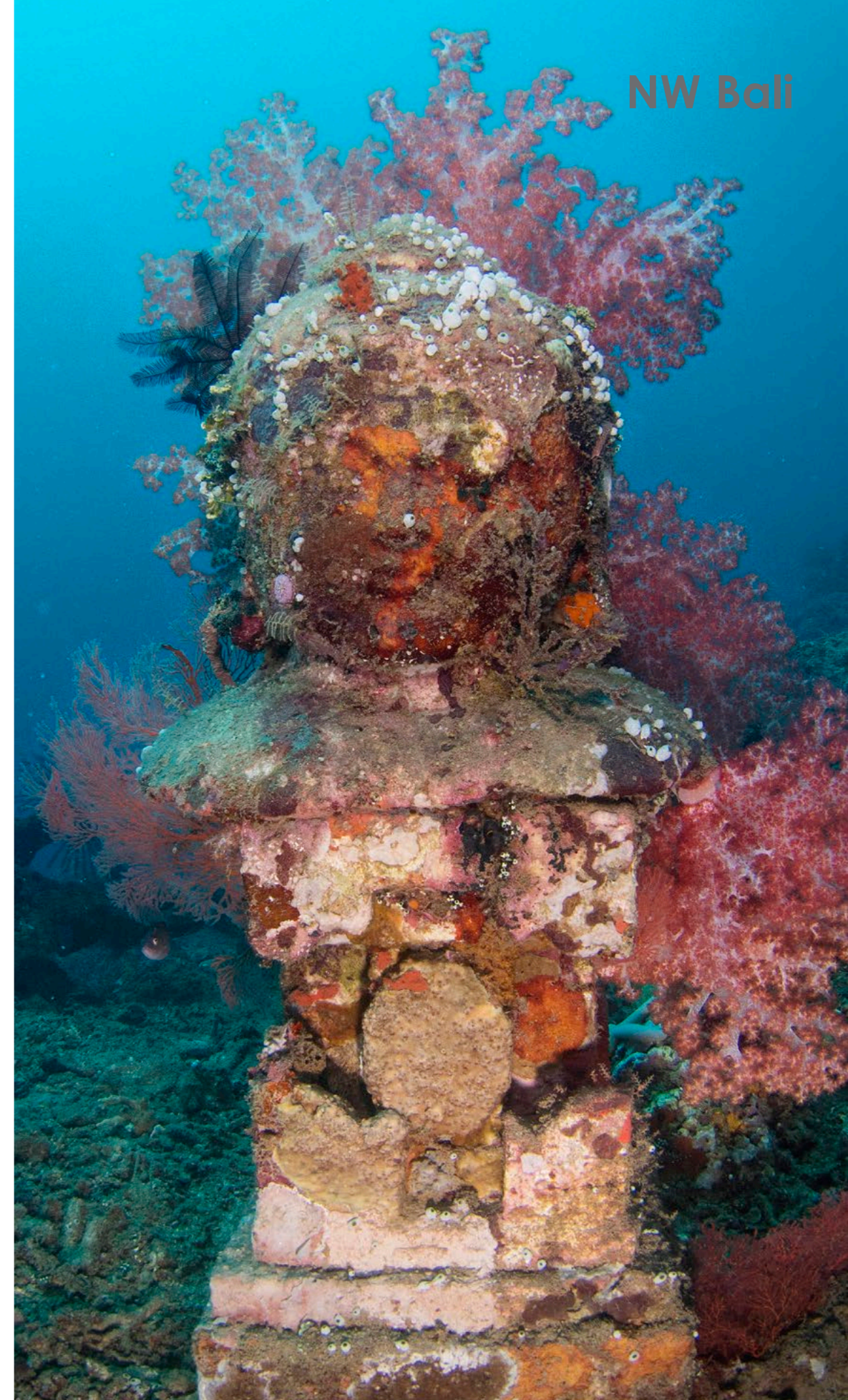
Rarely do you come across someone who has a negative opinion about Bali. More often than not, you will find previous visitors raving about Bali as magical, some suggest it is spiritual, and others find it relaxing, or even full of adventure. It is a place I have come to love and enjoy returning too often. But its magic is no secret, and anyone who has spent an evening on Kuta Beach will discover themselves among about 600 other soul-searchers... or perhaps just partying Australian 20-somethings. But I got a tip—sort of a do-not-tell-anyone whisper—of a still-secret place on the island of Bali, which is less crowded, quiet and less touristy than the popular destinations of Kuta, Sanur and Ubud.

After braving a few days among the masses in these areas, I headed northwest. The hair-raising, four-and-a-half-hour drive up and around two volcanoes showed me one reason why not many people make the trek this far from the airport. But my arrival under a blanket of stars with the sound of soft waves crashing as I went to sleep had me thinking that the long ride to Reef Seen Divers' Resort had been worth it.

A cozy haven

Waking up on my first morning, I walked out of my bungalow into the early morning light. The snug resort had eight rooms nestled among flowering trees and stone pathways that connected the rooms, restaurant and dive shop. A short walk led me past the turtle hatchery (more on that later) and I got a quick glimpse of two just-hatched turtles wandering around the sand enclosure. I made my way to breakfast and enjoyed my coffee while overlooking the beach.

Admiring the view and finding a new level of calmness, I headed over to the dive shop to get ready to dive. The island of Bali and all of Indo-



Statue of a goddess at Taman Pura, Underwater Temple Garden, in Pemuteran Bay; Sunshine streams down on large colony of fan coral (top left)



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NW Bali

Sunset over Pemuteran Bay, Bali; Goby on soft coral (left)



divers get our gear ready. Then we walked just a few feet on the beach to the boat and headed out for our first dive.

Diving

I only had three days of diving to explore this secret paradise, which almost did not feel like Bali at all. Heading out about ten minutes by boat, our first dives were at sites called Close Encounters and Napoleon Reef. Both were lovely natural reefs with lots of marine life, including some rare creatures such as nudibranchs, flatworms, tiny egg cowries, ribbon eels and a baby whitetip reef shark no more than a foot long, wedged under a coral ledge.

I spent my afternoon relaxing and napping until just before dusk



Jawfish

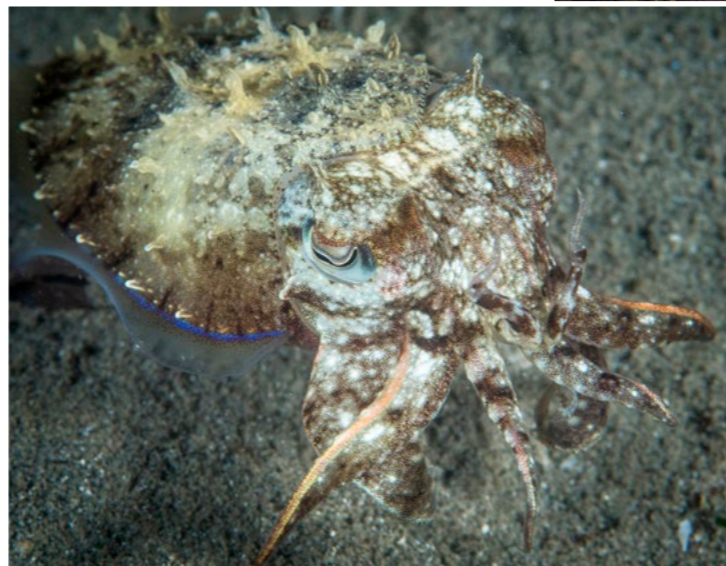
nesia fall within the Coral Triangle, which is the most biodiverse marine area on Earth. I was excited to get in the water and see it for myself. The lovely crew was all smiles, as they helped me and the other



Juvenile whitetip shark (above); Diver with large barrel sponge (top right); Cuttlefish (right)

when it was time for a night dive. During the briefing, Amanda, one of Reef Seen's long-time managers, told us we would be diving just down the beach from Reef Seen under the fishing dock, which was a muck dive that had some incredible resident creatures.

As we geared up, the sun was just setting, and the whole sky turned bright pinkish-orange, reflecting on the water as it faded to dark. Accessible by boat at high tide, we were going for a dive during a very low tide, so we walked in from shore. The black sand muck dive was an endless treasure hunt, with finds that included



a frogfish, two long-armed octopuses, a cuttlefish, harlequin ghost pipefish and more—all in water less than 10m (30ft). An hour later, none of us wanted to get out.

The majority of the dive sites Reef Seen visits are no more than a ten-minute boat ride away, allowing divers on the boat to come back in between dives to get dry, relax and enjoy the view. As I settled into a peaceful state, I started chatting with Reef Seen owner Chris Brown, and quickly learned that Reef Seen has another side, which is not just about lying around relaxing in the sunshine or enjoying cool Bintangs on the beach.



Pseudoceros bifurcus flatworm

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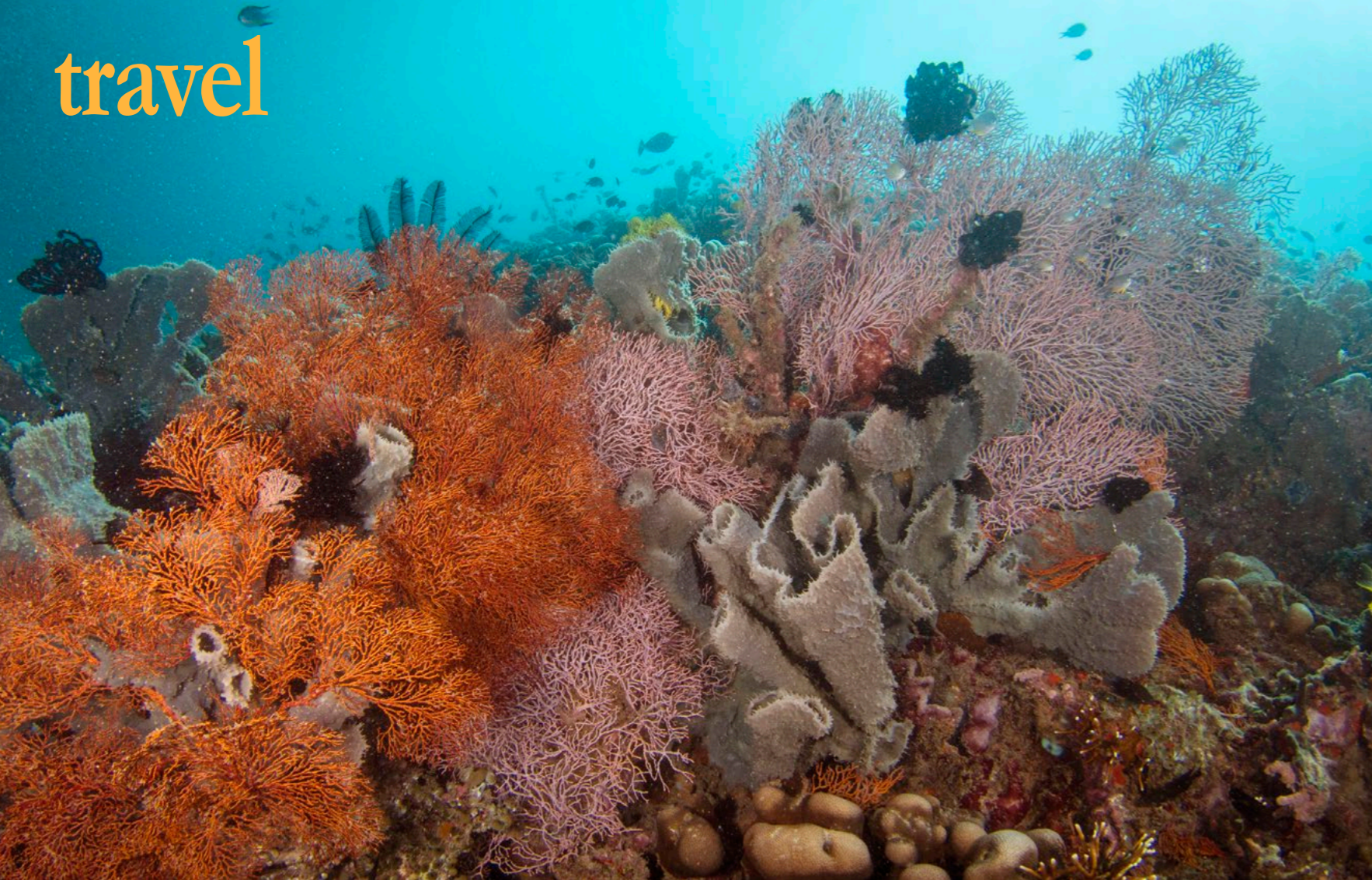
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Long-arm octopus on night dive





Juvenile lionfish

Healthy corals in Pemuteran Bay (above); Fishing boats moored along the beach (top right); When a blue ribbon eel is in its black phase (right), it is a male. It then transitions into a female when it becomes blue and yellow.

Reef Gardeners

On my second day of diving, we set out to see some of the numerous environmental and cultural projects Reef Seen has built. Chris opened Reef Seen 25 years ago, after finding the paradisiacal spot and deciding to stay. With illusions of relaxing and enjoying life in the small corner of Bali, he soon realized there were some problems occurring, and being a problem solver, he set out to fix them.

Like so many places in the world, the reefs of northwest Bali were facing so many pressures that it was suffering. Dynamite and cyanide fishing, as well as an overpopulation of crown-of-thorns starfish and drupella shells, had been destroying coral. Chris' idea was to create a program called "Reef Gardeners."

The program, still active today, aims to use education and dive training to train local fishermen and other members of the community in sustainable fishing practices and reef conservation and recovery. With funding from the Australian government, he was able to create a team of young people who became divers, were educated about the reef, assisted in reef protection projects and further educated the rest of the community in all of the above.

The Reef Gardener projects have included removing crown-of-thorns starfish and drupella shells; learning how to assist in repairing coral damaged by anchors, careless divers, nets and even natural causes such as storms; and helping in creating the artificial reefs in the



area: BioWreck, Temple Garden and the Garden of the Gods.

The program certified the participants through Rescue Diver qualifications, and many of these people have gone on to work in the local dive community and throughout Asia. Dive operations love to be able to hire dive guides with knowledge of the reef and trained in con-

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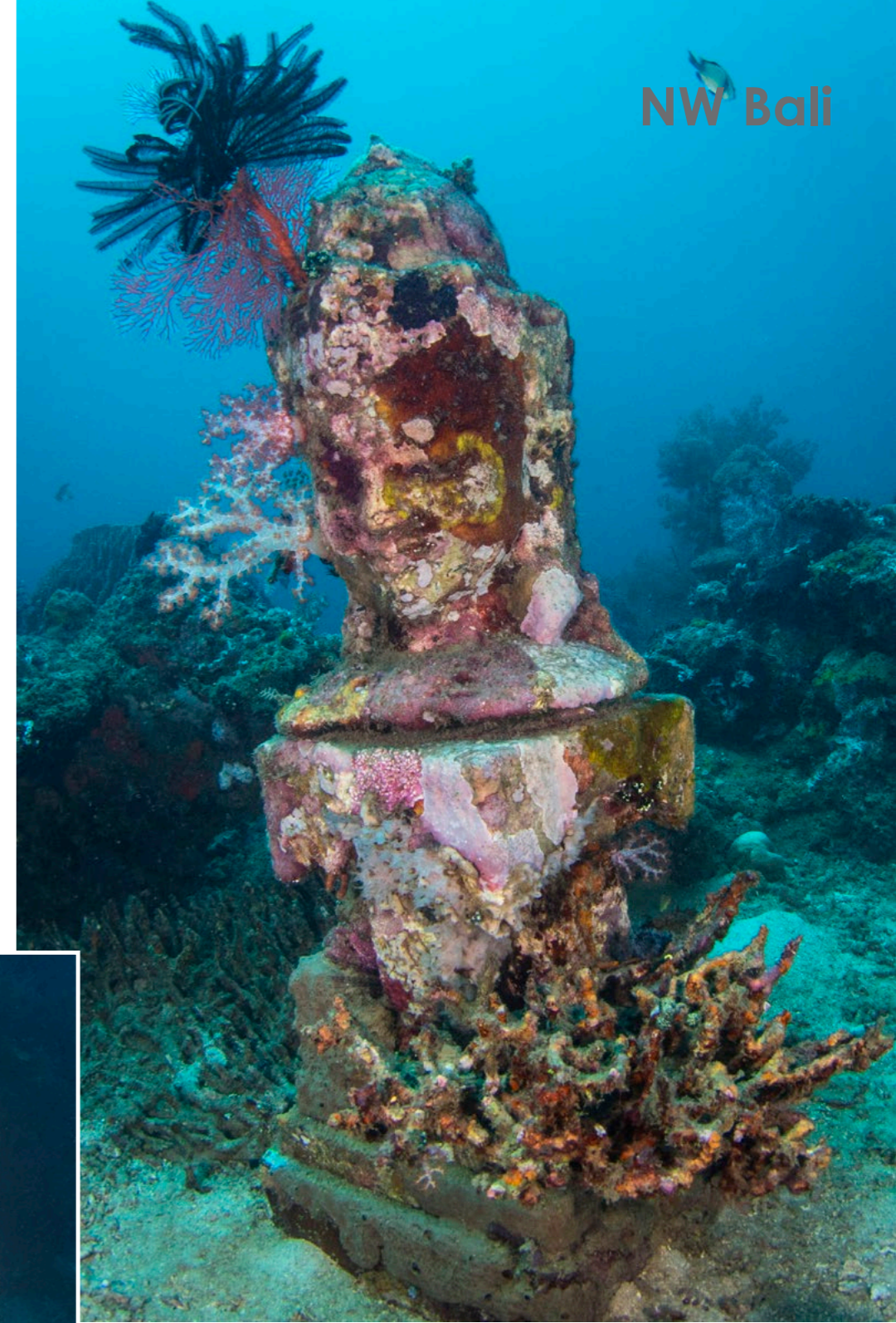
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THIS PAGE: Scenes from the underwater Temple Garden. Goddess head statue in the Temple Garden (right)

descending into the blue, you start to make out the shapes of the temple layout. Due to some winds and high surf, visibility was not perfect for my dive, but the milky water almost added a mystical ambience to the scene. A sort of underwater mist settled on what seemed to be an ancient underwater temple.

Divers can still see the gate keepers and swim through the entrance's split gate—one side of which was crumbling a little, which seemed fitting. A statue of the deity Ganesha was in the center of the underwater temple, with statues of other gods and goddesses as well as sea turtles and other figures surrounding it. The bright pink gorgonians were so thick, you could not make out parts of the statues. But I could not help but love how the ocean had decorated this underwater temple. I would like



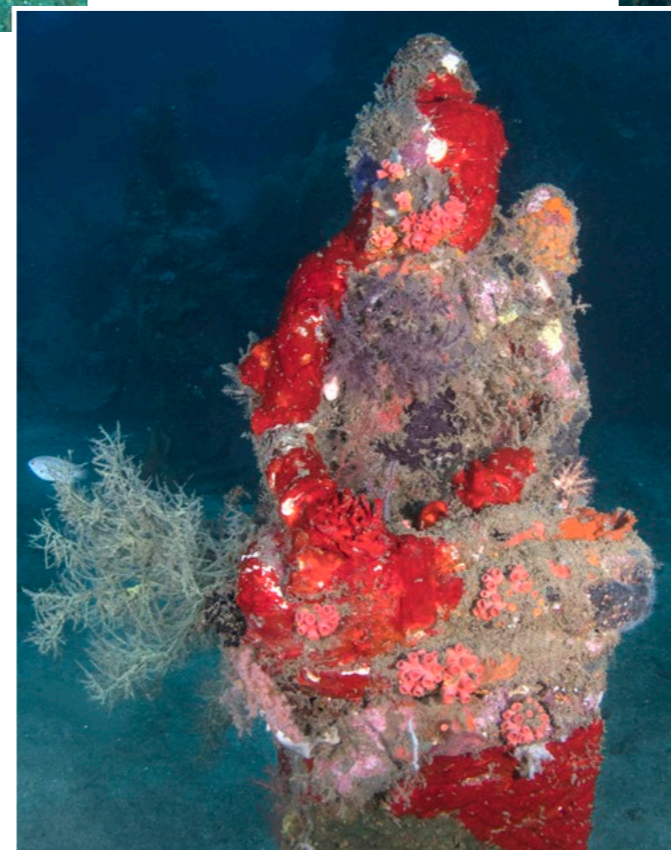
servation. Training through Reef Gardeners made it easy for the program's participants to secure those jobs, making it a win-win situation for the dive businesses and the local community.

Temple Garden

I wanted to see some of the projects Reef Seen and Reef Gardeners had created, so on my second day of diving, we visited an artificial reef project known as Temple Garden. Being the first dive operation in the area, Chris realized throughout the years that as tourism increased, more dive sites were needed in the area. If the increasing number of divers continued to only dive a few locations, it would likely have detrimental effects on those areas.

Using the concept of building an artificial reef to encourage coral and marine life expansion, Chris also incorporated the local culture. Instead of just sinking a ship or concrete blocks, his dream was to build an underwater temple. Securing funding from the Bali Rehabilitation Fund (established by Aus Aid) after the Bali bombings, Chris and the Reef Gardeners were able to build the underwater temple in 2005.

Before back-rolling into the water, you can see the remains of a temple on the hill directly in front of the dive site. While



Sitting Buddha statue in Temple Garden

to think the gods were quite pleased with it.

More than ten large stone statues could be found at around 26m (85ft) on a sandy bottom near a reef wall. Twelve years after its creation, it would be easy for a diver to swim past this area and miss it entirely, because

the ocean will have decorated the statues with gorgonian sea fans, encrusting it with colorful sponges and covering some of the recognizable features with purple barrel sponges. Fish swarmed the statues. Looking closely, we saw several species of nudibranchs and even an electric clam in one of the statues.



A baby olive ridley turtle swims towards open water after being released (left and above)

NW Bali

Sea turtles have a rough childhood. Female turtles bury their eggs in the sand on beaches where they are susceptible to predation by animals that dig them up. On today's beaches, it is not only wild animals but also stray dogs, and even humans, that are doing the digging. Sea turtle eggs are sold in certain Asian markets, where they are believed to have unproven medicinal benefits.

If the baby sea turtles made it through to hatching, they then must dig themselves out of the sand and crawl as quickly as they can to the ocean. The small sea turtles are faced with predators while still on the beach as well as once they get in the water. Artificial lights on land have been known to confuse sea turtles as to which direction they must go, and so sometimes they do not go to the

sunshine and clear skies was pleasant. As we pulled up on the beach, I noticed a lot of people gathered right at the shore break, looking at the sand. As we got closer, I asked our dive guide what was going on, and he said they were releasing baby turtles!

I knew Reef Seen had a turtle project, but had not had time to learn more about it yet. Getting out of the boat, we watched a family with two children place two turtles in the sand and the turtles make their way to the water. As a wave washed over them, they disappeared, and we observed their little heads poke up from the water to breathe a few times before disappearing off into the horizon.

Seeing another group about to release another baby sea turtle, I asked the dive staff if I could snorkel with it a short distance out into the water. They warned me that the baby sea turtles were fast (and they

were not kidding). I positioned myself several yards out from the shore and watched as the baby turtle climbed down the beach and into the waves. A minute later, I saw it right in front of me (like a speeding bullet, headed out to sea). I kept up for a little while, snapping shots as best I could. I could not help but think, "Good luck, little guy! I hope I run into you underwater again someday."



A quick Google search on the underwater Balinese Temple reveals a funny story from 2010 when many articles falsely reported that a true ancient underwater temple had been found. Many news agencies picked up the story before it was corrected to more accurately report that the temple was recently created and not an ancient archaeological discovery.

Either way, it was one for my list of favorite dive experiences. I cannot fully explain how much I enjoyed this dive site. Visiting temples is part of what one does in Bali, and to combine the spirituality of Bali with the ocean seemed like a perfect idea to me.

Project Penyu — turtle hatchery

Returning to the dive resort after visiting the Temple Garden, I was in a state of spiritual bliss. The short boat ride under



Reef Seen's environment and social project coordinator, Widya Hapsari, gives a tour of the turtle hatchery.

Turtle nests are reported to Reef Seen by the community. To protect them from predation or being eaten or sold, the eggs are relocated to the turtle hatchery. Once hatched, they are kept for two to four weeks while their shells harden. They are then more likely to survive in the open ocean. You can participate in releasing a turtle for a small donation to the project.





A baby olive ridley turtle makes its way to the ocean; Just released baby olive ridley turtle swims towards open water (right)

water.

Reef Seen saw the problem of locals using turtle eggs as food, or sold for money, as an opportunity to work together with the community to save the sea turtles. The idea was to make sea turtles worth more alive than dead.

They began offering monetary awards to locals for reporting sea turtle nests. Now the community shares information with Reef Seen about where the sea turtle nests are, so trained staff can retrieve the eggs so they can be protected.

Sea turtle nests are then relocated to the Reef Seen hatchery. Over the years, they have had green, hawksbill and olive ridley sea turtles. Reburied in a faux-beach, the baby turtles hatch as they would naturally, and then they are moved to holding tanks. Turtles are kept from two to four weeks in the holding tanks, because when they hatch, their shells are very soft. Keeping them safe while their shells harden, the turtles can then grow slightly larger and this will hopefully give them a better chance of survival in the open ocean.

Widya Hapsari, Reef Seen's Environmental and Social Project Coordinator (and a PADI Dive-master), gave me a tour of the facility. I will not lie; you could not wipe the smile off my face as I looked down at tanks full of baby



The beach at Reef Seen Dive Resort (above); Healthy reef (right)



can release adult turtles if they are ready for a donation too). If the problem is too severe, such as one sea turtle there with tumor disease (fibropapillomatosis), the staff try to get additional help for the animal. This turtle was headed for surgery else-

where to try and save it.

Garden of the Gods

Feeling as if visiting an underwater temple and seeing baby turtles was enough to keep me happy for days, we headed out for our second dive to another artificial reef created by Chris and the Reef Gardeners, known as the Garden of the Gods.

Bali is known as the island of gods and goddesses. The Garden of the Gods artificial reef is based on the legend of Dewata Nawa Sanga, or the nine guardians of the compass or direction. Underwater, a statue of the main god, Shiva, sits in the middle of the temple on the back of a turtle (on land, Shiva drives a cow, but it makes more sense to be on a turtle underwater, and it also honors

sea turtles. Several nests had been hatching while I was there, and every morning, as I walked past the hatchery to breakfast, I could see a few little turtles crawling around in the sand.

Sea turtle talks and tours of the hatchery are given every 30 minutes for a small donation, and if there are baby turtles, once a day, visitors can release one and receive a certificate (also for a small donation). These donations go back into the program to reward the locals for sharing information on turtle nests and injured turtles.

Widya also introduced me to two adult turtles in the facility. The facility is set up to receive sick or injured turtles, and they try to rehabilitate the turtles there and then release them if possible. (Visitors



NW Bali



Coral-encrusted lantern at the Garden of the Gods



Reef Gardeners dive boat

THIS PAGE: Scenes from the underwater Garden of the Gods

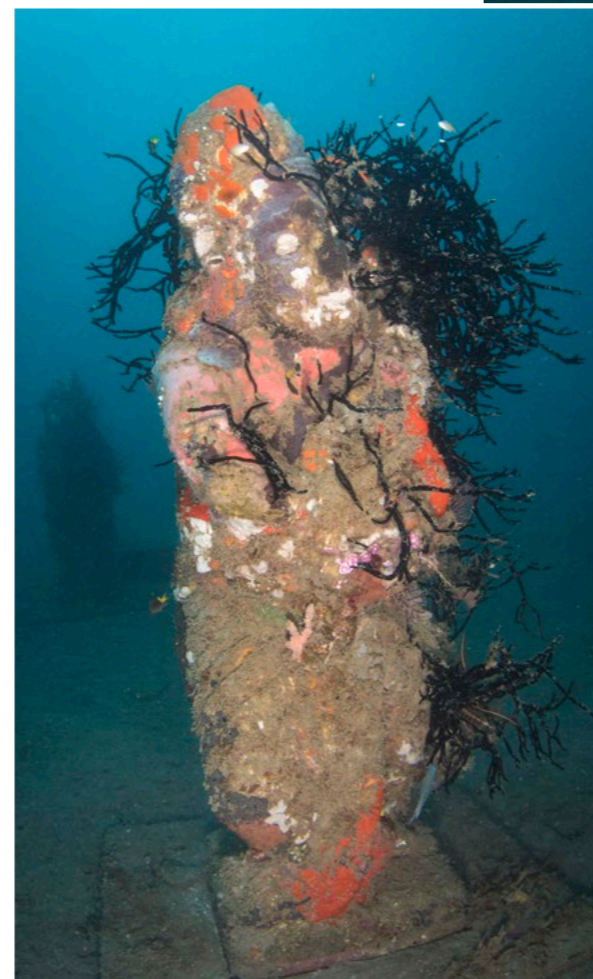


the turtle hatchery). Statues of the other eight gods—Brahma, Rudra, Mahadeva, Sangkara, Vishnu, Sambhu, Iswara and Mahesora—stand around facing the eight directions of the wind. Throughout the garden are statues of musicians and dancers, lanterns, benches and figures of marine life, including sea turtles. Giving divers and the local community the opportunity to participate, each statue was sponsored by guests or businesses.

A similar concept as the Temple Garden, the Garden of the Gods was completed in 2014 with all the work being done by hand. Sitting directly offshore from Reef Seen, the statues were lowered to a sandy patch from the surface, and the Reef Gardeners

positioned them and created the garden. Only three years underwater, marine life is already growing in abundance on and around the statues.

Diving the site was an incredible experience. What was once just a sandy patch was now an underwater temple that was attracting marine life and would continue to do so well into the future. Throughout the world,



we build temples as places of worship and to honor deities. They are physical places that allow people to visit and show gratitude and respect to whatever they believe in, and they are places for like-minded people to gather together, to contemplate, or just to be.

many spiritual moments. I can see no better way to respect the ocean and the incredible spirituality and culture of Bali. I cannot wait to see how the ocean continues to decorate these underwater gardens throughout the years.



As divers, I think we need more of these places for us to come together and show gratitude and respect for the ocean.

It was amazing to be on the island of Bali, the Island of Gods, and visit a temple (two, actually) underwater—a place where I personally have had

Bio-Wreck

The last diving day of my visit was spent checking out another Reef Seen/Reef Gardeners project called the "Bio-Wreck." Just a five-minute boat ride in front of the resort, the area was previously devastated by cyanide fishing and crown-of-thorns starfish. With an AusAID grant, the Reef Gardeners were able to set up a biorock artificial reef project.

Creating artificial reefs by sinking objects to provide a place for coral to grow is not a new concept, but biorock technology takes that idea one step further. Biorock artificial reefs are becoming more and more popular around the world and have been set up in over 20 countries in South-east Asia, the Caribbean, and



Diver at fountain in the Garden of the Gods



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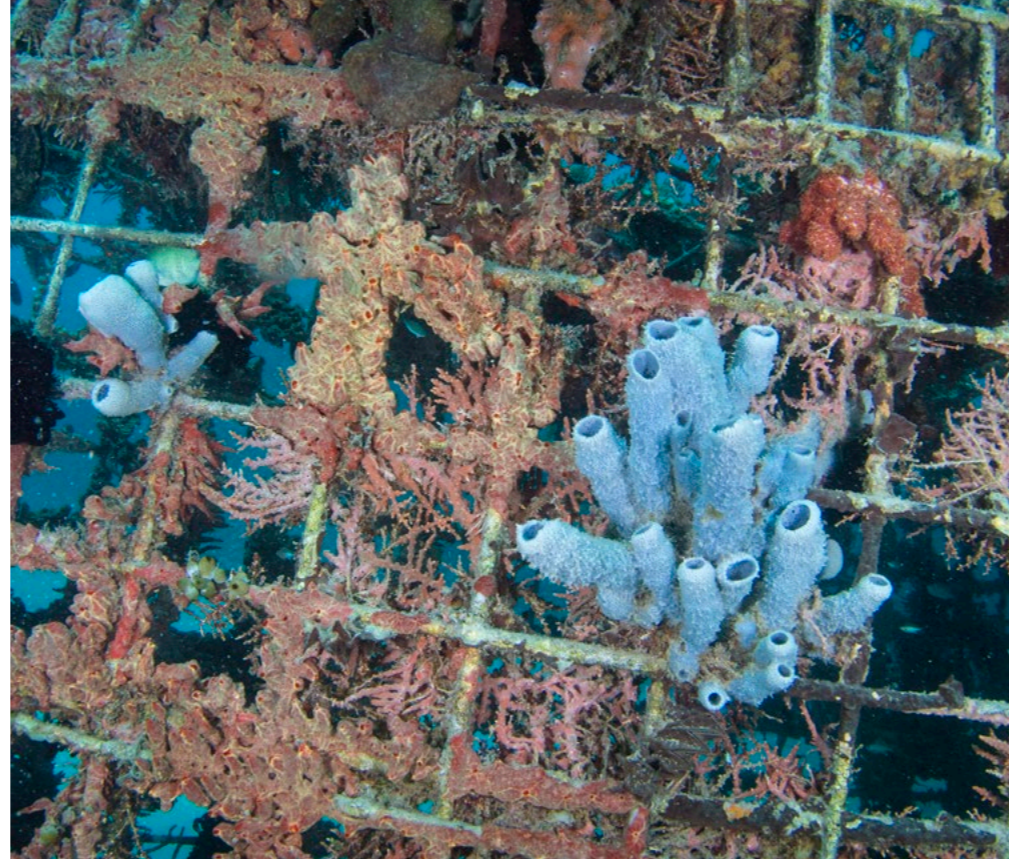



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THIS PAGE: Coral growth on the structures of the Bio-Wreck site

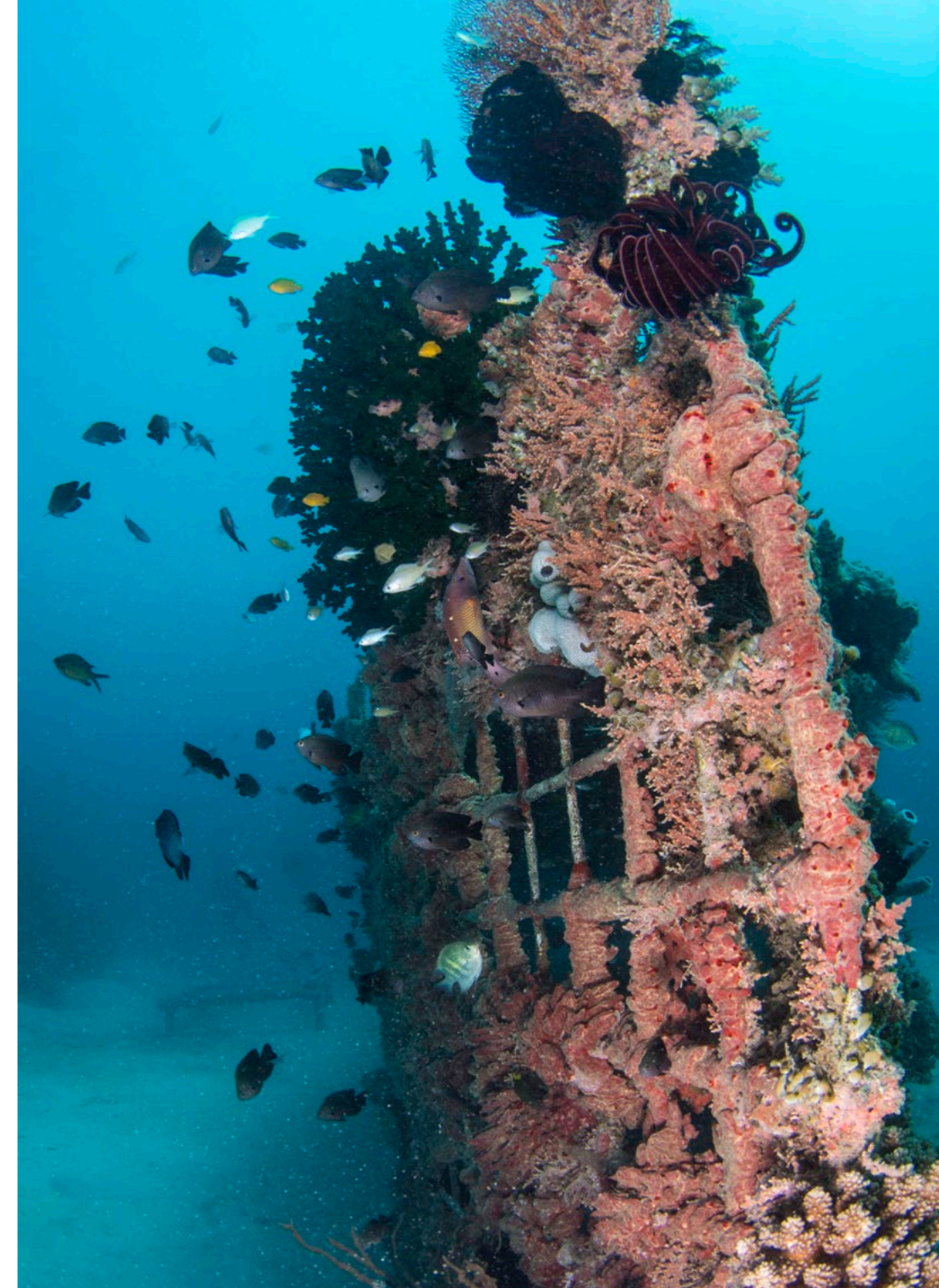
the Indian and Pacific Oceans. Their purpose is to encourage coral growth quickly and to provide a helpful boost to assist the reef survive environmental pressures. A conductive metal structure is sunk, usually made from rebar and wire mesh, and a low voltage direct current is applied.

A small floating solar panel can be seen on the horizon off Reef Seen's beach, which creates the electricity to power the Bio-Wreck. Structures shaped like a turtle and a boat frame were sunk, one in 2005 and one in 2009. I was told that this technology worked best when there was some natural coral reef nearby. In between the turtle and boat structures was a large coral reef area loaded with fish and covered in coral.

By using a small amount of electric current, salt water is electrolyzed and minerals are dissolved in the water, which then adhere to the structures. Those minerals attract and facilitate coral growth, and create a cement-like base for the adhering coral. Divers trans-

plant coral fragments, attaching them to the frame. Research has shown that biorock reefs grow three to five times faster than coral does naturally, that these reefs further strengthen over time, and that they are more likely to survive during times of environmental stress.

At the Bio-Wreck site, the boat mooring is located close to the solar panel float. Divers can descend to a mooring line leading to the turtle structure in the sand. Swimming around the turtle structure, one can see the coral growth and fish life around the structure. The dive then continues to a small wall-like reef with massive barrel sponges and gorgonian fans. Further exploring the natural reef, one will eventually come to another sandy patch where the boat structure is located. The boat structure has been submerged for a longer period than the turtle structure, so it has considerably more coral growth on it. Fish can be seen inside and around it; although, in some parts,



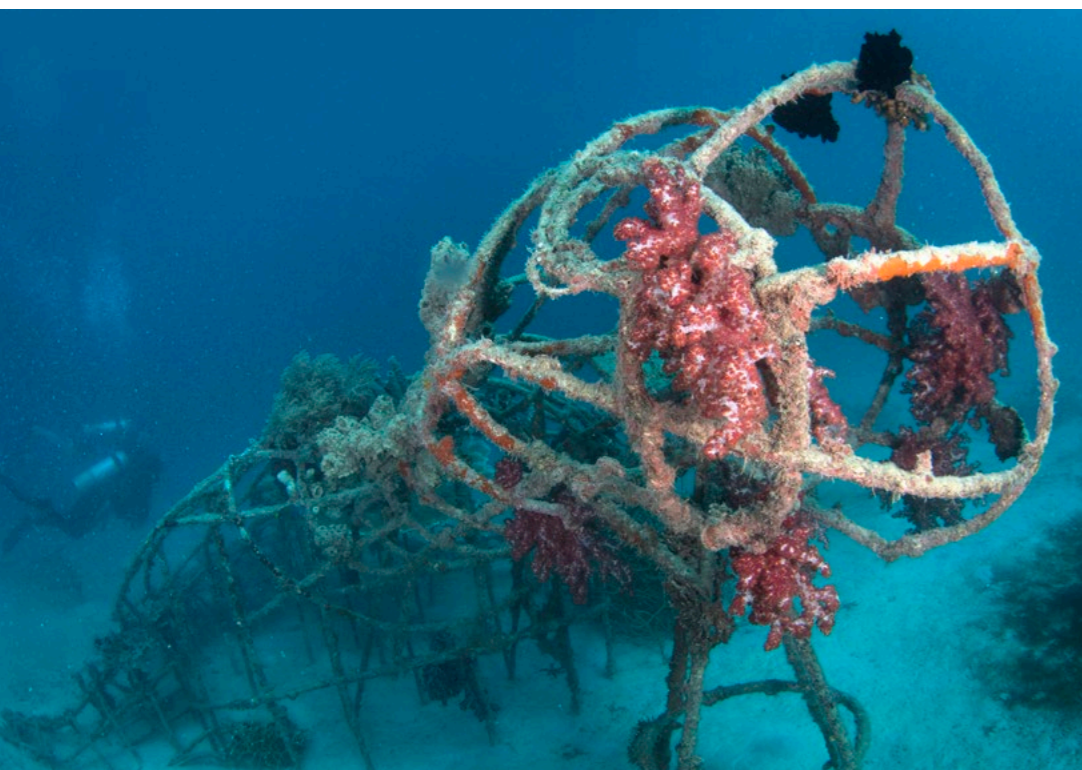
the coral is so thick that you can hardly see inside.

The resort

It is impossible not to see the sparkle in Chris' eye when he talks about his resort. He found an unknown paradise 25 years ago and opened the first dive shop in the area. As tourism has increased over the years, he chose not just to operate a business but to work with the community in making it a

better place. Managers Amanda and Adrian keep the show running, and their friendly demeanor makes you feel like you are at home as soon as you arrive. Amanda's dive briefings were so spot-on, it was almost uncanny how we saw everything she described we would.

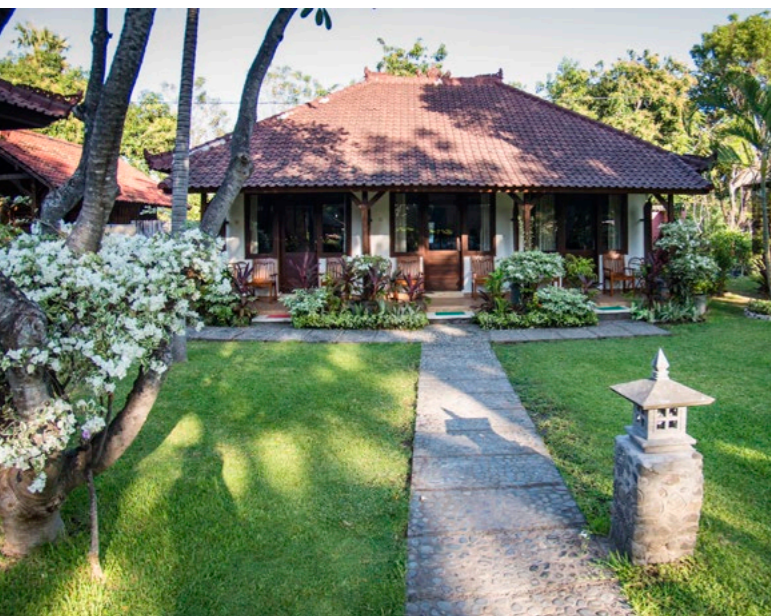
There is a beachfront snack bar where breakfast is served as well as sandwiches, ice-cream, beer and other light meals throughout



Coral growth on the head of the turtle structure at the Bio-Wreck site



Pair of golden-head sleeper-gobies (above); Scorpionfish (left); Clownfish on anemone (right); Garden view bungalows at Reef Seen Dive Resort (lower left); Morning coffee and breakfast at the resort's beach-side restaurant (bottom left); Pipefish on night dive (lower right)



so that divers can have long, relaxing surface intervals. Reef Seen also does day trips for divers and snorkelers to Menjangan Island, which is part of Bali Barat National Park—an area known for its beautiful coral reefs. The island is a one-hour boat ride away, and I heard it has great diving, although I ran out of time before get-

ting there. Snorkeling trips are also available.

Topside features

The area around Reef Seen is also very nice. I walked around town enjoying how much more laid-back and quiet it was compared to other parts of Bali. Many restaurants and spas line the beach and main road, and after a long walk, it dawned on me that not once had a tourist tout come up to me. No one offered me a taxi or asked me to come into their shop and “look,” or approached me in any way. The taxi drivers were still there, yet they only said “hello” and smiled at me. It was very pleasant compared to being bombarded in other areas of Bali.

It was sort of funny. I had been told about a secret, quiet, peaceful place on Bali, which Reef Seen was, but also it turned out to be a place full of activity in terms of conservation.

Whenever I visit dive operations such as Reef Seen, I am reminded of the important role divers as consumers play in conservation. Even those of us who only dive occasionally, or who live many miles from the ocean, can help conservation efforts by choosing to dive with a company that is actively working on conservation efforts. By supporting dive operations such as this with consumer dollars, we help them to continue to do the work they are doing.

Five days was far too short a visit, especially to a place with so much going on. It was a privilege to visit such a beautiful location (escaping the hustle and bustle of the rest of Bali), and to see the hard work of Reef Divers and the Reef Gardeners as well as their dedication to the ocean and conservation. Smiles from the staff were endless, and even after just a short time, the place grew on me like a second home. I hope to return. Donations can be made to all of Reef Seen's projects while visiting or on the website.

Dive season

Diving occurs year-round, but the drier season is May to September. Water temperatures in the Pemuteran Bay area are around 26-28°C (82°F).

Getting there

Ngurah Rai International Airport (DPS) in Denpasar/Bali receives international flights from many cities in Asia and internationally. Reef Seen Divers' Resort is 133km (82 miles) away and it will take four to five hours to reach. Reef Seen can arrange local drivers to pick you up at the airport or from around Bali. ■

Special thanks go to Reef Seen Divers' Resort (ReefSeenBali.com) Brandi Mueller is a PADI IDC Staff Instructor and boat captain living in the Marshall Islands. When she's not teaching scuba or driving boats, she's most happy traveling and being underwater with a camera. For more information, visit: Brandiunderwater.com.



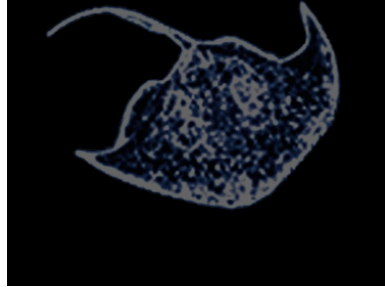
REFERENCES:
[HTTP://REEFSEENBALI.COM](http://reefseenbali.com)
[HTTPS://EN.WIKIPEDIA.ORG/WIKI/BIOROCK](https://en.wikipedia.org/wiki/Biorock)

the day, and there are plenty of restaurants nearby. There is also a spa on the property and the ladies give fantastic massages.

The dive operation is a PADI 5-star resort, and they teach Discover Scuba, open water and advanced dive courses. Dive sites are, for the most part, just a short five- to ten-minute boat ride from the resort, with the boat returning after each dive



fact file



Bali, Indonesia



SOURCES: US CIA WORLD FACTBOOK, XE.COM, CDC.GOV, STATE.TRAVEL.US, WIKIPEDIA.ORG, INDONESIA-TOURISM.COM, REEFSEENBALI.COM, BALI.COM

History Bali has likely been inhabited since prehistoric times originally by Austronesian people who migrated from Southeast Asia and Oceania. Indian traders likely brought Hinduism around the 2nd century. Islam spread into Java in the 15th century. The first European contact came in the 15th century by Dutch explorers and Dutch colonialists established a trading post in the 17th century they eventually ruled although their conquest long and turbulent over the years. The Dutch only ruled a short while until Japan occupied Bali during World War II and although the Dutch tried to regain rule after WWII they failed and Bali became part of an independent Indonesia in 1945 although the Dutch did not acknowledge it until 1949. 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. Bali is located 3.2km east of Java. The island stretches 153km east to west and 112km north to south, covering 5,780 sq km. The highest elevation is at 3,031m, which is the peak of the

active volcano, Agung. Bali's volcanic soil and ample rainfall have made its flora lush and prolific. The island is known for its white and black sand beaches, rice terraces, forests, and volcanic mountains.

Coral reefs surround the island. In northwest Bali, Menjangan Island is part of Bali Barat National Park and is known for its marine life and healthy coral reefs. Coastline: 54,716km. Terrain consists primarily of coastal lowlands, with interior mountains on larger islands.

Climate Bali enjoys a tropical climate with the dry season from May to September and November to March is the rainy season. Air temperatures are usually a constant 28-32°C at sea level and cooler in the mountain areas. Water temperatures range from 25C-29°C however around areas like Nusa Penida cold water currents can bring in water as cold at 17°C.

Environmental issues The island of Bali falls within the Coral Triangle, the most biodiverse marine area on Earth. It contains

over 3,000 species of fish, 6 species of turtles, and 75 percent of the world's coral species. Bali faces numerous environmental challenges many stemming from a rapidly growing population and increased urbanization. Land issues including deforestation, lack of waste water management, beach erosion, garbage disposal, and others also affect the marine environment such as with pesticides, sediment, garbage and other pollution going directly into the sea. Climate change and weather events such as El Niño's have increased coral bleaching around Bali and the rest of Indonesia. Overfishing and unsustainable fishing practices like cyanide and dynamite fishing still occur around Indonesia destroying the reef.

Economy A vast polyglot nation, Indonesia has experi-

enced 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. MasterCard and Visa are widely accepted in cities and tourist areas. Major airports and cities have ATMs but they can be difficult to find on the smaller islands. The island of Bali has numerous

1EUR = 15,834 IDR; 1GBP = 17,886 IDR; 1AUD = 10,571 IDR; 1SGD = 9,890 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 especially on the island of Bali. German, Spanish, and Russian are also common in the tourist areas.

Health Mosquito-borne illnesses occur and there are cases of malaria, dengue, Zika, and others. 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.

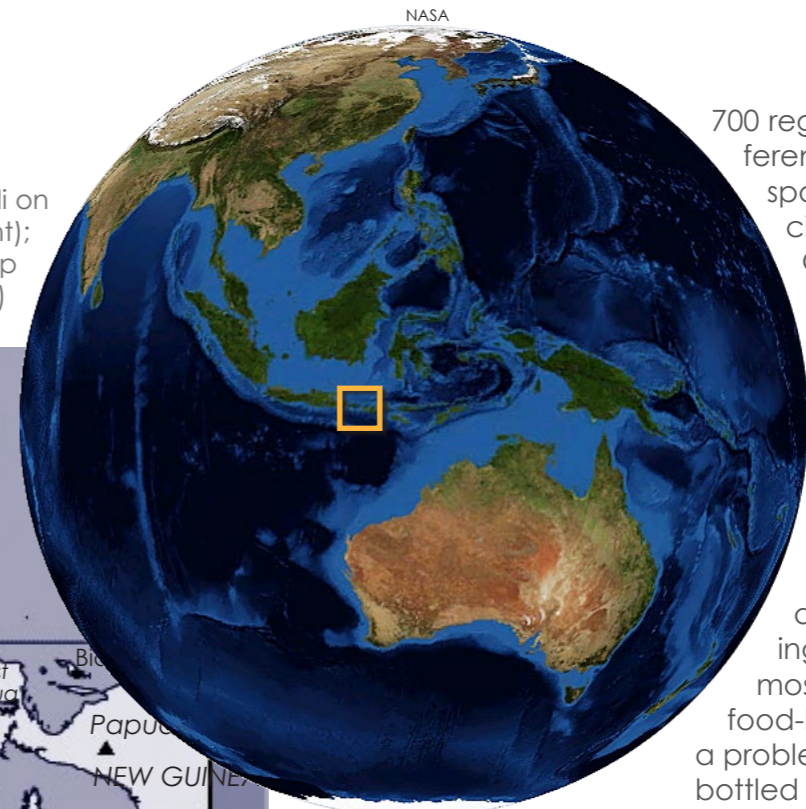
Decompression chamber The island of Bali has a chamber at Sanglah Hospital in Denpasar.

Travel/Visa Passport valid for six months beyond intended stay is required. There is a Visa-On-Arrival for 35 countries including USA, UK, most European and Asian countries. It is US\$25 for a stay of up to 30 days. Indonesia's visas requirements are ever-changing, so check with your countries State Department before traveling.

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/en

Location of Bali on global map (right); Location of Bali on map of Indonesia (below)



ATMs throughout the island, but be aware that ATM fraud is on the rise. Currency exchange rates will be better in large cities. Exchange rates: 1USD = 13,458 IDR;

Southern Australia

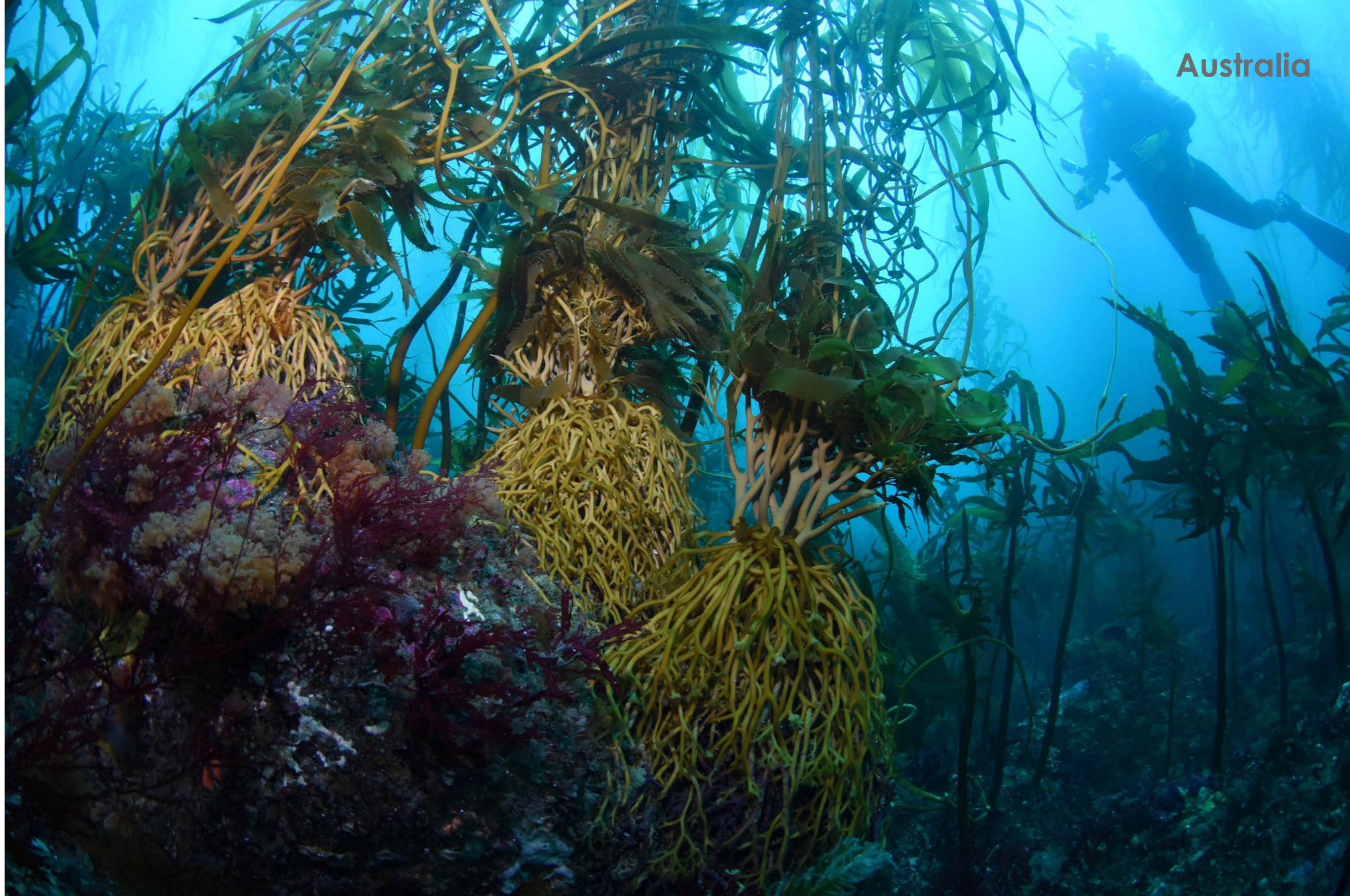
— *The Unique Marine Life of Australia's Temperate Seas*

Text and photos by Nigel Marsh



Giant kelp forest were once common around Tasmania, but most have sadly died off due to warmer seas and invasive species.

Most divers heading to Australia make a bee-line straight to the Great Barrier Reef. And while this wonder of the world has some amazing dive sites and marine life (and is still very much alive, contrary to claims in the media), it does not have many species that are uniquely Australian, as most of its tropical species are common throughout the Indo-Pacific region. To see Australia's most unique marine life, you have to travel south of the Great Barrier Reef and dive into the country's cooler temperate seas, as this is the realm of giant cuttlefish, PJs, leafies, weedies, wobblers, handfish, blue gropers, goblinfish and many other wonderful endemic creatures.



Australia's temperate waters are found in an area from Sydney to Perth. This region encapsulates southern New South Wales, Victoria, Tasmania, South Australia and southern Western Australia,

and has numerous dive shops and charter boats taking divers to the best local sites. Divers exploring this cooler region of Australia will discover a wonderful mix of boat and shore dives on rocky

reefs, jetties and piers, shipwrecks, sponge gardens and kelp beds. However, as great as the dive sites are in these temperate seas, the main reason this area is so special is its magnificent marine

life, with most species found nowhere else on earth.

There be dragons and wild horses

Australia's temperate seas are

one of the best places in the world to encounter members of the *Syngnathidae* family, with numerous seahorses, pipefish and pipehorses to be seen. Of these wonderful creatures, the most



The leafy seadragon (right and bottom) is the most highly prized photographic subject in southern Australia; With their weed-like body growths, leafy seadragons are well-camouflaged and hard to find around kelp and seaweeds.

Sydney's weedy seadragons (below) are more brightly coloured than their interstate cousins.



A Tasmanian male weedy seadragon with eggs attached to its tail

popular and the one that lures many divers to explore Australia's temperate seas is the spectacular leafy seadragon (*Phycodurus eques*), commonly called the "leafy."

Leafy seadragon. Only found off western Victoria, South Australia and southern Western Australia, this incredible fish is highly sought after by underwater photographers. Although growing to a length of 35cm and a slow swimmer, the leafy is a very difficult fish to find without assistance from an experienced local guide. Their leaf-like appendages and yellowish colouration help to camouflage them amongst seagrass and

kelp. But, even when found, if you take your eyes off the animal for a second, you can quickly lose it. Leafies are most commonly seen in South Australia, with spots like Rapid Bay Jetty and Tumby Bay Jetty being reliable places to encounter one or more.

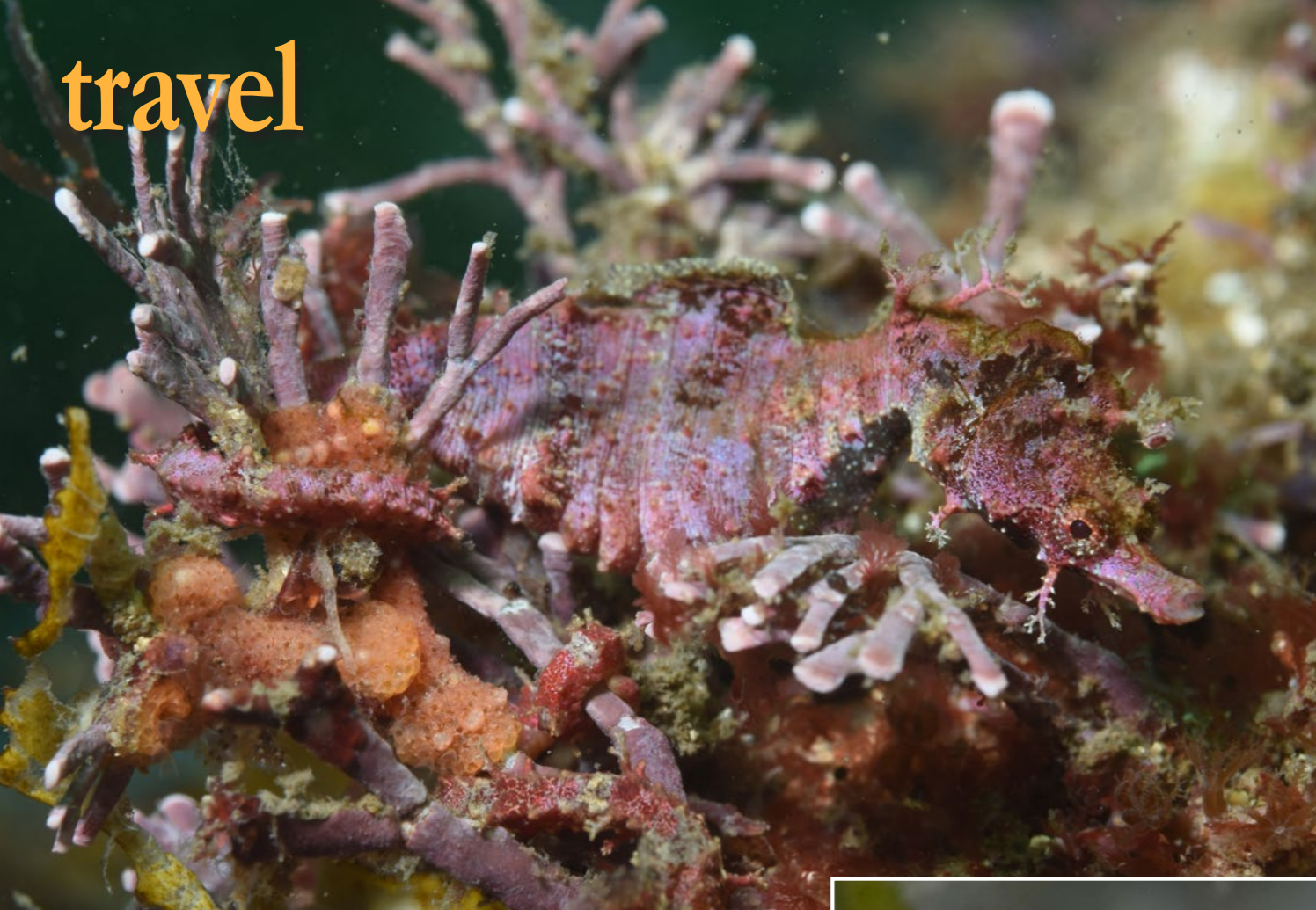
Weedy seadragon. There are actually three species of seadragons found in Australian waters, but the only other species commonly seen by divers is the weedy seadragon (*Phyllopteryx taeniolatus*). This brilliant multi-coloured fish is found throughout Australia's temperate zone and grows to a length of 45cm. Found around sponge gardens, sea-

grasses and kelp beds, weedies (as they are commonly called) are a little easier to spot than their leafy cousins. Their colouration also varies from state to state: The ones off New South Wales display bright pinks and yellows; the ones off Tasmania have vivid reds; while the ones off Victoria tend to have less colour. Weedies can be seen at numerous dive sites, with Kurnell off Sydney, Flinders and Portsea Piers off Melbourne, and Eaglehawk Neck off Tasmania all having a good population.

Watching seadragons is always a delight, especially when they are busy feeding, sucking up tiny mysid shrimps. Photographing them can sometimes be a little



tricky, as they do not like the attention and regularly turn away from the camera. Seadragons may have a hard exoskeleton, but they are actually very delicate and fragile creatures, and should never be touched or handled. Photographers are also asked to limit the number of photos, as the flash can stress them.



A common species seen at sheltered Sydney dive sites is the lovely White's seahorse (left). The largest seahorse found in southern Australia is the big-belly seahorse (below); Shorthead seahorses (center) are small and often difficult to find hidden amongst seaweeds; The big-belly seahorse (bottom) is especially common in Melbourne's Port Phillip Bay.

The tiny Sydney pygmy pipehorse (above) is only found at a limited number of dive sites around Sydney; A small and pretty seahorse only found in Australia's temperate seas is the shorthead seahorse (right).

White's seahorse. Australia is blessed with the world's greatest variety of seahorses, pipefishes and pipehorses, with these cute little critters abundant in southern waters. Sydney is home to a great number of seahorses, with the most common species being the White's seahorse (*Hippocampus whitei*). This species is encountered at many sheltered Sydney dive sites, even in Sydney Harbour, clinging to sponges, kelp, ropes, netting and just about anything else.

Big-belly seahorse. The world's largest seahorse species, the big-belly seahorse (*Hippocampus abdominalis*), is also common in southern waters. Growing to a length of 35cm, and sporting a rather large stomach, the big-

belly seahorse is a creature that is hard to miss. This species is particularly common under jetties and piers, with Melbourne's Port Phillip Bay being a great place to see this lovely seahorse. Another seahorse seen around Melbourne is the shorthead seahorse (*Hippocampus breviceps*). This small species is often difficult to find, as it likes to hide amongst seaweeds.

Sydney pygmy pipehorse. Another unique animal from this family to look out for off Sydney is the Syd-

ney pygmy pipehorse (*Idiotropiscis lumnitzeri*). This tiny creature is a cross between a seahorse and pipefish, and is hard to spot as it clings onto similarly coloured

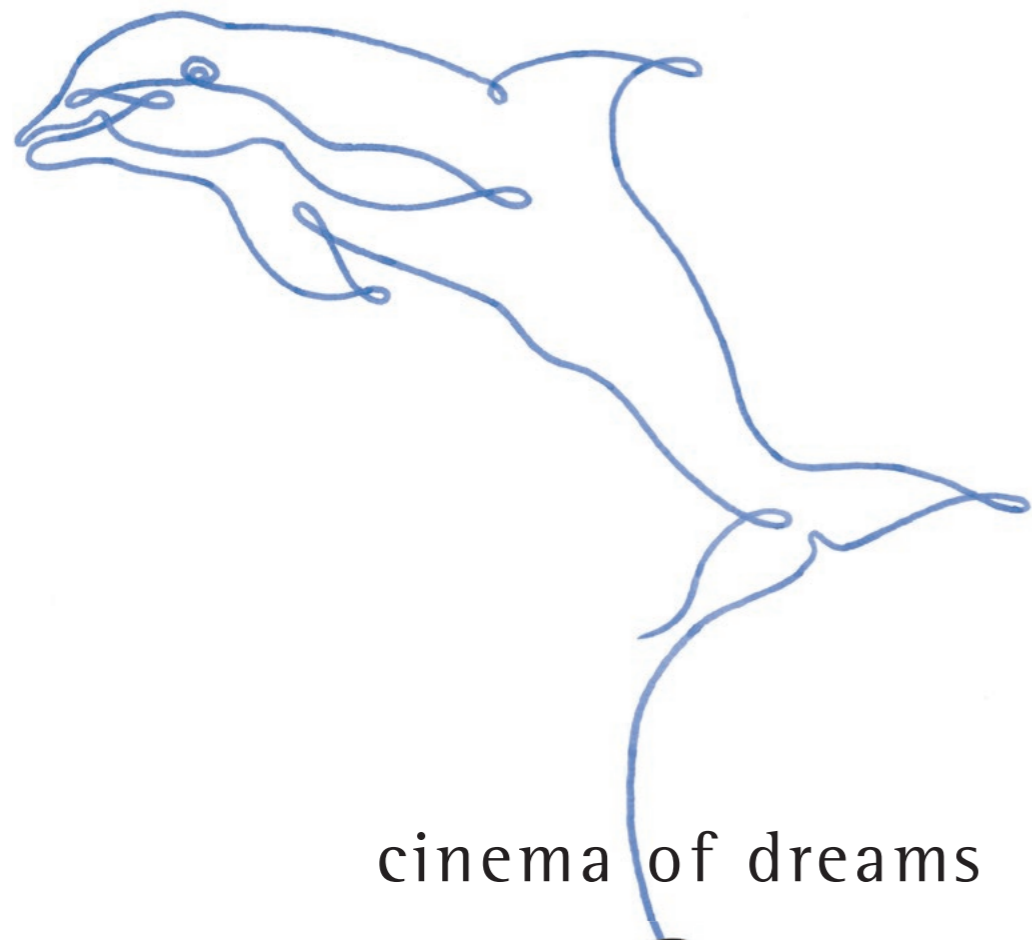


algae. Only discovered in 1997 by an observant Sydney diver, this wonderful little fish is found over a very small range and a local guide is very handy in pointing them out. The best place to see the Sydney pygmy pipehorse is Bare Island in Botany Bay; the last time I dived this site, I found three clinging to one patch of algae.



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Southern Australia is home to many unique frogfish, including the spectacular tasselled frogfish; The endangered spotted handfish (right) is only found off Hobart in Tasmania.

Weird Aussie fish

Almost all the fish divers encounter in Australia's temperate seas are endemic to this region. While the common species in families like the leatherjackets, morwongs, weedfishes, boarfishes, wirrahs, cowfishes, seaperches and trumpeters are fun to watch and photograph, southern Australia also has many weird fish that are very special.

Frogfish. Frogfishes are usually associated with tropical waters, but a great variety of these very photogenic creatures are also found in Australia's temperate seas. Many

of these endemic frogfishes are small and very cryptic, so they can be difficult to find. However, one member of the family is large and well worth looking for: the tasselled frogfish (*Rhycherus filamentosus*). Covered in branching filaments, the tasselled frogfish is a master of camouflage and often challenging to spot on similar looking backgrounds. This species is often found on jetty pylons in Melbourne's Port Phillip Bay and also under jetties on South Australia's



Yorke Peninsula. Having a local guide beside you is recommended to point out this spectacular fish that grows to a length of 23cm.

Handfish. A unique family of fish only found in southern Australia are the handfishes. Closely related to the frogfish, these fishes also have



Another bizarre Aussie fish is the strange goblinfish (left), which is sometimes found in Melbourne's Port Phillip Bay. When alarmed, the goblinfish fans its pectoral fins and looks a bit like a chicken (below); One of the rarest fish in Australia's temperate seas is the spotted handfish (bottom).

flares its dorsal fins to make itself look bigger. Seek local advice to see this rare fish as they are very difficult to find.

Goblinfish. Diving the cool waters of southern Australia, divers will en-

a head lure and walk on their fins, but have more prominent fins. All fourteen members of the handfish family are very rare, and also threatened with extinction due to habitat loss and invasive species. However, there is one member of the family that can sometimes be found at a few selected dive sites off Hobart: the beautiful spotted handfish (*Brachionichthys hirsutus*). This strange fish grows to 12cm in length and is found on sandy and muddy bottoms where it feeds on small worms and crustaceans. When alarmed, the spotted handfish stands on its pectoral fins and



counter members of the scorpionfish family, but the one underwater photographers most seek is the bizarre goblinfish (*Glyptauchen panduratus*). This very strange fish has a blood-red ring around its pupils and a small flattened head on the end of an extended neck. When threatened, the goblinfish fans its feather-like pectoral fins, which makes it look like a chicken. The goblinfish grows to 20cm in length and is rarely seen by divers, as it is nocturnal and likes to hide under seaweed and rocks. However, they are occasionally seen under piers in Melbourne's Port Phillip Bay.

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Prowfish. Another family of fish only found in southern Australia are the prowfish. These strange fishes lack scales, and instead have leather-like skin, which they regularly moult. The most common member of this family that divers encounter is the peculiar Red Indian fish (*Pataecus fronto*). Only found off New South Wales, the Red Indian fish looks like a red sponge and is generally found in sponge gardens sitting next to red sponges. They grow to 35cm in length and are often found in pairs, so if you can find one, there is generally another one nearby. Red Indian fishes generally do not like to swim, and move across the bottom by rocking from side to side, pretending to be a piece of broken sponge. The two best spots to see the Red Indian fish are on the rocky reefs off Sydney and Jervis Bay.



The Red Indian fish is a weird prowfish only found around sponge gardens in New South Wales





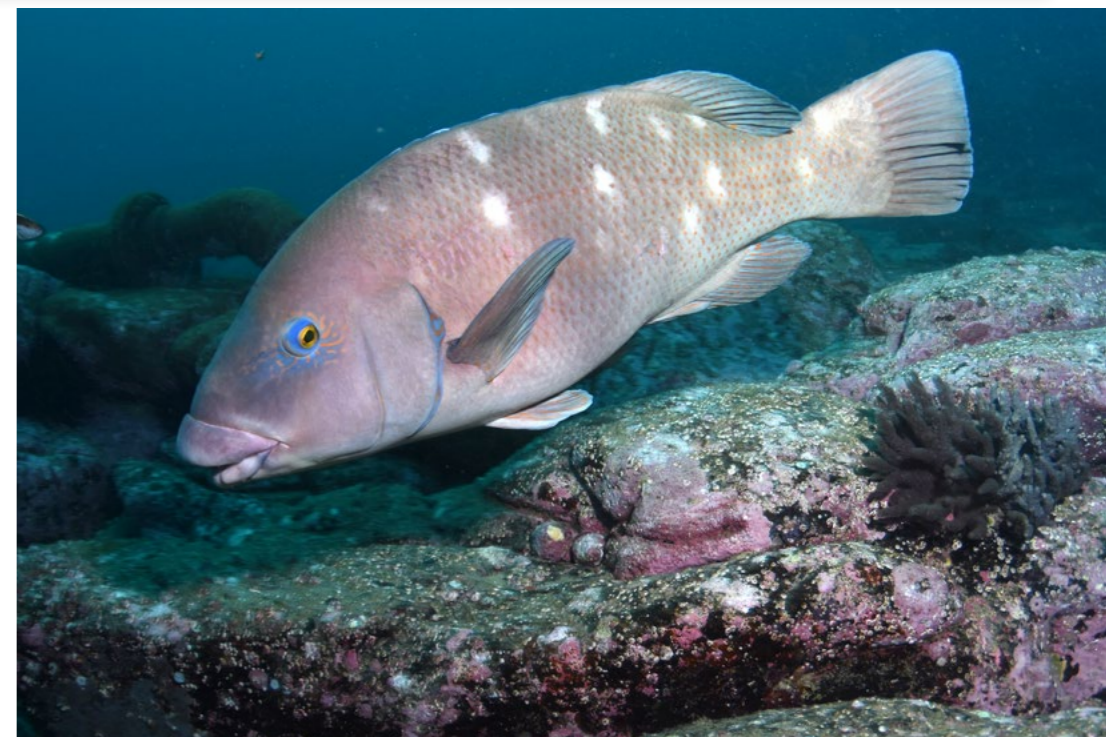
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The friendliest and cheekiest fish in New South Wales is the eastern blue groper wrasse (left)—they also have quite an appetite for sea urchins; The southern blue devil (below) is a common species on rocky reefs with lots of caves and ledges; The eastern blue devil (below left) is only found in New South Wales and is a spectacular camera subject.



Every site in New South Wales is home to a family of friendly blue gropers.



Cute blue companions and bold devils

Blue groper wrasse. The wrasse family is very well represented in Australian waters, with dozens

of these small colourful fish seen darting around sponge gardens and rocky reefs. But the two largest members of this family are a delight to dive with: the eastern



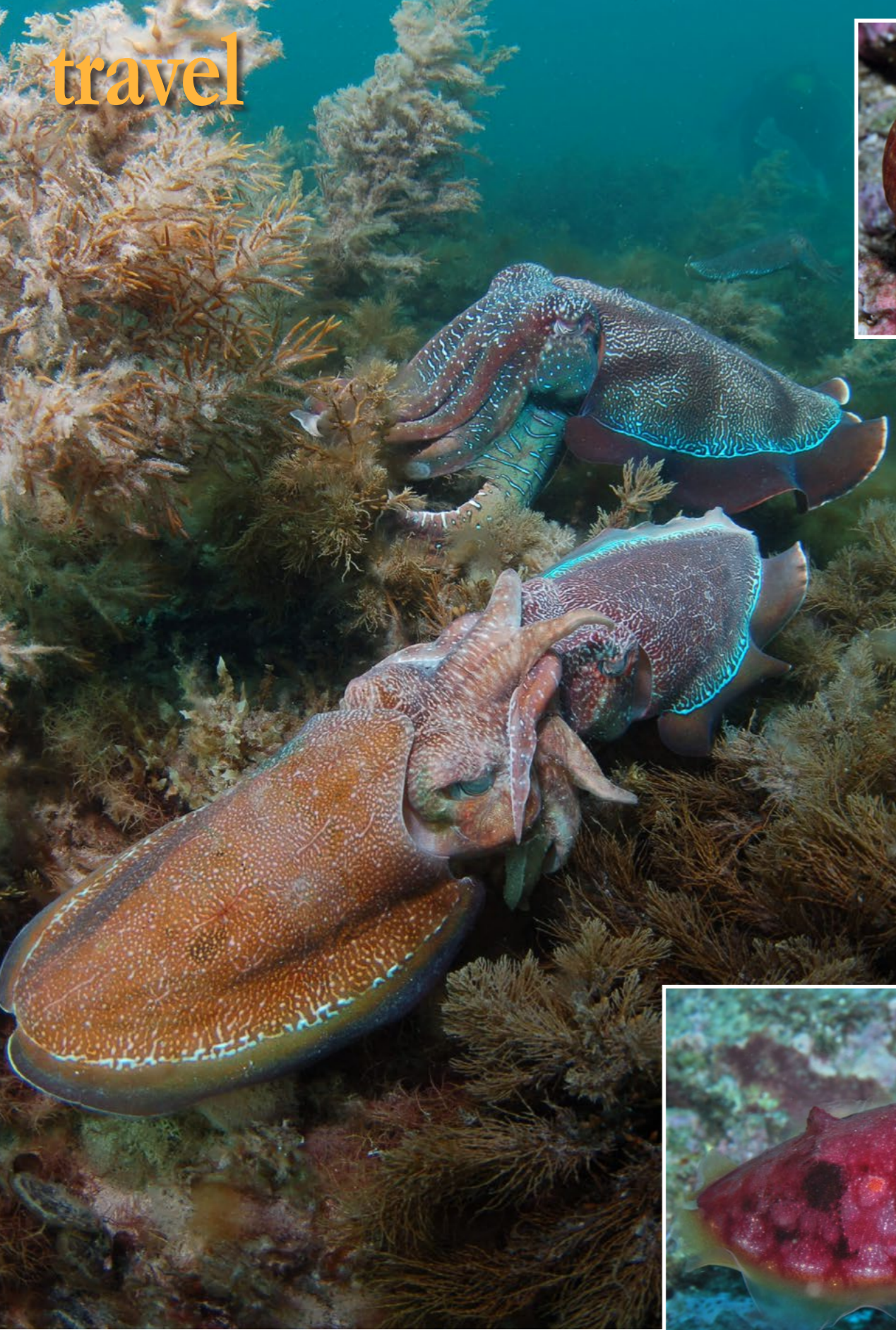
blue groper wrasse (*Achoerodus viridis*) and the western blue groper wrasse (*Achoerodus gouldii*). Both are simply called blue gropers, and while the western variety is larger, growing to 1.6m in length, the smaller eastern variety

is far more friendly. Found at dive sites throughout New South Wales, these cheeky blue fish follow divers around like loyal puppies, expecting a free feed of broken-up sea urchin. They can be very persistent, and it is not unusual

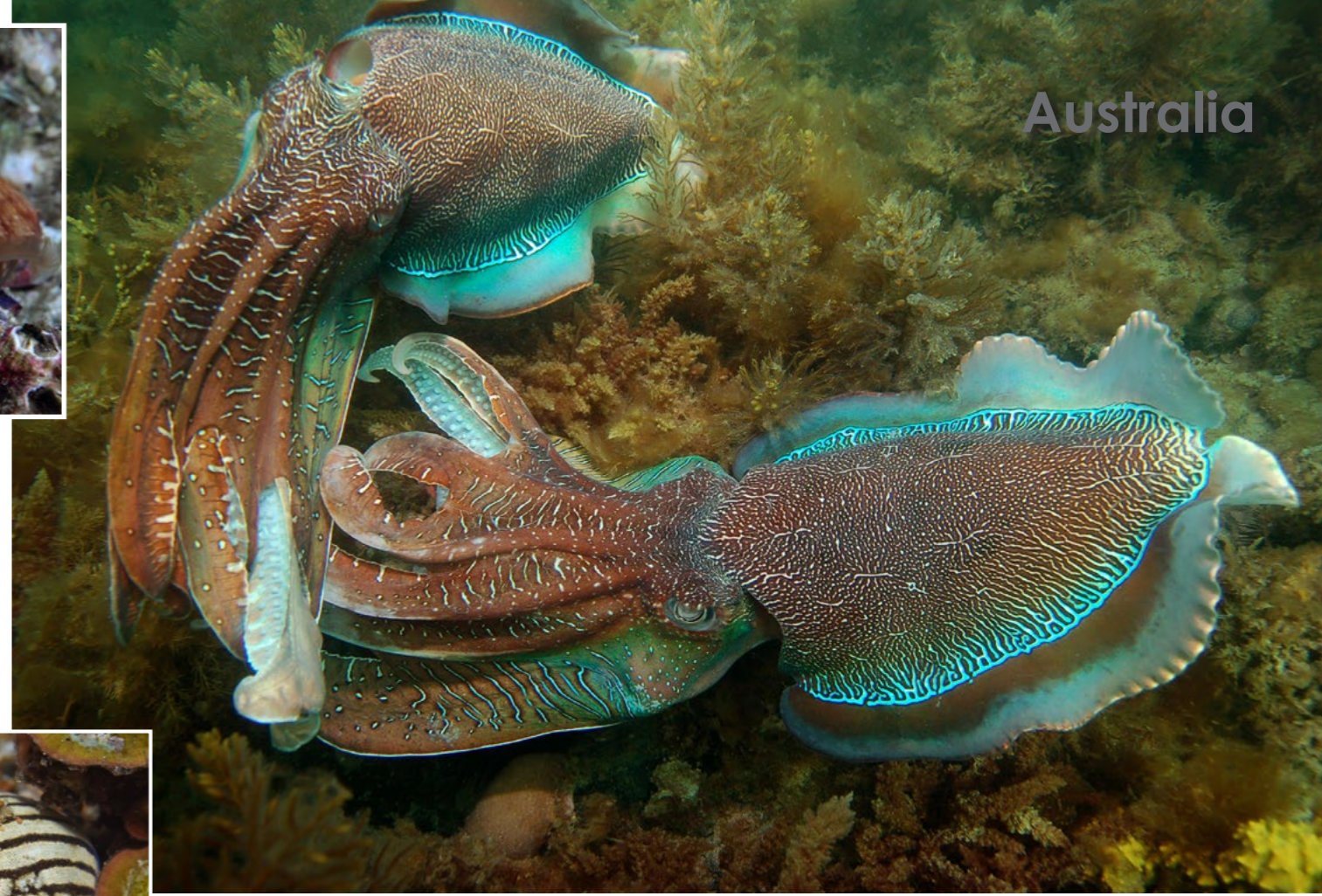
to be taking a photograph and having a metre-long blue groper nudging you for attention.

Blue devils. Other blue fish to keep an eye out for in Australia are the blue devils. This family contains several members, but the two most spectacular specimens are the eastern blue devil (*Paraplesiops bleekeri*) and the southern blue devil (*Paraplesiops meleagris*). These striking fish, with their vivid blue spots and colourful

markings, grow to 40cm in length and are found on rocky reefs. They like to shelter in caves, but are often curious of divers and will venture close to inspect an intruder. The southern blue devil is very widespread, found from Melbourne to Perth, and commonly seen at many dive sites while the eastern blue devil is only found off New South Wales, with Jervis Bay and Sydney being two of the best spots to encounter one.



The reaper cuttlefish is one of Australia's smallest and cutest cuttlefish species (above); A pair of male giant cuttlefish fight for the right to mate at the annual cuttlefish aggregation at Whyalla (right); A very unique member of the cuttlefish family only found in southern Australia is the striped pyjama squid (below).



Tangling with tentacles

Australia's temperate waters are a great place to see invertebrate species. In this area, nudibranchs, sea stars, sea spiders, shrimps, crabs, shellfish and flatworms are common. However, divers will also find Australia home to the greatest collection of cephalopods on the planet. Octopus, squid and cuttlefish are common around Australia, with the great majority of southern species endemic.

Giant cuttlefish. One member of this family that already attracts underwater photographers Down Under is the wonderful giant cuttlefish (*Sepia apama*). Growing to a length of over 1m, these huge cephalopods are found throughout Australia's temperate seas. Giant cuttlefish are often curious of divers, and have been known to follow a diver around a dive site, and grab torches, gauges and cameras. While giant cuttlefish can be seen anywhere across their range, Whyalla in South Australia is the best place to observe them. Each winter, thousands of giant cuttlefish gather on the rocky reefs

near Whyalla to breed, the only mass breeding of any cuttlefish species in the world.

Reaper cuttlefish. A number of smaller cuttlefish species are seen across southern Australia, including the reaper cuttlefish (*Sepia mestus*) in New South Wales. This cute little cuttlefish reaches a length of 15cm and is always a pretty pink or red colour. Found on rocky reefs and around sponge gardens, the reaper cuttlefish always makes for a great camera subject.

Striped pyjama squid. The most spectacular member of this family found in southern Australia would have to be the brilliant striped pyjama squid (*Sepioloidea lineolata*). A type of bottletail squid, this striking animal has bold black and white stripes and grows to 7cm in length. A nocturnal species, the striped pyjama squid hides under a layer of sand during the day and emerges at night to feed. One of the best places to see this wonderful critter is under Edithburgh Jetty in South Australia.

The annual giant cuttlefish aggregation (above) at Whyalla is quite a spectacle where divers can witness mating, fighting and other behaviours (above); Reaper cuttlefish (right) are only found in New South Wales, and generally have a red or pink colouration (right).





The southern keeled octopus is best seen at night under the many piers found in Melbourne's Port Phillip Bay (above left); The southern white-spot octopus is an endemic species only seen in southern Australia (above right); A common species seen at night in temperate Australia is the southern blue-ringed octopus (right); One of the strangest octopus divers will encounter in Australia's temperate waters is the southern sand octopus (left).



Octopus. Many divers head to muck diving sites like Lembeh to see the octopuses, but divers can see more species of octopus on

a single night dive in southern Australia than in a month of diving at Lembeh. Two spectacular dive sites where divers will see

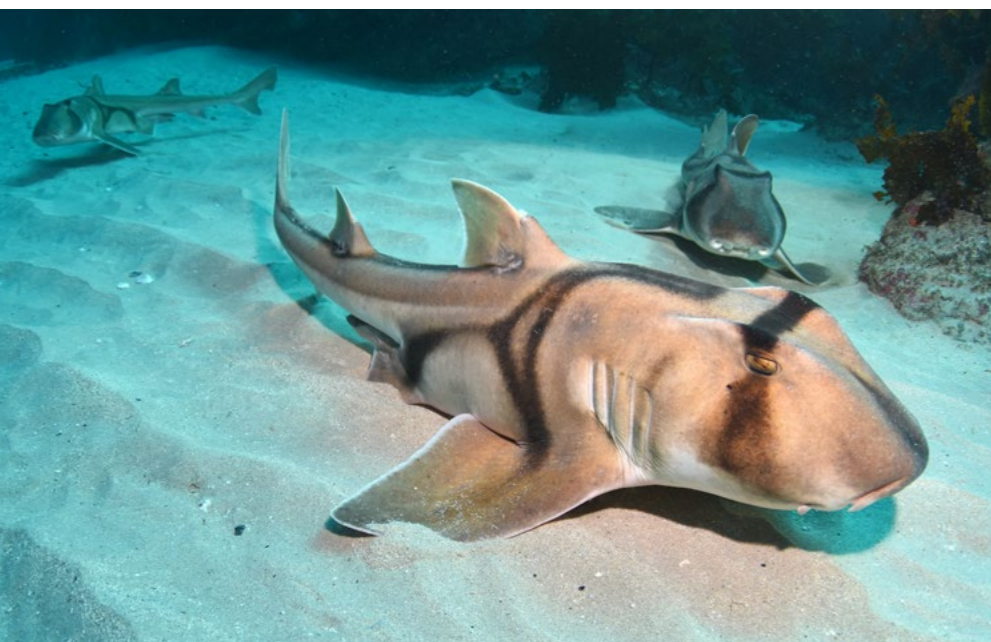
abundant octopuses are Edithburgh Jetty in South Australia and Blairgowrie Pier in Melbourne. Night dives at either of these sites will expose divers to a wide variety of octopus species. The most common species is the southern keeled octopus (*Octopus berri- rima*). This species generally lives in the sand, but will also take up residence in discarded cans. Also common are huge Maori octopi (*Octopus maorum*). This species has an arm span of over 3m and is often curious of divers, allowing for very close interaction.

A species that you may not want to get close to is the south-

ern blue-ringed octopus (*Hapalochlaena maculosa*). These highly venomous octopi are often seen crawling across the bottom and fortunately they are not aggressive and prefer to avoid divers. More unusual octopus species that divers can encounter include the frilled pygmy octopus (*Octopus supercilliosus*), pale octopus (*Octopus pallidus*) and the south-

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Large banded wobbegongs like to rest in caves and under ledges (above). The spotted wobbegong (right) is one of the largest bottom-dwelling sharks found throughout Australia's temperate seas, but is best seen in New South Wales; Jervis Bay is a good place to see dozens of docile Port Jackson sharks (left).

Aussie sharks are best viewed in temperate waters.

Wobbegong sharks. The most iconic family of sharks found in Australia waters would have to be the wobbegongs

waters, but the two largest members of the family are found in southern Australia.

The spotted wobbegong (*Orectolobus maculatus*) is one of the most common shark species found in southern Australia. Growing to a length of 3.2m, these large sharks are found on rocky reefs and shipwrecks from southern Western Australia to southern Queensland. While they can turn up anywhere across their range, they are most abundant off New South Wales. These large ambush predators are easy to approach for photographs as they spend most of their time lazing on the bottom and waiting for prey to swim close enough to be snatched. But be

warned, they don't like to be harassed or cornered, and many a diver has been bitten by a stirred-up wobby.

The other wobby species that divers encounter in southern Australia is the banded wobbegong (*Orectolobus halei*). This species is found over much the same area as the spotted wobbegong, and reaching a length of 2.9m, it isn't much smaller. This species prefers to shelter in caves and overhangs, so is not seen as often as the spotted wobbegong, which

like to rest out in the open. Both banded and spotted wobbegongs can be seen at dive sites throughout New South Wales, with Jervis Bay and Sydney having a good population.

Port Jackson shark. The cutest shark divers can see in southern Australia is the Port Jackson shark (*Heterodontus portusjacksoni*). The largest member of the hornshark family, the Port Jackson shark (or "PJ"), grows to 1.6m in length and is



Shark-infested waters

Australia is a great place to see sharks, and if you believe the media, we have "shark-infested-waters." Divers can encounter a variety of reef shark species in tropical waters, plus whale sharks off Ningaloo Reef, schools of grey nurse sharks off New South Wales and great white sharks off Port Lincoln. But the truly unique

or wobbies. The wobbegong family comprises 12 species, ten of which are found in Australian waters. The name "wobbegong" is an Australian Aboriginal word meaning "shaggy beard," which is a great description of these unusual sharks that have a flattened body, colourful skin patterns and a fleshy beard around the head. Most wobbies inhabit tropical





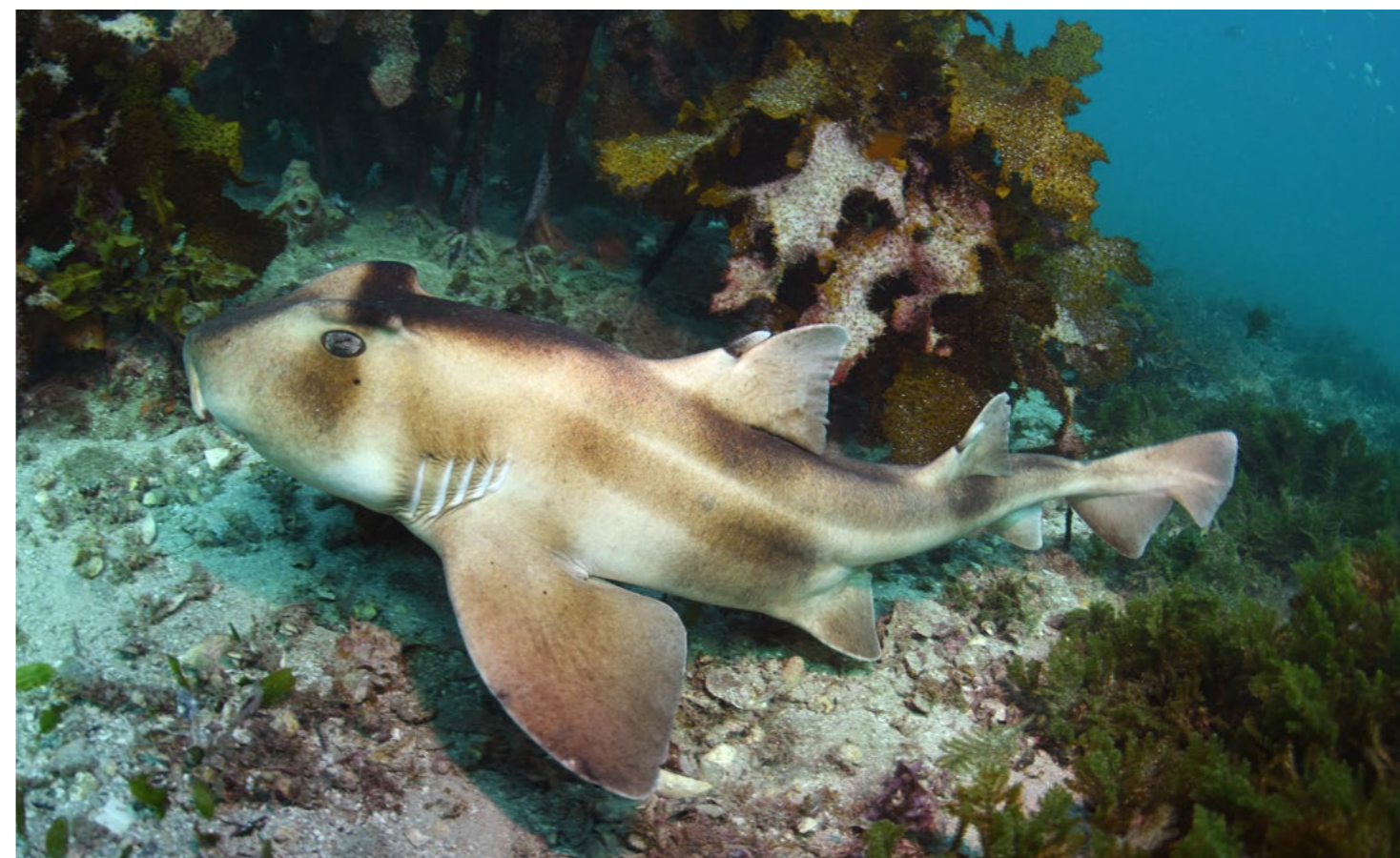
found over the same area as the wobbies mentioned above. However, southern New South Wales is the best place to encounter them. These lovely sharks have tiny teeth and are very docile, happy to sit on the bottom while a diver inspects them closely. They also migrate with changes in water temperature, and while PJs can be seen year-round, their numbers increase dramatically at shallow rocky reefs over the winter months when they gather to breed. Wintertime off Sydney and Jervis Bay is a great time to see dozens of these wonderful sharks on a single dive.

Diverse species. Many other endemic shark species are seen in southern Australia, including the blind shark (*Brachaelurus waddi*), crested hornshark (*Heterodontus galeatus*), varied catshark (*Parascyllium variolatum*), draughtboard shark (*Cephaloscyllium laticeps*) and Australian



angelshark (*Squatina australis*). These temperate waters are also home to a great variety of rays, with many endemic stingrays, stingarees, shov-

elnose rays, skates, electric rays and eagle rays to be seen. Finally, this area also has a good variety of marine mammals, with dolphins, whales



The crested hornshark is only found on rocky reefs off New South Wales (above); Australia's temperate waters are home to a number of species of endemic skates, including the large Melbourne skate (left); Another endemic shark species only found in New South Wales is the reclusive blind shark (top left); Australia is home to the world's largest variety of small stingarees, including this banded stingaree which is common in Tasmania (top right).



Australia



Southern Australia is a great place to encounter friendly long-nosed fur seals (above); Australian fur seals, found in large colonies in southern Australia, can even be seen around Melbourne piers (top right); Eastern fiddler ray is only found off New South Wales (left).

in winter from 10°C to 15°C (~50°F to 59°F), so depending on where you dive, and at what time, you might need either a 5mm or 7mm semi-drysuit or a drysuit.

While most areas in southern Australia can be dived year-

round, some areas are definitely better over summer and others better over winter. Always seek local advice before booking to find out when it is the best time to dive for weather conditions or certain creatures.

One final factor is visibility, and the good news is: It isn't green. Temperate waters in many countries are generally loaded with plankton, algae and nutrients, which leaves the visibility dark and green. In southern Australia, you can get green water at times, but in general, the water is blue, and the average visibility varies from 5m to 15m. Visibility over 20m or 30m is not uncommon, especially when the weather is calm.

So, next time you are looking for a dive destination with something different and unique, why not treat yourself to the temperate waters of southern Australia? ■

Nigel Marsh is a widely published Australian underwater photographer and writer based in Brisbane. Over the years, he has produced a number of books for children and divers—his latest being Underwater Australia and Muck Diving for New Holland Publishers. For more information, please visit: Nigelmarshphotography.com.



Australia's rocky reefs are coloured by magnificent sponge gardens, like this one in Tasmania.

and three species of seals found in southern Australia.

Diving conditions

The water may be cool in Australia's temperate seas, but putting up with a little cold water is a small price to pay for encounters with incredible marine life. In reality, it is not freezing cold; over summer, this region varies from 17°C to 23°C (~63°F to 73°F), and

round, some areas are definitely better over summer and others better over winter. Always seek local advice before booking to find out when it is the best time to dive for weather conditions or certain creatures.

One final factor is visibility, and the good news is: It isn't green. Temperate waters in many countries are generally loaded with plankton, algae and nutrients, which leaves the



Victoria's Secret

Text and photos by Scott Bennett

Discovering Melbourne's Surprising Underwater World



Melbourne skyline (above); Mornington Beach (top right); Rye Beach (right); PREVIOUS PAGE: Mosaic leatherjacket

“You can dive in Melbourne?” was the baffled response from a Queensland hotel concierge upon telling her I was heading to Victoria to dive. And this was from an Australian who WAS a diver! When overseas visitors think of Australia, the Great Barrier Reef immediately comes to mind. However, Australian diving is not just about coral. Along the continent’s southern coast is an undersea world far removed from the tropics.

Although a long-time tropical diver, trips to the Great Lakes, South Africa and Denmark have triggered my interest in temperate diving. Seeing new environments and species have amped up my enthusiasm, especially with regards to photography. *X-Ray Mag’s* editor-in-chief, Peter Symes, has often told me he preferred temperate to tropical diving, and I was starting to see the light. The cold-water bug has bitten; it is just the actual “cold” part I am less than enthused by.

With a visit to Australia in the works, I was eager for a new dive destination. I had read many articles about Victoria diving and I had always been intrigued. Melbourne’s Port Phillip Bay and environs are host to a diversity of marine life, in-

cluding a critter long on my must-see list: the weedy seadragon. I was also hoping to witness one of Victoria’s seasonal wonders: the autumn spider crab migration.

Melbourne’s diving scene quickly proved to be an entirely different animal. Melburnians know the marvels at their doorstep, and the area is home to a vibrant diving community. Despite dive shops aplenty, dive resorts and liveboards are conspicuously absent. This is the land of do-it-yourself diving, a fact I discovered while trying to plan my visit.

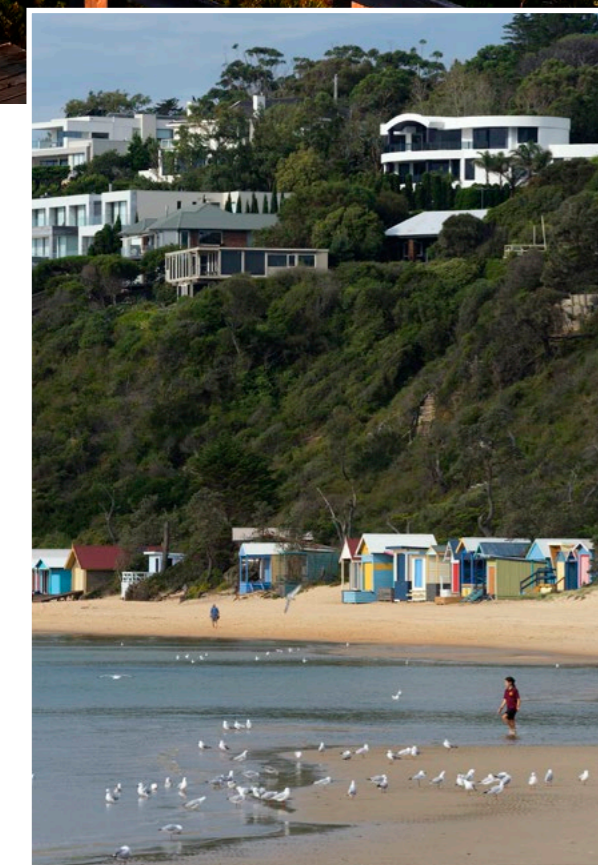
Before leaving Canada, I researched dive shops and settled on Harbour Dive, located right in Mornington town. I decided to concentrate on shore diving, and it seemed like a good central location. For

accommodation, I chose the Brooklands of Mornington, as it was within walking distance of the shop. Having never traveled south of Melbourne, I did not quite

know what I would find. Certainly, the diving would be good, but I had no idea what to expect about the place itself. I purposely avoided looking at photos of



CLOCKWISE FROM FAR LEFT: Sunset on Mornington coast; Mornington countryside; Mornington Harbour; Crested dove (bottom right); Mornington Beach (bottom left)



it online, as I wanted to be surprised. In a nutshell, I was. In spades.

Getting there

Just getting to my hotel proved to be an adventure. Although airport shuttles service Mornington, they were limited to three daily, with the last one departing before my arrival. A taxi ride would cost more than my Brisbane-Melbourne flight, so what to do? The answer was a Skybus shuttle to nearby Frankston, which had numerous departures. From there, I would take a taxi to Mornington.

Baggage retrieved, I found

the shuttle stop and boarded my bus. I quickly realized that Melbourne was big. Huge, actually. The trip to Frankston proved a lot longer than anticipated. What I expected to be an hour-long trip turned into two and a half hours, even longer than my flight from Brisbane. Yet, the pleasure of travel is not just in the destination, but the journey as well. The evening was beautiful and coastline views sublime. As the sun set behind Port Phillip Bay, I could not see the other side.

From Frankston, I flagged a taxi and finally arrived at the hotel as it was getting dark. Incorporating a historic home-

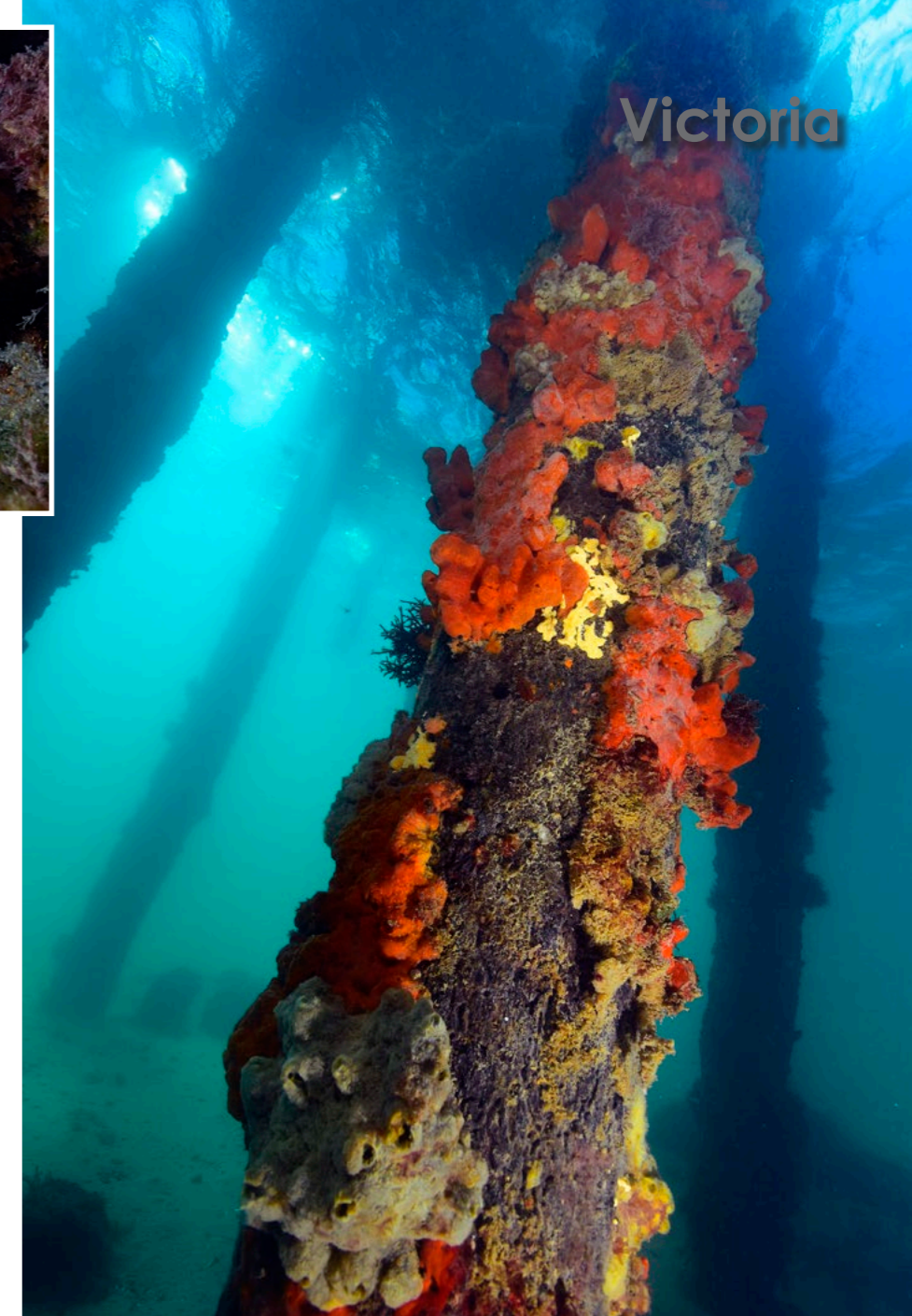
stead circa 1878, the Brooklands proved to be a pleasant surprise. Quiet and secluded, the rooms were more like townhouses, with their own driveways, set amid three acres of gardens.

Diving

The next morning, I went to Harbour Dive, ready for the day's adventure. Established in 2000 as a small family-owned dive shop, the business has grown into a multi-faceted retail and training center. Original owners Cathie and John Warren remain at the helm, and today the shop certifies

more divers than any other store in Victoria.

Since I did not have a car, Cathie had arranged a guide and transport for me. This proved to be very expensive, but my only option. I met up with instructor Steve Juffkins, who would be both chauffeur and dive buddy for the next few days. After doing the necessary paperwork, I got fitted for some gear. Fortu-



CLOCKWISE FROM LEFT: Magpie perch at Rye Pier; Diver under Rye Pier; Eleven-armed seastar; Spider crab; Sponges on Rye Pier pylon; Bluespotted goatfish; Moonlighter perch

dive. Augmented by a peerless blue sky, the scene looked tropical, although I knew water temperatures

would be a different story. There was plenty of parking, but one downside: the 150m walk down the pier to get to where the diving was. Fully geared with weights and camera, it proved to be a real workout.

Stopping for a breather, I glanced over to what I thought was a patch of vegetation in the shallows. "There's a stingray," remarked Steve and I halted, jaw agape. Even from a distance, I could see it was massive! Measuring over 2m across, smooth stingrays are the world's largest and are frequently encountered at Mornington's dive sites. Although their barbed tails are highly venomous, their dispositions are benign and readily approach divers. My pace quickened noticeably.

A divers' platform at water level allowed us to finish gearing up. Being high tide, it was already a few

inches underwater. Ready to go, a giant stride plunged me into a new world. For the uninitiated, temperate diving is very different than the tropics. There are no coral gardens or turquoise waters teeming with colorful reef fish. While not the most beautiful of locations, looks can be deceiving; there are treasures to be found!

Although the average depth was 11m, we kept shallow for most of the dive. Sponges proliferated, the pylons shrouded with growth of all colors. The seabed was strewn with mussels and broken shells along with eleven-armed sea stars as big as dinner plates. Old tires concealed magpie perch and bluespotted goatfish as moonlighter and barber perch milled about the pylons.

Closer scrutiny of the sponges revealed creatures hiding in plain

nately, early autumn temperatures off Mornington were around 21°C in the shallower waters, so a 7mm suit with hood proved more than adequate. In winter, temperatures can plummet to a chilly 8°C. With car fully loaded, we set out for Rye Pier. Even distances on the peninsula were greater than anticipated, so I was happy to have someone else doing the driving.

Rye Pier. Featuring a sweeping beach of white sand, Rye was a beautiful spot just to visit, let alone





sight. A green eye betrayed a mosaic leatherjacket, its orange body perfectly mimicking a sponge. Leatherjackets proved especially common; along with mosaics, we spotted horseshoe, toothbrush and Gunn's leatherjackets. Australia has more than any other country, with 60 of the world's 97 species residing within its waters. Of these, 22 are found only in the south, inhabiting sponge gardens, sea grass and rocky reefs.

Rye is renowned for spider crabs, which congregate during autumn in astonishing numbers. Unfortunately, I did not witness the mass migration, but they were around. Away from the pier, Steve found a pair on the sandy, pinchers wielded defiantly. A quick search yielded several more, all allowing a close approach for photography.

Suddenly, a dark shape in the corner of my eye made me turn; a huge smooth stingray was gliding in my direction. It was not aggressive, merely



curious (tell that to my pulse though) and veered off at the last second. In stark contrast was a tiny ray the size of a small plate. Steve later told me it was a juvenile smooth stingray. I could scarcely believe this toddler would mature into a 2m behemoth!

Elsa's Reef. Positioned approximately 50m off Rye Pier in 6-7m of water was Elsa's Reef, an artificial reef home to some distinctly eclectic objects. Bicycles, sculptures and twisted metal frames provided refuge for spider crabs, as did a bench laden with bottles. An

octopus darted into a recess while another crab sported a multi-pronged sponge atop its head. Steve gave a sign he was cold, so we headed back. Final dive time: 90 minutes, with nearly half a tank of air left. How great is that?

CLOCKWISE FROM ABOVE: Juvenile smooth stingray; Large 2m adult smooth stingray at Rye Pier; The mosaic leatherjacket's clever camouflage is betrayed by its green eye; Pair of horseshoe leatherjackets; Gunn's leatherjacket



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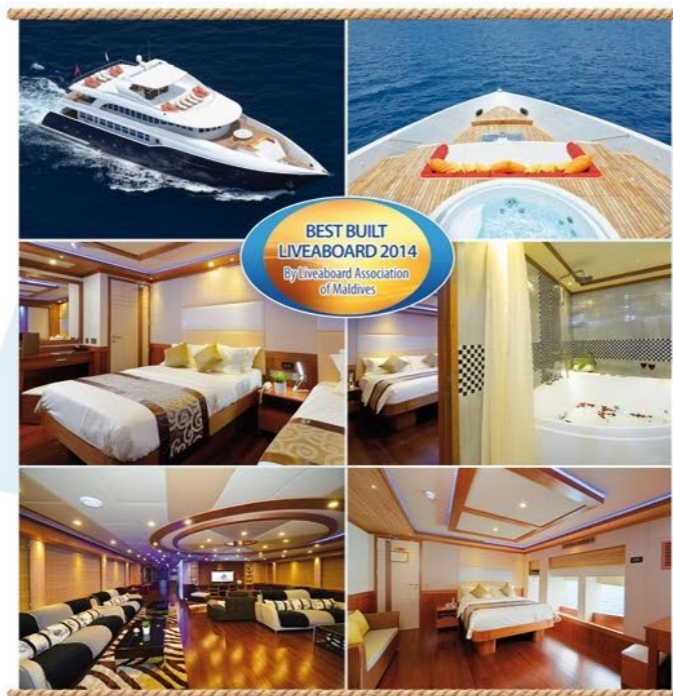


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With the rest of the afternoon free, I pondered what to do. I had originally considered hiring a car to see the fairy penguins at Phillip Island. That is, until Steve told me it would be a two-hour trip EACH WAY, effectively nipping that plan in the bud. Steve recommended I take a walk down to the bay. Grabbing camera and tripod, I set out, not having a clue what to expect.

Mornington

"Undiscovered gem" is one of those phrases that gets bandied about with predictable frequency, yet it perfectly encapsulates Mornington. Located 57 km south of Melbourne's CBD, it is a world away from the urban hub-bub. Celebrated for its beautiful beaches and village atmosphere, Mornington is a popular destination for day-tripping Melburnians. Lined by restaurants and shops, the pleasant main street led right down to the water.

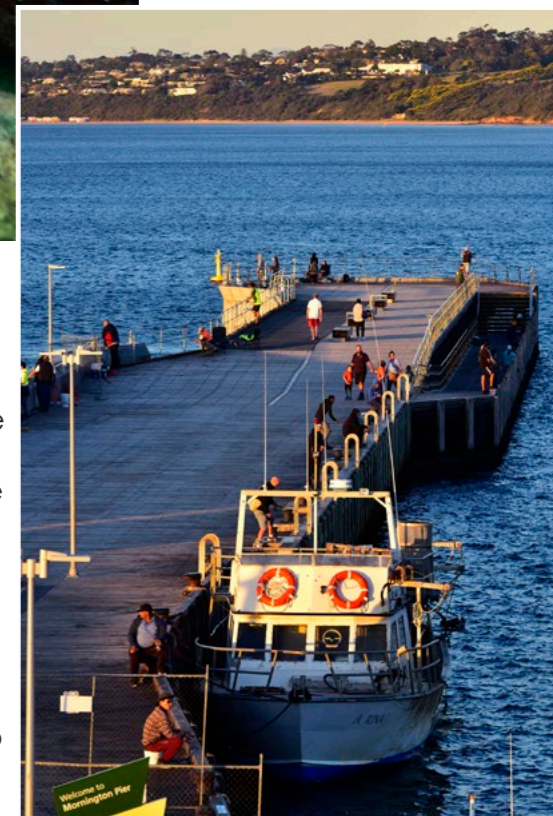
A path led down to

the beach and I decided to investigate. Here, I discovered one of the peninsula's most endearing features: beach huts. I had seen similar structures in the United Kingdom, but these were colorfully painted and on actual sand rather than stones (no offense to my UK friends). Cool and quirky, they were a joy to photograph. In the distance was a surreal sight. So vast was the bay that Melbourne's skyscrapers appeared to ascend right from the water like something out of Waterworld. Wandering over to Schnapper Point, Mornington's pier teemed with tourists and fishermen,



Victoria

At Elsa's Reef, an odd artificial reef composed of bicycles, sculptures, twisted metal frames and a bench laden with bottles provides refuge for spider crabs (left); Mornington Pier (below); Colorfully painted beach huts dot the beach at Mornington (bottom).

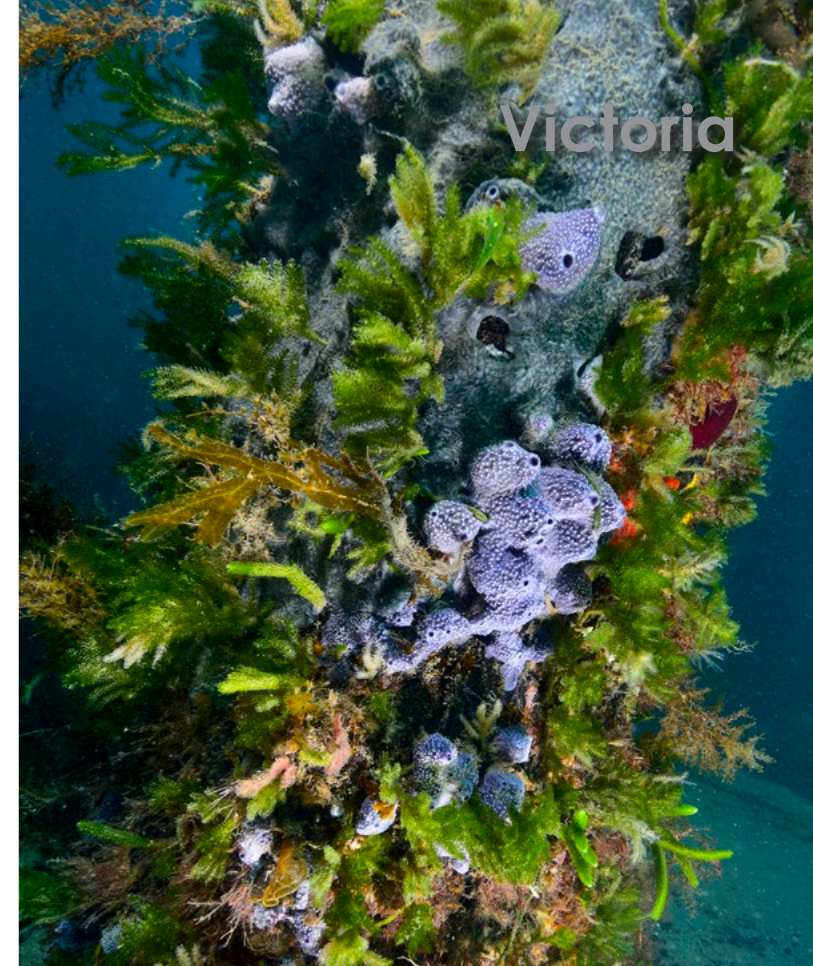


as sailboats cruised in the beautiful evening light.

Feeling peckish, I ventured back to the main street for some dinner. Despite it being mid-week, all the restaurant patios were packed. Looking for something different, one place immediately caught my eye. Serving up traditional Afghan cuisine, the Marco Polo oozed atmosphere, its interior ornamented with tribal rugs, lanterns



Various seaweeds and kelp grow on the pylons of Flinders Pier (left), which is a site renowned for weedy seadragons (above); Sponges also grow on the pylons (top right); Ascidian tunicates, or sea squirts, can also be found at the site (right).



Victoria

and brass hookahs. The mixed grill of lamb and chicken kebabs provided a delectable finish to an unexpected day!

More diving

Flinders Pier. The next morning, Steve picked me up at 9:00 and we set out for Flinders Pier. After diving Rye, I could not wait to get back in the water! The drive was picturesque, passing rolling green hills interspersed with vineyards, farmland and patches of eucalypt forest. Wineries are a big business here, with 170 found throughout the peninsula. Unfortunately, diving and wine-tasting do not mix...

fishermen and divers alike. Sheltered from the waters of Bass Strait by West Head, it is a magnet for life, including squid, King George whiting, Australian salmon, silver trevally, wrasse, leather-jackets and short-finned pike. However, it is renowned for residents that lure photographers from far and wide: Here be dragons!

Seadragons, to be exact; Flinders is a prime habitat for weedy seadragons, an Australian endemic found only in southern and eastern Australia. Close relatives of seahorses, they are slow-moving, relying on camouflage as protection against predation.

Lacking a prehensile tale, they drift

along, feeding on tiny crustaceans and other zooplankton, their leaf-like appendages resembling swaying seaweed. Like seahorses, the males are tasked with caring for the eggs. Females lay around 120 eggs on the brood patch on the underside of the males' tail. Once fertilized, they are carried by the male for approximately a month before the hatchlings emerge.

According to Steve, Flinders is best dived with northerly winds below 20 knots on an outgoing tide. With winds coming from the southeast, conditions were not sounding good. With limited diving days, I did not want to miss the seadragons, so we decided to try.

From the pier, surface conditions were not overly rough, but we could not see bottom, even in the shallows. Plunging in, visibility proved dismal; the worst I had encountered in 25 years of diving. I could barely discern Steve a



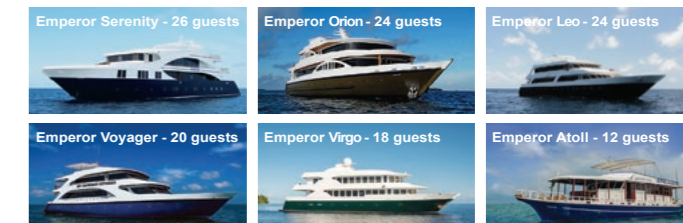
meter in front of me, and after 10 murky minutes, we called it a day. To say I was disappointed was an understatement. Yet, a glimmer of hope flickered. Conditions the following day (my last) were set to improve, so we would try again. All digits were now crossed!

The next morning, it was back to Flinders. Steve was busy with a class, but an amiable young fellow named Brenton Barling would guide me for the day. Conditions had improved, so it was the moment of truth! Heading down the pier, we met another underwater

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CLOCKWISE FROM LEFT: Verco's tambja nudibranch, weedy seadragon, old wife, southern eagle ray, and blue weed-whiting at Flinders Pier

photographer. She had encountered five seadragons, so I was feeling cautiously optimistic.

Now that I could actually see, Flinders proved noticeably different than Rye. Although sponges were present, there was a lot more seaweed, with dense aggregations of brown and green varieties. Resembling chunky pipe-cleaners, green seaweed (*Caulerpa brownii*) shrouded the pylons along with ascidians in a range of colors. Amidst the green was my first nudibranch: a Verco's tambja.

Yet, Mornington's piers are not just about the critters; there are some much larger creatures in residence. Swimming to the end revealed a surprise. Laying on the bottom was a Southern eagle ray. With a square, blocky head, it looked quite differ-

ent to its tropical cousins. I managed to quickly snap a few photos before it vanished in a flurry of silt.

We had been in the water over 20 minutes and still no seadragons. I was starting to get antsy; the very thought of coming all this way and not seeing any was disconcerting. Relief came with Brenton waving frantically. Could this be it? The answer was a resounding YES! There, amongst the weeds, was my seadragon, and it was as exquisite as I hoped. Ornamented with intricate weed-like appendages, its reddish-brown body and tubular snout was accented with yellow spots. Slow-moving yet graceful, I marveled as its tiny fins propelled it along.



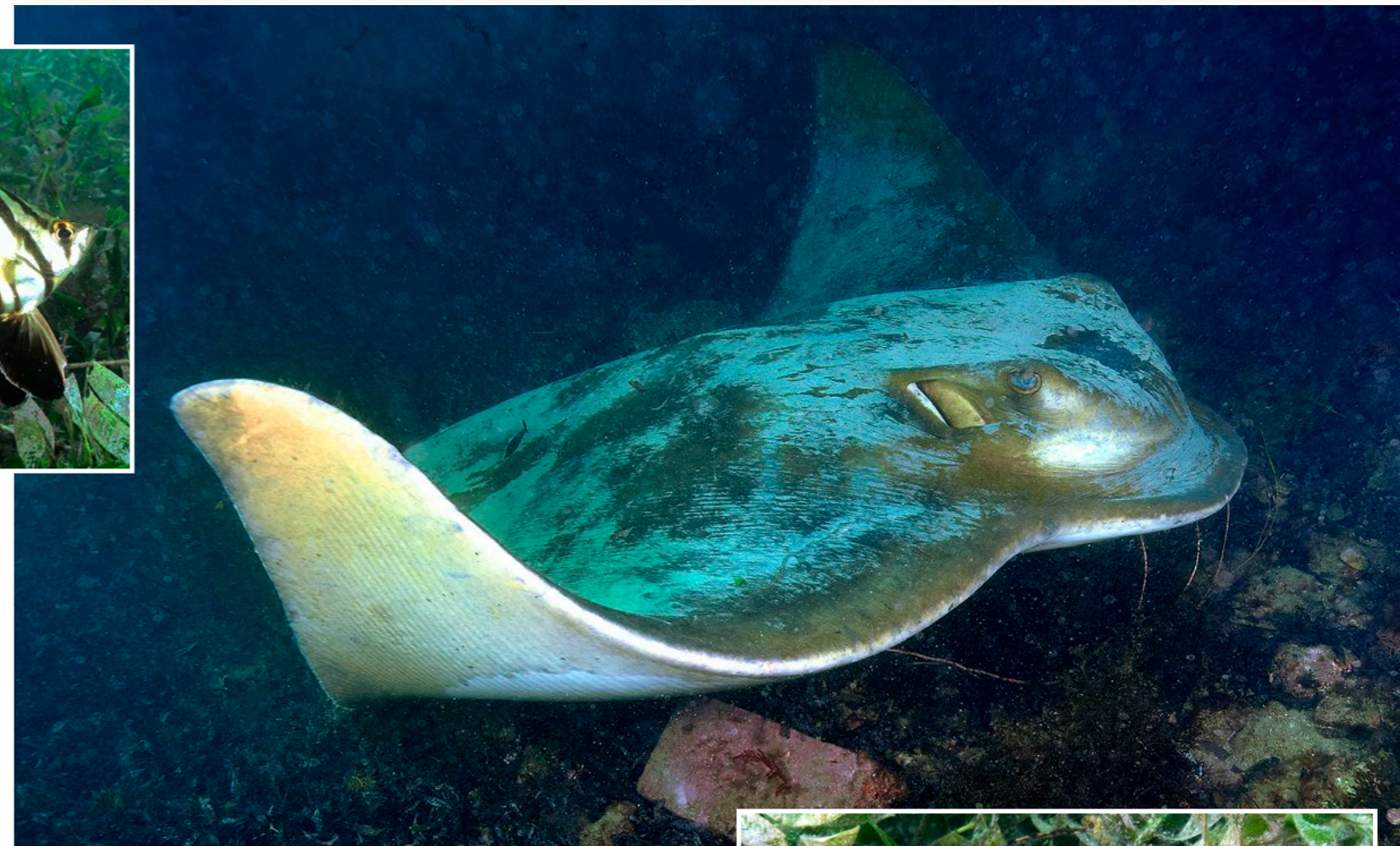
DIVE ñ DIVE

Expect The Unexpected



Broken Rock
3°33'21.1"N 72°56'13.2"E
South Ari Atoll, Maldives

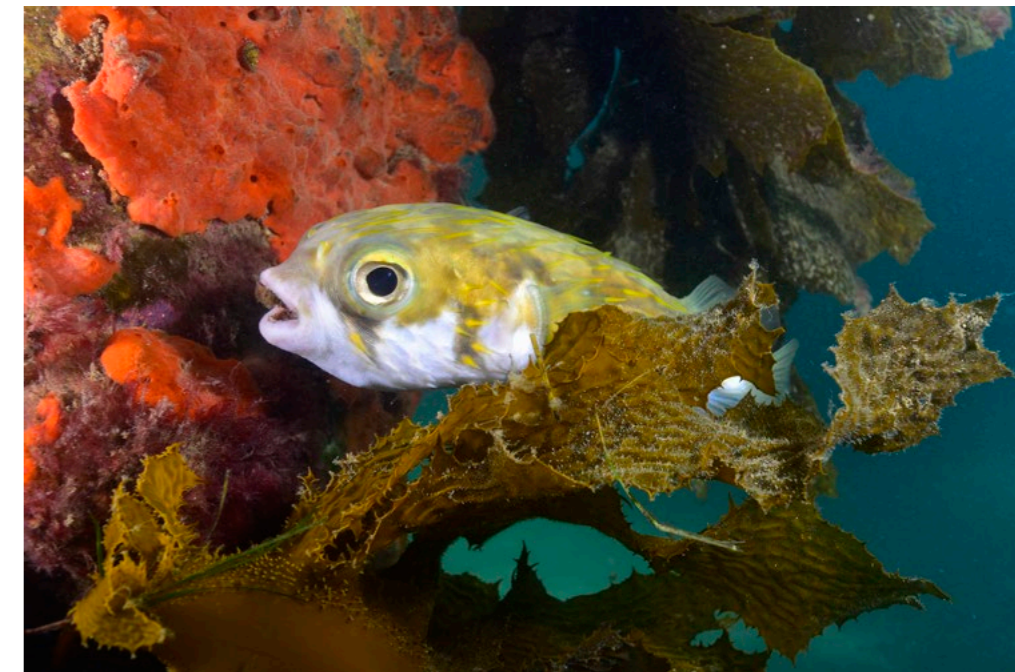
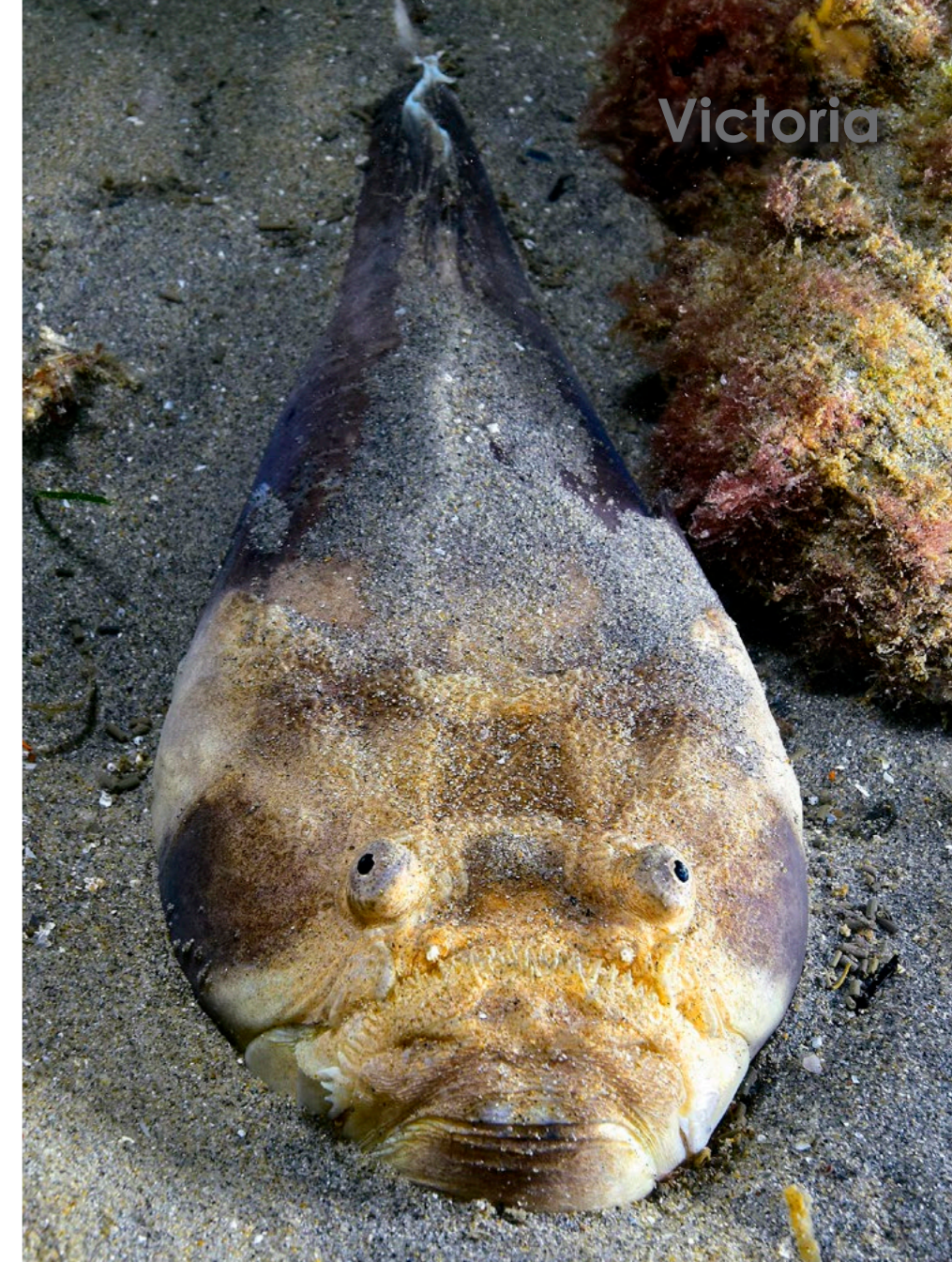
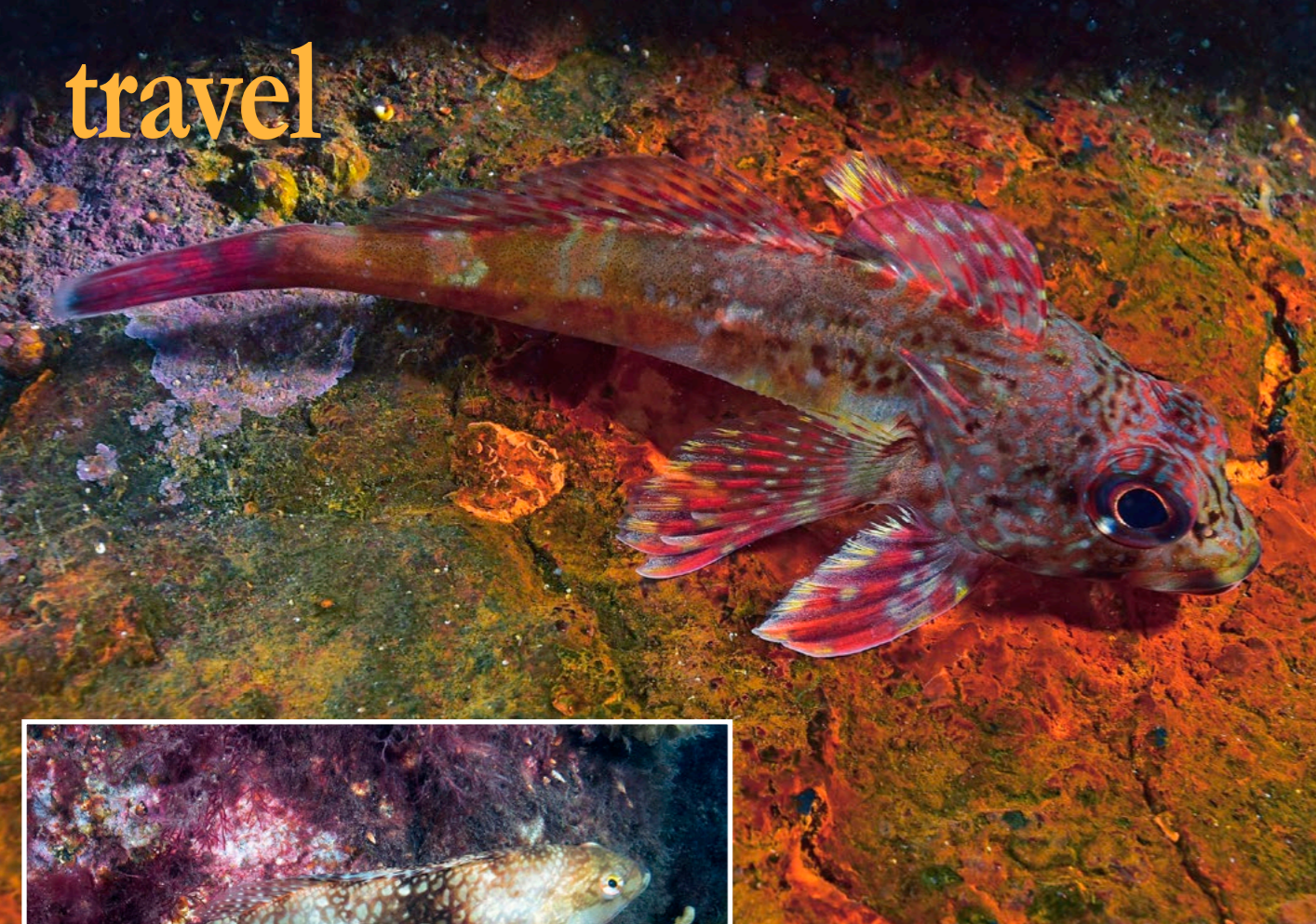
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I quickly took a wide shot for the record and then slowly moved closer. Although vastly improved from the previous day, visibility was still murky, so I photographed it against the seagrass. I followed it for a few minutes until it vanished into the seagrass. How could something so big (around 46cm) and colorful vanish? Still, I had seen my seadragon and I was thrilled! During the mating season in spring, hundreds congregate here. What a sight that would have been!

Although we did not find any other





CLOCKWISE FROM LEFT: Female bluetooth wrasse, dragonet, biscuit star, Blairgowrie shell, stargazer and globefish at Blairgowrie Pier

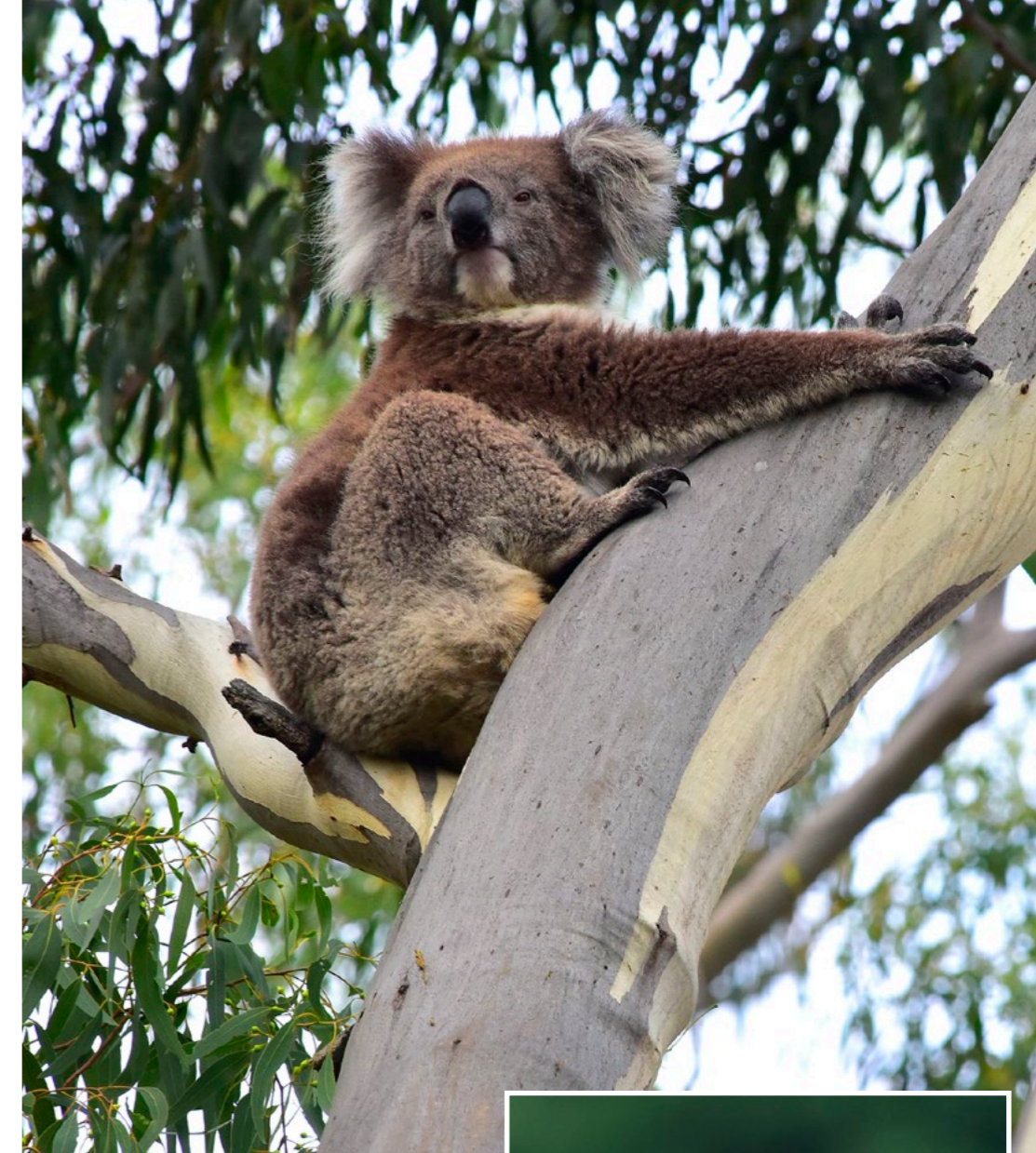
With a huge head and upturned mouth like a bulldog, the common stargazer will not win any awards in the beauty department. Found off Southern Australia, they are ambush predators, burying themselves to leave only their eyes and top of the head exposed. This species was much bigger than the ones I had encountered in the tropics, and the first I have seen during the day. Fortunately, it was not camera shy, so I was able to shoot straight-on portraits. A nearby toothy flathead proved equally cooperative. I was liking this!

Moving from the sand, I then concentrated on the pier itself. So much growth encrusted the pylons that the original structure was practically indiscernible. By this point, I had become adept at finding mosaic leatherjackets and spotted at least half a dozen, along with eleven-armed seastars, biscuit stars, moonlighters, balloonfish and bluetooth wrasse. Close inspection of a Blairgowrie shell revealed it to be surrounded by cleaner shrimp.

Just before surfacing, I discovered a real treasure. Perched on a pylon in a meter of water was a dragonet (*Bovichtus angustifrons*). With a large head and tapering body, it sat upside down on a pylon just beneath the waterline. Even with a 70-minute dive, it just was not enough time to enjoy all there was to find. This was just the tip of the iceberg, as there were plenty of other species I did not get to see, including pot-bellied seahorses, cuttlefish, blue-ringed octopus, prowfish, anglerfish and Port Jackson sharks, to name but a few. Although I was sad to leave, my trio of dives left me yearning for more.

specimens, further exploration of the seagrass revealed blue weed-whiting and old wife, another species endemic to southern Australia, identified by a pair of prominent dorsal fins and zebra-striped coloration. The politically incorrect moniker refers to the sound made by the fish's grinding teeth when caught. How this relates to wives is a topic I refuse to speculate upon.

Blairgowrie Pier. Heading back to Port Phillip Bay, our final stop was Blairgowrie Pier, a favorite among local underwater photographers. Beneath the pier, sand predominated, with patches of seagrass alongside the pylons. What first appeared lifeless proved to be anything but, and within minutes, I found my first critter.



Kangaroo with little joey in pouch (left) and pair of emu (above) in the Serendip Sanctuary, less than an hour's drive from Melbourne; Koala bear in a gum tree at You Yangs Park (right); Eastern rosella (lower right); Windsor Hotel in Melbourne (lower left)



Topside excursions

Having already checked out of my hotel, I commenced the long trip back to Melbourne. Luckily, it was quicker than expected, with the train traveling from Frankston to Flinders St. Station in under an hour. Melbourne, which is located in the state of Victoria, is a city I have always liked. Australia's second largest city, it reminds me a lot of my hometown of

Toronto, with skyscrapers, streetcars and a diverse multicultural population. Nearly a quarter of Victoria's residents were born overseas, and the city of Melbourne is home to residents from 180 countries. Melbourne has the largest Indian population in Australia and the largest Greek population outside Athens. As one can imagine, it is also a culinary utopia.

From the station, a short taxi ride delivered me to the Windsor Hotel. Established in 1883, the Grand Dame of Melbourne hotels proved a remnant of old-world charm. The guest list is a who's who of royalty, world leaders and celebrities, from Edward VIII, Prince of Wales, and Katherine Hepburn to Meryl Streep and Anthony Hopkins. I would be going

out in style.

With a free day before departing, I wanted to experience some of Victoria's above-water nature. While researching day trips, I discovered a nature tour company called Echidna Walkabout. Their "Kangaroos and Koalas in the Wild" tour sounded perfect, so I reserved a spot before leaving home. The tour encompassed the Serendip Sanctuary and You Yangs Park, with eastern grey kangaroos in the former and koalas in the latter.

Serendip. Less than an hour from Melbourne's urban bustle, we arrived at Serendip. Located on Victoria's volcanic Western Plains, the sanctuary encompasses about 1.5 sq km of grasslands and wetlands. It did not take long to find the kangaroos, with a sizeable mob residing in the grassland near the parking lot. A slow approach

yielded some close-up encounters. A number of the females had joeys, with assorted heads and feet protruding from their mothers' pouches.

After the kangaroos, we explored some of the roads traversing the park. Some 150 bird species breed at or visit the sanctuary, including sulphur-crested cockatoos, honeyeaters, eastern rosellas, cape barren geese and whistling kites. Suddenly, our guide Scott braked and his binoculars shot up. "There's a tawny frogmouth in that tree," he whispered. Utterly still, the bird was virtually imperceptible amidst the bare branches. I marveled as to how Scott even saw it at all, let alone while driving! Nearby, a pair of emus provided another photo stop.

Before lunch, we stopped at the billabongs, isolated ponds left behind after a river changes course. Although one was dry,

another was brimming with water and home to an abundance of waterbirds, including black swans, pink-eared ducks, moorhens, stilts and herons.

You Yangs. Leaving Serendip, it was only a 10-minute drive to the You Yangs. The park is home to a healthy koala population, which the company monitors to ensure the best possible sightings. In addition, Echidna Walkabout established the Koala Clancy Foundation, a non-profit organization dedicated to the protection of wild koalas, predominantly around the You Yangs and the Western Plains of Victoria. Every wild koala sighted is photographed, named and identified.



Notes are taken on the sex of the koala, its location, the tree species and the height of the tree where it is found.



Parking the vehicle, we meandered among the sugar gums, their twisted shapes mottled yellow to orange. The forest was strangely silent, the only sound our crunching footsteps. Within minutes, Scott stopped and gestured to a nearby gum tree. High above was a koala, a female he identified as Mara. Approaching quietly, we got a clearer view. Then, a surprise: on a branch above was her joey.

Once spotted, it is pretty much guaranteed they will not go anywhere. Koalas sleep up to 22 hours a day, as their bodies need a lot of energy to digest gum leaves, which are fibrous and low in nutrition. We spotted two more that afternoon, with Scott introducing each by name, history and family tree. It is always enthralling to see animals in their native habitats, and the tour certainly delivered



A walkabout in Melbourne has some surprises. Near Flinders St. Station (above), urban art (left and below) can be found on AC/DC Lane, which is dedicated to Melbourne's favorite rock bands; Southbank, situated on the Yarra River (right), is a hub for Melbourne's entertainment scene, where you can find lots of cafés, restaurants and shops as well as the city's arts and convention centers.

as promised. Next time, I will have to do one of their multi-day tours.



Meandering in Melbourne

After getting back, I spent the evening walking around the downtown. Bordering the Yarra River, Southbank was home to some pretty impressive skyscrapers. Once a ramshackle industrial area, it has transformed into a hub for Melbourne's entertainment scene, with scores of restau-

rants, cafés and shops along with the arts and convention centers. The river looked cleaner too. At one time, it was joked the Yarra was the only river in the world to flow upside down.

An unexpected discovery was the city's street art. Just off Flinders Street, a series of back streets and alleys revealed some of the most amazing murals I had ever seen. No mere graffiti, this was sophisticated urban art. Hosier Lane and Duckboard Place were virtually psychedelic, with every surface a dazzling exhibition of color and

imagery. AC/DC Lane was dedicated to Melbourne's favorite rockers, the walls adorned with images of the band. There were restaurants too, along with the Cherry Bar, which bills itself "pretty much the best rock n' roll bar in the world".

For my final night, I thought it fitting to have Greek food and nearby Gazi fit the

bill. Although chock-full, I was seated alongside the open kitchen, watching the staff cook up a storm over the huge, flaming grill. I decided on souvlaki and there were some novel variations. I chose two: beef with fries, caramelized onion, parsley and horseradish tzatziki; and softshell crab with mint, coriander, honey and mayo. Diverse and exciting, just like Melbourne itself.

With my whirlwind visit at an end, I was both exhausted and elated. A refreshing change from the tropics, one can indeed dive in Melbourne. Despite doing only a few dives, I was hooked. With its combination of marine life and above-water charm, Mornington proved a revelation and a place I must return to. Victoria's secret is out!

Helpful tips

The best way to experience Mornington's dive sites is to travel with a buddy and hire a car, which allows freedom to explore at your own pace. There are no 40-minutes-and-back-on-the-boat limitations; although, one must be self-reliant. It is handy to have a box of spare O-rings

and other assorted bits and bobs—just like going on a picnic.

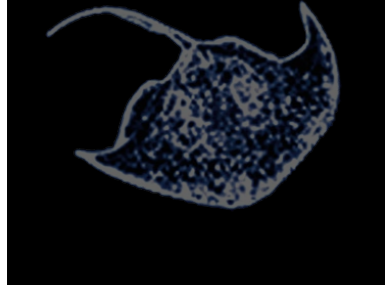
The piers are easily accessible with plenty of parking. The only difficulty is the long walk to the diving platforms. It is a good idea to bring along a diver flag for the benefit of passing boats. While diving, it is imperative to check for boats and fishing lines. If you plan to stray from underneath the pier, a marker buoy is a good idea. With plenty of fishermen about, getting tangled in someone's line is a real possibility, so a dive knife is a useful accessory.

It is best to bring your own gear, or hire some from a dive center. If traveling solo, try to hook up with one of the local dive clubs to see if a day excursion is planned. With my identification skills for the region lacking, a useful tool was the Port Phillip Bay marine life website (PortPhillip-MarineLife.net.au). Through the website, I could identify all the species I photographed. ■

Special thanks go to Harbour Dive Australia (HarbourDive.com.au) and Echidna Walkabout (EchidnaWalkabout.com.au).



fact file



Australia



SOURCES: US CIA WORLD FACTBOOK, XE.COM, CDC.GOV, STATE.TRAVEL.US, GOOGLE.COM

History About 40,000 years ago, aboriginal settlers arrived on the continent from Southeast Asia. In the 17th century, the first Europeans began exploration. Formal territorial claims were first made in 1770, when Capt. James Cook took possession of the land in the name of Great Britain. In the late 18th and 19th centuries, six colonies were created which federated and became the Commonwealth of Australia in 1901. Rich in natural resources, the new country began to rapidly develop agricultural and manufacturing industries. The country made a major contribution to the British effort in World Wars I and II. During the past century, Australia has transformed itself into an ad-

vanced, internationally competitive market economy. Due in large part to economic reforms in the 1980s, the country boasted one of the OECD's fastest growing economies during the 1990s. Long-term concerns include pollution, ozone layer depletion, and conservation and management of coastal areas, especially the Great Barrier Reef. Government: federal parliamentary democracy. Capital: Canberra

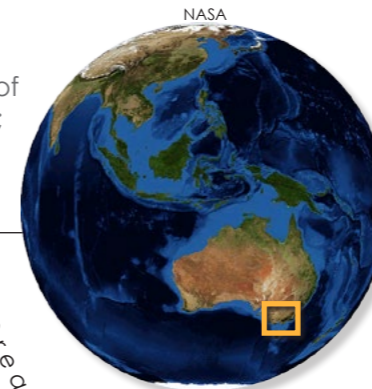
Geography Located in Oceania, Australia is a continent between the Indian Ocean and the South Pacific Ocean. It is made up of six states and two territories: Australian Capital Territory, New South Wales, Northern Territory, Queensland,



South Australia, Tasmania, Victoria and Western Australia. It has several dependent areas including Ashmore and Cartier Islands, Christmas Island, Cocos (Keeling) Islands, Coral Sea Islands, Heard Island and McDonald Islands, Norfolk Island, Macquarie Island. It is the world's smallest continent but sixth-largest country with a majority of the population concentrated along the eastern and southeastern coasts. Perth, on the west coast, is affected by the invigorating tropical sea breeze known as the "Fremantle Doctor". It is one of the most consistent winds in the world. Coastline: 25,760km. Terrain: mostly low plateau with deserts and fertile plains in southeast. Lowest point: Lake Eyre, 15m. Highest point: Mount Kosciuszko 2,229m

Climate is generally arid to semi-

Location of the state of Victoria on global map (right); Location of Melbourne on map of Australia (below)



Australia economically competitive. What's fueling the economy? Rising domestic output, robust consumer and business confidence and rising exports of agricultural products and raw materials.

Key factors include low inflation, Australia's emphasis on reforms and growing ties with China. However, drought, weak foreign demand, and strong import demand inflated the trade deficit from \$8 billion in 2002 to \$17 billion in 2005. But Conservative fiscal policies maintain Australia's budget in surplus from 2002 to 2005.

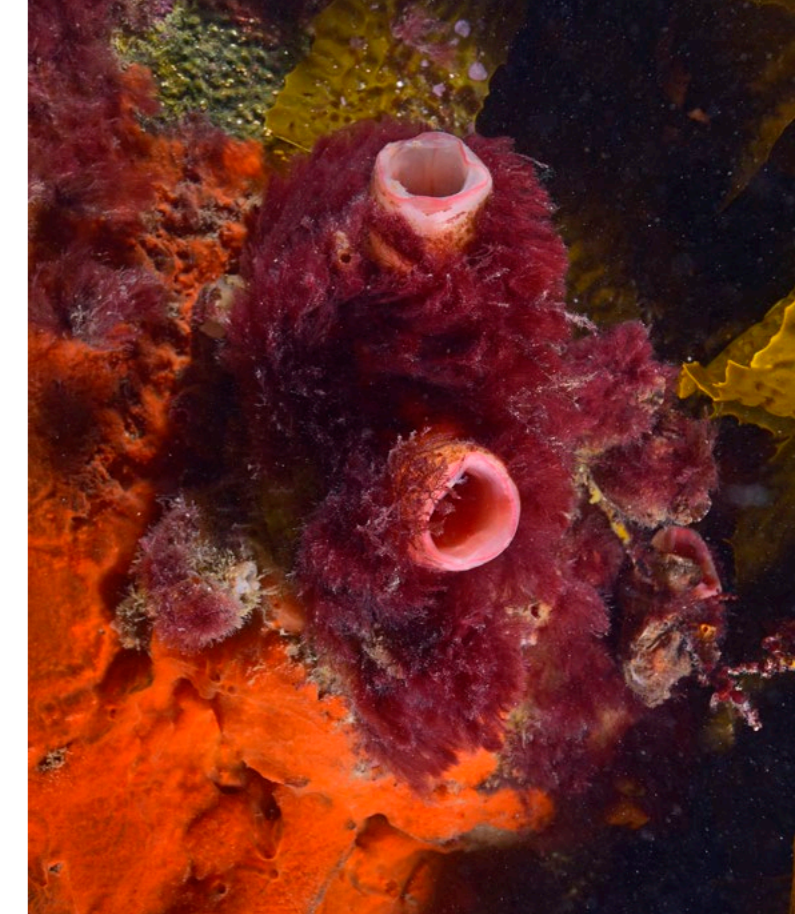
Population 23,232,413 (July 2017 est). Ethnic groups: English 25.9%, Australian 25.4%, Irish 7.5%, Scottish 6.4%, Italian 3.3%, German 3.2%, Chinese 3.1%, Indian 1.4%, Greek 1.4%, Dutch 1.2%, Australian aboriginal .5% (2011 est). Internet users: 20,288,409 (2016)

Languages English 76.8%, Mandarin 1.6%, Italian 1.4%, Arabic 1.3%, Greek 1.2%, Cantonese 1.2%, Vietnamese 1.1% (2011 est.)

Currency Australian dollar (AUD); Exchange rates: 1 USD= 1.29 AUD, 1 EUR=1.51 AUD, 1 GBP=1.68 AUD, 1 SGD=.94 AUD

Economy A Western-style capitalist economy with a per capita GDP on par with the four dominant West European economies keeps

Ascidian tunicates (right)



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Eleven-arm sea star

The Little Life on the
Great Barrier Reef

Text and photos by Brandi Mueller





Sapphire flatworm and *Tubastrea* coral at night (above). PREVIOUS PAGE: Soft coral cowrie on coral

There is nothing small about the Great Barrier Reef. It is not only the largest coral reef system on Earth, but probably the most well-known. You would be hard-pressed to find divers who do not have it on their dive wish lists. It is Earth's largest living structure and reaches over 2,300km (1,400 miles) down the coast of Queensland, Australia. It covers more than 344,400 square kilometers (133,000 square miles) and comprises over 2,900 individual reefs and 900 islands. One could probably generalize and say, "It's big."

Love and respect for this massive reef system goes back many years (possibly with the exception of Captain James Cook, who found himself run aground on it). It has been a marine park since 1975 and is a UNESCO World Heritage Site. The amount of marine life that call it home include over 1,600 species of fish, 630 echinoderm species, 450 species of coral, 30 species of whales and dolphins, 14 species of sea snakes, and over 3,000 mollusk species. Just Heron Island alone has been documented to have 300 species of nudibranchs.

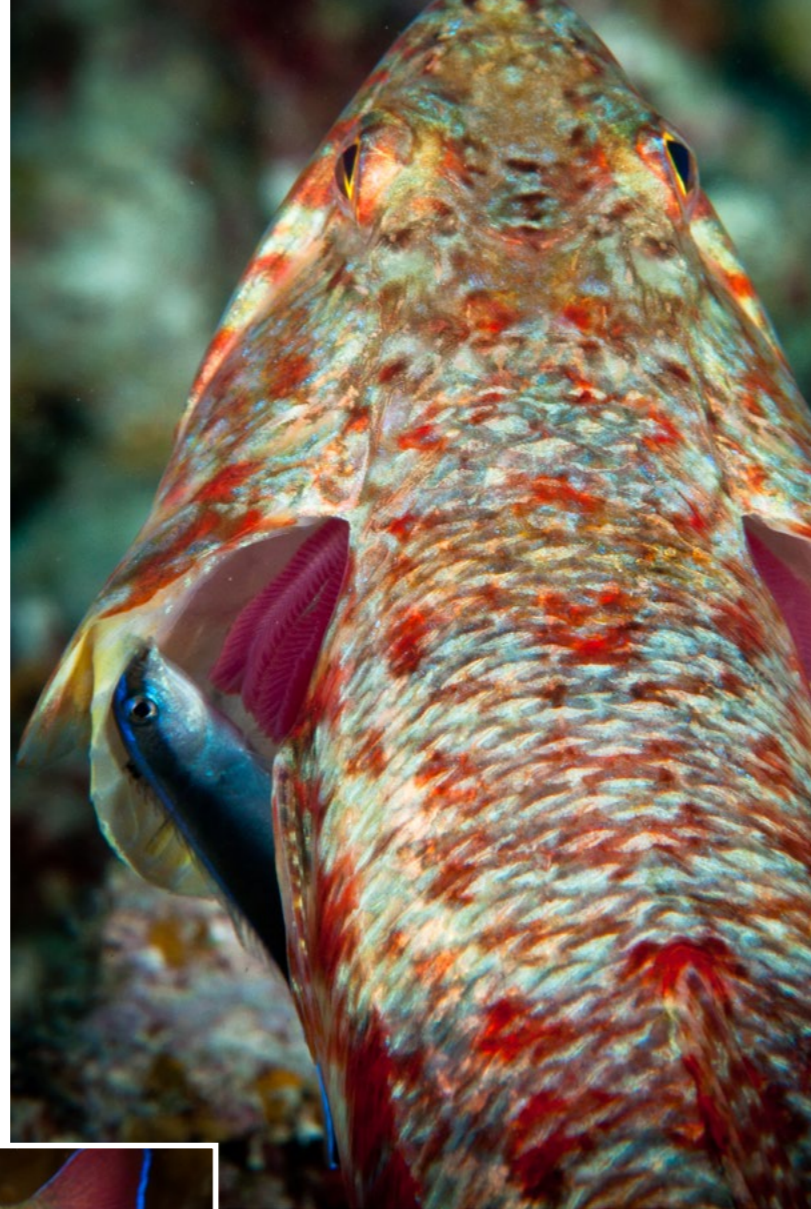
Just a touch south of the Coral Triangle, which is the most biodiverse region of marine life, the Great Barrier Reef has extensive biodiversity all on its own. Many endangered and threatened animals live in or visit the Great Barrier Reef, including the vulnerable dugong, friendly dwarf



Starry Okenia nudibranch (*Okenia stellata*)

Goniobranchus sp. nudibranch





Lizardfish getting cleaned by a cleaner wrasse (above); Pipefish (top right); Indian nudibranch, or *Caloria indica* (right)

minke whales, and six species of sea turtles which lay their eggs on beaches within. But there is so much more to the Great Barrier Reef than just the big stuff!

Best dive sites for little stuff

I would argue that any dive site can be good for viewing little stuff, but the Great Barrier Reef has some sites that are perfect for critter hunting.

Lighthouse Bommie. My favorites include Lighthouse Bommie which is a coral pinnacle that starts around 30m (100ft). On the bommie itself, divers often find many species of nudibranchs and flatworms.

Pixie Pinnacle is another bommie with plenty of fish life. Every time I dive there, I liken the "pix-

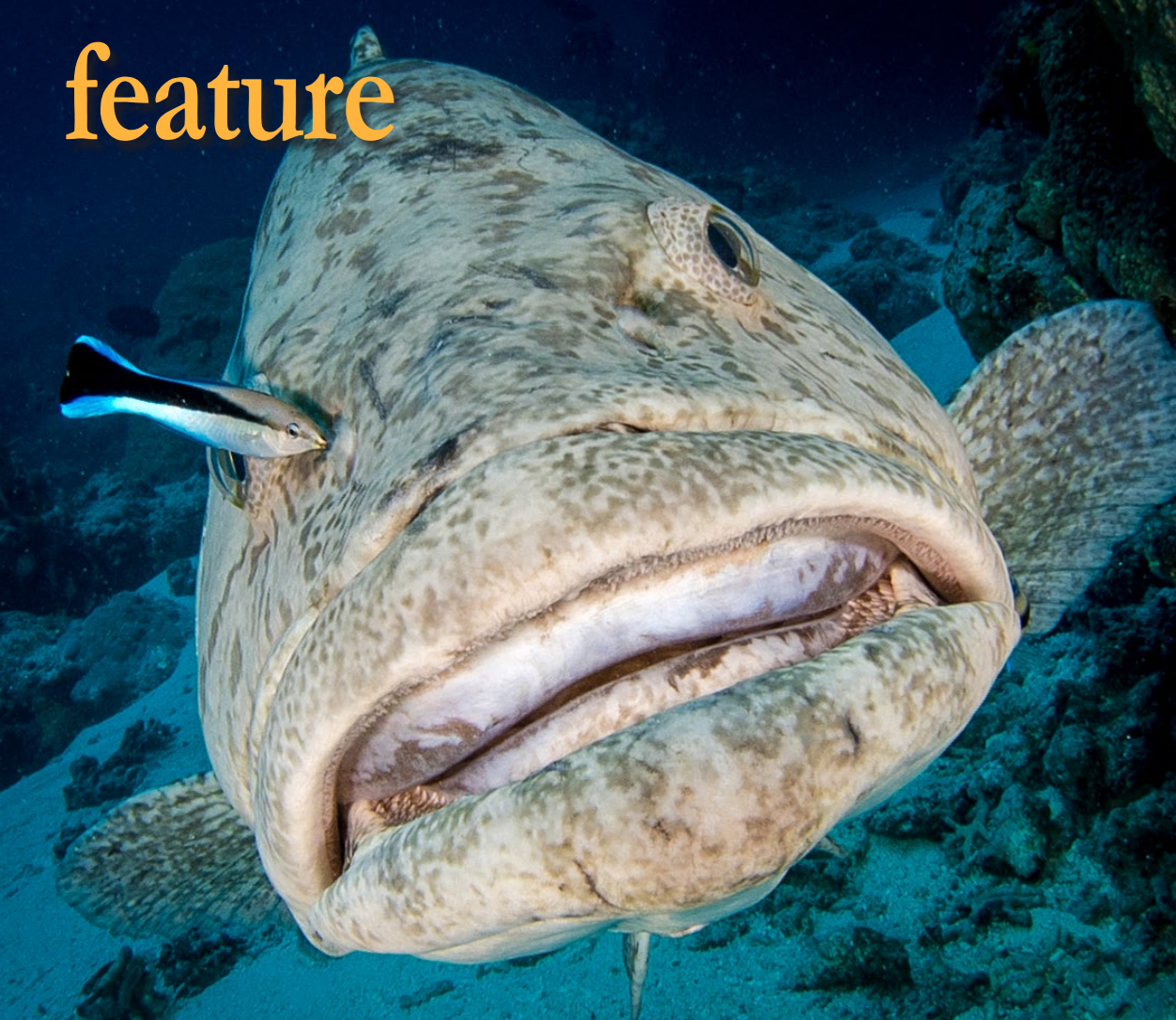


ies" to the thousands of purple, pink and orange anthias that flit about the bommie. It is also a great site for nudibranchs, colorful anemones with anemonefish, lionfish, and cleaning stations where fish come to be cleaned by cleaner wrasse, which remove parasites from the fish.



Anemone shrimp

Anthias (above); False clownfish in anemone (top left)



GBR

Potato cod being cleaned by bluestreak cleaner wrasse (top left); Leaf scorpionfish (above)



Snake Pit. (Yep, you guessed correctly) Snake Pit has a large population of olive sea snakes. These can be great photo subjects for macro or wide angle.

Cod Hole. The famous Cod Hole has plenty of small stuff to see if you can take your eyes off the huge potato cods for which the site is known. Some-

times, the cods are being cleaned by the tiniest cleaner wrasse. When they open their mouths wide, you can see the wrasse around their teeth. Nudibranchs, as well as anemones and lots of other fish, can be seen around the site.

Steve's Bommie. Steve's Bommie is another coral pinnacle great for spotting false clownfish, leaf scorpionfish, nudibranchs and flatworms.

Night dives. Night dives on many dive sites are almost always good for spotting little creatures, partly just because of how we dive at night. We slow down and are limited to the small beam of our flashlights, so our focus changes to examine only small areas at a time. The Great Barrier Reef has excellent night dives, which are some of my favorite times to find the little stuff.

Final thoughts

While the Great Barrier Reef might not seem like a good destination for macro diving at first, looking closely at the reef (and every reef in the world, for that matter) will reveal intricate patterns, colors, and possibly things you have never seen before. A moving starfish might expose its numerous, tiny tube feet. What might be an ordinary lizardfish may, on closer inspection, also include a tiny cleaner wrasse picking parasites off the lizardfish's gills. Once you avert your eyes from the big stuff, you will be shown a whole other (tiny) world of macro life on the Great Barrier Reef. ■

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



Flatworm (above); Tube feet of a starfish (right); Small octopus, possibly an algae octopus (far right)

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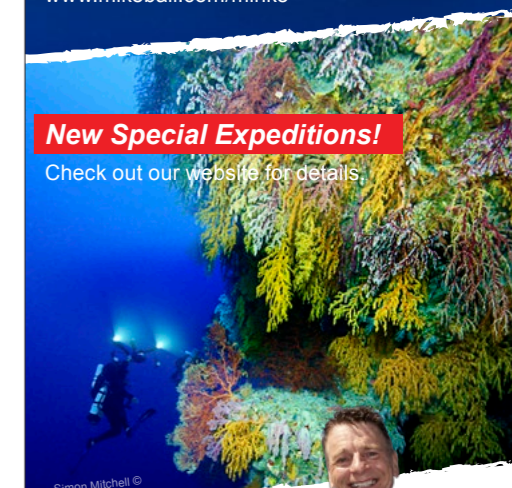


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Australia's Incredible
Leafy Seadragon

Text and photos by Don Silcock





Leafy seadragons are found in the southern and western coasts of Australia.

Australia, the great brown land down under, is home to many iconic and often strange-looking creatures, both above and below the water. But few are as unique and visually spectacular as the leafy seadragon!

Known colloquially as “leafies”, they are also known by the common name Glauert’s seadragon. Leafy seadragons are endemic to the southern and western coasts of Australia, but are particularly synonymous with South Australia, where they have been adopted as the state’s marine emblem.

Timid creatures that grow to between 20 and 24cm in length, they use their ornate leaf-like appendages as very effective

camouflage to blend in with their surroundings and become almost invisible to the untrained eye.

Belonging to the same family as seahorses and pipefish, Australian leafy seadragons are generally brown to yellow in body colour, while their spectacular appendages are typically olive-tinted. Leafies can also change that colouration if they need to, such as when they are in open water and take on the appearance of floating seaweed.

Habitat and lifestyle

Leafy seadragons are most commonly found among patches of kelp and seaweed, usually in sandy areas and at depths of less than 30m, living a mainly solitary existence with a life cycle of between five to seven years.

It was thought that leafies stayed in a specific habitat throughout their lifespans, but

recent research has shown that occasionally they will migrate up to several hundred metres away from their primary locations. They seem to have a keen sense of direction and are able to navigate back to their primary spots again.

Their kelp and seaweed habitats provide ample supplies of small crustaceans such as sea lice, plankton and larval fish, which they suck up through their long, pipe-like snouts. Leafy seadragons do not appear to have any specific predators—which is perhaps the ultimate compliment to their amazing camouflage.

Propulsion

Like all bony fish, the leafy seadragon uses its swim bladder to maintain position in the water column. It has two small fins: one on its back close to the tail, which provides forward movement; and a second on the ridge of its neck,



Leafy seadragons (above and previous page) grow up to 24cm and can change colour to resemble floating seaweed.



Seadragons

History of Edithburgh Jetty on point-of-interest sign

until they are ready to hatch and change colour from pink to purple or orange. The eggs hatch at a rate of two to three at a time, and the male assists the hatching by shaking his tail and rubbing it up against seaweed and rocks—a process that typically takes many hours.

When they emerge from their eggs, the young leafy seadragons are between 4mm and 7mm in length. They are completely on their own, surviving initially by living off the still-attached egg capsule until their snouts are developed enough to start hunting. Leafies are fully grown after about two years and ready to mate, but it is estimated that only about five percent of the hatchlings survive to reach that maturity.



The reef by Edithburgh Jetty in South Australia is a good place to find leafy seadragons.

Females deposit up to 300 eggs on the underside of the males' tails, which they carry and incubate for up to eight weeks until the eggs hatch.

which allows it to steer and turn its body to change direction.

Although the incredible leaf-like appendages look like some form of fins, they actually play no part in how leafies move through the water and are simply there for camouflage. The overall effect being that leafy seadragons seem to float majestically through the water.

Reproduction

The leafy seadragon's breeding season is during the warmer months of the southern hemisphere, starting late in the Australian spring around October and ending in late February as the summer comes to a close.

Reproduction is temperature-dependent and triggered by warmer coastal

water. When the mating season starts, the males give up their solitary lifestyle to court the females. When mating occurs, the females deposit between 250 to 300 bright-pink eggs onto the spongy "brood patch" on the underside of the males' tails.

The males then incubate the eggs, carrying them for between six to eight weeks



Located on the southeastern corner of Yorke Peninsula and around 50km west of Adelaide, Edithburg Jetty (above) is a popular place for leafy seadragons and various seabirds. The main threats to leafies are bad weather and poaching by rogue divers for the aquarium trade.

table big waves, can sweep them from their safe havens and wash them up on the shore.

While storms and big seas are part of nature,

and as such, factored into the overall ebb and flow of the leafy seadragon's reproductive cycle, global warming-induced changes to Australian weather patterns are impacting these delicate creatures. However, the bigger threat is the insidious practice of poaching leafies for the aquarium trade. Their superb presence in the water makes them so highly prized, they

are believed to fetch prices of up to AU\$15,000.

Conservation

Poaching has had such a dramatic impact on the overall numbers of leafy seadragons that by the early 1990s, they became officially protected in the states of South Australia, Victoria and Western Australia. By the end of that decade, they were provided with national protection by the Australian government.

Despite these actions, the leafy seadragon has been classified as "Near Threatened" by the IUCN since 2006. Anecdotally, experienced South Australian divers found that before poaching really



Threats to survival

There are two main threats to the survival of leafy seadragons: bad weather and rogue divers poaching them for the aquarium trade and private collectors. Unlike their cousins the seahorse, leafies have no tail, and therefore, no way to attach themselves to the kelp and seaweed in their habitats. So, harsh weather conditions and the inevi-



Great care is needed when diving and interacting with leafy seadragons, as they are very delicate creatures and get easily stressed. They are quite sensitive to bright lights so should not be exposed to extended use of strobes and video lights. As their swim bladders are easily damaged, they should not be moved up and down in the water column. Divers seeking leafies can stay at the Edithburg Hotel in Edithburg or Tipper's Bed & Breakfast (above).



became bad, it was quite common to see up to 30 leafies at the most popular sites. These days, it is a good day if five are encountered. So, there is clearly a long way to go before these iconic creatures are restored to their former status.

Where to see leafy seadragons

The jetties and bays of South Australia, plus the state's very scenic Kangaroo Island, are the best places to see leafies—with Rapid Bay, Victor Harbour and Edithburg probably the best locations. Both Rapid Bay and Victor Harbour are about 85km south of the state capital Adelaide and are very popular dive sites, while Edithburg is on the southeast corner of Yorke Peninsula and about 50km

west of Adelaide, across Gulf St Vincent, but some 225km away by road. All three are shore dives with easy access in good weather. I have personally had the most success at Edithburg; although, I must say, that I was guided and doubt I would have been able to find them on my own.

How to see leafy seadragons

Because the leafy seadragon's camouflage is so effective, it is surprisingly difficult to spot, even when it is in front of you. So, unless you have unlimited time, patience and sense of humour, you will probably be best served by using a guide. Several years ago, the choices for guides were quite limited, but these days, a quick check with Google shows that a

lot of dive shops and various individuals offer "leafy seadragon tours." I had the help of a guide, Carey Harmer of Leafy Sea Dragon Tours, and was very pleased with my trip. It is money well spent, really, if one factors in the cost of getting down to South Australia, car hire and accommodation.

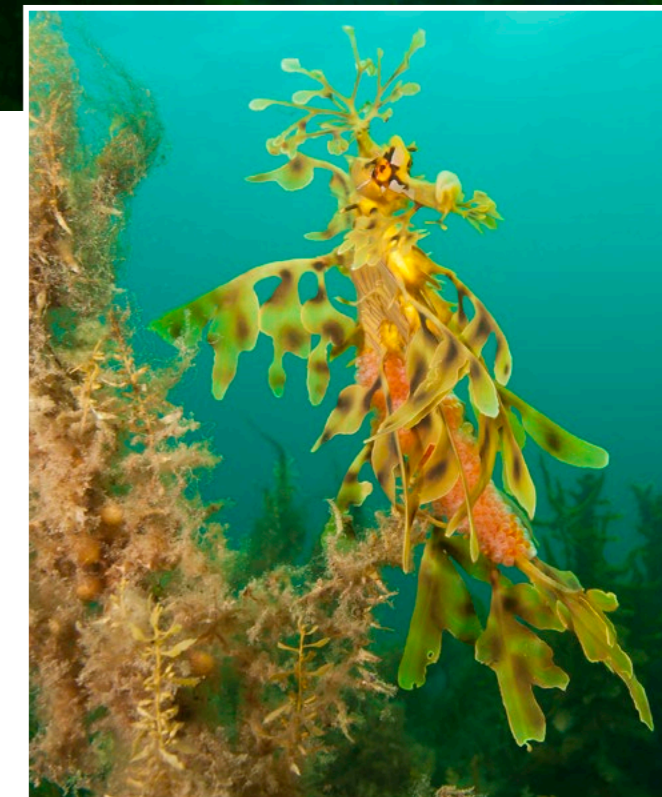
Leafy seadragon etiquette

Leafies are very delicate creatures which are very territorial and easily stressed. So, great care is needed when interacting with them, particularly if the males are carrying eggs. Under no circumstances should they be moved up and down in the water column, because their swim bladders are easily damaged by sudden

changes in pressure. Similarly, leafies do not have any eyelids and are believed to be quite sensitive to bright light. Therefore, they should not be exposed to video lights over an extended period or excessive use of strobes.

Overall, the leafy seadragon is an impressive example of Australian marine biodiversity and encounters with them are truly memorable. However, they must be respected and treated with great care. ■

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



Australia's Giant Cuttlefish

Text and photos by Don Silcock



They are big. The giant Australian cuttlefish can grow up to half a metre in length and weigh up to 11kg. A male (right) protects his female concubine during mating. PREVIOUS PAGE: A large male cuttlefish patrols the reef.

The giant Australian cuttlefish (*Sepia apama*) is the largest cuttlefish in the world, reaching up to half a metre in total length and weighing in at around 11kg. Solitary animals, they are found all along the coastline of the southern half of Australia—from Central Queensland on the eastern coast, right around the bottom of the continent and up to Ningaloo Reef in Western Australia.

Incredibly photogenic creatures, they have a fascinating ability to rapidly change their colour and skin texture, an ability which they use to great effect as camouflage when they are hunting or being hunted, to communicate with other cuttlefish and as part of the amazing displays they use to impress potential partners during the mating season. The giant Australian cuttlefish are also remarkably intelligent and are said to have the largest brains of all marine invertebrates.

Both male and female cuttlefish have relatively short life cycles of one to two years. Interestingly, they have two alternate development cycles, with the first using a “growth spurt” over their initial

seven to eight months to reach maturity by their first summer, so they are ready to mate at the start of winter. The second cycle involves much slower growth, in which they do not reach maturity until they are in their second and

final year.

Although not scientifically proven, the most probable reason for the alternate cycles is that it is nature’s way of hedging bets, so that if a catastrophic event occurs one year, there is a back-up

population that can still breed the following year.

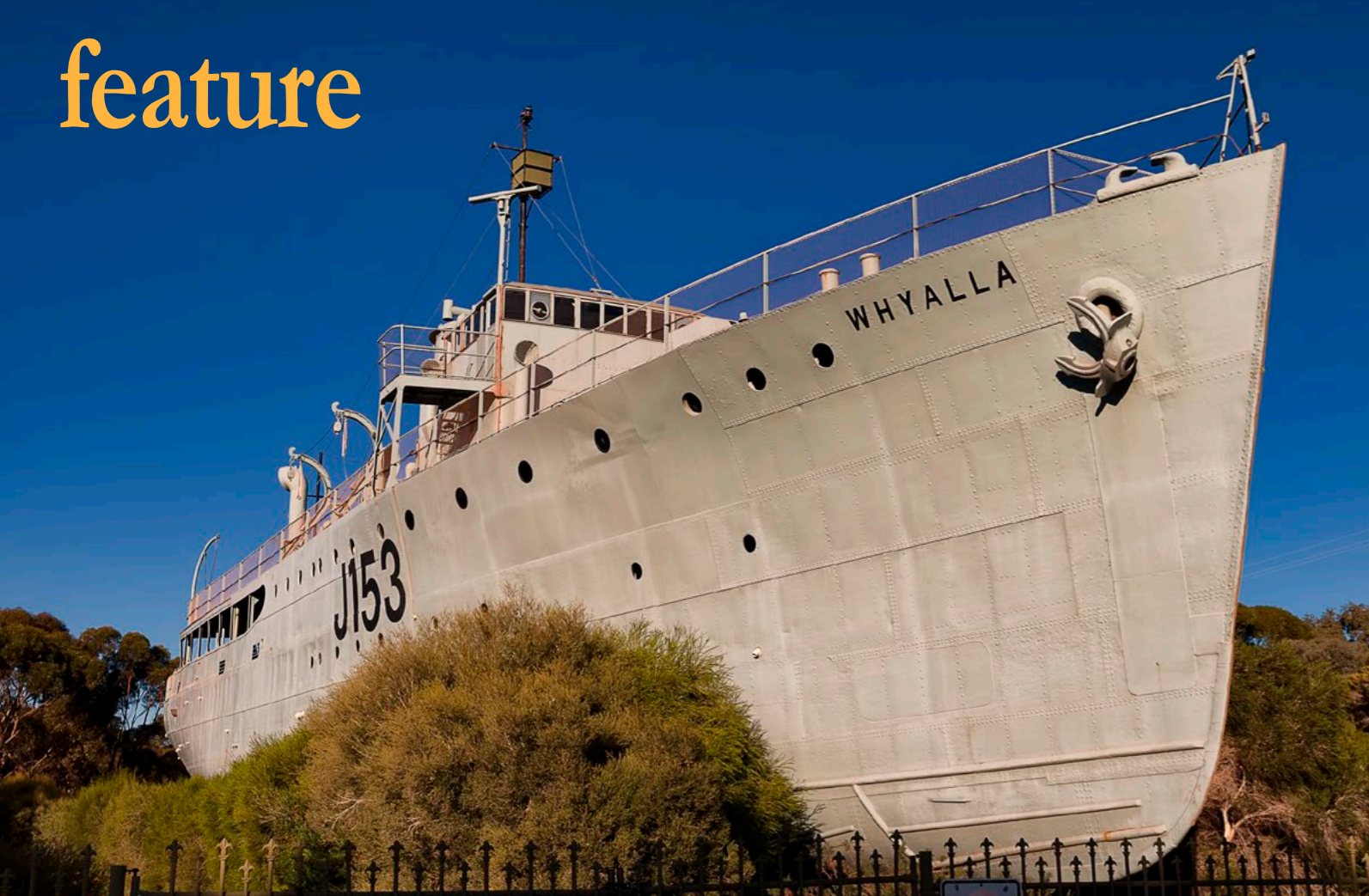
Mating

As winter approaches, the cuttlefish abandon their solitary lifestyles and aggregate together to mate

in small groups of up to 10 individuals—everywhere that is, except at Whyalla in South Australia’s Spencer Gulf, where hundreds of thousands gather during the annual giant Australian cuttlefish aggregation.

The reality is that you would have to be quite lucky to stumble upon a typical mating aggregation, but at Whyalla’s aggregation, you literally could walk into the sea off the beach and the cephalopod version of Sodom





HMAS *Whyalla* (top left) welcomes visitors to South Australia, where divers can find aggregations of giant cuttlefish off the coast; Black Point cuttlefish aggregation area (above); Large male cuttlefish at Whyalla (right)

and Gomorrhah is all around you! It has been called the “the premier marine attraction on the planet” by distinguished marine biologist Roger Hanlon of the Woods Hole Oceanographic Institution, and starts from around the middle of May each year and lasts for about two months.

Whyalla's giant Australian cuttlefish aggregation is really quite unique as *Sepia apama* is not known to gather in such large numbers anywhere else in the world. It is also an incredible spectacle to behold and one that allows the underwater photographer very close access (particularly to the large bull males, something that is simply not

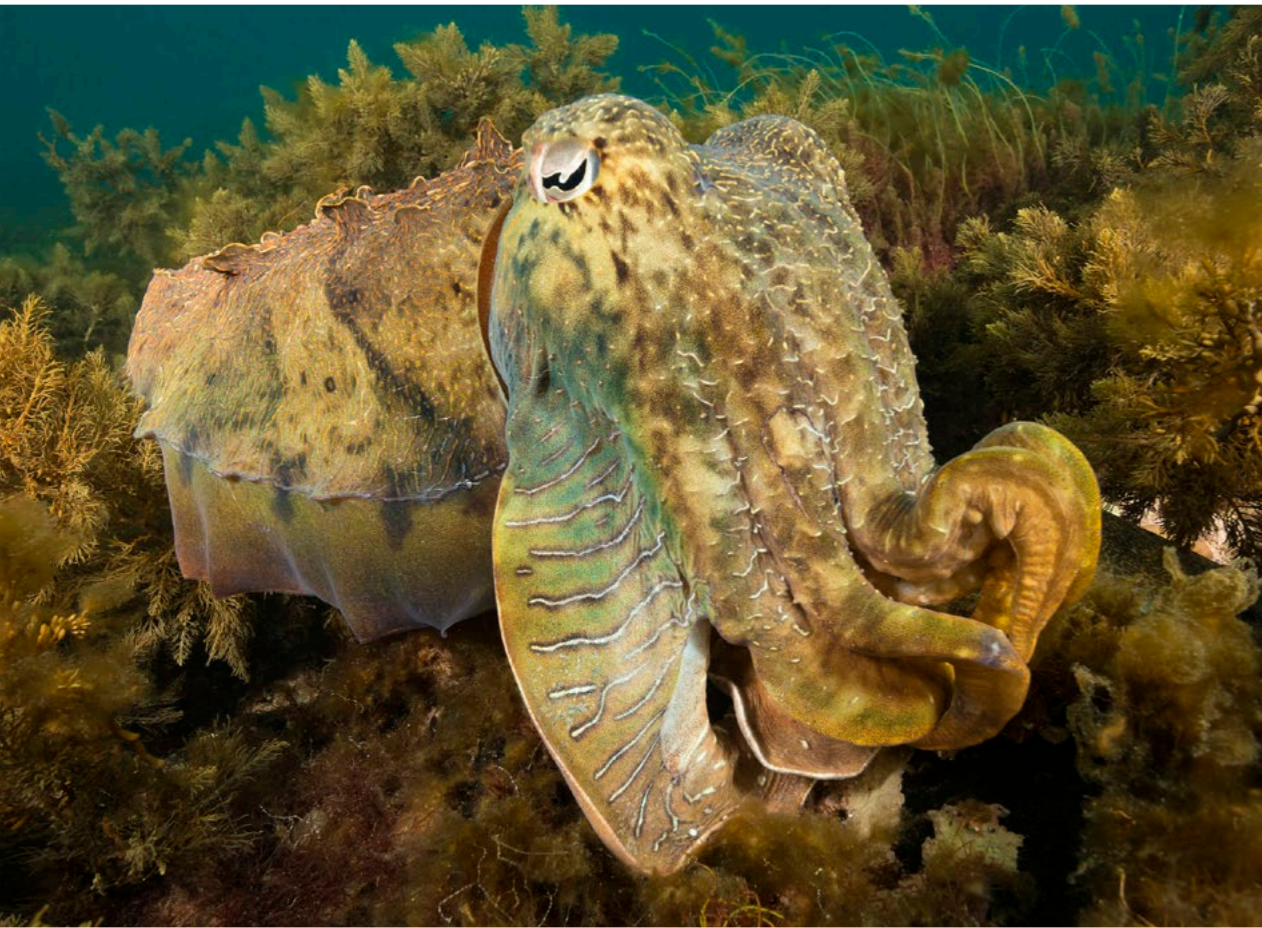
possible at any other time). So preoccupied are the bulls with ensuring their role in the reproductive process, they simply ignore divers and photographers as they concentrate on the task at hand.

To put their dilemma into perspective—overall, the population of giant Australian cuttlefish has a male-to-female ratio of almost 1:1. But during this unique mating event at Whyalla, that ratio changes and can reach as high as eight males to one female. So, the competition is incredibly intense and explains the large bull males' preoccupation with their captive females—one slip in concentration will ensure that the prize is



Divers enter the Fenceline aggregation area where giant cuttlefish collect during mating season





Large male being challenged by other males (above); Large male displaying his colours (right); Large male hiding and protecting his female concubine (left)

seized by one of the many competitors. The stakes are very high for all the older participants, as it is the last roll of the dice for them, and all will be dead by the end of the mating season, as the cycle of life evolves and continues.

Polyandry
The technical term for how giant Australian cuttlefish mate is “polyandry,” which basically means that each female cuttlefish will have multiple male partners to ensure better genetic variability of the species. All of it makes sense from a

somewhat dry overall perspective, but when viewed in practice at Whyalla, where so many cuttlefish have gathered and the females are outnumbered by as many as eight to one, it takes on a completely different dynamic, and “spectacularly promiscuous” would probably better describe the apparently licentious and almost wanton behaviour.

Apart from the larger size of adult bull males, it is almost impossible to distinguish a male giant Australian cuttlefish from a female—even the cuttlefish themselves cannot tell the difference and males display a subtle zebra pattern on their sides

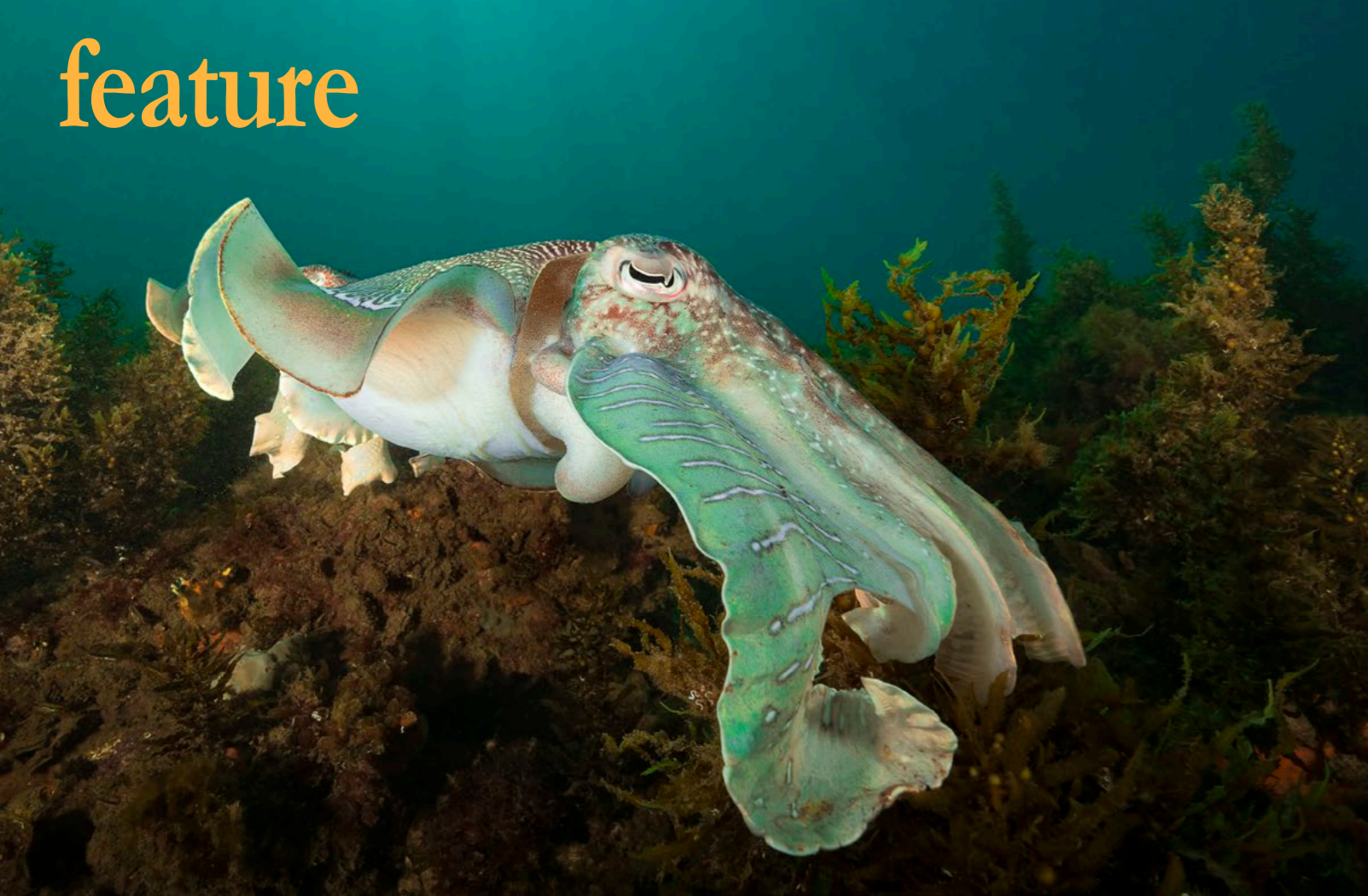
to signal their gender.

The large bull males will put on the most spectacular colour displays to try and attract a female, but it is up to the female whether or not to accept. Studies have shown that up to 70 percent of the time, they do not. If she does accept, the bull male will then try and keep her hidden in the sea grass—out of sight from all the other males. But that is not easy with so many other males around, most of whom are smaller and still in their first year of life.

These smaller males are often referred to as “sneakers” because, lacking the physical size and strength to challenge

the bulls, they adopt an alternate strategy of pretending to be a female and sneaking in with the real female while the bull is busy fending off larger males. The interpolator then tries to mate with the female—often with great success and much to the annoyance of the bull when he realizes what is happening.

Conservation
Cuttlefish conservation in Whyalla has been somewhat of a long, but ultimately (for now, at least) successful journey. Talk to the local divers who have been around for a while and they will tell you



Large male with his female mate (above); Large male displaying his colours (top left); Young challengers gather behind a large male protecting his female concubine (top right).

that early on, they did not think there was anything special about the annual aggregation of giant Australian cuttlefish around Black Point and Point Lowly. They assumed that similar events must be occurring elsewhere; but as word spread and marine biologists and scientists from around the world came to see for themselves, the exceptional nature of the aggregation became clear—it just does not take place anywhere else in the world.

A great story, no doubt, but if it were not for the tremendous efforts of some of those local Whyalla divers and nature's amazing capability to restore itself when we get out of the way, the chances are that it would now be a significantly different story. It is likely that the annual aggregation has been taking place for hundreds, if not thousands, of years.

The giant Australian cuttlefish is a short-lived animal with a life cycle of one to two years. It is also semelparous, which means it has a single reproductive episode and then dies. In contrast, us humans (and most animals) are iteroparous and are capable of

multiple reproductive cycles over the course of our lives.

The main aggregation area around Point Lowly and Black Point is perfectly suited for the purpose for which the cuttlefish have adopted it, as it is relatively sheltered. And unlike much of the upper Spencer Gulf—which is mainly sand, sea grass flats and mudbanks—there are numerous shallow rocky reefs that are perfect places for the females to hide their eggs.

So, here is a species that has evolved and thrived in a very specific manner because it has the almost perfect location to ensure its propagation; then, along comes Man. Things changed significantly for the giant Australian cuttlefish population of the upper Spencer Gulf back in 1997 when about 250,000 of them—roughly 250 tons—were taken during the annual aggregation by commercial fishermen for export to Southeast Asia.

Up until 1997, there had been very limited recreational and commercial fishing of the cuttlefish, but so lucrative was the 1997 catch that the word spread. In 1998, a much larger contingent of boats arrived in Whyalla

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CLOCKWISE FROM LEFT: Mating pair of giant cuttlefish surrounded by challengers; Large male protecting his female concubine from young challengers in the background; Spent giant cuttlefish in the final days before death; Mating cuttlefish pair

Cuttlefish

would indicate that the total ban is working, but the total population is still well below where it was after the terrible events of 1997 and 1998.

So, for now at least, it appears that the immediate danger has passed, and we can thank the tremendous lobbying efforts of the local Whyalla diving community for that. ■

For more information and insight on these wonderful creatures, plus the logistics of diving with and photographing them, check out Don Silcock's Complete Guide to the Giant Australian Cuttlefish. The author's website has extensive location guides, articles and images on some of the best diving locations in the Indo-Pacific region. Please visit: Indopacificimages.com.



even before the cuttlefish did. Within four weeks, an estimated 150 tons of cuttlefish had been harvested, and the stock was so devastated that there was basically not much left to catch.

Surveys

After much local lobbying, the South Australian Primary Industries Minister stepped in and, in a widely-applauded decision, closed the area to fishing until September 1998 and ordered a three-year assessment of the overall situation. In 1999, SARDI (South Australian Research and Development Institute) assessed the upper Spencer Gulf population at 182,585, and their subsequent surveys in 2000 and 2001 showed similar, but slightly less numbers. The next proper survey was in 2005



and then again in 2008—which showed respective numbers of 127,785 and 75,295.

SARDI commenced their surveys again in 2013 and recorded a total population of 13,492, meaning a 97 percent decline against the 1999 high of 182,585—which, in itself, was recorded after the loss of

about 400,000 cuttlefish because of the devastating harvesting in 1997 and 1998. Those terrible numbers in 2013 prompted a total ban on catching cuttlefish in the upper Spencer Gulf and most interestingly the SARDI surveys of 2014 recorded a population of 57,317 in 2014 and 130,771 in 2015—which





PETER GODFREY-SMITH

Gloomy octopuses, or *Octopus tetricus*, (left and below) have been found to reside at a site at Jervis Bay, off Sydney along the eastern coast of Australia.

"Animals were often pretty close to each other, often within arm's reach," said Stephanie Chancellor, a doctoral student in biological sciences at the University of Illinois at Chicago. She is also one of the authors of a paper on the subject, published in the journal *Marine and Freshwater Behavior and Physiology*.

"Some of the octopuses were seen evicting other animals from their dens. There were some apparent threat displays where an animal would stretch itself out lengthwise in an 'upright' posture and its mantle would darken. Often another animal observing this behavior would quickly swim away," she said.

Such behavior could be territorial, but Chancellor said that more research would be needed to determine what the actions mean.

This is the second site where this unusual behavior has been observed. The first site is located in Jervis Bay, off the eastern coast of Australia, and named Octopolis. It comprised several dens as well as a flat, human-made object about 30cm long. ■

SOURCE: UIC TODAY, TAYLOR & FRANCIS



The city of gloomy octopusses



SYLKE ROHRLACH / WIKIMEDIA COMMONS / CC BY-SA 4.0

Scientists have discovered a second site where gloomy octopuses interact with one another, debunking the popular belief that octopuses are solitary animals.

Octopuses are generally solitary animals that interact with one another only when mating. However, those gloomy octopuses (*Octopus tetricus*) residing at a site off the eastern coast of Australia (off Sydney to New Zealand) have been observed interacting with one another—either directly (via den evictions) or

indirectly (via posturing, chasing or color changes).

Dubbed Octlantis, the site measures 18m long and 4m wide. It is at a depth of about 10 to 15m, and comprises several patches of exposed rock and beds of discarded shells from consumed prey. There

are 13 occupied and 10 unoccupied octopus dens there.

Judging from footage captured by four GoPro cameras situated at the site, about 10 to 15 octopuses were occupying the site. Mating, signs of aggression, chasing, and other signaling behaviors were observed.



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Edited by
Peter Symes

Equipment



Sea-Scooter

Yamaha has just released a brand new Sea Scooter (DPV) product line for both professional and recreational divers. All Yamaha Sea-Scooters are local safety standard compliant. The Sea-Scooter—a high performance, portable and easy-handling dive propulsion vehicle—features proprietary battery technology for prolonged use. It is lightweight, easy to carry, and promotes activities in fresh or salt water recreation.

Yamahaseascooters.com



Blueye

The Blueye Pioneer is a new low-cost underwater drone designed for ad-hoc and periodic inspections of vessel hulls, but appears to also be quite useful to divers who want to inspect a dive site, or perhaps survey a wreck before immersion. The inspecting drone transmits video via a thin umbilical cable to the surface and is easily controlled using a smartphone, tablet or goggles, and the Blueye App. Blueye Pioneer's thrusters allow it to operate in heavy currents and dive to 150m. It is a compact (45 x 25 x 35cm) drone, weighing in at only 8kg. On a related note, passengers sailing on the Norwegian shipping line Hurtigruten's newest ships will be able to watch on TV screens, the marine life passing below, following the installation of these new drones. Blueyeroobotics.com



Seaseeker

The Seaseeker mask has been specially engineered to work with snapchat spectacles, which is a pair of connected sunglasses that allow users to film their surroundings and instantly upload the resulting movies to their user profiles. It looks like a pair of ordinary sunglasses, but it packs one of the world's smallest wireless HD video cameras into its frames and connects directly to a user's social media profile via Bluetooth or Wi-Fi and transfers "memories" into the app in a new circular video format. The Seaseeker mask works with Snap Inc's spectacles to allow you to livestream photos and videos from depths of up to 50m (150 ft). An adaptor keeps the Snapchat Spectacles aligned inside the mask and positions the camera for a wide-angle underwater point of view. The mask has been created by the global cruise company Royal Caribbean, which worked with creative agency MullenLowe to create the prototype. [Royal Caribbean International](http://RoyalCaribbeanInternational.com)



Blawesome

Don't you just hate donning a clammy wetsuit, which isn't dry, after your previous dive? The Blawesome is a compact, durable, portable blower, which the manufacturer states, can dry and disinfect your wetsuit in less than 20 minutes. A powerful centrifugal blower blasts 290m³/h inside the suit, while a heater warms the airflow. The airflow temperature is controlled to not raise over 38°C (100°F) to protect the equipment. Thewetsuitdryer.com

Suunto EON Core

The EON Core, with its clear, legible color screen is a fully-featured and customizable dive computer, designed with both the novice and technical diver in mind, offering Gauge, Air, Nitrox, Trimix and CCR modes. The EON Core is ready out-of-the-box, but the features can easily be modified by the wearer to fit individual needs. Large numbers and text with high-contrast colors are easy to see even in murky waters, or when diving at night, and the large buttons are easy to press even with gloves on. The battery is easily recharged via USB. Dives are transferred and settings changed in the Suunto Movescount App by connecting easily over Bluetooth with a mobile device. Software is also updatable by the user. The lightweight, compact composite case, with elastomer strap (or bungee), is comfortable on any wrist size and comes in different styles. The computer is depth rated to 80m (262ft) and connects wirelessly, with up to 10 Suunto Tank PODs to display tank and gas information. Suunto.com





Taking the SEABOB for a Spin



Text by Millis Keegan
Photos courtesy of Millis Keegan and SEABOB

The SEABOB is a luxury seatoy designed for “fun in the sun.” Corporate divers or technical divers are not invited to this party—unless they are vacationing, of course. No, this is a unit for scuba divers, freedivers or snorkelers, and meant to be purely recreational.

I could not help but fall in love with the unit the first time I saw it. You will too. Just look at it! So sleek... such beautiful lines. I followed those lines with my hand and thought to myself: We are going to have so much fun!

It took a few minutes to get used to it, but that was truly all it took. The steering and diving part came naturally, in no time. A bit of pressure, and I was diving. You will soon discover that you control the unit with your body's movement. Relax, stretch those arms and allow yourself to be comfortable. You



Easy controls on the SEABOB make driving the unit fun and fast!

comfortable? Great. Now it is time to test its limits (and yours).

The SEABOB comes in two models, the SEABOB F5, and the SEABOB F5S. I was, of course, handling the F5S—the fastest of the two. A light touch on the green control grip regulates the speed, and in no time, a driver can reach up to 18 km/h (11 mph) underwater.

Believe me, that is fast, when you are pushing through water. I soon discovered that my body was not as sleekly designed to move through water as the SEABOB. My mask was pressing on my face and my regulator was vibrating in my mouth. But it was fun!

I aimed for a wreck site where the event of the day was already taking place: a shark feeding. The visibility was amazing. I could see the wreck from afar, as I zoomed through the water. I felt like a superhero: the underwater

Wonder Woman—that was me! I was coming in fast, perhaps a little too fast, and had to make a sharp right as I reached the aft of the wreck, to avoid interfering with the many sharks now circling around the feeder. If one finds oneself going too fast, or feeling out of control, all one has to do is to let go of the trigger, and the unit stops smoothly.

Letting go never crossed my mind though—probably a stupid instinct left over from the car-racing days of my youth. But the SEABOB responded immediately to my body weight shifting right, and I glided with elegance (at least in my head) around the wreck, a safe distance from the action.

I parked myself and my SEABOB at a point in the water column, facing the wreck, and took a moment to just observe. I was in awe. The sharks circled around the designated feeding station with such grace. Their motions were slow and controlled, yet it seemed like they could turn in a split second. They were totally ignoring the colorful school of scuba divers on scooters, who were zipping back and forth, over and around the wreck.

I admit it. In my head, I had this idea to observe and then try to mimic the sharks' movements. But

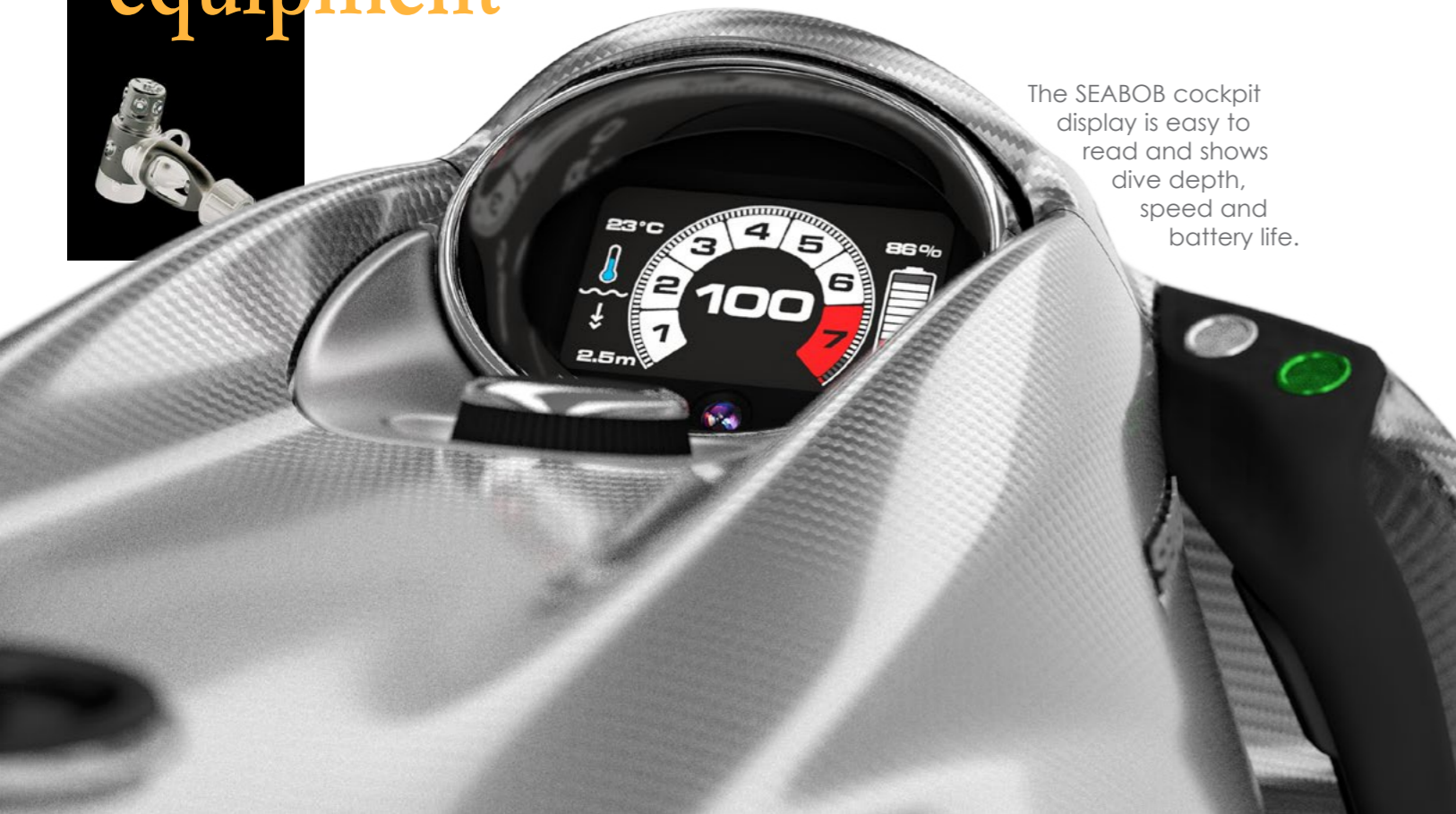
after a few minutes taking notes and comparing my fellow divers' appearances, side by side with these magnificent creatures, the conclusion was an obvious, “no.” No way.

With every turn, every movement, we clearly demonstrated that we were merely clumsy visitors in the sharks' world. Sure, evolution has given sharks more than a few hundred million years to reach perfection, but still, not even on a SEABOB could we compare with the sharks' grace. Instead, I waved to my buddy, and we headed straight out, away from the wreck, over a vast sandy bottom.

I pushed the scooter to its maximum speed, using all six power levels, until my face vibrated. I had a hard time holding on. I was having the time of my life—this thing was so fast! It was so easy to maneuver, and so silent in the water.

I spotted a large stingray embedded in the sandy bottom, and decided to come to a halt and sneak up behind it. The plan was to hover above it, waiting for the moment when it took off, which almost inevitable happens when one gets close. Then I would follow it, from a safe distance away. Not this time, though. The way I slowly glided





The SEABOB cockpit display is easy to read and shows dive depth, speed and battery life.

through the water towards the stingray, appeared to be non-threatening to it. I was totally ignored, until I eventually glided too far and shadowed the stingray. The ray took off, but only for a few meters, before it lay down again. I could take a hint, and aborted the stalking.

Safety first

There is no chance of losing one's bearing and propelling too deeply while driving the SEABOB. The SEABOB will never go beyond the sport diving limit of 40m. A safety cut-off feature will make sure this does not happen, and it is programmable to any depth above this limit. One does not have to worry about losing the SEABOB to the depths either, as it is buoyant and will return to the surface.

The cockpit, or display, is easy to read, and right in front of the driver's field of vision. As a diver,

one wants to know one's dive depth. This reading is also displayed, along with speed and battery life. Speaking of the bat-

tery, its run time is one hour, and one can quick-charge the battery in 1.5 hours.

The SEABOB is light-weight. It is

very easy to handle, especially for divers who juggle tanks on a regular basis. Depending on the model, the unit weighs 29-35kg at

the surface, with 14-10kg buoyancy in the water.

Fun stuff

The unit can be outfitted with a built-in cam-system, with two integrated, easily-operated full HD-cameras—one pointing forward and one facing the driver. So, yes, you CAN take a selfie! A built-in storage system and a WLAN transmission module talks to an app, which you can download to your smartphone or tablet, so you can retrieve your footage quickly and easily after your dive.

How does it work?

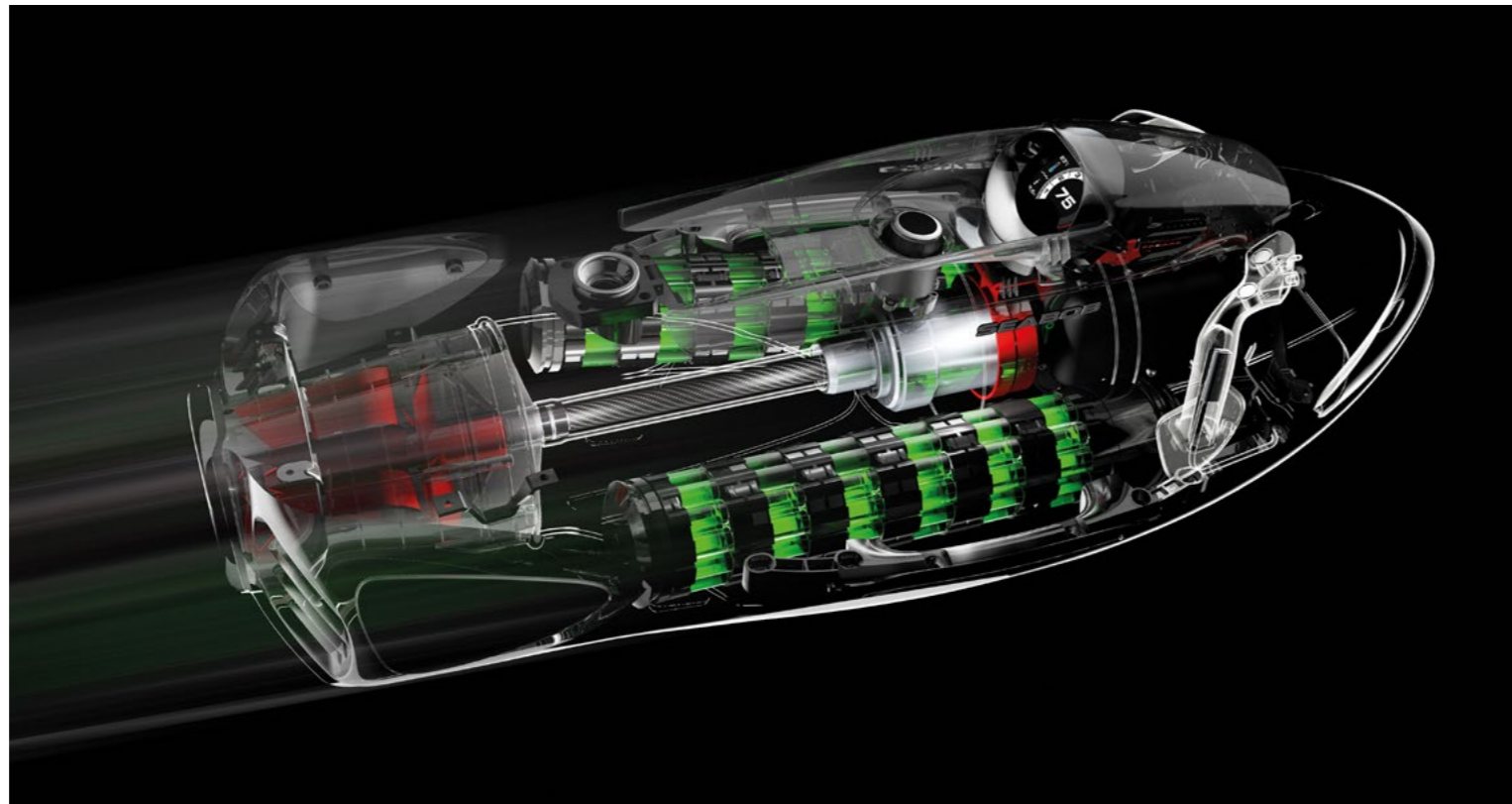
The SEABOB Power System moves the unit by employing the principle of water displacement. Water is sucked in by a rotating impeller, which is then forced out under high pressure, thus thrusting the unit forward. "Thrusting," I know,

sounds so harsh—like a race horse exploding out of its stall when the gate opens. In practice, the SEABOB moves smoothly and silently in the water, right from the get-go.

A green unit

The manufacturer stated that the SEABOB is made with a sustainable, environmentally-friendly approach. The E-Jet power system, which is electrically powered, keeps the costs of operating the unit low. The material choices used in the SEABOB's construction make the unit light-weight. The drive unit is made using premium carbon elements, with ceramic coatings and metals resistant to salt water. ■

For more information, please visit: Seabob.com/en.



Blueprint of the SEABOB gives a glimpse of its inner-workings

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Text by Simon Pridmore

You must walk before you can run, so why do so few dive centres teach people how to swim before they learn to dive?

Something I try to do in my series of scuba books is identify and discuss disconnects between expectations and reality in scuba diving today. In other words, I address gaps between what non-divers, new divers and even experienced divers expect from dive professionals and what the professionals actually deliver.

A good example of a diving disconnect is the issue of basic watermanship.

The swim test

In the early days of scuba diving, most of the people who signed up for courses were ocean people. They were beach-goers, water sports enthusiasts, sailors, underwater hunters or ex-military folk. One thing they had in common was that they

were all swimmers and comfortable in the water. The swim test that was, and still is, a mandatory part of a beginner's scuba class was trivial and hardly necessary. The instructors would just tell the students

what they had to do and leave them to it, while they prepared the equipment for the more important bits of the course. It was conducted on an honour basis. Nobody counted laps or timed the floats.

Everybody could do it, so why bother? From a professional point of view, not much has changed today. The swimming test is still just given cursory attention and dispensed with right at the beginning of

the first pool session. Instructors, clubs and dive centres take the attitude that nobody in their right mind would sign up for a dive course if they could not already swim, and swim well. They certainly do

Scuba Confidential:

The Swimming / Diving Disconnect

PIXABAY





opinion

not see it as their job to teach people to swim. Most scuba instructors are not qualified swimming teachers anyway, a fact that might surprise people outside the dive industry. Also, over the years, as basic diver training courses have become shorter, the watermanship element has been reduced. The emphasis is completely on teaching students to handle the equipment and ticking skills checkboxes.



Swimming



Swimming skills today

However, watermanship standards among people who sign up to learn to dive these days are very different than what they used to be. In Asia, where scuba diving is booming, especially among young adults, there is no real tradition of children being taught to swim or families going to the beach on vacation. Most of the people that sign up to learn to scuba dive are far from being water babies. Many, in fact, cannot swim at all. I use Asia as an example, but the problem is universal.

Why do people who can't swim or swim poorly sign up

for scuba diving lessons? One might think that a basic human self-preservation instinct would ensure that this does not happen. But, herein lies the disconnect in expectations. Many non-divers assume that, if they need to be able to swim or to be good swimmers in order to scuba dive safely, then they will be taught to swim as part of the course. When this doesn't happen, they conclude that divers don't actually need to swim very well because they have the equipment to support them in the water. Thus, they become entirely dependent on this equipment to keep them alive

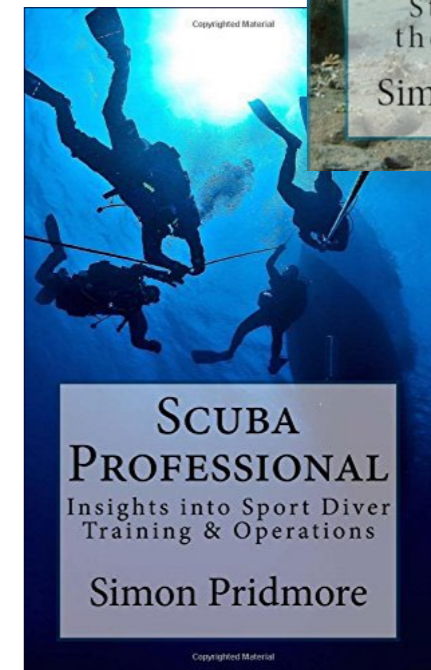
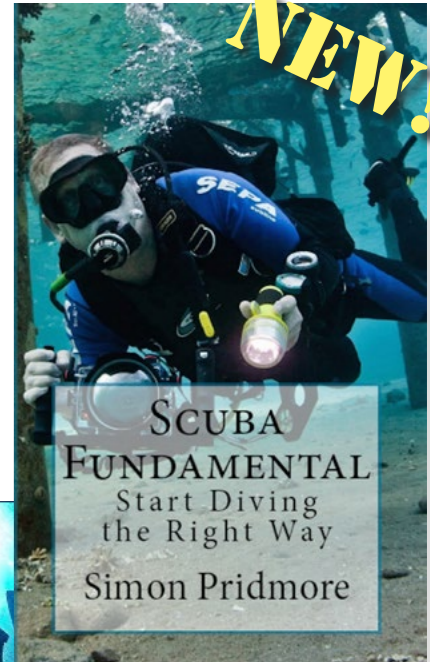
both underwater and on the surface, and are at enormous risk of drowning if it fails: which, of course, at some point it will.

Self-deception

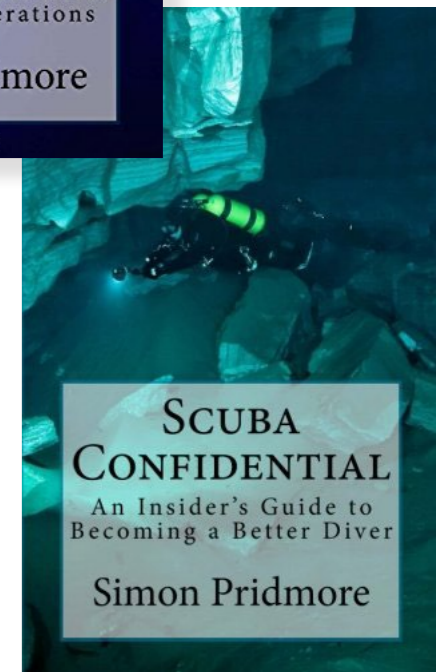
All over the world, many non-swimmers and very poor swimmers become certified scuba divers. For this to happen, a considerable degree of deception and self-deception must be involved. The swim and float test requirements on the course must either be waived by the instructor or faked in some way by the student. Or, perhaps, they both tacitly conspire in the mythology that it does not matter.

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PIXABAY

Everyone involved in bringing new divers into the sport must notice this trend. You might expect that they would be concerned and do something about it. However, this is extremely rare.

Swimming instruction

A swimming coach badge makes an excellent additional string to any instructor's bow. It means that if the instructor has a student diver who does not swim well, they have the skills to fix the problem, instead of closing one eye and moving on, or kicking the student out of the course. After all, quite apart from the benefit to the student, it is also in the professionals' interest that new divers be comfortable in the water. They are easier to teach, they learn more quickly and they are more likely to become long-term customers rather than open water dropouts.

With qualified swimming instructors on the staff, a dive centre or resort can offer general watermanship classes as well as diving classes, helping people learn to swim or become more at ease in the water. This gives the dive centre a wider customer base, brings more people into the store and exposes non-divers to scuba diving. As they became better swimmers and lose any fears of the water they may have had, diving classes represent a natural progression, so the dive centre's core business grows as well.

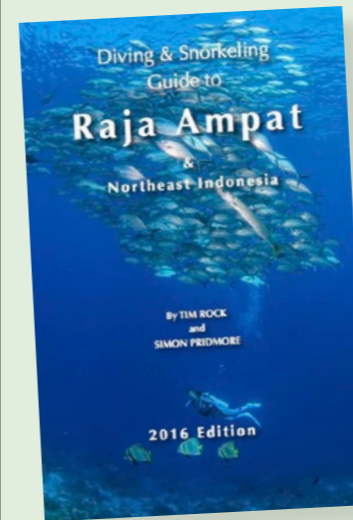
This just seems to make so much common sense. It is hard to imagine why so few dive centres do it and why so few instructors learn to teach swimming as well as diving.

Final note: In this article, I do generalise. I know that there are instructors and dive centres all over the world that offer swim-

ming lessons, but they are in the minority. The case I am making here is that it should be normal that dive operators offer this service rather than exceptional. ■

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 and Operations and Scuba Fundamental: Start Diving the Right Way. He is also the co-author of the Diving and Snorkeling Guide to Bali and Raja Ampat and the Diving and Snorkeling Guide to Northeast Indonesia, as well as a new adventure travelogue called Under the Flight Path. This article is adapted from a chapter in Scuba Professional. For more information, please visit the author's website at: SimonPridmore.com.

New Dive Guide to Raja Ampat



As part of their series of 2016 Diving and Snorkeling Guides, authors Tim Rock and Simon Pridmore have produced a brand new guide to Raja Ampat and Northeast Indonesia.

Diving or snorkeling in this remote region at the edge of the Pacific Ocean is a life-affirming, bucket-list-topping experi-

ence! Abundantly rich in marine life, these seas are proving to be a gift for divers that keeps on giving. Raja Ampat is the superstar destination, but other areas such as Cenderawasih Bay, Triton Bay and Southwest Halmahera are shining brightly too and acquiring similarly mythical status.

This richly illustrated, detailed and informative guide is the first to cover all of these incredible places! It tells and shows you—the adventurous travelling diver—what to expect from this remote, fascinating and often downright astonishing part of the world. It will help you plan your trip, enhance your experience when you get there and provide you with the best possible souvenir of your visit. Available on Amazon.com

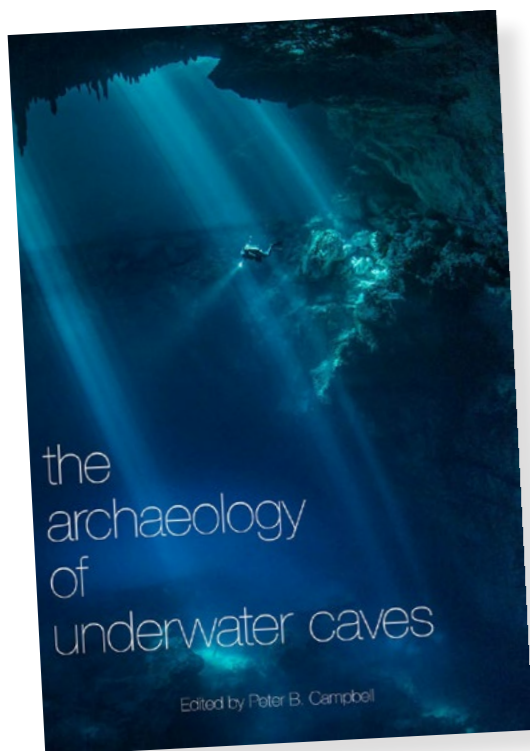


PIXABAY





Edited by
Catherine
GS Lim



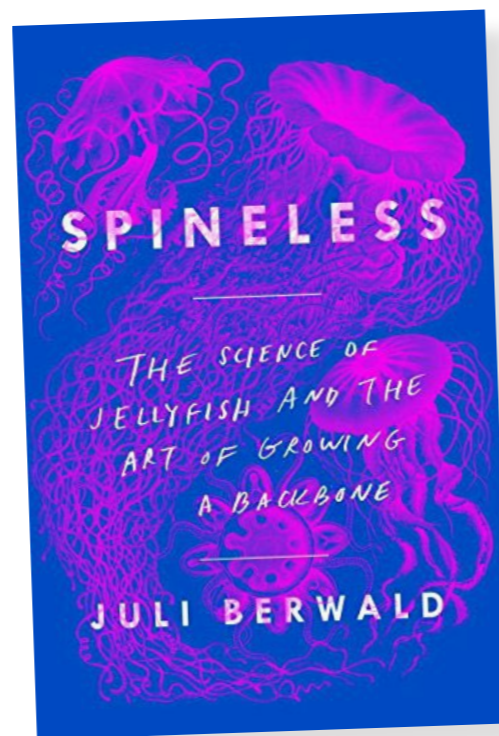
Underwater Caves

The Archaeology of Underwater Caves, by Peter B Campbell.

This edited volume draws on the last 60 years of underwater cave research, much of which has not yet been published. With an international coverage spanning the Paleolithic through to the modern era, the book's

contents include human origins, sea level and climate change, ritual and religion, and subsistence in many different cultures. It contains chapters penned by principal researchers (like Dan Lenihan, Jean Clottes and Nic Flemming) who have been responsible for the development of this emerging sub-field.

Paperback: 250 pages
Publisher: The Highfield Press
Date: 30 September 2017
ISBN-10: 0992633672
ISBN-13: 978-0992633677

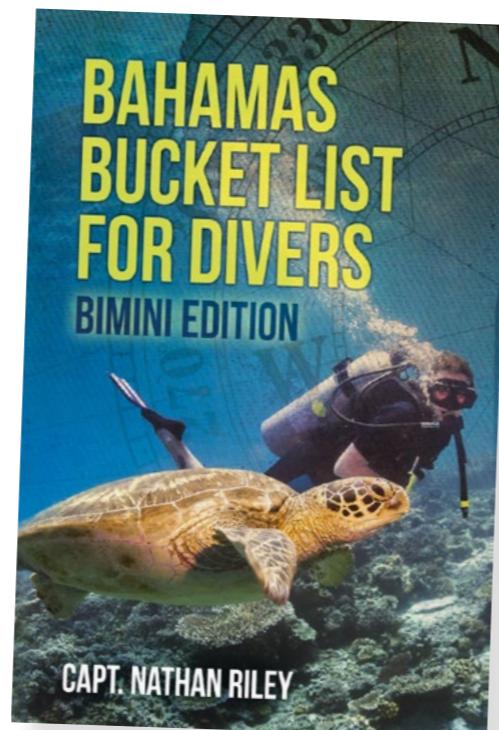


Jellyfish

Spineless: The Science of Jellyfish and the Art of Growing a Backbone, by Juli Berwald.

Let's face it. "Spineless" isn't an appealing word to use when composing titles for a book. However, considering that the subject of the book is the slippery, multi-tentacled—and spineless—jellyfish, one sees the logic of the title. In this book, prompted by unprecedented jellyfish blooms that toppled ecosystems and collapsed fisheries, author Juli Berwald explores the complexity of the ominous jellyfish. She meets scientists who study them, goes on Japanese fishing boats to see them in the wild, and even raises them in her living room. This book also highlights the damage we have inflicted on the climate and oceans, and calls for us to acknowledge our collective responsibility to safeguard the planet.

Hardcover: 352 pages
Publisher: Riverhead Books
Date: 7 November 2017
ISBN-10: 0735211264
ISBN-13: 978-0735211261

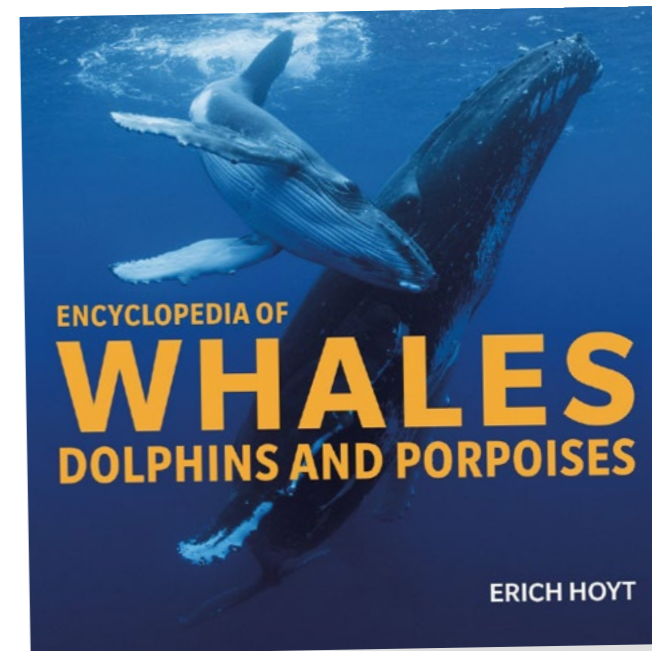


Bimini

Bahamas Bucket List for Divers: Bimini Edition, by Nathan Riley.

Read about the history, culture and soul of the Bahamas from an expert scuba diver and sailor with extensive first-hand knowledge about it. Amidst reading about pirates and modern-day drug runners, you will find out how the Bahamas and Bimini came to be. Of course, this book also contains details about the dive sites in the region, so you can compile your own personal Bahamas Bucket List.

Paperback
Publisher: Atlantic Publishing Group Inc
Date: 31 August 2017
ISBN-10: 162023422X
ISBN-13: 978-1620234228

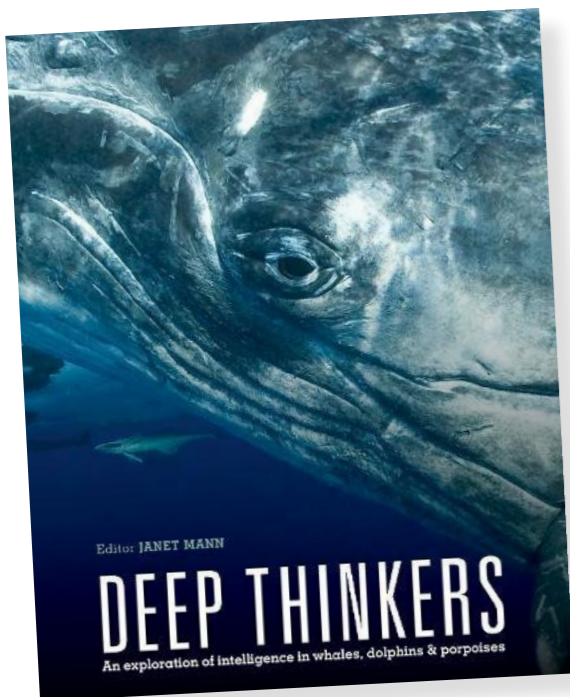


Whales

Encyclopedia of Whales, Dolphins and Porpoises, by Erich Hoyt.

In this book, whale researcher Erich Hoyt draws on decades of personal experience and a comprehensive familiarity with latest developments in cetacean studies to give readers unique insights into the lives of these marine animals. Covering some 90 cetacean species (including a newly discovered species in the genus *Berardius*), this book contains information about cetacean biology, behaviour, society and culture, and also calls for international protection of both at-risk populations and their habitats. The write-ups are complemented with illustrations by artist Uko Gorter as well as colour photographs by Brandon Cole and others.

Hardcover: 300 pages
Publisher: Firefly Books
Date: 1 September 2017
ISBN-10: 1770859411
ISBN-13: 978-1770859418

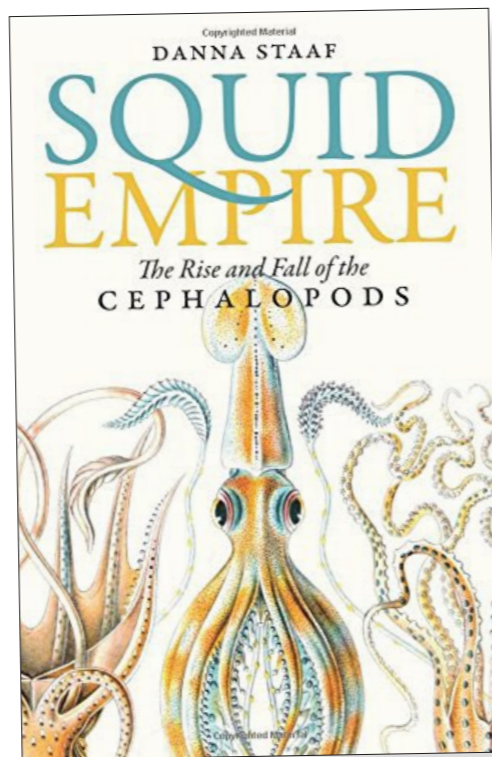


Whales

Deep Thinkers: Inside the Minds of Whales, Dolphins, and Porpoises, by Janet Mann.

This book delves into the current understanding of and research on dolphin and whale cognition, communication and culture, giving us a glimpse into the astounding capacity of the cetacean mind. The chapters, penned by the world's leading whale and dolphin researchers, compare the intelligence markers of cetaceans with those of birds, bats and primates, and ask how we might properly define intelligence in nonhumans. Includes more than 150 informative illustrations.

Hardcover: 192 pages
 Publisher: University of Chicago Press
 Date: 26 September 2017
 ISBN-10: 022638747X
 ISBN-13: 978-0226387475

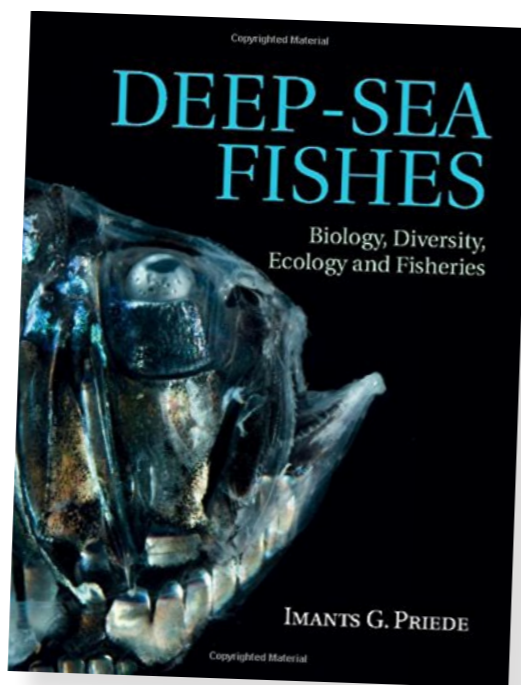


Squids

Squid Empire: The Rise and Fall of the Cephalopods, by Danna Staaf.

As the first animals to rise from the sea floor hundreds of millions of years ago, the ancestor of the modern squid, the cephalopod, is truly a modern living dinosaur. However, as fish evolved jaws, they too had to evolve, streamlining their shells and developing defensive spines. Eventually, some lost their shells and evolved more efficient defensive mechanisms like camouflage, fin-supplemented jet propulsion and perhaps a higher level of intelligence. This book tells the epic story of the cephalopod, spanning prehistoric times before the first dinosaurs all the way to the present day.

Hardcover: 256 pages
 Publisher: ForeEdge
 Date: 3 October 2017
 ISBN-10: 1611689236
 ISBN-13: 978-1611689235

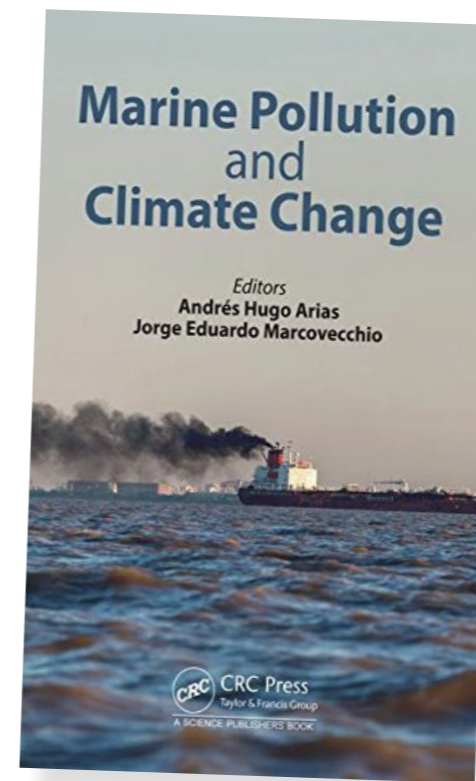


Deep Sea

Deep-Sea Fishes: Biology, Diversity, Ecology and Fisheries, by Imants G. Priede.

Welcome to the world of deep-sea fishes. This book contains the latest research and discoveries about these diverse groups of animals. It tells of their evolution, physiology and ecology as well as their history from their discovery in the 18th century to the present day. There are also illustrations of them and their deep-sea environment, together with explanations of how they adapt to the deep. The book also considers the effect of deep-sea fishing on sustainability, making it a resource for biologists, conservationists, fishery managers and those interested in marine evolution and natural history.

Hardcover: 504 pages
 Publisher: Cambridge University Press
 Date: 18 September 2017
 ISBN-10: 1107083826
 ISBN-13: 978-1107083820

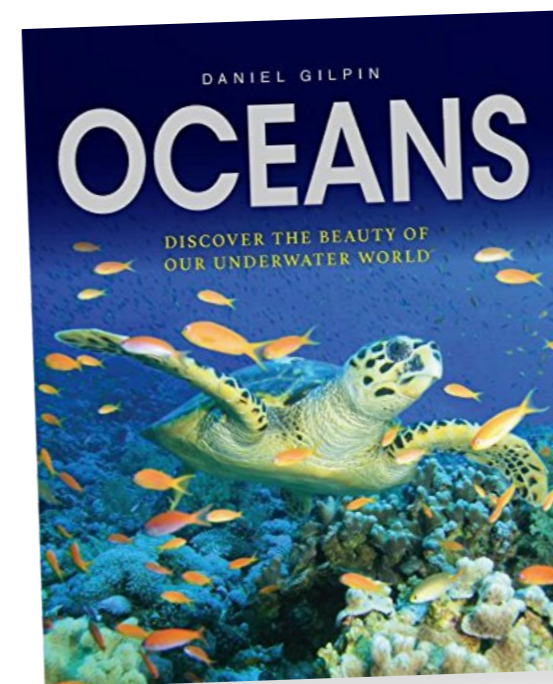


Marine Pollution

Marine Pollution and Climate Change, by Andrés Hugo Arias and Jorge Eduardo Marcovecchio.

Pollution of the oceans is now global. A broad overview of the climatic, legal and economic globalization of marine pollution is covered in this book. Inside, you will find out how oceans have transformed since ancient times to the present day; the roles that marine currents and changing climates play; how marine pollution from fossil fuels, carbon dioxide, pesticides, heavy metals, plastics, marine debris and new contaminants is linked to climate change; the effects of species invasion and international shipping on our seas; how the Arctic and Antarctic environments are being affected; as well as what governments are doing to stem the tide of pollution and climate change in the oceans.

Hardcover: 392 pages
 Publisher: CRC Press
 Date: 25 October 2017
 ISBN-10: 1482299437
 ISBN-13: 978-1482299434



Oceans

Oceans: Discover the Beauty of Our Underwater World, by Daniel Gilpin.

In this reference book, author Daniel Gilpin takes readers on a journey around the world, from tropical reefs to icy polar waters, to "visit" a fascinating array of marine creatures that live in a variety of different marine environments. All amid the unique breath-taking beauty of the underwater realm.

Hardcover: 256 pages
 Publisher: Parragon
 Date: 5 September 2017
 ISBN-10: 1474893171
 ISBN-13: 978-1474893176



Clever sharks have robust social networks

In the media, sharks are depicted as solitary animals, swimming the vast seas on their own. Even in sessions where sharks are attracted to a specific location (for example, during a shark feeding session), the sharks behave as individuals.

Some recent research has arisen to debunk this misconception. The fact is that sharks develop strong social networks with one another, to the extent of forming their own "cliques" during the breeding season.

A study by Macquarie University

showed that the social networks of the blacktip reef shark are so strong that it is not affected when individual sharks were removed. In fact, the population could survive being reduced by 50 percent before the entire network collapsed. Describing this as a sign of a resilient society, study author Dr Johann Mourier from the Centre de Recherche Insulaire et Observatoire de l'Environnement explained that: "The sharks have many relationships with other sharks in their network, so a large number of sharks can be removed from the network before the network breaks down."

Sharks have traditionally been assumed to show some form of social structure only in specific situations like mating, feeding or migrations. "Even though their

social structure is not as complex as that of some mammals, sharks can display an affinity for one another," said study co-author Associate Professor Culum Brown from the University's Department of Biological Sciences.

Hanging out with the lads

In another study by Macquarie University, researchers observed that sharks prefer to hang out with specific individuals in their social network, usually those of the same gender and size.

They discovered this after using social network analysis to study the social interaction of Port Jackson sharks in southern Australia. This species undertakes large migrations, from Jervis Bay in New South Wales all the way to Tasmania, and back.

Long-term relationships

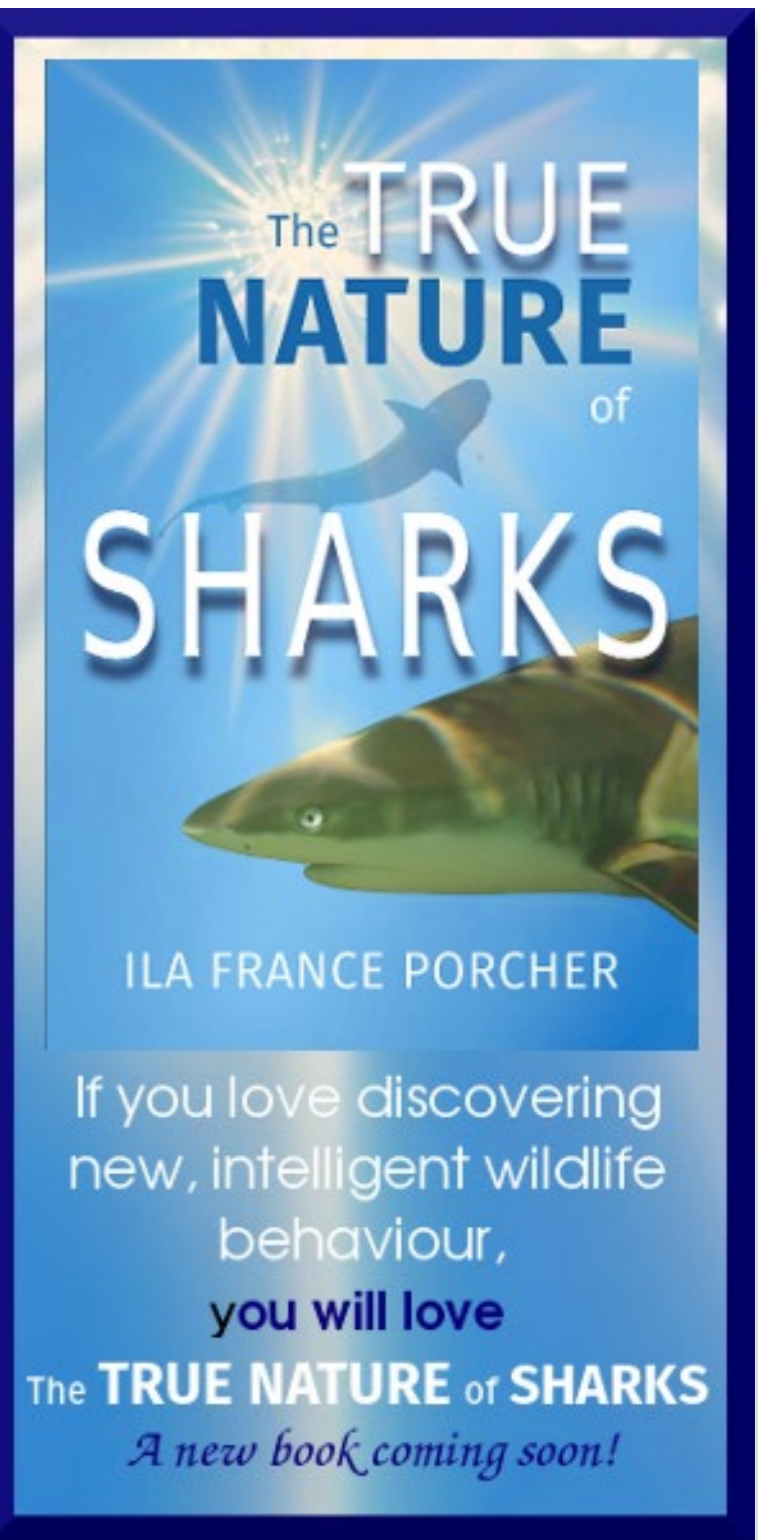
"One of the exciting things about this research is that we found the large aggregations that these sharks form in the breeding season is not a random collection of individuals. These sharks prefer to hang out with other individuals

who are similar to them," said Brown.

Co-author Jo Day from Taronga Zoo elaborated, "Both males and females return to the same rocky reef to breed year after year, which is unusual for sharks, but it means that these sharks establish long-term relationships over many years."

Strong networks

The discovery that sharks form strong



social networks gives us a better insight into their lives and helps us to better understand—and appreciate—them as a species. In addition, as Brown said, it "will help dispel the "mindless killer" label these fascinating creatures are all too often lumped with." ■ SOURCE: ROYAL SOCIETY OPEN PUBLISHING

shark tales



PETER SYMES

Sharks can live a lot longer than previously thought

Scientists usually determine the age of a shark by counting the growth zones in their vertebrae, somewhat in the same way as the tree rings of a tree. However, more and more studies have suggested that this method may be underestimating the actual age.

In a recent study, Dr Alastair Harry from James Cook University looked at 53 different populations of sharks and rays that had already been intensively researched by other scientists and discovered that in nearly a third of the populations studied, the animals' ages had been underestimated.

In his research, Harry compared

two methods of checking the accuracy of the sharks' age.

Two methods

One of the methods—called chemical marking—involves catching a shark and injecting it with fluorescent dye. This leaves a permanent mark in its spine. When the shark is recaptured at a later

date, the scientists count the number of bands that have formed since the shark's first capture.

In the other method—called bomb-carbon dating—scientists use carbon traces from nuclear tests in the 1950s to estimate the shark's age.

Systemic problem

Based on the findings, age was likely to have been underestimated in nine of 29 genera and 30 percent of the 53 populations studied, including 50 percent of those validated using bomb-carbon dating. It was found that age was generally underestimated in larger and older individuals.

Misleads management

"Age underestimation appears to happen because the growth rings cease to form or become unreliable beyond a certain size or age. Across the cases I studied age was underestimated by an average of 18 years, and up to 34 years in one instance. From the amount of evidence we now have, it looks like the problem is systemic rather than just a few isolated cases," said Harry.

The study holds wide-ranging implications for the management of commercial fisheries and beyond. According to Harry, "It could lead to inefficient prioritisation of research, monitoring and management measures. If it's as widespread and common as it seems from this study, the impacts could also be substantial from a wider scientific perspective, affecting the many disciplines that also use baseline life history data." ■

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IPE in Technical Diving

— Risk & Response

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While recent incidents have brought immersion pulmonary edema (IPE) into the limelight, it has always been a significant hazard to divers with pertinent risk factors, and doubly so for divers exploring overhead environments, or incurring significant decompression.

IPE is the abnormal leakage of fluid from the bloodstream into the alveoli, the microscopic air sacs in the lungs. Symptoms include shortness of breath, coughing up bloody sputum, and respiratory distress. Leakage into the alveoli results in fluid buildup in the lungs, and interrupts gas exchange, similar to drowning. It is important to note that fluid resulting from IPE comes from within the body, rather than from inhalation of surrounding water.

While the condition is most often the result of heart failure or other cardiac problems, there are other risk factors and it can occur without obvious medical cause, and in otherwise healthy individuals. IPE has presented in individuals who are young, healthy and fit, and the risks of IPE may be exacerbated by some diving conditions. Underwater, the symptoms of IPE can cause serious injuries or fatalities. Know the risks and keep yourself safe in the water.

Risk factors and mechanisms

IPE is a relatively uncommon condition that was first reported as “cold-induced

pulmonary edema” in 1989. Since then instances of the condition have been reported in warm water, but exposure to cold water remains a risk factor. Medical risk factors include cardiac disease, hypertension, age and diabetes.

Activity and environmental risk factors include cold water exposure, high-intensity exercise, and difficult work of breathing, like you would experience with a high-density breathing gas at great depth, or from a poorly performing regulator. In healthy individuals, the primary concerns are activity-based and environmental risk factors. Some experts believe that IPE can be caused by high-intensity exercise or poor work of breathing because a strong, forced inhalation against resistance may cause the lungs to respond by leaking fluid out of the capillaries and into the alveoli.

The primary cause of the condition is hydrostatic pressure in the pulmonary capillaries caused by immersion due to the shunting of blood to the core through peripheral blood vessel constriction. This can be exacerbated by cold, which causes peripheral vasoconstriction. The combination of the two factors, combined with negative pressure breathing (or breathing against resistance), may increase pressure difference between the capillaries and the alveoli sufficiently to cause fluid leakage into the alveoli. Some researchers contend that some individuals may be abnormally predisposed to IPE, either by left-ventricular hypertrophy, or by genetic predisposition, but these risk factors have yet to be confirmed.

Emergency response

Should you experience symptoms of IPE during a dive, it is imperative that you end the dive immediately, or as rapidly as possible. For divers in overhead environments, it is advised that they exit the environment as quickly as possible, without exacerbating their symptoms with avoidable exercise.

Being towed by a buddy, or using a scooter, may effectively lower your exertion levels and avoid symptom worsening. Divers with significant decompression obligations should minimize exertion, be monitored by their buddy, and proceed to exit the water as quickly as possible, modifying gradient factors or skipping some decompression entirely, should their symptoms begin to worsen.

Once a diver is on the surface, they should breathe 100 percent oxygen, and be transported to immediate medical evaluation. Prehospital treatment may include CPAP if symptoms are serious, or begin to worsen. Symptoms of IPE often resolve once a diver has exited the water, but an underlying cardiac issue may have initiated the event, and physician must determine if there is an identifiable cause for the symptom onset.

Fitness to dive

Individuals who experience IPE must be evaluated on a case-by-case basis, and the cause of their condition, if any, should be identified and remedied. The majority of young and healthy divers who experience IPE can return to diving with proper precautions, and a thorough cardiac evaluation.

Individuals who have known or potential cardiac disease require more scrutiny before being cleared to dive. These individuals should have evaluations prior to diving to ensure that they have do

not have heart valve problems, blockages in their coronary arteries, as well as any other cardiac risk factors. Any diver who experiences recurrent episodes of IPE should refrain from returning to diving, and any individual who experiences IPE, even if cleared to dive again, should return to technical diving slowly and with appropriate considerations for potential future return of symptoms. ■

For more information on IPE and diving, visit DAN.org/Health.





*If you can meet with
Triumph and Disaster
And treat those two
impostors just the same...*

*Yours is the Earth and
everything that's in it...*

— Excerpts from the poem "If"
by Rudyard Kipling

Text by Matt Jevon
Photos by Andrey Bizyukin

In my time, I have been head coach and assistant coach to pro, semi-pro and national league rugby teams as well as the Irish women's team. I have been a sports psychologist and an advisor on performance and setting performance environments in rugby, golf, motorcycle racing, rally driving and many other professional and Olympic sports. I am now a technical diving instructor as well. Why the mini-CV? Well, I have seen a few things develop over that time, and I want to try and get some balance back.



ANDREY BIZYUKIN

Analysis & Reflection

As Learning Tools

Technology, especially if affordable, can go anywhere. Tiny camera digital video, for example, has made a fantastic difference to the work we can do as coaches, instructors and the development potential for athletes and students.

Skills development-wise, the quality and immediacy of feedback is astonishing. We can use programmes like Quintic and Dartfish for deeper movement analysis and to illustrate the points we as coaches or instructors want to make. Tactically or

technically, we can look at cue utilisation, pattern recognition, learning styles, etc. It is pretty incredible. The thing is, even with all these tools, we are only really doing half a job!

The same is all too often true in ana-

lysing other sports I have been involved in. When something goes wrong, we will spend hours on analysis, working out what the glitch or anomaly was, tackling the error chain, fixing the problem; and then, in the training session, change the behav-



ours or the participants until the problem and failure is eradicated or controlled. But... when we succeed or win, we go celebrate, chalk it up to great preparation, amazing talent, luck—whatever attribution we want to use. However, sure as eggs are eggs, we do not apply the same effort and detailed analysis to working out what went right, asking how we succeeded that time, what factors and behaviours should be repeated and practised until sec-

ond nature, or were we just lucky this time?

- Success is not final.
- Failure is not fatal.
- It is the courage to continue that counts.

The measure of success

The number of non-divers or recreational divers I meet who tell me they could not possibly consider

deep rebreather diving or cave diving—both of which I love—is amazing. They tell me I am brave, or sometimes they tell me I am stupid—who knows, they are both probably right. But, what gives me the courage to do those dives is knowing that I have been meticulously trained by the best instructors I could find. That I have practised and rehearsed the skills they imparted to me regularly. That I have analysed and reflected on every dive I have done, good or



ANDREY BIZYUKIN



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bad. I even have a custom-made logbook with specific space on the page where I can record things about where I need to improve.

So, what do I reflect on? There is the obvious dive executed versus plan, but that is really a success vs failure measure. All team back, fit and well. Again, that is the key success measure. No, there are more meaningful things to reflect on. Schon, who was a big researcher on reflective practice in coaching, suggests we should reflect in action and on action. Kabat-Zinn proposes we would be enhanced as coaches and people by practising mindfulness. Being aware of our thoughts and emotions here and now, in the present. So, reflection does not start after the dive or the event; it starts during the dive, by becoming aware and noting how we

feel and what we are thinking in the dive. Only then can we get greater value on our post-dive reflections or analysis. My preference is to use some simple cognitive behavioural techniques to enhance reflections in and on action, but it is worth exploring others. Cognitive behavioural approaches suit my own thinking style well.

Mindfulness

Specifically then, reflect on the thoughts, feelings and actions from the moment you started preparing for the dive, until the kit is washed and put away. Be mindful of what triggered these thoughts and feelings. Were there distractions? Breathtaking scenery, amazing cave formations, slight kit issues, discomfort, etc. Were there things you did that enhanced your connection to the dive, the

sense of being aware and connected and fully in control? How did the behaviours and moods of others around you impact upon you? How was your preparation in the previous 24 hours, including sleep, travel, diet, hydration, mental imagery of the dive, planning and review, mission clarity, research on the conditions?

Luck

Account for and be honest about luck. If you exceeded the limits of training or experience, you were lucky. If you have not had the training to understand why, meaningful reflection will be hard. A few weeks ago, I was chatting with a very good diver who had just completed an extended range diving course with a 55m dive on air. The dive was done in the company of four other very experienced divers, including



two technical instructors to meet training standards and to provide the diver with the experience. They wanted to do another deep air dive for fun. I asked the usual questions about oxygen toxicity and narcosis, especially if there was stress, etc. The diver felt these were not issues to them. They wanted to save money on trimix. I asked about gas density issues. I was met with a blank look. Fair enough, I suppose—it is not really on the training agency curriculums until advanced trimix. The thing is, the diver did not know what



ANDREY BIZYUKIN

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he did not know about all the risks of deep air diving, and pretty much based the risk assessment on oxygen toxicity and narcosis. He might enjoy a long diving career doing deep air dives and saving on helium costs for years, blissful in his ignorance. But for me, if he does 50 deep air dives without incident, he will have been very, very lucky.

Think not just of the what, but also the how and why. But please, invest as much time in the great dives, where all went perfectly, as in the dives where the whirly thing got hit by the soft and smelly.

A safe and awesome dive is never achieved in a day. Nor will 5,000 dives be any guarantee, unless they have been meaningful dives and you have reflected on and learnt from each one. Every dive has something to teach us and the positive lessons are more fun than the negative, more enjoyable to analyse and reflect on, and will reinforce great thoughts, habits and feelings that will make diving more fun and much safer. ■

A native of the Republic of Ireland, Matt Jevon, MSc., is an experienced and passionate open and closed circuit 100m trimix diver and full cave diver.

Whether using backmount, sidemount or his favourite JJ-CCR rebreather, Jevon believes technical diving is all about being safe, having an awesome dive and enjoying experiences few people share. Jevon holds instructor qualifications from TDI, PADI TECREC and IANTD, and partly owns South West Tech—a TDI dive centre in Ireland. Jevon is also an approved JJ-CCR instructor and dealer. In addition, he is a sports psychologist, senior rugby coach and works in strategy and private equity. For more information, please visit: Swf.ie and Mattjevon.com.



Text by Mark Powell

Diving instruction has standards, qualifications, materials, governing bodies and best practices. So why do we see such poor examples of diving practice? Why do so many new divers struggle with the basic skills? Why do tech divers forget some key techniques? Is it poor instruction or something else? At least six of DAN's Ten Most-Wanted Improvements in Scuba Diving (see table on next page) are covered in every entry-level diving course, but the problems still occur.

Why are students not learning this stuff in their scuba classes? The reality is that instructors do teach it, but the students are not learning it, or at least they are not putting what is taught into practice. There is a fundamental problem, and when there is a fundamental problem, we usually need to go back to basics.

Let me ask you a question: Do you know

what learning is? I assume most of you just mentally answered "yes" without a second thought. Of course, you know what learning is. However, before you read on to the next paragraph, I want you to define what you mean by "learning."

There are a number of dictionary definitions of "learning." Some are listed below:

1. *To memorise knowledge or information*

2. *The acquisition of knowledge or skills through study, experience, or being taught*

3. *A permanent observable change in behaviour*

The first definition seems suitable for an academic subject, or a situation in which one needs to pass an exam but does not seem appropriate for diving, which is a more practical activity. The second definition seems better, as it refers to skills.

Permanent change

I prefer the last definition, as it matches the

type of learning that we need in diving. There are two aspects to this definition. The first part is that learning involves "a permanent change." 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."

This is a fundamental problem with most scuba training. We do not look for

Achieving Our **Teaching Objectives**

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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 the student will be able to perform the skill in a week, or a month, or under stressful situations. This is a critical aspect, but one we will have to return to in a later article.

Observable change

The second aspect of the definition calls for an “observable change in behaviour.” It is critical that we understand what change in behaviour we are looking for. If we do not know what change we are looking for, how will we know if we achieve it? However, many instructors believe (or have been taught) that teaching involves following a process. If they follow the correct process, then they have taught the student. That may be true; they may have taught, but it does not mean the student has learnt.

I have often seen instructors become frustrated because their students “just don't get it.” When asked what they mean by “it,” the instructor struggles to

answer. They may not be able to answer, but they are confident that they will recognise “it” when they see “it.” This is a one of the key mistakes in teaching. Without knowing exactly what you are trying to achieve, it is difficult to put a plan in place to achieve it.

Learning objectives

This is where the idea of a learning objective, or a learning outcome, comes from. The learning objective is the “observable change in behaviour” we are looking for. In other words, we start with the end in mind. Determine what change we are looking for, and then determine how we can achieve that change.

A learning objective is a deceptively simple concept. We just need to come up with a specific testable change that we want to see. This is easy to say, but like many skills, it takes practice. Common mistakes made may include making the objective too general or impossible to test. Another common mistake is one in which the objective focuses on what the instructor will do, when it should focus on what the student will be able to do.

To avoid some of these problems, a good way to structure an objective is to put it into the following format:

“By the end of this session, you will be able to _____.”

(Wherein the blank represents the objective.)

This can be used to detect poor objectives. For example:

“Today, I am going to talk about decompression theory.”

“In this pool session, we will go through mask clearing.”

In both cases, the emphasis is on the instructor, or the process. There is no focus on the behaviour of the student. Using the structure suggested above, we can refocus these aims on the student. For example:

“By the end of this session, you will know all about decompression theory.”

DAN'S 10 MOST-WANTED IMPROVEMENTS IN SCUBA DIVING:

1. Correct weighting
2. Greater buoyancy control
3. More attention to gas planning
4. Better ascent rate control
5. Increased use of checklists
6. Fewer equalising injuries
7. Improved cardiovascular health in divers
8. Diving more often (or more pre-trip refresher training)
9. Greater attention to diving within limits
10. Fewer equipment issues/improved maintenance

“By the end of this session, you will have mastered mask clearing.”

This is better. The aims are focused on the student. But are these realistic objectives?

Knowing all about decompression theory is a hugely ambitious goal, which would take years to achieve. This is just not feasible. Of course, most instructors would say that they did not mean “all about decompression theory.” They just meant “the relevant parts of decompression theory to the relevant level.” Which then begs the question: What are the relevant parts and what is the relevant level?

Testable objectives

We can be more specific by focusing on

the second condition—that the objective should be testable. How will we test that the objective has been met? How will we prove that the behaviour has been achieved? We can do this by focusing on the actual change in behaviour that we want.

“Knowing” is not a change in behaviour and is not a productive word to use in an objective. Equally, “understand,” “learn,” “respect” or “appreciate” are too vague to be used in an objective. These are internal mental states, whereas the objective should specify the external behaviour, or action, we are looking for. Consequently, the objective should use an action or “doing” word, such as “explain,” “list,” “assemble,” “define,” “calculate,” “plan,” “analyse,” “describe,” etc.



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We can use a more appropriate “doing” word to create a more specific behaviour. For example:

“By the end of this session, you will be able to list two factors that affect our No Decompression Limit.”

“By the end of this session, you will be able to clear a flooded mask.”

By structuring the objective in this way, it makes it much easier to test whether the students have achieved the objective. The objective is the behaviour we want them to achieve. So, we just ask them to demonstrate that behaviour. For example:

“Now that we have completed the decompression theory section, can you list the two factors that affect our No Decompression Limit?”

The behaviour described by the objective will vary depending on the level of the course. For example, the level of decompression knowledge expected of an open water diver will be very different to that expected of a technical diver. See the following:

Open Water:

“By the end of this session, you will be able to list two factors that affect our No Decompression Limit.”

Trimix:

“By the end of this session, you will be able to describe the impact changing the high and low gradient factors will have on our decompression profile.”

It is essential that we have a realistic expectation of the behaviour we want from the diver. Expecting the same proficiency in mask clearing from open water divers



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on their first pool sessions versus their last open water dives is unrealistic, as is expecting the same level of proficiency of an open water diver and a divemaster candidate.

We also need to look at the conditions under which we want the skill performed. Students clearing their mask while kneeling on the bottom of a pool may be appropriate for the first pool session, but by the end of the pool sessions, and certainly by the time the students are in open water, we want them to be able to clear their masks while neutrally buoyant. These are the conditions in which they may need to perform the skill when in the real world, so our objective should be to ensure that they can achieve the skill under these conditions:

“By the end of this session, you will be able to clear a flooded mask while maintaining neutral buoyancy.”

Performance level

The last thing to consider is the level of performance that is acceptable. If the student is being asked to clear his or her mask while neutrally buoyant, then what level of variation would be considered

acceptable? How many attempts or breaths would be considered acceptable? This will be linked to the audience; again, you would expect a different degree of performance from an open water student and a divemaster trainee or technical diving instructor candidate. For example:

Open water student:

“By the end of this session, you will be able to clear a flooded mask within three attempts, while maintaining neutral buoyancy, to within plus or minus 1m (3ft) of your starting position.”

Divemaster trainee or technical diving instructor candidate:

“By the end of this session, you will be able to clear a flooded mask with a single attempt, while maintaining neutral buoyancy, to within plus or minus 0.5m (1.5ft) of your starting position.”

When setting learning objectives, consider:

- Audience
- Behaviour
- Conditions
- Degree

Learning objectives are the closest thing we have as instructors to a magic wand. If you can construct a specific, testable objective that is appropriate for the level of the student, then it makes it much easier for you to structure the lessons required to achieve that objective. It makes it easier for students to understand what they are being asked to achieve, and it makes it easier for the student and instructor to tell whether the student has achieved the required level. All of this makes for a much more productive learning environment, and makes it much more likely that the teaching carried out by the instructor results in learning by the student. ■

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.



PHOTO COURTESY OF MARK POWELL

Mark Powell



Project Baseline

Facilitating Needed Underwater Science

AMANDA WHITE / PROJECT BASELINE

A donation for time aboard the M/Y *Ad-Vantage* (above) made the GUE New Zealand's Project Baseline mission in Fiji possible.

Text by Michael Menduno
Photos courtesy of Project Baseline

Project Baseline's team conducted over 100 video transects of coral reef and benthic habitats of the Great Astrolabe Reef in Fiji, one of the largest barrier reefs in the world, to compile baseline reports in order to effectively monitor the health of the reef.

Having completed two high-profile collaborative research projects in 2016—one with the National Oceanic and Atmospheric Administration (NOAA) documenting the U-576 WWII German submarine at a depth of 721ft

(220m) off North Carolina along the US East Coast, and the other working with the Nekton Oxford Deep Ocean Research Institute (Nekton) to conduct the XL Catlin Deep Ocean Survey in Bermuda—Project Baseline continues to find ways to broker and facilitate needed underwater exploration and research. Its recent proof-of-concept project in Fiji conducted in collaboration with scientists from the University of the South Pacific (USP), based in Suva, Fiji, and Nova Southeastern University (Nova) in Ft. Lauderdale, Florida, and the super-yacht owners who provided the vessel, is a prime example.

Over the 14-day mission on 14-27 May 2017, Project Baseline's team conducted over 100 video transects of coral reef and benthic habitats of the Great Astrolabe



AMANDA WHITE / PROJECT BASELINE

Dr Todd Kincaid (center), along with the captain of the *Ad-Vantage*, Peter Rowsell (right), gives the morning briefing.

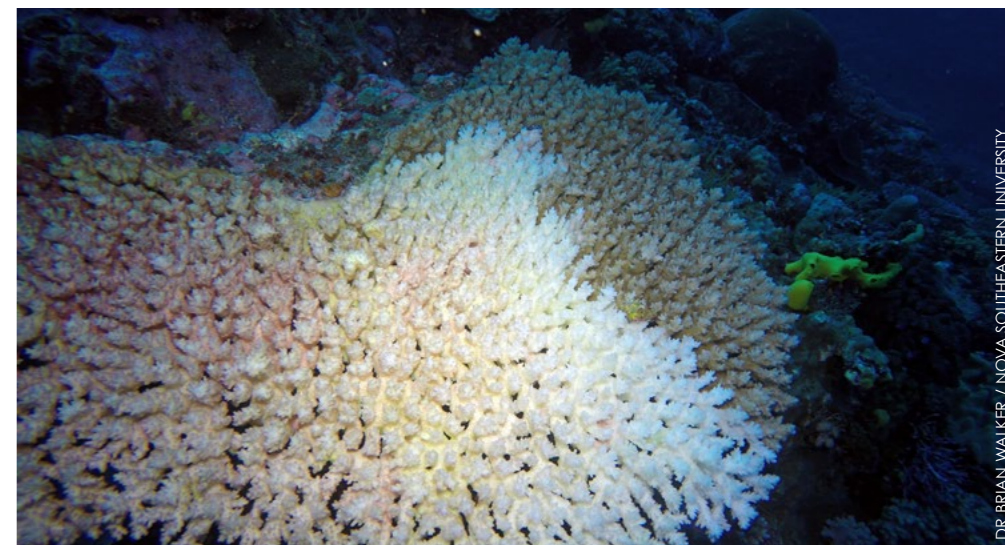
Reef, one of the largest barrier reefs in the world, facilitated dives for scientists from USP and Nova, and conducted 12 dives on submersible Moby collecting vertical video transects from depths of 50 to

362m. In addition, they were able to engage with the local communities in Malolo and Kadavu on the mission and its relevance to their historical and cultural relationship with the sea.



ROB WILSON / FRONTLINE PHOTOGRAPHY

On a reef wall at North Astrolabe Reef in Fiji, there is a surgeonfish and several table corals.



DR. BRIAN WALKER / NOVA SOUTHEASTERN UNIVERSITY

The red tissue on the left of this coral at Namotu Reef in Fiji is dead, while the white in the middle is diseased; the brown portion on the far right is healthy. The cause of the disease is unknown.



ROB WILSON / FRONTLINE PHOTOGRAPHY

At Astrolabe Reef, Dr Brian Wilson from Nova Southeastern University in Florida records coral reef health and species.



Dr Charles Messing commences a dive in the *Ad-Vantage's* submersible, Moby, to record crinoid.



AMANDA WHITE / PROJECT BASELINE

"The mission allowed us to monitor the health of the northern-most part of the reef far from human settlements and haunts and contrast it with areas near tourist hubs. The Fijian government doesn't have the resources to do this by itself," explained Dr. Rico, head of marine sciences at USP, who along with his students, is preparing a baseline report based on the data that was collected. The report will be used to help government policy-makers protect Fijian reefs.

A long time ago, in a reef far, far away...

Ironically, the origins of the Fijian project stretches back to 1998, the year that Jarrod Jablonski and now Project Baseline director Todd Kincaid, formed Global Underwater Explorers (GUE). At the time, British accountants-

turned-divers Mel Jeavons and Jamie Obern volunteered with the National Trust of Fiji, a Fijian government-sponsored conservationist organization, to run a coral and fish survey of the remote islands. There, they befriended a fellow volunteer named Sarah.

Flash-forward nearly 20 years to 2015/2016, Jeavons and Obern, who got married and became GUE divers, were running their training company Tech Dive New Zealand, based in Tutukaka, Northland. Meanwhile, their friend Sarah Foulis was now the chief stewardess and wife of the captain of the luxury yacht *M/Y Vantage*, which operated in the South Pacific. Even better, the ship's owners (who want to

At North Astrolabe Reef in Fiji, Dr Todd Kincaid (right) works with team GUE diver Jamie Obern (left) on the transects.

remain anonymous) were interested in donating their support vessel, *M/Y Ad-Vantage*—a 55m research vessel, which included a submersible and dive boats—for use in ocean research by recognized non-profit organizations. Jeavons, with the help of Jablonski and Kincaid began work on securing the ship.

Jeavons received the go-head on the boat in late 2016, but it took until mid-April 2017 to work out the details. Direct costs for the two-week survey project came to over US\$300,000, most of which were ship-related, but this included an amount for operating expenses, which was also fully funded by the owners of *Ad-Vantage*. That gave Kincaid and the Project Baseline team just three weeks to pull the project in Fiji together to meet the ship's sailing window—the most critical item being getting the necessary permissions from the Fijian government.

Kincaid and Jeavons engaged Rico at USP, who said he would welcome the collaboration. Rico wrote a request letter and had it hand-delivered to the Prime Minister of Fiji. However, there



MARTIN MCCLELLAN / PROJECT BASELINE

was no time to wait for approval before organizing the rest of the project.

Gambling on ocean science

Kincaid had already engaged marine scientists Brian Walker and Charles Messing at Nova, and scrambled to assemble the rest of their citizen scientist research team—including New Zealand-based GUE instructor Russell Hughes, Tech Dive New Zealand photographer Rob Wilson, explorer Martin McClellan of *SS Tahoe* fame, submersible pilot Randy Holt and safety officer Shane Zigler—and make travel arrangements.

"We totally gambled and decided to act as if," explained Kincaid, who said that up to that point, everything had been done on a handshake; there was no paperwork. "The Prime Minister's letter actually arrived the day I arrived on the *Ad-Vantage*. No one other than the captain and

I knew that the ship wasn't going anywhere without that letter."

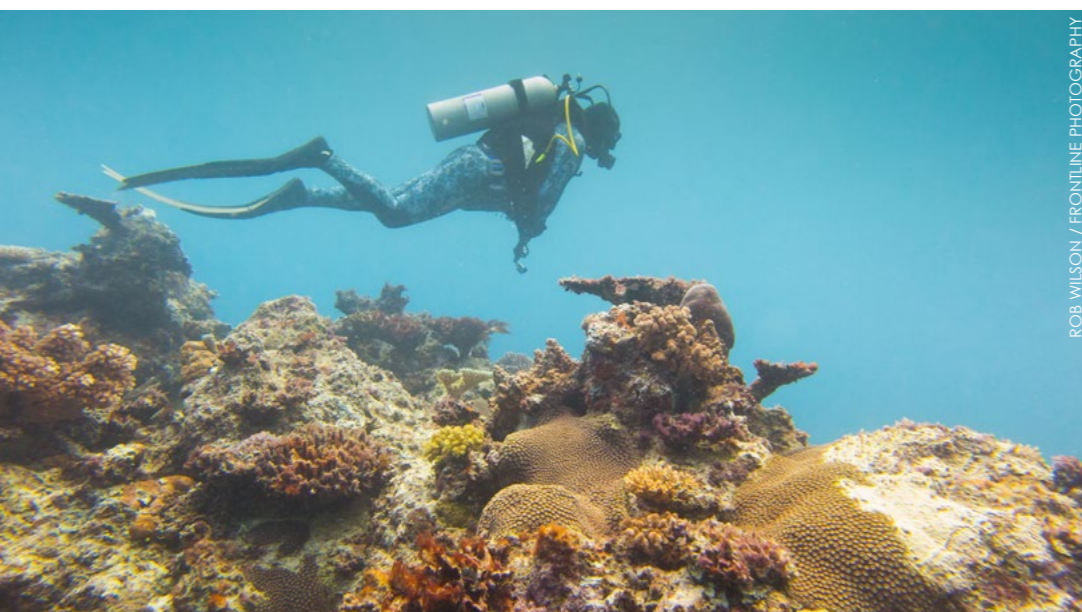
However, organizing a scientific mission in three weeks' time was not their only challenge. They still needed to secure permission to dive from the local village chiefs who oversaw the fishing grounds, which was accomplished with the help of Rico and USP.

In addition, sea conditions arising from Tropical Cyclone Ella, which passed north of their target area the day before the expedition was scheduled to begin, forced the team to delay the diving for three days and seek out alternative protected locations. Interestingly, the coral reef transects, which were taken during three-hour or longer rebreather dives, were limited to 100ft (30m) of depth due to the fact there was insufficient time to obtain any helium. GUE's Project Baseline evidently practices what it preaches.

In the aftermath of the project, the scientists Rico, Walker and

Messing are working together with graduate students to analyze the copious visual and other data gathered during the mission. Tech Dive New Zealand's Jeavons and Obern will continue to work with *Ad-Vantage* in the South Pacific region, while Kincaid, a water scientist, scouts out possible super-yachts for future baseline projects. Citizen science will never be the same. ■

Michael Menduno is an award-winning reporter and technologist based in California, USA, who has written about diving and diving technology for more than 25 years and coined the term "technical diving." He was the founder and publisher of aqua-CORPS: The Journal for Technical Diving (1990-1996), which helped usher technical diving into the mainstream of sports diving, and organized the first Tek, EUROtek and AsiaTek conferences, as well as Rebreather Forums 1 and 2.



ROB WILSON / FRONTLINE PHOTOGRAPHY

Dr. Rico Rico dives Astrolabe Reef near Kadavu.





Have the sun behind your diver for a silhouette.

Text and photos by Kate Jonker

By adding divers to our underwater photos, we are able to bring about a sense of exploration, highlight a focal point and provide a sense of scale to the scene, especially in wide-angle reef and shipwreck photography.

Over the years, I have learnt a number of tricks that have helped me take better photos of divers. You might want to give them a try on your next dive.

Check your buoyancy

My advice to any diver wanting to take photos—get your buoyancy right before you take your camera underwater. You cannot take photos if you are flapping around trying to stay afloat, or if you are constantly inflating and deflating your BCD. If you focus on getting your buoyancy right



How to Take Really Great **Photos of Divers**

before you take your camera into the water with you, your images will be so much better from the start, and the reef and your fellow divers will thank you for it.

Your model

Although it is easy to snap away at other divers underwater, your results will be disappointing and you will probably start annoying people if you are constantly firing your

strobes in their faces. To take really great photos of divers, you need to have a patient buddy who is willing to model for you, is comfortable in the water, has good trim and excellent buoyancy skills. A fellow un-

derwater photographer is ideal, as you can take turns modelling for each other.

Floaty equipment

Make sure your model's equipment is in



photo & video



It is always a good idea to ask before you take a photo (above); Clear masks give great lighting to a diver's face (right); Use another photographer as your model (top right).

trim, clipped away and not dangling. Dangling equipment—whether it is gauges, octo, torch or surface marker buoy—looks untidy and could pose a threat to the reef. Incorrectly positioned equipment, such as an octo hose over the model's shoulder (instead of tucked underneath the arm) looks unprofessional and will certainly raise a few eyebrows.

Your model's hair

Long, free-flowing hair can be hard to control underwater. The only time it can be successfully managed is if you are taking a photo of your models whilst they are swimming. All they need to do then is quickly tip their heads backwards and swim across the frame, as you take photos of them with their hair flowing beautifully behind them. For photos where your models are not swimming, get them to tie their hair back or put a hoodie or bandanna over it. This looks so much neater. Bandannas can also add a splash of colour to your photos and suit both male and female models.



Masks

Always remember to use your favourite mask "anti-fog" before getting in the water. Firstly, you need to ensure you can see clearly when taking photos. There is also nothing worse than seeing photos of divers with fogged-up masks. It is hu-

man nature to want to see the eyes, and a fogged-up mask is distracting, looks unprofessional and simply ruins the shot. Similarly, make sure your models do not have too much water lying in the bottom of their masks.



Some buddies can add a touch of humour to your photos.

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photo & video

Add a diver to give a sense of scale—especially to wrecks (right);

Divers inside wrecks can give a sense of exploration (below);

Viewers will follow your model's gaze (lower right).



Mask types

I find that for the majority of photos, a clear or transparent skirt is the better choice. This allows more light to enter the mask and highlights the face and the eyes. For more of a “tech” shot, dark-skirted masks work well, but you really have to get your lighting right in order to light up the inside of the mask and the diver's eyes correctly.

Adding colour

Get your model to wear gear with colourful details. Masks, fins, wetsuits and even BCDs with colourful inserts always help to add a splash of colour to a photo. I personally prefer these “splashes” to all be the

same colour or shade. A touch of waterproof mascara and eyeliner can also help to make the eyes pop, but it is not necessary to go overboard—try to keep make-up natural (for male divers, make-up is not compulsory).

Using a torch

A nice strong torch can be used in so many ways, especially when you are photographing a diver in a cave or wreck, or where you have a dark background and the diver is in silhouette. Have your diver use a torch to highlight certain areas, as the viewer's eyes will naturally follow the beam of light. When models are closer to you, they can




even use their torches to give a snooted effect to the image.


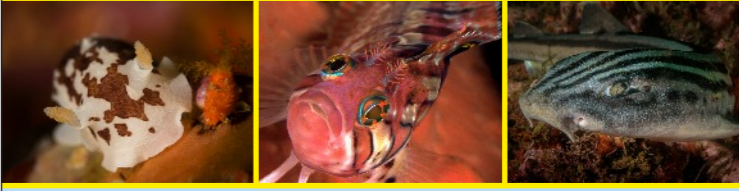
Camera and strobe settings

Start your dive with your preferred camera settings for wide-angle shots and adjust your camera speed to lighten or darken the water column in the background. Use your strobes to add light to your foreground and your model. Make sure the model is as close to the centre of the image as possible, especially if you are using a fish-eye lens, or the model will become distorted if too close to the edge of the frame.

If your models are farther away, you will not be able to light them up, and they will have a blue cast to their skin and hair. In this case, concentrate on lighting up the foreground and have the diver as a silhouette against the background. Have the reef,



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gorgonian or marine creature as the star of the show; light them up and have the diver's silhouette in one of the quarters of the frame.

Plan your shots in advance

To benefit the most from your limited time underwater, it helps if you both know the dive site and the kind of marine animals you expect to see. Discuss the shots you want to take in advance. I find it useful to have similar images on my iPad or smartphone, which I can show my models beforehand, so that they have an idea of what I am trying to achieve.

Model positioning

For close shots where your model is looking at a fish, critter, sea fan or artefact, have the model face your direction with her or his mask, but have the model's eyes looking at the point of interest (the angle should not be too great). This will enable you to light up the model's eyes with your strobes and create a point of interest, as the viewer will follow the model's gaze. For closer shots, get the model to look over your shoulder instead. Divers looking straight into the camera always tend to look cross-eyed and a little crazed.



Light up the foreground and have your diver in silhouette behind (above); Fellow photographers often make great models (top left); Divers add a sense of adventure to a photo (left).





Never allow your models to sit, stand, touch or hold onto any marine life, reefs or wrecks. Not only can they damage the reef or marine life, they could also injure themselves on stinging or sharp objects.

For wider-angle shots, models should ideally swim across the frame, parallel to your camera, preferably with their knees together and one of their legs bent in kicking motion. This is the most natural way to photograph a diver and gives you the opportunity to get really great action shots.

When I am acting as model, I

find it really useful to look at my reflection in my buddy's dome port to check whether my positioning is correct.

Bubbles

Exhaled bubbles in your model's face will ruin a shot. As divers should never hold their breath underwater, tell your models to breathe normally and take your shot once they have exhaled and the bubbles are clear of their faces and slightly above their heads. I also prefer to leave the bubbles in the image, keeping it natural rather than removing them in post-processing.

Divers exploring reefs adds a human element to the image (above); Not every photograph can be planned in advance (top left); A diver watching marine creatures can create a sense of interest (left).



If your diver is too far away to light with your strobe, use them in silhouette (left).

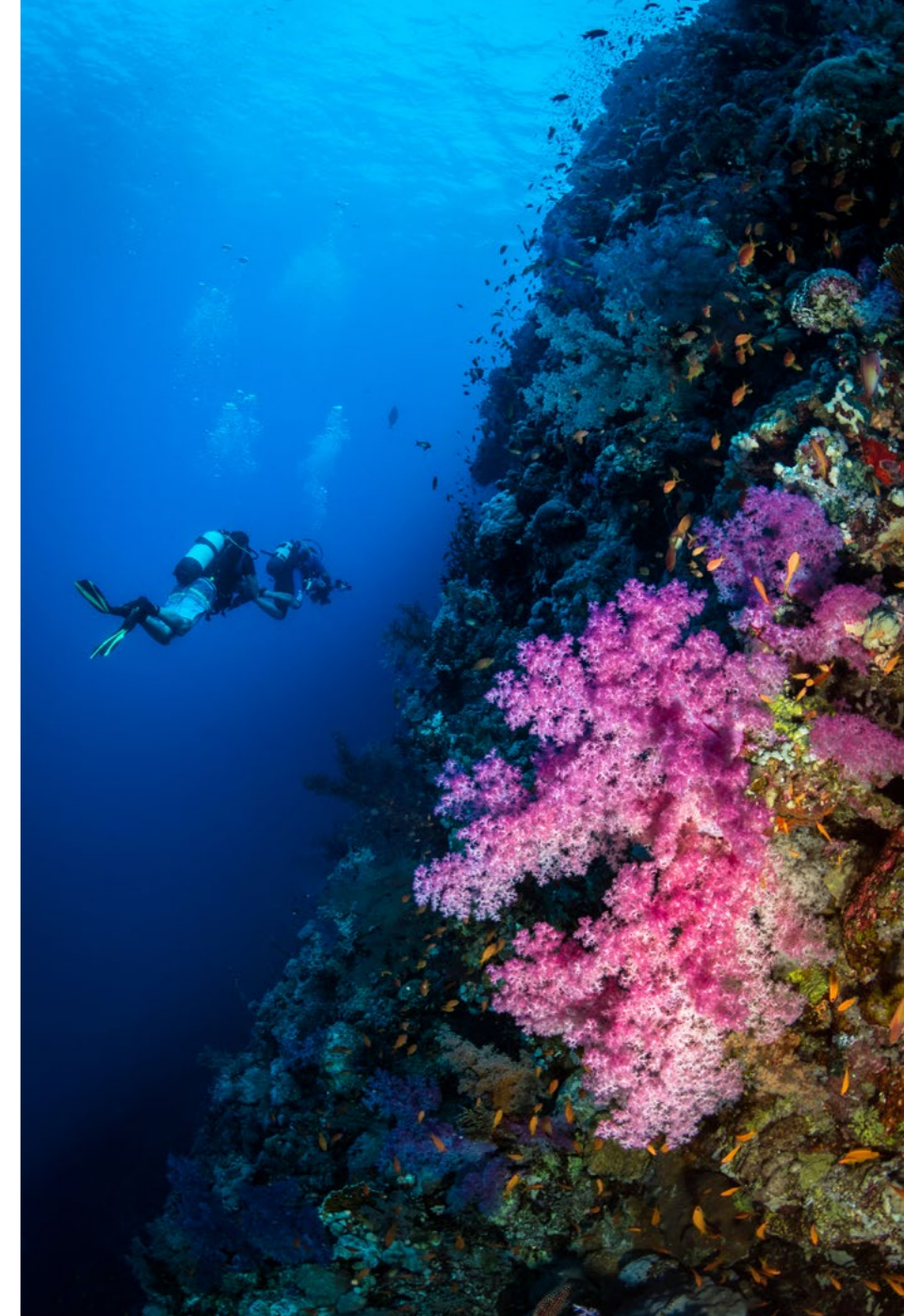
Communicating with your model

In order to get the images you want, communication is paramount, and it is therefore vital that you agree on the hand signals you will use, which could include:

- Come closer or move farther away
- Swim in this or that direction
- Go up or go down
- Hold your body horizontal or vertical
- Stop
- Face this way or face the other way
- Keep legs straight
- Bend your knee (and which knee)
- Do it again
- Torch on or off
- Look at the subject or look over my shoulder

Taking really great photos of divers underwater requires pre-planning and communication. It really is a team effort. Once your model has dived with

you a few times, she or he will start to understand what you require of them, especially if you look at and discuss the images together afterwards. Always remember, though, that it has to be enjoyable and safe for both of you and have no impact on the environment. ■



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Divers exploring wrecks adds human interest to the image (above); Have your diver look at the item of interest (right); Adding divers to big-reef images adds a sense of scale (top right).



Kate Jonker is an underwater photographer and writer based in South Africa. She teaches underwater photography courses and is a dive guide, photographer and skipper for her husband's scuba diving centre, Indigo Scuba in Gordon's Bay, Cape Town. For more information, visit: Katejonker.com.



photo & video

Edited by Peter Symes

Amhipac

Not yet spotted in the wild but about to appear on Kickstarter shortly, the Amhipac seems to be a sleek and quite compact housing for iPhones 6, 6S and 7, made from rigid polycarbonate. According to specs provided, it is only waterproof to a modest 10m, but sports a touchscreen that works underwater. This lets the user select focus, pinch to zoom, toggle photo and video modes and even use other apps on the phone. This is made possible thanks to two layers of durable clear film, which create a low-pressure air pocket. The 100mm scratch resistant dome enables the user to take over-and-under shots. Amhipac.com



Hero6

The GoPro HERO6 Black action camera provides more processing power than the preceding model, the HERO5, while keeping to a familiar design. It is waterproof to 10m (33ft). The optimized GP1 processor brings higher frame rates in 4K, 2.7K, and 1080p HD resolutions. Where previous models maxed out at 30 fps in 4K, the HERO6 Black can muster 60 fps for rendering smooth motion or even slow motion in timelines with slower frame rates. Other processor-intensive tasks, such as image stabilization, have also been improved in the HERO6. On the back there is a 2" touchscreen LCD for quickly navigating menus. Once your settings are locked in, the classic one-button interface can take over for quickly starting and stopping recording and changing settings on-the-fly. GoPro.com



FA6000

Made from durable, injection-molded polycarbonate, the Fantasea FA6000 Housing for the Sony a6000 camera is depth-rated to 60m (200ft). The housing, being shock-resistant, also makes it suitable for outdoor photographers who want to capture the action of activities such as white-water paddle sports, sailing, boating, surfing, fishing, hunting, backpacking and camping. An interchangeable lens port and lens gear accessories are available, allowing for the use of a wide range of lenses. All essential camera controls and functions are accessible with clearly-labeled controls. Sonydive.com



YS-D2J

Sea&Sea has announced the updated version of the YS-D2 Strobe, with the designation YS-D2J, in which reliability has been improved. The overall specs and features are similar to the previous model. Exposure control comprises DS-TTL II, Slave TTL and 11-step manual control. The depth rating is 100m (330ft). Four AA alkaline batteries will provide approximately 150 flashes. Two diffusers and red filters are included with the strobe as standard. The strobe is equipped with a target light (approximately 100/300 lumen). In use (target light switch in ON position), the light will be automatically turn off when the strobe fires and will automatically turn back ON after 0.5 sec. Seaandsea.jp

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Jay Maclean



P O R T F O L I O

portfolio



Always Curious (2013)
by Jay Maclean
Acrylic on plywood
48 x 24 inches

All Puffed Up (1999)
by Jay Maclean
Oil on canvas
60 x 60 inches



PREVIOUS PAGE: *Hunting by Night* (2014) by Jay Maclean. Acrylic on plywood, 48 x 40 inches. The artist describes the scene as: "a predator fish chasing small prey in a plankton-rich sea. In reality, the fish would all be asleep at night, but it made for an interesting extension of the dot technique."

RIGHT: *Blue Coral Spawning* (2014) by Jay Maclean. Acrylic on plywood, 48 x 40 inches. About the work, the artist states that it is "a semi-abstract coralscape, with most of the work done feverishly in six hours."

Text edited by Gunild Symes
All artwork by and all photos
courtesy of Jay Maclean

With a background in marine fisheries biology, Australian artist and diver Jay Maclean, who is based in the Philippines, creates brilliant paintings of stunning underwater scenes using unique angles and artistic techniques. *X-Ray Mag* interviewed the artist to find out more about his artwork, insights and creative process.



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

JM: I grew up fascinated by the biological world, collecting insects and freshwater fish and other aquatic bugs as a kid. At university, I learned more about all these organisms and became determined to make a career out of this learning. I did a master's degree, at the University of Queensland in Brisbane, Australia, in marine fisheries biology. Through it all,

I wanted to be in the tropics, where the greatest variety of life—fish, corals, insects, you name it—was to be found.

That dream came true, first in a two-year stint in Papua New Guinea working on oyster and pearl oyster culture for the government, where I first experimented with oil paints in my spare time. Most of my working life was in the field, a lot of scuba diving and some of us went weekend recreational diving too. I could have done that forever, but I had a young fam-

ily, and the country—it was a colony on the verge of independence—was becoming very unsafe.

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

JM: Well, the answer to your first question had to include how I got underwater. The second part of the dream was seven years later; I found a fisheries job in the tropics, again in



Peacock Grouper (2014)
by Jay Maclean—the fourth
in the coralscape series
Acrylic on plywood
48 x 40 inches

Jay Maclean

big success. Half the 20 paintings were sold at the opening. The Embassy then took the exhibit to the University of the Philippines campus in Davao in the southern part of the country. Large fish portraits thus became my first direction; I saw that big is better in attracting viewers. Over the years, I switched

to acrylic. In recent years, I have begun to work corals into the portraits. With corals came gradually a tendency toward impressionism to give the scenes a dynamic feel. *Hunting by Night* (4ft x 3.4ft) [see first page of article] was the latest and most satisfying work to date.



Lionfish (1988) by Jay Maclean. Oil on canvas, 60 x 36 inches.



Giant Clam (1990) by Jay Maclean. Oil on canvas, 48 x 18 inches

the Philippines, where I have lived since 1980. Diving was and is a regular weekend activity. The underwater scenery there is so beautiful and so threatened by fisheries and pollution, I wanted a way to get people's attention to the problem, not by dire threats but by highlighting the underwater beauty.

Coincidentally, I fell in with a well-known artists' colony in Angono near

Manila. Had some rudimentary lessons in oil there, and after that, there was no stopping me. I simply worked on mainly small canvases experimenting with color and memory of how fish look underwater—not sideways taxonomic views as many "underwater" artists paint to show their ignorance of underwater life—but top-down views and looking up from beneath fish and coral ledges, etc.

A Manila restaurant owner offered to host an exhibition when he saw my early fish paintings. At that stage, I was making small works but had one large 5 x 3ft portrait of a lionfish [upper right] in the display. The Australian Embassy cultural officer at the opening offered to have the Embassy host another exhibition, if I had more large fish portraits. I worked feverishly for six months, and it was a





Coralscape 2 (2014)
by Jay Maclean
Acrylic on plywood
48 x 40 inches
Of the painting,
the artists stated
that it "took days
as I became
engrossed in new
kinds of coral."

and, coming from Australia, I was intrigued by the omnipresence of painting by dots—preceding Seurat by millennia—in aboriginal art. So I combined those concepts. And always there remain the mysterious dark parts, the inner reef.

X-RAY MAG: What is your relationship to the underwater world and coral reefs? How have your experiences underwater influenced your art?

JM: My wife and I have a very close relationship with the underwater world, more than most. We have been scuba diving together since the early 1980s in different parts of the Philippines as well as other

tropical countries in Asia and the Pacific as well as Bermuda.

But more than that, we have a rustic beach house right beside a coral reef a few hours from Manila, where we have spent nearly every weekend and often more for the past 20 years, and we did much the same in a leased house nearby for 10 years before that!

The reef, being at our doorstep,



Beneath the Drop-off (2013) by Jay Maclean
Acrylic on plywood, 48 x 24 inches

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

JM: Images and music crowd in on me when I snorkel (I have stopped diving now, which is not a handicap since the nearby reefs are fringing and extend down only 10m). I have periods when underwater photographs help but mainly only as reminders.

The reefs have dark fissures and holes leading into almost a fourth dimension of life within. I keep these in mind by starting with a black or dark navy blue canvas and build a scene to grow over it in layers. I use fairly thin acrylic, not chunky from the tube, so it dries fast, and as I work on large canvases (2 x 3ft minimum), I usually show light and shade by layering also.

For the most recent ones, like the coralscape series, I photograph the stages/layers and sometimes find I would have preferred to stop before adding more layers. That becomes a guide for the next piece.

As for the dotted works, I recalled the bioluminescence of plankton by night—how one can make a phosphorescent trail by waving one's hands about during night snorkeling;

portfolio

Coralscape 5 (2014) by Jay Maclean. Acrylic on plywood, 48 x 40 inches. Of the fifth and last painting in the coral-scape series, the artist said that it "was a more realistic interpretation, based on an old underwater photo of mine."

is irresistible. It is the source of inspiration of nearly all my paintings. (Read more about the artist's observations and perspective on typhoon Glenda's destruction of the local reef in 2014 in his book, *Electric Angels and Pink Bikies: The Expatriate Life*, here: <https://www.amazon.com/Electric-Angels-Pink-Bikies-Expatriate-ebook/dp/B074MLC9F9>).

X-RAY MAG: In your relationship with reefs and the sea, where have you had your favorite experiences?

JM: Hmm... We have dived and swum with most tropical marine life, from tiny seahorses to whale sharks; one experience that stands out is when we were investigating a coral ledge and a 4m wide manta ray glided just overhead—yes, I made several paintings of mantas after that!

As for special interactions, speaking as a fish—as my wife often calls me—witnessing how our reef recovers after disasters over the years is almost like fretting over a child (or our fingerlings, to continue the analogy). Having watched "our" coral reef wiped out by crown-of-thorns starfish plagues, bleached, destroyed in typhoons, and damaged in earthquakes—recovering each time—I feel as the fish might, in seeing their homes rebuilt.

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

JM: As I implied earlier, marine conservation became a "passion" early on and still holds me. The main message is that we do not want to lose these fragile



Out Late Definitive (2013) by Jay Maclean. Acrylic on canvas, 36 x 24in. Of the work, the artist said: "More radical is this near monochrome work. Bleached corals? Nighttime scene? You decide."



organisms of such beauty.

Of course, conservation means much more than that. At the moment, I am consulting on a project that is helping coastal communities in several Pacific island countries (Fiji, Papua New Guinea, Solomon Islands, East Timor and Vanuatu) to manage and conserve their marine resources.

However, whales and dolphins for

instance, gained protection not because of their place in marine ecosystems but through an appeal to recognize them as animals we can associate with. I think tropical reefs and their inhabitants may be "saved" similarly because of their visual, mythological appeal, not because they protect the land, etc., which is the "stick" approach of most conservationists and activists. The carrot works far better.

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

JM: A simple message. Surely we must care for the wondrous beauty and diversity of life in the other 70 percent of our planet, particularly in tropical seas where marine life is at its most prolific and colorful, for our children and their children to witness.





Ethnic Reef 2 (2012) by Jay Maclean (left). Acrylic on canvas, 24 x 36 inches. The painting depicts butterflyfish in phosphorescing coral. The artist states that the painting marks "a new line of thought . . . dots that could be of aboriginal origin or evening phosphorescence, as plankton brushes against fish and corals."

Jay Maclean



Sweepers (1999) by Jay Maclean (above). Acrylic on plywood, 60 x 36 inches. Of the work, the artist stated: "These fish lurk in big schools in caves by day. They swirl out in oceanic ballets at dusk."

else you would like to tell our readers about yourself and your artwork?

For more information, please visit the artist's website at: <https://sites.google.com/site/macleanstory/jaymacleanacrylicpaintings>.

JM: No, I'm exhausted! But many thanks for your interest in my paintings. I hear the muse knocking at the door again already! ■

Comfort Zone (2009) by Jay Maclean (below). Acrylic on plywood, 60 x 24 inches



X-RAY MAG: What are the benefits and challenges of being an artist in the world today?

JM: The main benefit for me, and I imagine most artists, is the immense satisfaction of creating a lasting work that I really like myself; the secondary benefit being if someone else likes a piece enough to buy it. The loss of the artwork is part of the impetus to start again!

But like in other appetitive behaviors, once sated, the desire arises again each time a piece is completed. The challenge is always to go

beyond to produce something even better each time. I do not depend on my art as a livelihood, and that helps in terms of freedom to explore, not do what is popular per se.

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

JM: Well, the flatterers use the hackneyed "beautiful" when they like a piece; others feel happy, in the colors and shapes of coral paintings. A 5 x 2ft painting of an anemone sheltering a clownfish [right] found a place in a resort restaurant where

children love it (the Disney "Nemo" effect, alas).

X-RAY MAG: Any upcoming projects, art courses or events?

JM: No. I am in the doldrums... In fact, while waiting for the muse to return, I am self-publishing books of short story compilations and more serious works. I have produced five books in the last three months, with two more to complete. (See: <https://books.pronoun.com/jaymaclean>).

X-RAY MAG: Lastly, is there anything

