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X-ray mag

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July 2013
Number 55



Normandy
D-Day Wrecks

Costa Brava
Underwater Wine

Egypt
Red Sea Wrecks

Turkey
Uluburun

Portfolio
Lauren Kussro

Profile
Dr Mark Erdmann

INDONESIA
Raja Ampat

COVER PHOTO BY STEVE JONES

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COVER PHOTO: Diver on vibrant coral reef, Raja Ampat, Indonesia
Photo by Steve Jones

School of fusilier, Raja Ampat, West Papua, Indonesia. Photo by Steve Jones



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Photo: SDAA/MIDE TTL Photo Competition 2012
 Vanessa Mignon (Australia) Portfolio Honorable Mention

The dive community needs you ...



the full picture, as the dive industry was also struggling during many of the preceding years when the global economic climate was still upbeat. Diving could also just simply have fallen somewhat out of fashion. As in so many other matters, it is probably a mix of many reasons and mechanisms.

financed. Aside from setting up shop and trade wares, one would also have to organise classes and training and often also trips. And even when it is a labour of love, as is often the case, passion only goes so far. The bottom line is without enough customers coming in through that door, the economic realities soon put an end to any enterprise.

And this is where the dive industry now needs you.

Let's face it and call a spade a spade.

The dive industry is not faring so well, and the patient has been unwell for quite some time.

Since the glory days of the 1990s when every successive year saw a steady growth in reported certifications, the 21st century has been pretty much seen as one long, protracted contraction of business.

Industry bodies and trade organisations have long since recognised this worrisome trend, analysed its causes and attempted to come up with remedies—some more successful than others.

So what seems to be the problem? The ongoing financial crisis may have a role to play, as many like to point out, but it's not

This is, however, not the place to go into detailed macro- or micro-economic analysis or reflections on how the industry should get back on an even keel while facing the ever-mounting competition for attention from other leisure activities.

The matter at hand is what to do about it right here and now and get going.

Running any dive operation is quite capital and labour intensive and often comes with a meagre return on investment. One needs a premises, inventory, compressor, class room, equipment, access to a pool, zodiac or boat, vehicles, perhaps a trailer and a minibus, etc—all of which need to be

We need to recruit more new divers, so bring a friend. Diving has now been made easy to learn, and it is a great social activity for friends and families alike where you can share experiences, and once in a while, great life-changing adventures and mind-broadening encounters with underwater wildlife unequalled to what one can experience on dry land.

To that affect, DEMA created the Be a Diver campaign, which you can find on www.beadiver.com

So please spread the word

And let's make diving attractive and fashionable again.

—The X-RAY MAG Team

... to bring a friend



News edited
by Peter Symes

from the deep NEWS



PETER SYMES

How Coral Islands Form

Charles Darwin got it almost right when he, in 1842, hypothesized that coral atolls develop as coral grow settle in top of sand and lava from islands and grow upwards while the island itself ages and subsides creating first a fringing reef, then a lagoon-bounding reef and finally an atoll. But there is much more to it, a team of researchers from the U.S. Massachusetts Institute of Technology (MIT) has found.

Darwin did his research in the Society Islands in the South Pacific, where the sinking of islands and rising sea level create perfect atolls. However, Darwin's theory could not explain the wide variety of reef formations, which is where the new research comes in.

It turns out that many islands do

not follow this classic sequence, and reefs are shaped by many other factors than just reef subsidence. Rather, reef morphology is down to the combined effects of island subsidence, coral growth and glacial sea level cycles, a new model of the reef evolution demonstrates. The model shows that different combinations of reef accretion and island subsidence only produce results resembling the observed distribution of modern reefs if the model is coupled with sea level oscillations driven by ice age cycles.

While most of his contemporaries thought atolls were only thin sheaths of coral, Darwin correctly believed they can grow to thousands of feet thick and got it mostly right, but he didn't know about these glacially induced sea

level cycles. It later also turned out that the Society Islands where Darwin made his observations is one of the few places in the world where sinking islands and sea level rise create perfect atolls.

In cooler areas such as Hawaii, corals grow slower, and the underlying volcano is sinking quickly, and when the sea level is at its lowest, narrow fringing reef terraces form. But when a glacial melt occurs and the sea level rises fast, the combined effects are more than the corals can keep up with, drowning the reef each time.

Glacial cycles are the primary driving force behind the shaping of coral islands today. ■

SOURCE: MAY 9 GEOLOGY JOURNAL

Plants actively shape marsh landscapes to benefit themselves

Scientists have long believed that the distribution of plants within a marsh is a passive adaptation in which species grow at different elevations because that's where conditions like soil aeration and salinity best meet their needs.

But a team of scientists from Duke University and the University of Padova in Italy has found intertidal marsh plants in Italy's famed Venetian lagoon were able to subtly tune, or adjust, their elevations by producing different amounts of organic soil, and trapping and accumulating different amounts of inorganic sediments as part of a complex interplay with the environment.

Each plant species strives to build up the elevation of its substrate to within a favourable range for its survival in very much the same manner corals do.

The finding may help scientists better predict marsh ecosystems'

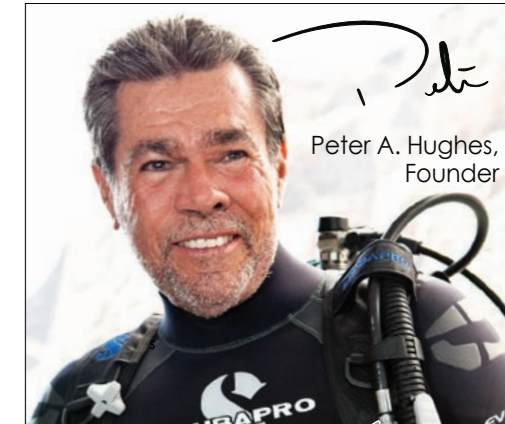
resilience to climatic changes such as sea level rise. The differences in substrate-building capabilities between species are often minute, but they allow each species to stabilize the soil within different stable states, or layers, in the marsh. Some species prefer elevations at or below mean sea level; others prefer higher elevations that are less often inundated.

"Obviously, this is not a conscious choice on the part of the plants," said Marco Marani, professor of ecohydrology at Duke. "It's a natural mechanism—how marshes work. We just didn't understand it in such detail until now." For the new study, the team used an electronic theodolite, which is able to measure elevations accurately to within less than one millimeter. ■

SOURCE: PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES



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Edited by
Catherine GS Lim

Mariana Trench not so dead after all

Anyone looking at pictures of the jagged surface of the Mariana Trench would naturally conclude that it is totally devoid of any organisms. At almost 11 kilometres deep—and as the deepest place on Earth—how on in the world could anything survive way down there?

On the contrary, new research has surfaced revealing otherwise. Recently, samples collected by an unmanned submersible contained a large number of microbes, prompting scientist Dr Robert Turnewitsch to state that "the deepest parts of the deep sea are certainly not dead zones".

In 2010, together with other scientists, Turnewitsch had sent the submersible into the depths of the Mariana Trench to retrieve samples of the murky sediment within. Then, back in their labs, examination of the oxygen levels of the samples revealed the single-celled microbes. Elaborating on this, Turnewitsch said, "These microbes, they respire as we do. And this oxygen consumption is an indirect measurement of the activity of the community."

The extreme depths didn't seem to bother the organisms, which were treated to an abundant supply of dead plants and animals that drifted down from the surface and become trapped within the trench's steep walls.

"The amount of food down there and also the relative freshness of the material is surprisingly high—it seems to be surprisingly nutritious," said Turnewitsch.

Twice as many microbes were found at the bottom of the trench than at a nearby site just six kilometres deep. The large population of microbes has given rise to the suspicion that the Mariana Trench might play a key role in the carbon cycle and in regulating the climate, by removing the carbon from the ocean and the overlying atmosphere.

Turnewitsch added that "the Hadal trenches [where the Mariana Trench sits] may play a more important role in the global marine carbon cycle than was previously thought". ■ SOURCE: BBC



WALLACE / NOAA / WIKIMEDIA COMMONS

Marine animals help disperse seagrass, new study says

Seagrass is important in so many ways. Much as we know of the biodiversity of coral reefs, seagrass ecosystems are gradually becoming known as critical habitats and nurseries for many marine species as well as powerful carbon sinks. Yet, seagrass is still a mystery. How does

Lead author of the study, Sarah Sumoski with the Virginia Institute of Marine Science, stated, "Traditional thinking is that eelgrass disperses by abiotic mechanisms such as floating seeds, floating reproductive shoots, or currents pushing seeds along the seafloor."

animals which carried the seeds further distances than perhaps wind and waves would, but the seeds germinated successfully after the journey. However, the distance the seeds were carried was also an important factor in the success of the seagrass colonizing new areas.



FILE PHOTO: NOAA

Researchers studied eelgrass (*Zostera marina*) found in the Chesapeake Bay, USA

seagrass spread its seeds? How does it colonize a new area? These questions and more were the focus of a new study published in the Marine Ecology Progress Series. The study findings showed that several marine species played a key role in dispersing seagrass. Prior to this discovery, it was assumed that seagrass was dispersed by wind and waves.

She continued, "Our study shows that eelgrass seeds can also be dispersed through consumption and excretion by fish, terrapins, and birds—providing a means to bring seeds to isolated areas."

Distance matters. Not only did the researchers find that seagrass seeds did indeed survive in the guts of these

"We estimate that the fishes could disperse eelgrass seeds 10s to 100s of meters, while the maximum dispersal distance for terrapins is around 1,500 meters, or about a mile. The scaup [seabird] was the champ, with a maximum dispersal distance of more than 10 miles," stated Sumoski.

It was also found that seagrass seeds dispersed by animals might have a better chance to survive than if dispersed by wind and waves.

"[Animals] prefer to live under the conditions that favor seagrass growth and thus will tend to carry seeds to areas where they'll germinate. Wind and currents can easily disperse seeds into areas unsuitable for seagrass growth," said Sumoski.

The study highlights the importance of understanding seagrass ecosystems, which have come to be some of the most threatened by water pollution, dredging and coastal development. While a third of the planet's seagrass ecosystems have disappeared, restoration in many cases is thought to be a possibility. ■ SOURCE: MONGABAY.COM

How do oysters make pearls round?

Pearls are being rotated as they grow within the pouch that holds them inside the soft mantle tissue of molluscs.

Pearls typically rotate once every 20 days or so, which creates the rotational symmetry; any differences in growth rate along the axis or rotation get copied around the entire circumference.

Pearl rotation is a self-organized phenomenon caused and sustained by physical forces from the growth fronts, Spanish and French researchers find.

Formation

Pearls are formed of nacre, more commonly known as mother-of-pearl. Nacre is an astonishing material. It is a composite that consists mostly (about 95 percent) of the

mineral aragonite, a form of calcium carbonate (the fabric of chalk and marble), together with five percent organic material: proteins, peptides, lipids and polysaccharides.

The nacre is made of chemicals secreted by the same kind of cells responsible for making the mollusc's shell. A crucial difference between shell and pearl nacre arises from the different geometries of the shell and the pearl; the pearl is immersed within its pearl sac and as such, unlike the shell, is free to move within it.

Several layers grow at the same time, creating terraces that can be seen on a pearl's surface when in-

spected under a microscope. These terraces hold the key to the pearl's rotation.

As new calcium and carbonate ions, or chitin or protein molecules, stick to the step of a terrace and become part of the growing crystal, they release energy, which warms up the surface. Water molecules in the surrounding fluid bounce off the step edge and impart a small force in the opposite direction.

Because the terraces make up a ratchet shape, the small kicks imparted by warmed water molecules act in the same direction causing the growing pearl to rotate. ■



Pearls are naturally formed by many species of molluscs in response to the presence of a foreign body such as a parasite

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Breaching the Final Frontier

A gold rush of the 21st century is in the works, and it may come as early as 2016.

However, instead of gold, the nuggets in demand are nodules of mineral-rich rocks from the seafloor. Copper, manganese, cobalt—and yes, also gold—are just some

of the minerals that can be extracted from these nodules.

Although the possibility of deep-sea mining has been discussed for years, its implementation has only become more viable today with modern technological advances and the higher commodity prices.

In mid-May 2013, the United Nations published its preliminary plan describing its proposal on how the extraction of the mineral-rich nodules should be conducted.

Its International Seabed Authority (ISA)—which oversees deep-sea mining—acknowledged that “we are at the threshold of a new era of deep seabed mining”.

Seabed mining management

Established to manage seabed mining, the ISA has shifted its focus from handling bids for mineral exploration—17 licences have been issued so far—to figuring out how to license the first mining operations and how the proceeds should be shared.

Considering that actual mining operations hasn't even started, isn't it a tad premature to be issuing licences and discussing profit distribution?

Hardly. Take, for example, the Clarion-Clipperton Zone, a five-million sq km area in the eastern Pacific. It has been estimated

that more than 27 billion tonnes of nodules could be found there. With the huge profit potential, any self-respecting company would want their shovel to be first in the seabed.

This being a new industry, the ISA also faces the challenges of identifying companies with the necessary skills to mine the seabed. As it states, “Competence cannot be gained without actual mining at a commercial scale; but at the same time, mining should not be allowed without prior demonstration of competence.”

Environmental impact

The plan also mentioned the need of extending the benefits of the mining operations beyond commercial motivations, and also highlighted the fact that the mining would cause inevitable environmental damage.

Some of the mining will be conducted at underwater hydrothermal vents, which before 1977, were thought to be devoid of life. We have since learnt of the many diverse species that live at these vents, from two-metre long tubeworms, purple octopi and white crabs to snails the size of tennis balls, to name a few.

According to Professor Paul Tyler, a biologist at the National Oceanography

Centre, “If you wipe out that area by mining, those animals have to do one of two things: They disperse and colonise another hydrothermal vent somewhere or they die. And what happens

when they die is that the vent becomes biologically extinct.”

Cindy Van Dover, director of Duke University's Marine Lab said, “We're still just grappling with this reality of commercialisation of the deep sea. [...] We haven't yet studied the ecosystem services and functions of the deep sea to understand what we'd lose.”

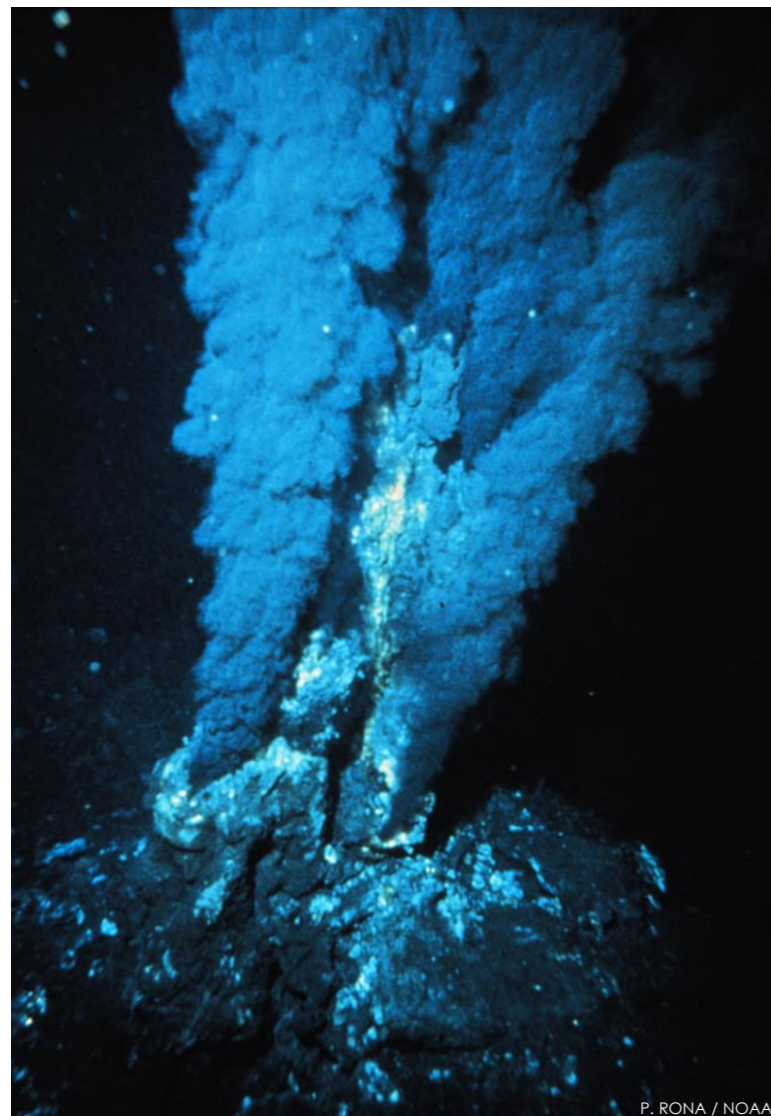
Conservation

The deep sea being a relative unstudied ecosystem, scientists are urging more debate and study into the impact of deep-sea mining on the environment and marine life before commercial extraction commences.

Dr Jon Copley, a biologist from the University of Southampton, said, “I don't think we own the deep ocean in the sense that we can do what we like with it. Instead, we share responsibility for its stewardship.”

He added, “We don't have a good track record of achieving balance anywhere else—think of the buffalo and the rainforest—so the question is, can we get it right?”

■ SOURCE: BBC



P. RONA / NOAA

Black smoker, mid-ocean ridge

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Chagos marine park ruled lawful

On 1 April 2010, the British government designated the Chagos Archipelago as a no-take marine reserve creating what was at the time the largest marine protected area (MPA) in the world. The declaration was, however, highly controversial. Fierce opposition has come from the native islanders (Chagossians) who have been battling the British government in the U.K. courts for the right to return to the islands ever since they were expelled between 1967 and 1971 to allow the United States to establish an airbase on Diego Garcia, the largest island in the Chagos archipelago. The eviction has been described by critics as one of the most shameful episodes in modern British colonial history.

Now, the U.K. high court has upheld the government's decision to create the controversial marine park. The Chagossians say the move, involving a ban on

commercial fishing, was unlawfully aimed at preventing them from resettling their former "paradise" homeland.

The marine park was created by British diplomat Colin Roberts in his role as commissioner for the British Indian Ocean Territory on the instructions of the then foreign secretary David Miliband in April 2010.

Chagossian lawyers said the move followed British consultations with the United States during which the Americans were assured that the use of their base on Diego Garcia would not be adversely affected by the MPA, BBC reports. Roberts denied under cross-examination at the high court that the marine park was created for the "improper purpose" of keeping the Chagossians out, as the United States wanted, and said it was for environmental and conservation purposes. ■



Painting of HMS *Challenger* by William Frederick Mitchell (1845–1914)

The Chagos marine reserve protects the world's largest coral atoll (the Great Chagos Bank) and has one of the healthiest reef systems in the cleanest waters of the world, supporting nearly half the area of good quality reefs in the Indian Ocean.

A U.S. air base, which has been established in Diego Garcia—the largest island in the Chagos archipelago—got the native inhabitants evicted from their islands

Century-old ship aids ocean and climate change research

Surprising results were found in a recent study by U.S. and Australian researchers who combined data collected by HMS *Challenger*, which carried out the world's first scientific survey of ocean life 135 years ago, with modern day climate science models. Findings of the study suggest that we are under-estimating the impact of global warming in a significant way.

"Our research revealed warming of the planet can be clearly detected since 1873 and that our oceans continue to absorb the great majority of this heat," said the study's lead author Dr Will Hobbs, who is a researcher at the University of Tasmania's Institute for Marine and Antarctic Studies. "Currently scientists estimate the oceans absorb more than 90 percent of the heat trapped by greenhouse gases, and we attribute the global warming to

anthropogenic causes."

Using data collected by *Challenger* as a base-line, researchers found that 40 percent of sea level rise is the result of expansion of sea water due to warming, further confirming the role of human-produced global warming in the past century.

"The key to this research was to determine the range of uncertainty for the measurements taken by the crew of the *Challenger*," said study co-author Josh Willis, who is a climate scientist at NASA's Jet Propulsion Laboratory. "After we had taken all these uncertainties into account, it became apparent that the rate of warming we saw across the oceans far exceeded

the degree of uncertainty around the measurements. So, while the uncertainty was large, the warming signal detected was far greater."

In the study, researchers were also able to demonstrate the amount of thermal expansion in sea level rise in the ocean prior to the 1950s. Climate models were the only way to estimate this change before this study.



"This research adds yet another suite of compelling data that shows human activity continues to have a dramatic influence on the Earth's climate," said Hobbs. ■

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Diver at the wreck of the USS *Susan B Anthony*

Text and photos by Steve Jones

On 6 June 1944, the largest invasion fleet ever assembled went into action off the coast of France, leaving a legacy that makes this area a wreck diver's paradise.

It's no easy feat to reach the descent line in even this mild current. With twin tanks and a stage cylinder adding to my considerable camera clutter, I may as well have been wearing a parachute.

Nonetheless, this is only a minor challenge when compared to what faced the men gathered in this bay on 6 June 1944. Not only did they each carry a huge weight of equipment as they stormed the soft sandy beaches, but they also had to contend with the hail of bullets pouring down on them from the German machine gun emplacements. Feeling somewhat humbled by this knowledge, I pulled myself down the descent line with renewed determination toward the wreck of the USS *Susan B Anthony*.

USS *Susan B Anthony*

Hand over hand we descended, being careful not to let go of the line until we reached the wreck. The dive boat captain's skill in plac-



ing the shot line became evident 60 feet down when I saw a large barrel appear out of the gloom—a heavy anti-aircraft

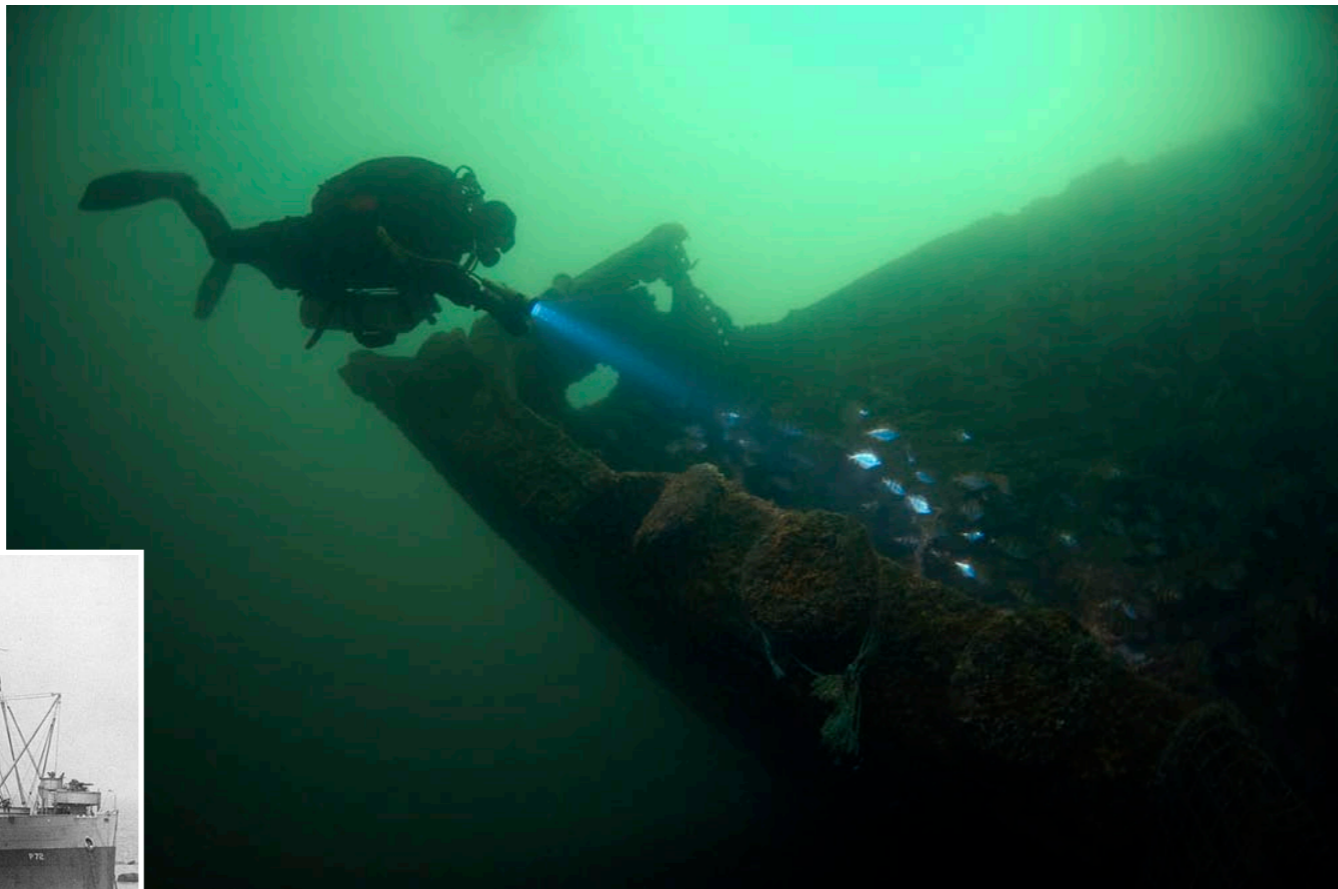
deck gun still pointing defiantly at the surface. My dive partner, Paul, illuminated the weapon's intact gearings with his torch

before we descended further into the mass of wreckage below.

Visibility was a clear 35 feet enabling us to appreciate the

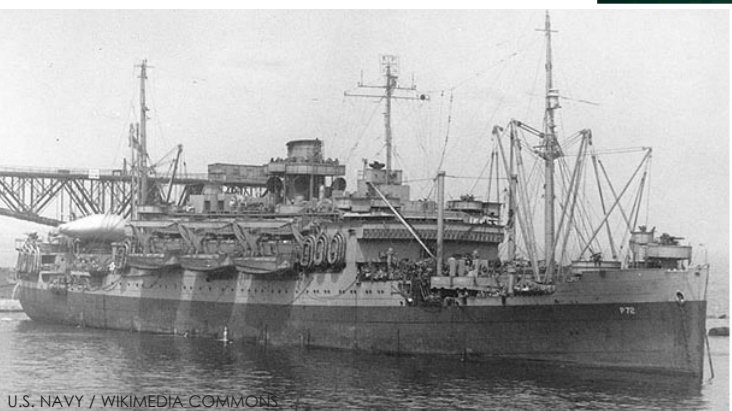
vast size of this former cargo ship. Weighing in at over 8,000 tons, she crept into the Baie de Seine in the early hours of June

7, carrying 2,288 troops, part of the "Force B" landing group. She struck a mine and despite attempts to save her, she dis-



D-Day Wrecks

USS Susan B Anthony



U.S. NAVY / WIKIMEDIA COMMONS

appeared beneath the waves within two hours. All 2,689 people on board were saved, setting a record for the largest rescue of people without loss of life—a small yet welcome miracle during such a destructive period in history.

Following the skipper's advice, we proceeded to the bows over teak decking, which have survived over 65 years in these cold North Atlantic waters. Swimming between the bow and the seabed, I emerged to be greeted by a large school of fish: pouting, which belong to the cod family. They seemed to swarm all over the wreck, in far greater numbers than I've seen on the other side of the English Channel, bringing color to an otherwise monochrome scene.



THIS PAGE: Scenes from the wreck of the USS Susan B Anthony

We now headed aft, and I noted that fish were not the only animals in abundance here. Every hole seemed to hold a lobster, crab or conger eel, a result of the French government's strict "no take" policy on the wrecks. Neither

marine life nor any other artefact can be taken from them, and the authorities have been known to impound and heavily fine dive vessels that do not comply. This may be bad news for souvenir hunters, but great news for those of us who want to see these



wrecks as they were when they went down.

The wreck's superstructure started to open up as we approached the area of mine damage, allowing emerald shafts

of light to stream into the remains of the holds—a positively surreal scene. Intact wreck eventually gave way to twisted, torn metal interspersed with deck machinery. The seabed below us was strewn

with live 20mm anti-aircraft shells. We were now just over an hour into the dive and had not even begun to explore the stern section of the ship. However, the current was really starting to pick up again, and we knew that if we stayed much longer, we'd be swept off the wreck or worse, into it. The stern would have to wait until another time.

We launched our delayed buoys and jumped off, watching the

wreck disappear into the distance, as we were carried away by the increasing flow of water. At this rate, we would have drifted some distance by the time we reached the surface, even





Sherman tank on LST 523 sunk by a mine (right); Point du Hoc, where U.S. Rangers scaled the cliffs on the morning of 6 June 1944 to knock out gun emplacements before the landings would begin (far right)

though our rich decompression mixes would have cut down our hang times considerably.

Interval

As with most of the English Channel, diving in this area can only be done at slack water, the window when the waters slow as the tides change. The currents are too strong to dive at any other time, so two dives a day would be the most we could achieve.



D-Day Wrecks



With our next diving window around five hours away, we began gas blending, using oxygen that we had brought from England since there were no facilities to buy nitrox nearby. The small on-board compressor made heavy work of the whole job, and the rebreather divers in our group did not miss the opportunity for some laughter at our expense. We whittled away the hours with a fine selection of French cuisine to help us on our way.

Landing Ship Tank 523

Gas mixing all finished, we found ourselves on station over the wreck of the LST 523. We'd be seeing the legendary Sherman tank on this dive, a full compliment of which went down when this heavy landing craft hit a mine. It was late afternoon now, and the light faded rapidly as we made our way down the 100 feet of shot line. Visibility was distinctly poorer than during our morn-

ing dive, and our powerful HID torches were needed to illuminate the wreck.

More than ten minutes in and there was no sign of a tank. Were we on the wrong wreck? Impatiently, I signalled my frustration to Paul who delighted in pointing out the upturned Sherman right below me. With my eyes more accustomed to identifying critters, I had completely missed it.

I took note of the distinctive wheel cogs, an easily recognisable feature of this tank. Thereafter, we seemed to run into tank wrecks constantly, intertwined with the mangled wreckage of the craft that carried them. Pollock and large sea bass looked on cautiously, unaccustomed to divers in this rarely dived area.

Empire Broadsword

The following day, we turned our attention to another giant, the 7,000-ton *Empire Broadsword*. This infantry land-



THE WRECKS OF THE BAIE DE SEINE

At 5.34 AM on 6 June 1944, 56 minutes before the D-Day landings would begin, a 5-inch shell was fired from a German gun emplacement near the pretty village of Saint-Vaast La Hougue. Seconds later, it tore through the engine room of U.S. Navy Patrol Craft PC1261. With the loss of 14 men, she became the first allied ship to be sunk on D-Day.

Many other small craft succumbed to enemy fire, mines and beach obstacles during the landings yet luckily only two large warships were lost on D-Day itself. Nonetheless, over the days that followed, mines and German counter attacks would take their toll on this fleet, as it continued to support the ground assault.

The sheer number of wrecks that lie on the seabed in the Baie de Seine is testament to the destructiveness of this period in history and the variety is huge: large troop carriers, cargo vessels, landing craft and destroyers accompany oddities such as the temporary Mulberry Harbours—it's simply a mecca for wreck divers. ■

Sherman tank on Landing Ship Tank (LST) 523

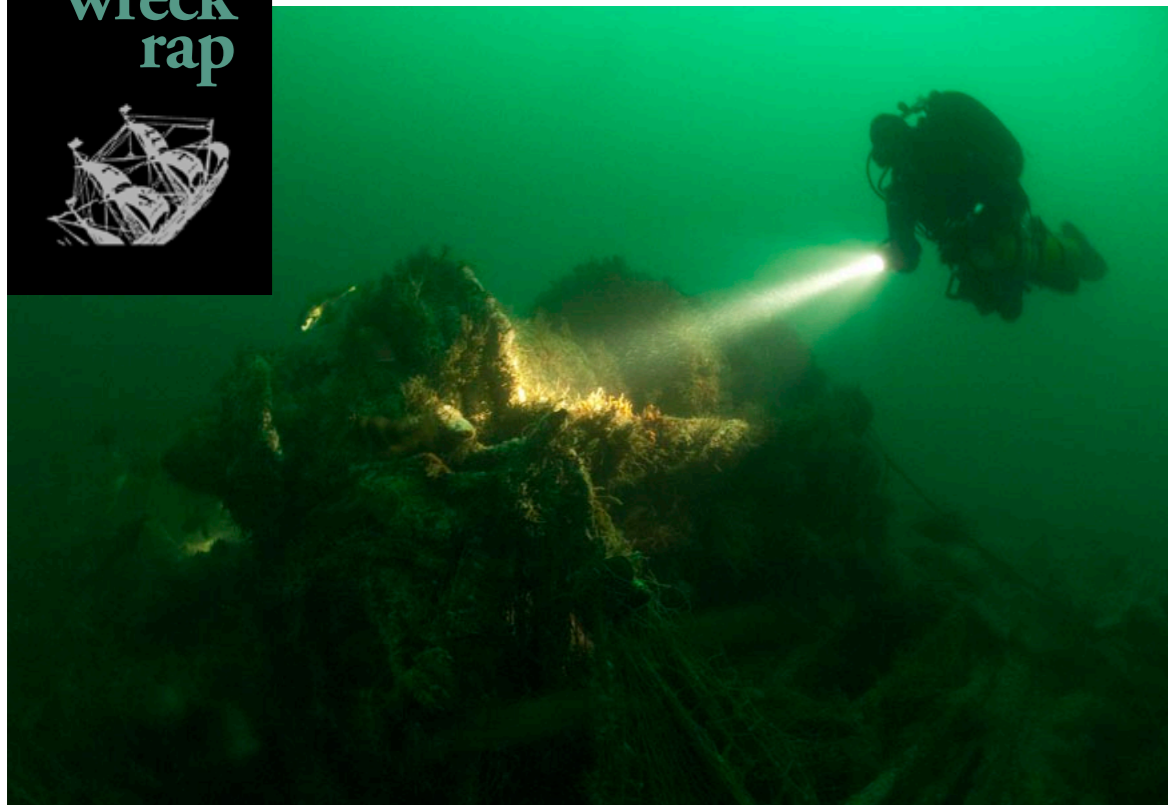
Diver at wreck of the *Empire Broadsword*



wreck rap



Diver on wreck of HMS *Computator*



tion to the deeper wrecks, many of which have been hardly dived at all.

HMS *Computator* was an armed tug that went down in January 1945 and rests upright on the seabed in 115 feet of water, the deck machinery and a gun all still in place. The *Turquoise* was an armed coaster that was torpedoed in 1942 and now lies intact in 140 feet of water, shrouded in fish life. Both wrecks stand 25 feet from the seabed and although much smaller than the large troop carriers, they are excellent dives.

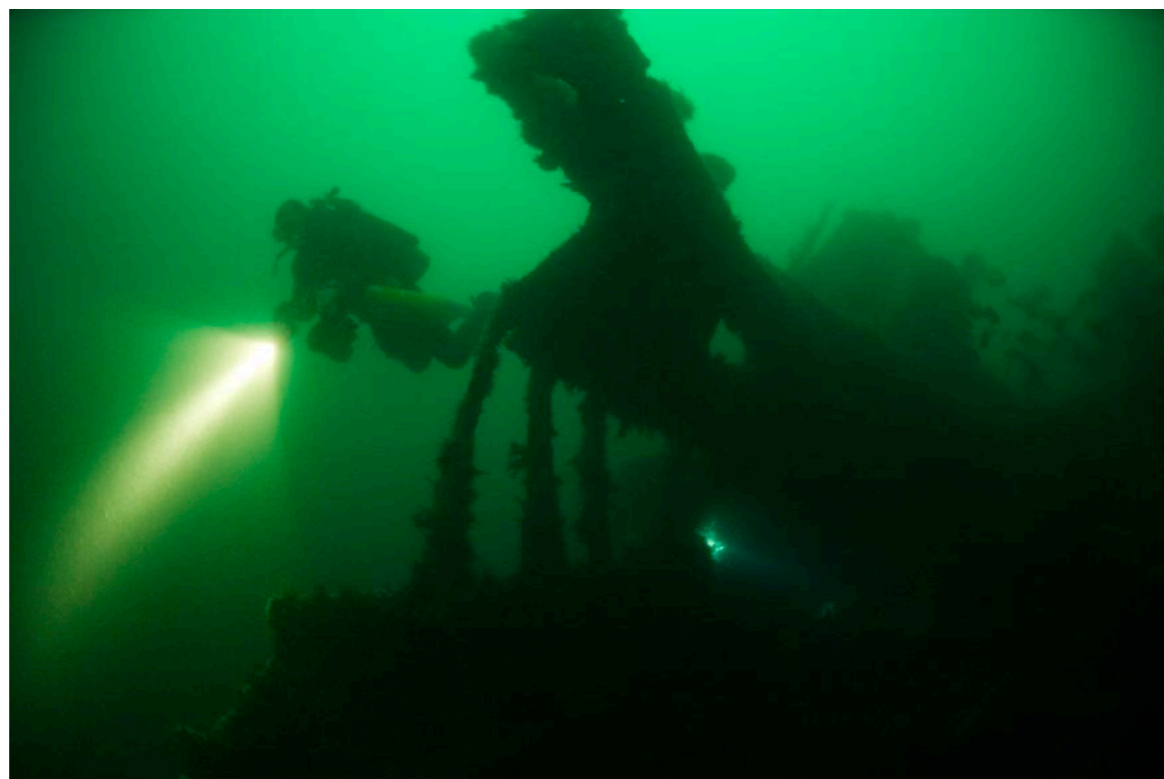
Beyond D-Day wrecks

The ships that sank in support of D-Day are not the only wrecks of interest in this bay. Throughout the war, ships were lost in this area, and as a busy shipping region, a fair few casualties occurred in peacetime also. As the week progressed, we turned our atten-

ing ship survived the June 6 landings, successfully deploying 18 landing craft to Sword beach. However, on July 2, the ship hit two mines causing such huge explosions that they blew several landing craft off the ship and inflicting heavy casualties.

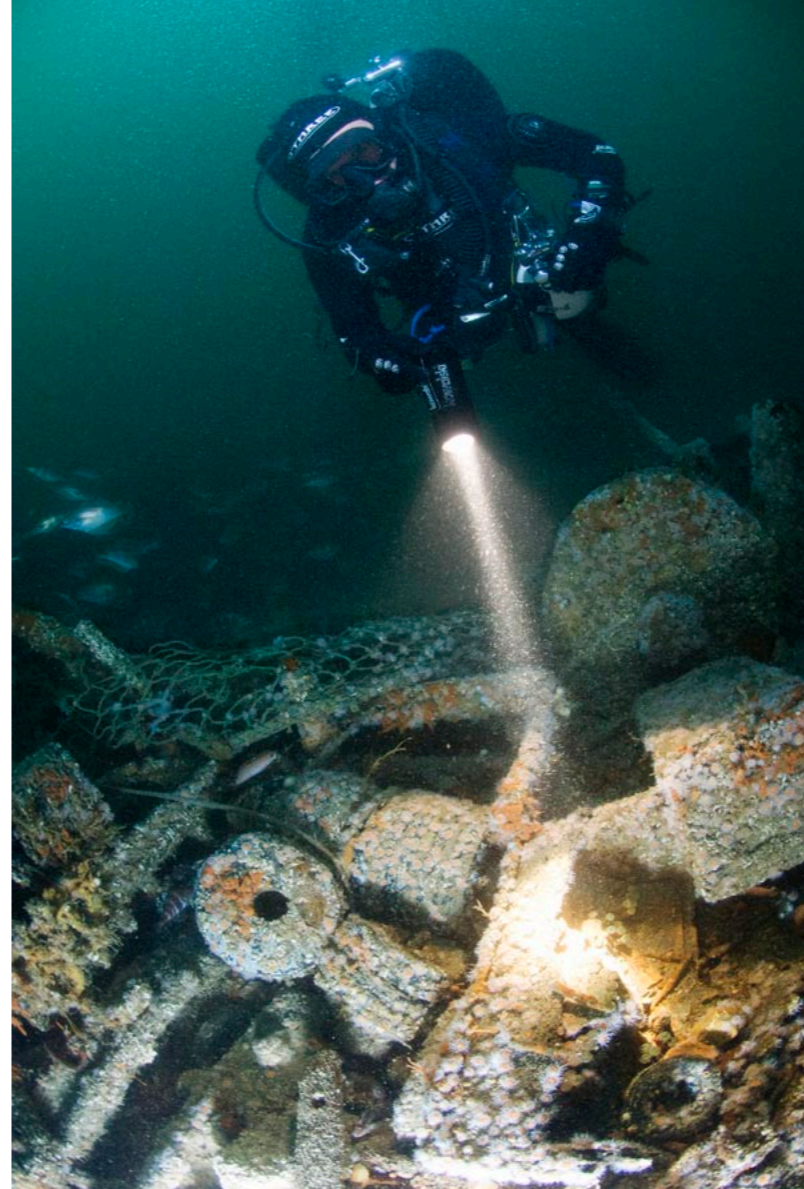
We were now given a taster of the changing visibility in this bay. Long gone was the 35 feet of visibility we enjoyed yesterday. We could now barely see ten feet in front of us, with the plankton so thick I could see it between my mask and camera.

We dropped to the stern at 90 feet amongst a load of live ammunition, something I was getting used to very quickly here. My initial disappointment at the water clarity soon disappeared, as I soaked up the atmosphere of this dive. The mine damage opened the ship up considerably, so reeling off, we explored the catacomb-like bridge sections. Gradually, we made our way up the ship, and as the current started to flow, we found ourselves sheltered behind the huge mass. We finished the dive at the bow of the ship, in only 30 feet of water since this wreck stood 60 feet off the seabed.



Diver on wreck of the armed coaster *Turquoise*

Diver illuminates artefacts on wreck of HMS *Computator*



During our week, we managed to explore 12 wrecks in the Baie de Seine, leaving over a hundred remaining for future visits. Before I came on this trip, my vision of D-Day centered on the thousands of troops trying to gain a foothold on the beaches, and in cases like that of Omaha, meeting fearsome resistance. I'd rarely spared a thought for the brave crews of the ships that took the troops to the beaches, those that faced the mines, fast attack boats and bombers whilst supporting the Normandy campaign. This trip changed that. The success of D-Day relied as much on the brave sailors who manned the ships as it did on the heroic troops who assaulted the beaches. Their combined sacrifice helped bring an end to one of the darkest periods in human history.

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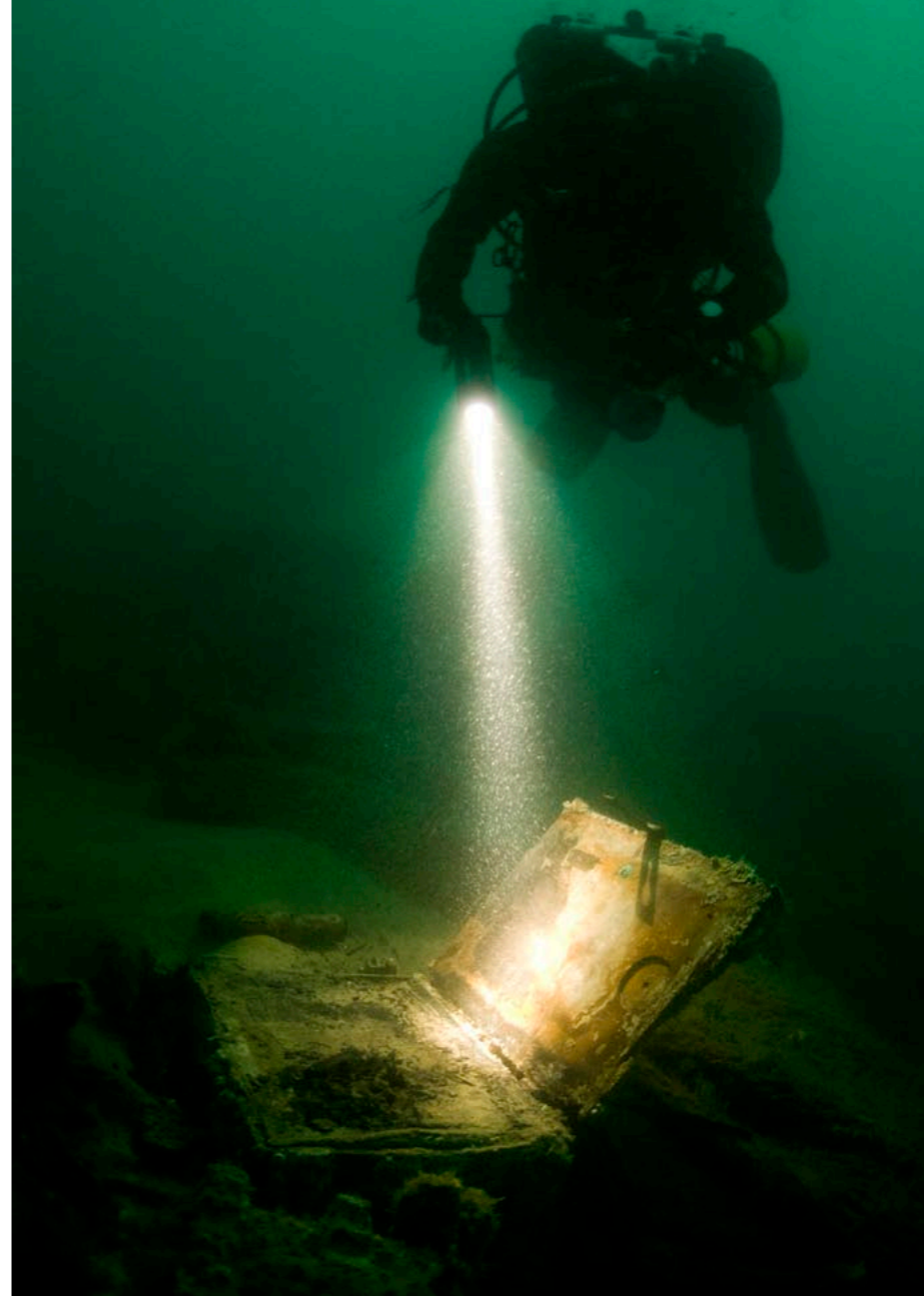
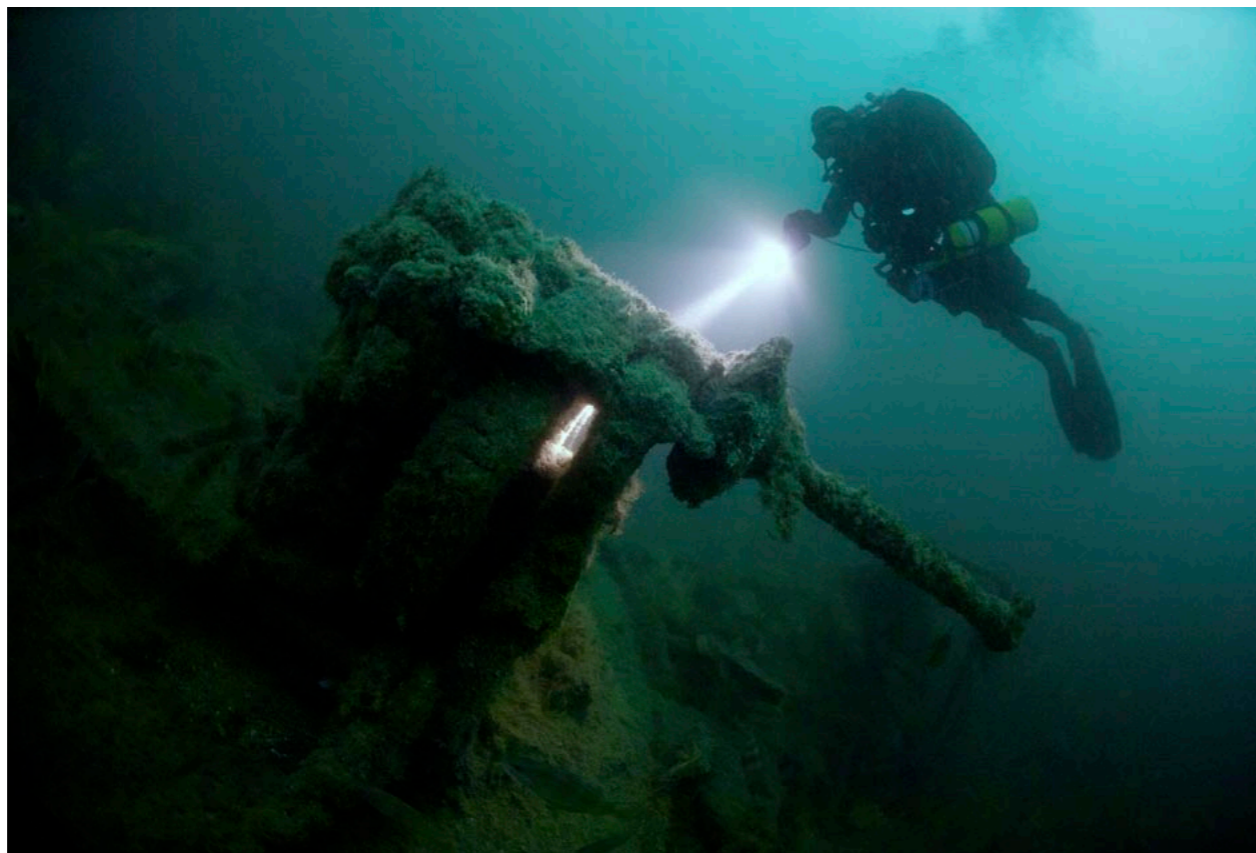
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Tanya Burnett





Diver on unknown wreck 137; Diver investigates artefacts on the wreck of mine-sweeper SGB-7 (far right)



What it takes

The variety of wrecks in the Baie de Seine offers something for experienced recreational divers through to technical divers. The shallower wrecks can be comfortably tackled with well-honed recreational diving skills, although you should be at ease in occasional low visibility and be adept at dealing with the

currents, which may be encountered at the beginning and end of your dive. Use of nitrox will ensure you get the most out of the two diving windows each day.

The deeper wrecks are more challenging and therefore rarely dived. This

is prime Advanced Nitrox territory where decompression skills, twin tanks of back gas and stages full of rich deco mix were needed for us to get the most out of our dives.

All divers need to be skilled in deploying delayed surface marker buoys from depth since fixed ascent lines are not used in these waters due to the currents. Drysuits were essential for us to stave off the cold during long run times. Finally, gas blending skills proved a huge bonus since nitrox was hard to find in this area.

Five photography tips

1. Go wide

Visibility is often poor in the bay, so you need to get as close as possible to your subject. Fisheye lenses perform best in these conditions, enabling you to get close to your subject while getting as much of the wreck in as possible.

2. Shoot with natural light

High sediment levels in the water makes

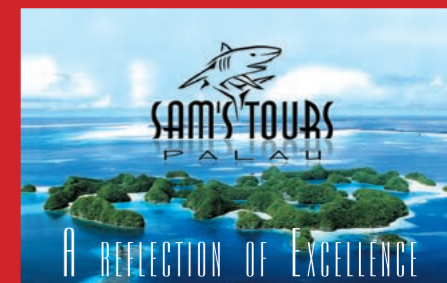
strobe lighting a challenge in these waters—backscatter is almost unavoidable. Try leaving your strobes on the boat, and instead, focus on the form and contrast of the wreck. This technique lends itself to black and white photography, but with some thought on your subject choices, you'll also get great results in color. Without those strobes, you'll also keep your clutter levels under control.

3. High ISO's

Cameras with excellent high ISO performance, such as Nikon's D700, are in their element in these conditions. On these wrecks, you'll want to be shooting at ISO 3200 or higher in order to get your shutter speed high enough to avoid camera shake. Even so, you will still need to keep



Diver on unknown wreck no. 137; there are hundreds of unidentified wrecks in the Baie de Seine



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Diver on unknown wreck number 137 (below); Diver on wreck of *Cornacopia* (lower right)



The Normandy American Cemetery and Memorial sits on a cliff overlooking Omaha Beach (left and below)



NEED TO KNOW

WHEN TO GO: May through September offers the best diving and weather conditions. The water may be subject to increased plankton levels in early and late summer. The bay is exposed and diving is at the mercy of local weather conditions, although there is plenty to do topside if the weather prevents diving on any day.

DIVE CONDITIONS: Diving can only be done in the windows when the tide changes, so only two dives a day are possible. Visibility can vary greatly from 5-18m/15-60ft and water temperatures range from below 10°C/50°F in early spring to a maximum of 17°C/62°F by September.

OPERATORS: The best way to dive the D-Day wrecks is via one of the British vessels that cross the Channel. We used Steve Johnson's excellent outfit, Channel Diver (www.channeldiver.co.uk), and based ourselves in the fishing village of Saint-Vaast la Hougue.

PRICE TAG: Boat hire for six days diving is approximately US\$700 each based on ten divers. Accommodation is approximately \$550 for a twin room based on two people sharing for the week. Hire of tanks and weights is extra.

TOPSIDE MUST-SEE: Be sure to visit the U.S. cemetery overlooking Omaha beach; it is an incredibly moving experience. Pointe du Hoc, where U.S. Rangers scaled the cliffs to knock out German artillery emplacements, is also thoroughly worth the visit, and the 30ft-deep craters will leave you wondering how any German troops managed to survive the preceding aerial bombardment. They did, and the subsequent fighting was fierce. Coupled with the historical interest, the Normandy countryside is beautiful, and French cuisine is world-renowned. Just make sure you include enough days to take it all in. ■

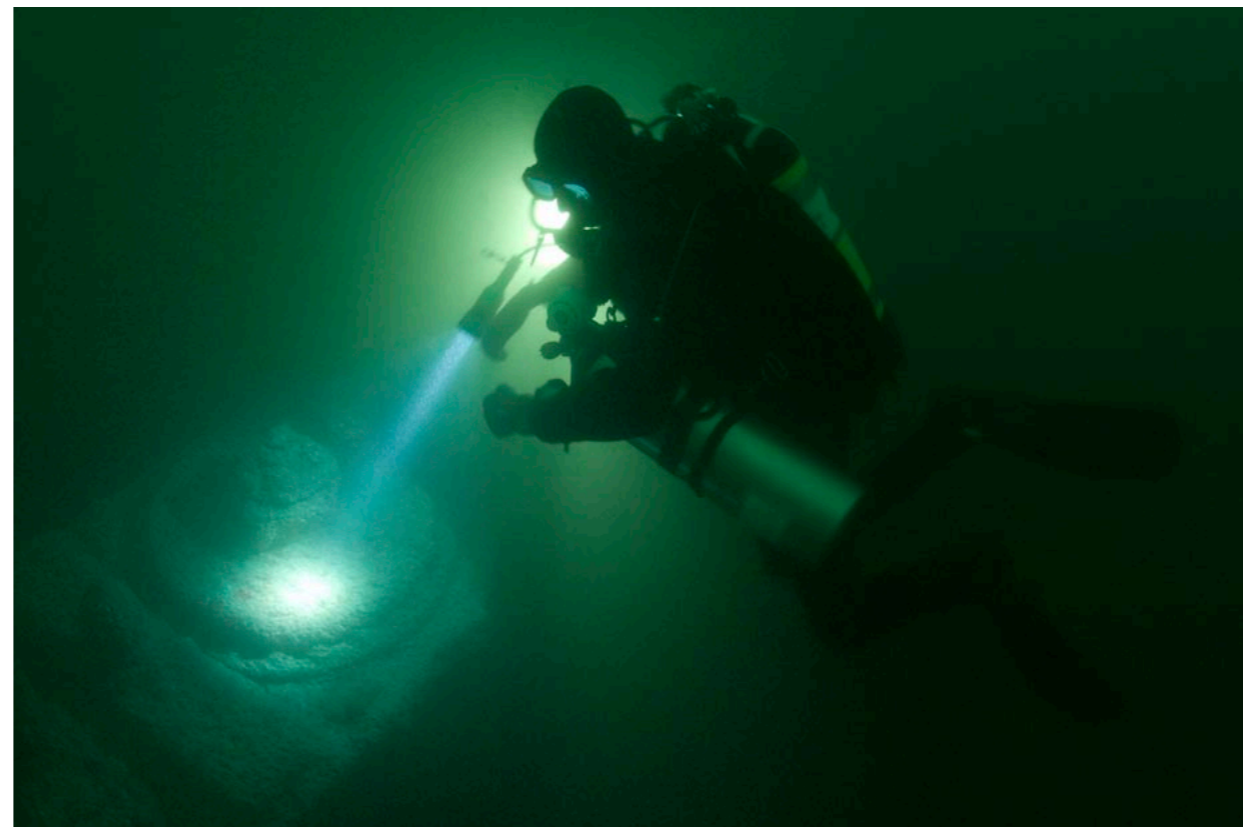


top quality aluminium housing is more than tough enough for a challenging life in the hands of a technical diver, and the optical glass dome is among the best available. The excellent ergonomics of the housing make it easy and intuitive to operate even with gloved hands. ■

Steve Jones is a widely-published underwater photographer and journalist based in the United Kingdom. For more information, visit: Millionfish.com

REFERENCES AND FURTHER READING:

- M. JAMES. *D-DAY WRECKS OF NORMANDY*. ISBN: 0953185605
- M. HASTINGS. *OVERLORD*. ISBN: 978-0330390125
- A. BEEVOR. *D-DAY: THE BATTLE FOR NORMANDY*. ISBN: 978-0141048130
- LT H. V. BARRETT, USNR. *EXPERIENCES ABOARD THE FIRST SHIP SUNK IN THE D-DAY INVASION OF FRANCE*. (OUT OF PRINT BUT TRANSCRIPT CAN BE PURCHASED ON LINE FOR DOWNLOAD)



the camera's aperture wide open, often needing to shoot at F2.8, so a big dome port (8 inches or bigger) is also desirable, as these perform best at such wide apertures.

4. Use models

Do you want to shoot color images without strobes? Then let your dive partner light the wreck for you, picking out key features with their dive lamps. Focussing on your dive partner's lamp will also greatly aid autofocus, which can struggle down there in the dark and murky conditions. This technique requires practice. Medium-powered dive lamps are more suitable

since high-powered HID and LED lamps can blow the highlights out completely from your image unless aimed properly.

5. Monopod and tripods

Even with high ISO's and shooting at F2.8, the deepest wrecks will still only give you shutter speeds of around 1/10th of a second. Monopods and tripods come into their own here and will increase your hit rate, but you will need to think carefully about whether you want that level of equipment clutter on a deep dive.

Ideal Equipment. SEACAM Silver housing for Nikon D700 with SD Superdome—this



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Designed in the early 1930s, the Do-17 was one of the three main Luftwaffe bomber types used in the first three years of the war

German WWII bomber raised from English Channel

The Dornier Do-17 aircraft was shot down off the Kent coast more than 70 years ago during the Battle of Britain.

Designed in the early 1930s, it was one of the three main Luftwaffe bomber types used in the first three years of the war. The Dornier Do-17, sometimes referred to as the "flying pencil", was a World War II German light bomber produced by Dornier Flugzeugwerke.

On 3 September 2010, the Royal Air Force Museum London announced the

discovery of a Dornier Do-17 buried in the Goodwin Sands off the coast of Kent, England.

Attempts by the RAF Museum to raise the relic over the last few weeks have been hit by strong winds but the aircraft was successfully raised from the seabed on 10 June 2013. ■

Shipwreck in Sweden revealed to be 15th century Danish Royal Yatch

Identification of the wreck is a global sensation, according to Swedish researchers.

Over 30 years after divers stumbled upon a centuries-old shipwreck, Swedish researchers have revealed that the wreck is the Danish Royal Yacht *Gribshunden*, (Griffen), which sank in 1495, according a report in Swedish media.

The wreck of the vessel, which was discovered back in the 1970s, is located near the Swedish town of Ronneby, about 180km northeast of Malmo.

Professor of marine archeology Johan Rönby is the man behind the revelation. He said it was a once-in-a-lifetime find.

"For all who are interested in ships and marine archeology, this is a world-wide sensation," he told the Swedish newspaper *Expressen*.

Property of King Hans

The Royal Yacht *Gribshunden*



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The ships of Columbus by Gustav Adolf Closs, 1892

belonged to King Hans and was on its way to Kalmar in 1495 to negotiate with Sweden details of the Kalmar Union.

Researchers had long suspected that the wreck found off Ronneby in the 70's was indeed the Danish Royal Yacht. "It has surpassed all our expectations," said Rönby.

"It's almost as if, as a researcher, one might feel guilty that we had not understood it sooner."

"A Columbus ship"

The ship is unique, as it is one of the first

Scandinavian wooden ships that was built using a technique in which boards were stacked edge to edge—the so-called carvel built style. Incidentally, it is the same type of ship that Christopher Columbus used when he discovered America in 1492.

"Simply put, it is a Columbus ship. It's a *Santa Maria*, we're talking about," said Rönby about *Gribshunden*.

"*Gribshunden* is of the same era as the *Santa Maria*, and there is no ship of this kind as well-preserved anywhere in the world," Rönby told *Expressen*. ■

SOURCE: JYLLANDS-POSTEN

New underwater historic wreck trail being developed off southern coast of England

A conservation group in the United Kingdom is creating what will be one of the largest underwater tourist trails in the world. By 2018, divers will be able to enjoy a well-signed trail of shipwrecks from the 17th to mid-20th centuries.

Currently, there are three sites to explore including the Georgian

warship HMS *Colussus*, sunk in 1798 off the Isles of Scilly; the *Coronation*, built in 1685 and lost in 1691 off Penlee Point near Plymouth; and the *Resolution*, which sank off East Sussex during the great storm of 1703. Soon a fourth site will be added—Britain's first submarine, the HMS *A1*, which sank in 1911 and was rediscovered in 1989 at Bracklesham Bay. All in all, the conservation group English Heritage aims to include more than a dozen underwater

attractions, each with underwater signposts and waterproof guide books.

More attractions will be added to the trail in the future, as there are over 61 sites designated under the Protection of Wrecks Act 1973—which is only a small fraction of what is believed to be the total of wrecks around Britain. A license from English Heritage is required before divers can visit the sites, as unlicensed visits to any of the sites are illegal. ■

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Panoramic shot of *Charles Brown* wreck marks tenth anniversary of Caribbean artificial reef

A decade ago, the Caribbean island of Sint Eustatius bought the *Charles Brown* for a buck. While a symbolic exchange, it was a bargain at one cent per meter of steel. However, the board and specifically AT&T wanted to go further and make the vessel an artificial reef.

Almost everyone on the island helped clean and prepare the vessel for sinking, which took place on 25 July 2003. It was a prime example of how a little island could accomplish big things.

At 100m (327ft) in length, the *Charles Brown* is one of the largest and most awe-inspiring wrecks in the Caribbean. Ten years later, the wreck has been overgrown with reef life, attracting not only divers but large schools of horse-eye jacks, sea turtles and a huge resident barracuda named Charlie. Over the years, thousand of divers have

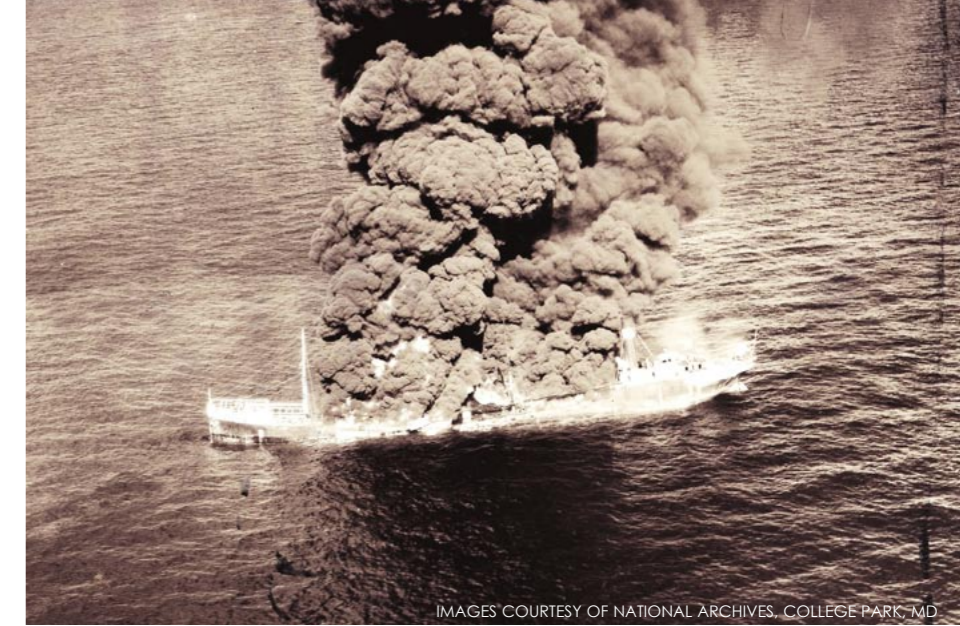
explored the wreck and observed the transformation of the naked white steel ship into a living reef, according to local operators.

"Like a good bottle of wine, it's getting better and better every day," said local underwater photographer, Mike Harterink, in a press release. Harterink, who is a PADI Course Director and DAN Instructor Trainer at the Scubaqua Dive Center on Sint Eustatius, has compiled a panoramic image of the *Charles Brown* to mark its tenth anniversary as an artificial reef.

"To get this photo, I was hanging on my SMB at ten meters below the surface, pushing the shutter about every ten meters while swimming over the wreck," stated Harterink. "Stitching the photo's together afterwards took a whole lot longer."

For more information: Scubaqua.com ■

Burning tanker *Potrero del Llano* Photo taken on 14 May 1942 by U.S. Army Air Corps



IMAGES COURTESY OF NATIONAL ARCHIVES, COLLEGE PARK, MD

NOAA identifies 36 wrecks as possible oil pollution threats

There are over 20,000 shipwrecks in U.S. waters. Some of them are leaking oil, according to a new report submitted by the National Oceanic and Atmospheric Administration (NOAA) to the U.S. Coast Guard.

In a press release, resource protection coordinator for NOAA's Office of National Marine Sanctuaries Lisa Symons said, "This report is the most

comprehensive assessment to date of the potential oil pollution threats from shipwrecks in U.S. waters." Symons added, "Now that we have analyzed this data, the Coast Guard will be able to evaluate NOAA's recommendations and determine the most appropriate response to potential threats."

In the report, NOAA found 36 sunken vessels resting on the U.S. seafloor that may pose an oil pollution threat, risking the health of the nation's coastal marine ecosystems. Seventeen of these wrecks were recommended for further assessment and possible removal of oil and oil cargo.

Over a hundred years of U.S. commerce and war



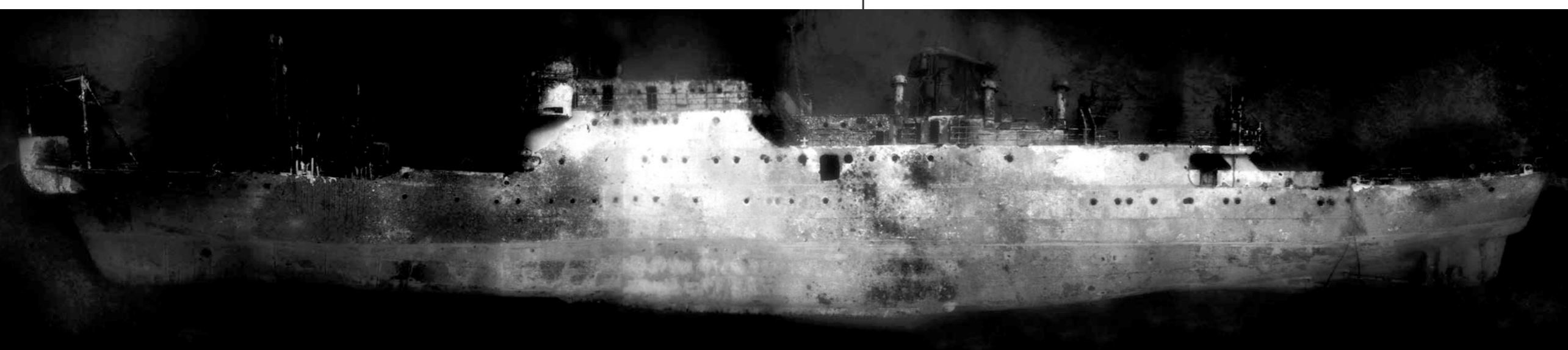
Map shows over 20,000 shipwrecks in U.S. waters

history are represented in the wrecks of the sunken vessels. Some were lost at sea in rough storms or in collisions and explosions. Others were lost during WWII, most of them off the east coast in the Atlantic Ocean and south in Gulf of Mexico.

NOAA's report will help oil response planning efforts, as well as resolve some mystery spills in which the source of the oil was not identified.

"The Coast Guard is pleased to receive these risk assessments from our partner agency NOAA and looks forward to our continued coordination on the matter of potential pollution associated with sunken vessels in U.S. waters," stated Captain John Caplis, the Coast Guard's chief of marine environmental response, in a press release. "Coast Guard federal on-scene coordinators receiving the risk assessments will carefully review the data and incorporate it into their area contingency plans."

So, who pays for the clean up? If the particular wreck still has an identifiable owner, that owner is responsible for the clean up. If there is no owner, then the Oil Spill Liability Trust Fund will most likely be tapped, according to the U.S. Coast Guard, who are charged with not only protecting those at sea and the sea itself but also response to maritime oil spills and the release of hazardous substances. ■



Wreck of the *Charles Brown*. Panoramic shot by Mike Harterink



The Oldest Wreck in the World **Uluburun**

Text by Rico Besserdich.
Images courtesy of the Museum of Underwater Archeology in Bodrum and the "360 derece" research group in Turkey

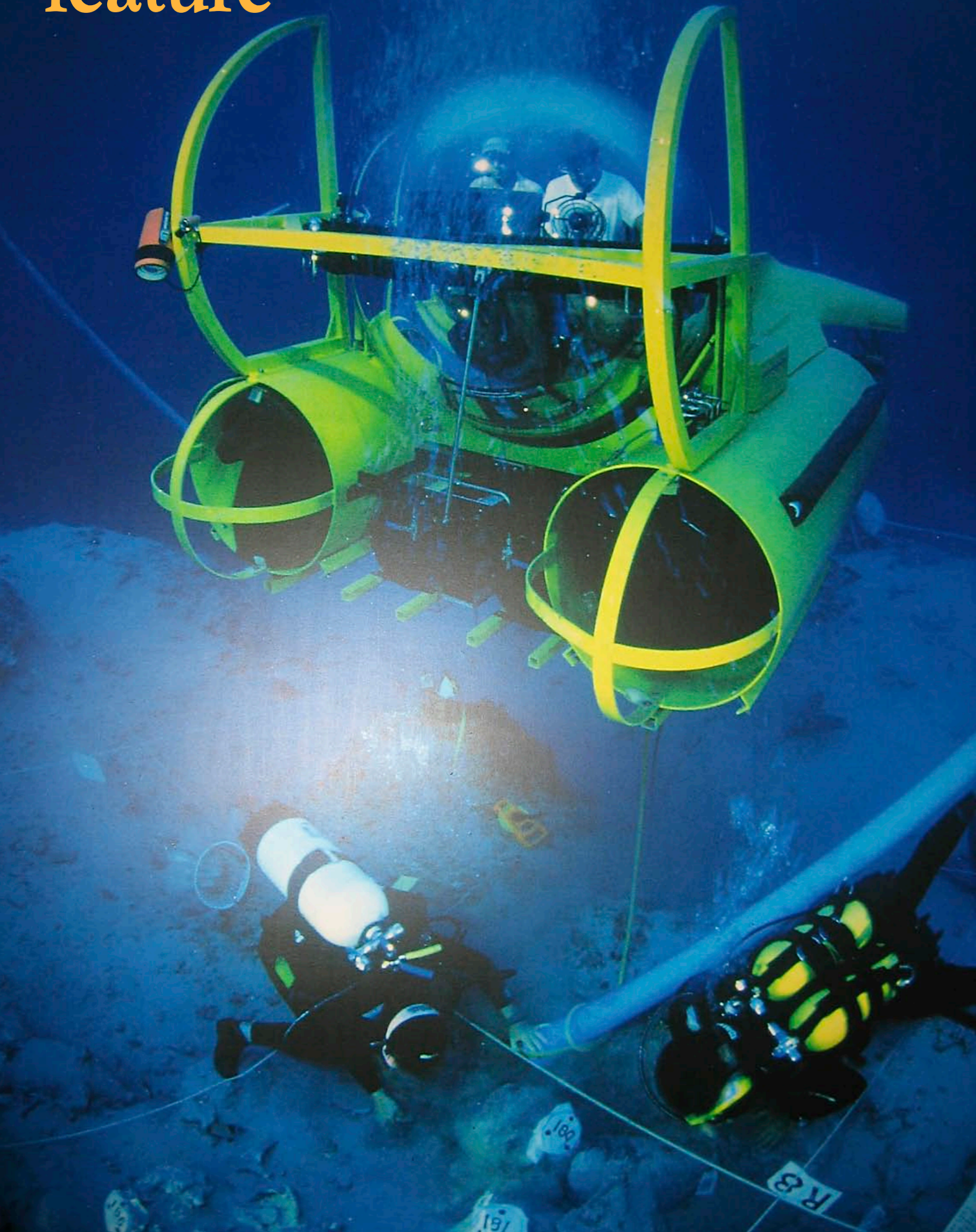
1300 BC—A merchant ship, laden with treasures from seven different cultures and commodities of Cypriot origin was traveling on a 1,700-mile trade route when it sank for unknown reasons at Cape Uluburun (near Kas on the south coast of the Antalya region of Turkey). Much knowledge about prehistoric trade and nautical navigation during the late Bronze Age, including secrets that could rewrite the whole story, began a sleep on the sea floor—a 3,300-year-long sleep.

1982 AD—A Turkish sponge diver discovered the remains of the wreck. This triggered euphoria among archaeologists around the world, and the later recovery and analysis of the findings definitively established underwater archeology as a serious science. Science was able to answer 1000-year-old questions, driving traditional analysts into desperation and changing the existing historic world view substantially.

Named after the place where it was discovered (Cape Uluburun), the *Uluburun* is the oldest known shipwreck in the world and a finding of superlatives. She brought answers to many questions, but she also introduced many new mysteries

A 1:1 replica of the *Uluburun*, built with the use of Bronze Age materials and craftsmanship, sails the Mediterranean Sea. Image provided by the "360 derece" research group, Turkey





Submersible *Carolyn* (left) of the U.S. Institute of Nautical Archeology at excavation site of *Uluburun* shipwreck and camp of the archeologists (right) during the ten-year period of excavations, Cape Uluburun, Turkey

that science has yet to explain, even today.

The Bronze Age

The *Uluburun* sank during the so-called Late Bronze Age. The Bronze Age—it sounds terribly old, doesn't it? Indeed it is! It was a time when the invention of the wheel was as remarkable as the invention of social networking is today.

The Bronze Age in itself was the successor to the Stone Age and the predecessor to the Iron Age. It lasted from about 2200 to 800 BC, but did not occur everywhere at once, because different cultures experienced different stages of development in terms of bronze. We are talking here about a general and broad time window.

The namesake of this period

was the metal alloy bronze, which comprises 90% copper and 10% tin. The use and processing of metals was already known to humanity, but it was limited to sterling metals (naturally occurring pure metals), such as gold, silver and copper.

The “invention” (mainly in Europe and the Middle East) of humanity's first alloy (which was much harder than copper) triggered a worldwide change with lasting consequences.

We could say the last trip of the *Uluburun* was in some way a consequence of these changes.

Along with the invention of bronze, the necessity to organize a “metallurgy chain” became apparent. Production needed tin, which was rare and not available everywhere. The appropriate logistics became essential.

With bronze, it became possible to accumulate wealth that was easy to transport; Bronze ingots were a common payment currency of the time, and where there is wealth, conflicts arise. The simultaneous emergence of heavily fortified settlements and the invention of the sword shows that our ancestors experienced troubles with jealous neighbors who tried to get their “undeserved” share.

Bronze also caused a serious upheaval in the social structure. The access to, and control of, resources (such as metals, metallurgy, communications and trade routes) resulted in the emergence of an upper social class and induced differentiation among people, the consequences of which we still feel



Archeologists working on first excavated findings

Uluburun



Replica of the *Uluburun* (right and left)—how the finding looked underwater; Excavation works (below). Images taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey

and transport at the time.

However, a fine structural difference with the *Uluburun* is that its pegs were not secured by wooden pins. This technique would later be called “Fenike-mortising” by the Romans. The *Uluburun* was certainly built for use at sea, which refutes the thesis that sailing in the Bronze Age was done exclusively within sight of the coast.

Because only about three percent of the ship's original hull was recovered, drawings from ancient Egypt, specifically the pictorial representation of the “fleet of Queen Hatshepsut in the land of Punt” (1500 BC), provided a significant visual reference for reconstructing the ship. After extensive research, we now know:

- The *Uluburun* was 15 meters long, 5 meters wide and had a draft of 1.4 meters. Her cargo is estimated to have been 20 tons. The width of the ship's trim was 6cm, and the pegs were at a distance of 20cm.
- The ship used a triangular sail, which provided a maximum speed of two nautical miles per hour, and two rudders to maneuver.
- The Turkish research group “360” proved this ship was oceangoing in 2005. By using techniques and materials from the late Bronze Age only, the “360” group built an identical

even today.

The geographically uneven distribution of metal deposits (particularly tin) resulted in a far-reaching and almost global trading network that also spread cultural ideas in addition to goods. Bronze was essentially pioneering the cross-border communication of knowledge between cultures. Even today, good ol' bronze has an essential word to say in the world of digital communication: No computer works without the elements of bronze. No bronze would mean no online social networks.

While our *Uluburun* sailed the seas, the world-famous bust of Nefertiti was made in Egypt. Odysseus returned home from his long odyssey. The Egyptian Pharaoh Echnaton established the first monotheistic religion. Moses' successor Joshua led the Israelites, and the Hittites dominated an area five times larger than Germany. These were turbulent times—from Haithabu to Karnak, as well as at Cape Uluburun on the southern Turkish coast, where a merchant ship with a cargo of priceless goods sank to its grave.

The Ship

The ship was built of cedar using the so-called “spigot technique,” which involves building the outer hull first and adding the



underlying “skeleton” (the frames and bars) later. Even 1,000 years after the demise of the *Uluburun*, this technique was still used to build Roman and Greek ships.

Archaeological finds in Egypt suggest that the archetype for this ship probably came from ancient Egypt. In particular, Pharaoh Echnaton drove the development of more resilient oceangoing ships to advance trade

replica of *Uluburun* and successfully sailed the Mediterranean.

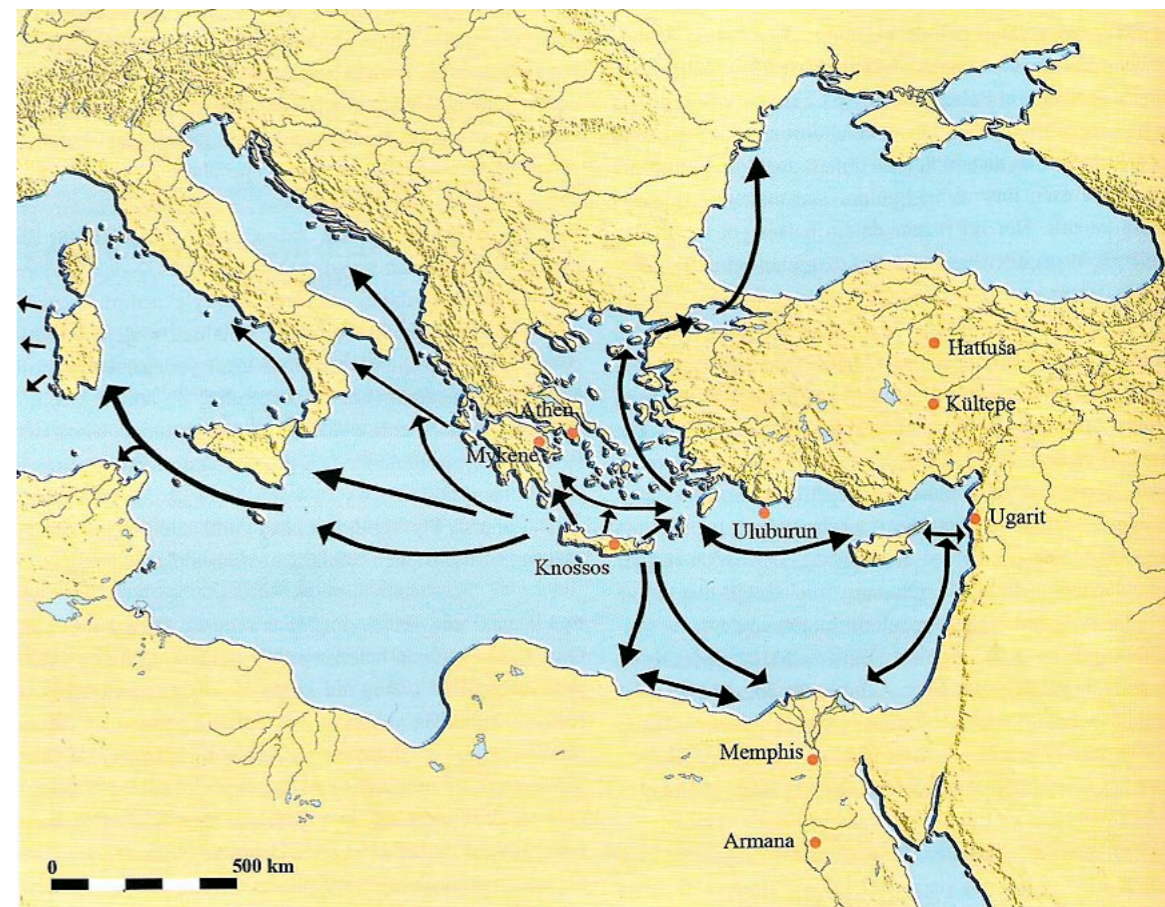
The following is the probable route of the *Uluburun*. From her home port on the Levantine coast, she sailed fully loaded to her (unknown) Mycenaean destination port. At night, she anchored in ports along the Turkish coast. The planned way back may have then taken her towards Marsa Matruh in northwest





Amphorae—Ancient cargo storage. Image taken with special permission at Museum of Underwater Archeology, Bodrum, Turkey

Trading routes of bronze during the late bronze age



common way to transport metal at that time, making carrying and securing the precious resource on pack animals and ships easier.

News of this discovery brought the Turkish archaeologist Cemal Pulak M. on the scene. Cemal was at that time an assistant to George F. Bass, the founder and director of the Institute of Nautical Archaeology (INA) in Texas, USA. After checking the “biscuit with ears” description, Pulak also dived at the site to see the ingots and also noticed several amphorae and ancient stone anchors. He initiated, together with George Bass, one of archeology’s most complex excavation projects at the time.

The discovery of the *Uluburun* was, and still is, regarded as a major discovery of the century, and neither means nor effort has been spared to finally obtain answers to so many unanswered questions about the late Bronze Age. The archaeological significance of *Uluburun* is compared with the grave of Pharaoh Tutankhamen. Two years after the discovery, the excavation was initiated.

As technical capabilities and know-how in Turkey were limited at the time, George F. Bass (known as the “father of underwater archeology”) provided extensive support and technology on behalf of INA.

INA sent its own research vessel,

the *Virazon*, to Turkey. The *Virazon* was equipped with a decompression chamber, side sonar, a proton-Magnometer, a compressor, an echo sounder, GPS, underwater scooters and a two-person submarine, *Carolyn*. It was the best that money could buy at the time.

On the rocks of Cape Uluburun, only 50 meters from the wreck’s location, a mobile village was built on stilts where the Turkish–American team of archaeologists experienced a veritable Robinson-Crusoe-style life far from civilization. During the ten years of excavation operations (1984–1994), archaeologists lived three months every year on a windy cliff, miles from the nearest village. In this solitude, George Bass and his wife, Ann, even spent their honeymoon.

Yasar Yildiz, now director of the Underwater Archaeology Museum in Bodrum, was actively involved as an archaeological diver in *Uluburun*’s excavation. Yildiz found a gold medallion of Egyptian origin at about 45 meters deep. He was also present during the salvage of the very first artifact in 1982. The wreck’s excavation comprised 22,413 dives over 6,613 diving hours at

depths between 44 and 61 meters (134 to 210 feet).

Dives at the wreck were done “barefoot” (without fins) to protect the artifacts and avoid disturbing the sediment as much as possible. TriMix was already around, but at the time, it was reserved solely for military use, so all dives were made with standard air, usually with double 12- or 15-liter tanks.

The data from each dive was recorded manually, not only to monitor the recovery, but also to ensure the safety of the divers. Each diver had a limited bottom time and mandatory surface breaks. The staff responsible for dive safety had a tricky job keeping enthusiastic archaeologists safe.

After mapping the wreck and its artifacts, each diver was assigned a grid square for which he was responsible. Recovery occurred only after surveying and documenting everything. Major findings were salvaged using lifting bags, while smaller

Egypt. The currents and winds in the area suggest such a route, as the *Uluburun* was unable to cross winds due to her simple sail.

Discovery and rescue

—Coordinates 36 ° 7 ' 43 "N, 29 ° 41' 9" E. A Turkish sponge diver named Mehmet Çakir was the official discoverer. In 1982, while

diving for sponges, he noticed an “odd structure” at a depth of 45 meters. He described it in his own words as “looking like a metal biscuit with ears”. It turned out that these “ear cookies” were oxhide ingots, which are ancient plates of raw copper with a shape reminiscent of dried ox hides. Oxhide ingots were a



Author Rico Besserlich and Yasar Yildiz, who was one of the archeological divers during the excavation of the *Uluburun* and who is today the director of the Underwater Archeology Museum in Bodrum, Turkey



Gold findings; Golden amulet showing Egyptian pharaoh Nefertiti (right)

artifacts were transported by the archaeological divers to the light of surface.

A total of 18,000 artifacts were recovered, some fully preserved and others fragmented. According to INA, after three months of excavation work underwater, two years of scientific work for the restoration, preservation and determination were needed. A total of 30 months underwater work resulted in 20 years of scientific

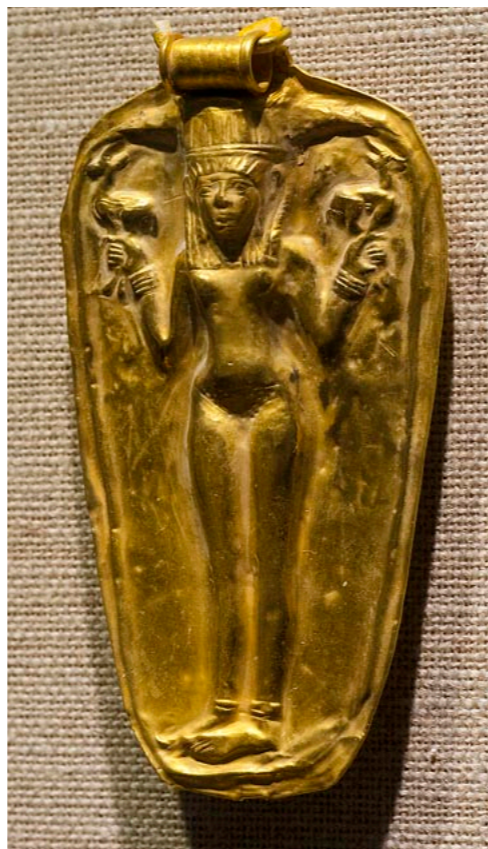
and archaeological reworking. Although the excavation was completed in 1994, the follow-up work still continues today. After 3,300 years rest on the sea floor, the *Uluburun* will not give up her secrets in a "short time" of just 20 years.

Treasures of Uluburun

The cargo of the *Uluburun* contained artifacts from seven different cultures: Mycenae, Kenan, Cyprus, Egypt, Kessiten,



Assyria and Nubia. This diversity of the various trade goods from different countries demonstrated how a very brisk trade took place over the sea 3,300 years ago. It is speculated that the *Uluburun* was a royal ship or of royal commission, but this cannot be proven.



The main cargo was ten tons of copper of Cypriot origin, divided into 354 oxhide ingots. There was also a ton of tin stored in 150 jars of Canaanite origin. Prior to this discovery, it was unknown to science how tin was transported at the time.

Part of the cargo was 175 glass ingots of various colors. Assuming that glass production had just been invented in Egypt, the glass items alone must have been priceless at the time.

Egyptian ebony, several ostrich eggs, elephant tusks, more than a dozen hippopotamus teeth and various processed turtle shells were almost certainly intended as an ensemble for early stringed instruments.

Also present were Cypriot ceramics, a huge amphora (130cm high) bearing the seal of Nefertiti, pomegranates and olive oil, gold jewelry, spices, 149 trade weights in the form of animals, cosmetic containers made of ivory in duck form, arrowheads, bronze swords and spears, oil lamps, a small bronze sculpture of the goddess Astarte (probably a

of personal use, such as fishing equipment, blades, needles for repairing fishing nets and typical boating features in the form of 24-stone anchors (two actually used as anchors, and the rest probably used as ballast).

The *Uluburun* carried the finest goods from the advanced civilizations of the Mediterranean. Its sinking must have hit its owner (or his client) hard financially.

If we measure the value of the ship's cargo by today's standards, we could imagine a 200-meter freighter loaded with 250 Ferrari 612 Scagliettis, 100 Hasselblad H4D medium-format digital cameras, two or three paintings by Da Vinci, 500

The oldest ship logbook in the world. All images this page taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey

lucky charm), hundreds of other ornaments (made from glass, cobalt, gold, bronze and electron), amber, pearls, and a gold scarab with the cartouche (name seal) of the Egyptian Queen Nefertiti. In addition, there were many articles

Rolex Yacht Master watches, 100 bottles of Mouton Rothschild (1945) and 100 bottles of perfume No. 1—Imperial Majesty Edition by Clive Christian (which goes for 250,000 AUD per bottle). Its sinking would cost the owners 275 million Euros (about 349 million AUD) and drive them into the deepest depression.

Many artifacts found threw up a new mystery. It was assumed at the time of the *Uluburun* pharaoh that Nefertiti was already dead, and the new Pharaoh Haremhab had left no stone unturned to eliminate all evidence of the existence of Nefertiti and her husband Akhenaton. Nevertheless, a golden scarab and



"Metal cookie with ears" —Bronze ingot



Golden statue of the goddess Anastarte

several sealed jars were found with her name on them. An unaccredited but persuasive argument suggests that the name of the great pharaoh, even after her death, was still a great force of protection, and therefore her name was used to protect the merchandise.

Similarly, two high-quality swords and ceremonial sticks indicate the presence of at least two high-ranking passengers, possibly of Mycenaean origin, possibly a royal emissary?

to look at chaos. The structure would not be recognizable to a layman as a shipwreck, and even the copper cargo seems at first glance more like a pile of scrap metal ("metal biscuits with ears"). Only through persistent and extremely careful archaeological and scientific work could salvaged treasures and secrets be revealed.

Three percent of the original hull had been preserved, which we lay people would not even have recognized as timber. Nevertheless, these wood

Age determination

We have to distance ourselves from the romantic notion that an aging shipwreck stays stylish and decorative, or that it waits in its entirety on the ocean floor for our discovery. Looking at the *Uluburun* initially was

residues made determining the age of the wreck possible at all. For this purpose, dendrochronology—from the Greek dendron (meaning tree), chronos (time), and logos (science)—was used to assign the pattern of the annual tree-rings (based on their different widths) to a particular known growth time. This of course also works on wood already in processed form (planks). The findings sparked controversy at the end, with fluctuations of plus or minus 200 years in determining the age of the *Uluburun*.

The dendrochronological analysis of the wood (the remains of the hull and extra firewood the sailors carried) showed a date of 1306 BC. It may have been two to three years later that the *Uluburun* sank, but the ship itself may have been even older. The generally accepted estimate is 1323 BC.

History is rewritten

"The *Uluburun* writes the story in a roundabout way," said Cemal Pulak, field director of the Institute of Nautical Archaeology (INA) in Texas. "So far, we

considered Greece to be the cradle of modern civilization, the glorious Bronze Age Greeks. The Mycenaeans were seen as paving the way for almost everything that our society makes: our thinking, our political actions, and even our lives. Now we have the first evidence of an overwhelming influence from the East."

The sailors of the *Uluburun* were not Mycenaeans, but Canaanites, ancestors of the Phoenician Semithischen. This little-known people developed the first long-



Bronze Age farming tools. All Image this page taken with special permission at Museum of Underwater Archeology, Bodrum, Turkey

Uluburun

distance trade over sea. The discovery of amber from the Baltic Sea area in the *Uluburun* wreck shows the extensive reach of the trading network.

"This ship is the king," wrote the Minister of Alaschija (Cyprus) as agent of Egypt. This correspondence is known as the "Amarna letters". In 1887, clay tablets were found showing the active exchange between the Egyptian court and foreign kings. Was the "ship of the King" meant to mean the *Uluburun*?

"I will bring you a gift of two hundred talents of copper," the king wrote to the Egyptian Pharaoh of Alaschija. Was this the *Uluburun*'s primary mission?

Before the discovery of the *Uluburun*, it was unclear how much a "talent" (an ancient unit of weight) actually was. The 354 copper ingots found brought light onto the matter; Each ingot weighed 27–28kg, and the cargo of approximately ten tons of copper corresponded closely to the amount of 200 talents. It is clearly evident that 3,300 years ago, an early "DIN standard" aimed to define a talent as 28kg. Two hundred talents was enough



Golden amulett

Findings from the Uluburun: Oil lamps.
All images this page taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey



were only found in royal courts. There were at least three literate dealers on board, which

was proven by the discovery of a wooden diptych, a double panel of boxwood with ivory hinges. This diptych is the earliest notebook known in human history. Text was written on wax tablets, but they

of classical archeology. Now, 3,300 years after her demise and 29 years after her discovery, the *Uluburun* is still a mystery that keeps the world of archeology in suspense, even



to equip a small army. Sufficient metal for 5,000 spearheads, 5,000 helmets, 5,000 swords, and 5,000 sets of armor. This was a truly royal gift, and the basis of the "Amarna letters" increases the likelihood of this being the mission of the *Uluburun*.

George Bass was in his early days often derided, because back in the 60's, he promoted the theory that the people of Canaan were influential in terms of navigation, commerce and industry, and that they were far more influential than the Mycenaeans. With the discovery of the *Uluburun* and its findings, the laughter stopped. Bass said, "Fortunately, this shipwreck surfaced during my lifetime."

This vessel contained the

largest ever collection of raw materials found. Other finds in the Mediterranean area consisted mostly of already processed materials, often of Mycenaean craftsmanship. The *Uluburun* proves the powerful Mycenaeans of the Kanaanärn were in some way dependent on others. A far-reaching consequence was, among others, that the work of Homer, including his *Iliad* had to be re-dated. He was previously thought to have lived in the Iron Age, but the events of the *Iliad* are now clearly Bronze Age.

The precious gifts of the *Uluburun* were so ostentatious that these were probably intended as additional gifts for a royal house. Also, the skills to craft ebony (which was also part of the cargo)



Skull decorated with gold; Jewellery from the Uluburun (top right)

have unfortunately not survived the thousands of years.

It is believed that a battleship would take a more direct route from A to B, rather than trading goods and commodities in different ports like you would expect from a merchant ship. However, this would only apply if the Amarna letters actually referred to the *Uluburun*. Finally, we know it, but it seems questionable whether a direct relationship would ever prove the crux

if what they have revealed so far is phenomenal! The exhibits and a full-size replica of the ship *Uluburun* are displayed in the Museum of Underwater Archaeology in Bodrum, Turkey.

Our only consolation is this: After our freighter with our beloved (and expensive) Mouton Rothschild 1954 wine bottles has sunk, we inform our insurance company quickly by e-mail from our computers, with bronze (the bringer of all evil or all joy—who knows?) ensuring a clean data transmission. ■

Rico Besserlich is a widely published dive writer and underwater photographer based in Izmir, Turkey. For more information, see: Maviphoto.com



Hollis Gear and NAUI team up on new Prism rebreather training

A new rebreather certification course has been announced by Hollis Gear and NAUI. The Prism 2 CCR Diver and Instructor certification course is now available for divers and instructors.

"I have been diving a Prism CCR since 1997," said Director of NAUI Technical Training Division Tim O'Leary in a statement. "We think that the Prism 2 will be a great addition to the training programs that NAUI has to offer."

John Conway, Training Director

of Hollis said, "We are very excited to have NAUI professionals offering training on the Prism 2. NAUI professionals are known for their dedication to training around the globe."

For more information, visit NAUI.org and Hollis.com. Interested dealers can contact their regional managers for additional information on becoming Hollis Prism 2 dealers or call Hollis Gear at 888-383-DIVE. ■



Pool session with a Hollis Gear Prism Rebreather

DEMA and DAN offer diver awareness poster

In order to keep divers safe this season, DEMA and DAN have joined together to offer a Dive Flag Awareness poster as well as a 15- and 30-second public service announcement, with assistance from the National Safe Boating Council and the United State Coast Guard. The spot educates divers and boaters of the correct way to use a dive flag to warn boaters that divers are in the water and should keep a safe distance.

"Our goal in sharing this important message is to remind both divers and boaters that they often share the same waters and in order to ensure an enjoyable experience, all must adhere to necessary safety precautions," said Executive Director of DEMA, Tom Ingram. "By increasing the awareness of the divers-down flag we hope to keep diving and the waterways safe for everyone this summer."

You can download the Dive Flag Awareness poster and get more information at: Dema.org ■



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New SSI/Poseidon professional program marks big change in recreational scuba diver training

Scuba Schools International (SSI) and Poseidon have joined forces to improve bottom time for divers by developing the Mark VI rebreather partnership. Once the domain of highly technical, analytical divers, the new rebreather technology is making waves in the dive industry as easy-to-master rebreather units are swiftly replacing standard open water scuba.

"The Mark VI unit is designed with the recreational scuba diver in mind," said Steve Newman, SSI International Technical Training

Director. "There is a revolutionary change happening in the scuba marketplace and the Mark VI rebreather is at the forefront of these changes."

Newman recently conducted the first 80-hour "Full Immersion" Mark VI training program in Grand Cayman in which a group of elite SSI training professionals came together to learn how to "migrate" from being standard open-circuit scuba instructors to full Mark VI Open Water Rebreather Instructors. The program included 12 dives and over 20 hours

bottom time with the new SSI/Poseidon training materials.

"The first part of the recreational rebreather revolution is helping the instructors to 're-think' the entire training process," said Newman. "Rebreather divers speak their own language and this 'immersion' program is the first step in transforming the process."

The Mark VI is lightweight and designed especially for recreational divers so that new divers can actually start their journey into the underwater world as rebreather divers and not as

scuba divers—a concept that is revolutionary in the dive industry.

"In the past, rebreather divers needed to be open-circuit, open water certified recreational divers first. Then, they would learn about the many elements of becoming a rebreather diver," said Newman. "This unit and the cooperative training between SSI and Poseidon means new divers can start with rebreathers if they choose to."

For more information visit: www.divessi.com ■



FCC to improve in-flight Wi-Fi

Tired of paying a stout fee for sluggish in-flight Wi-Fi? Well, there's good news—the U.S. Federal Communications Commission (FCC) wants to increase Internet speed for airline passengers. Their new proposal would free up 500 megahertz of airwaves for use in air-to-ground broadband—a vast improvement from, say, Gogo Inflight Internet's current utilization of just 3 MHz for 3G data service connection, further slowed by being spread out over hundreds of in-flight Wi-Fi users.

Julius Genachowski, the FCC's outgoing chairman, said in a statement: "This service would help meet consumer demand by

offering airline passengers access to better in-flight broadband and will increase competitive pressure on current systems to improve the quality of their in-flight services."

The proposal is fully backed by Qualcomm, the telecom giant that developed much of the current in-flight Wi-Fi technology. In fact, the company has been pushing for the freeing up of airwaves for this purpose for years. Qualcomm's senior vice president of government affairs, Dean Brenner, said in a statement: "The FCC's proposal for a next generation air-to-ground broadband service ... would greatly expand in-flight high speed broadband connectivity for airline passengers."

In the FCC's proposal, one or two companies will be awarded the 500 MHz in a license auction. The only obstacle that may arise is that the spectrum is currently being used for satellite communications. Rather than pushing satellite uplinks off the frequency, the new proposal would find inactive spectrum blocks and set them aside for air-to-ground mobile broadband service.

However, opponents of the FCC plan from the Satellite Industry Association complain that the new proposal would lower quality of service thereby costing satellite companies \$1 billion in lost revenue. ■

SOURCE: CNN MONEY

Airlines get shark-friendly

As the anti-shark finning campaign in the Asia Pacific region gains momentum, more and more airlines are jumping onto the bandwagon. First, it was Cathay Pacific, then it was Air New Zealand that decided to stop flying shipments of shark fins to Hong Kong, the world's largest market for shark fins. Now, we see Fiji's national carrier and Korea's top two airlines join the fray.

"We suspended shipments of shark fins on our cargo flights from March," said Korean Air spokesperson Cho Hyun-mook to Korea Real Time. Asiana Airlines said it would follow suit, hopefully stemming the import of shark fins to the country. According to the Korea Customs Service, 76 tons of shark fins were imported last year alone, worth US\$582,000.

In Fiji, spokesperson for Air Pacific Aubrey Swift said in a statement, "We believe a ban on the shipment of unsustainably sourced shark fins is the right thing to do, and have implemented this policy effective immediately."

In New Zealand, exposure in the local press got the ball rolling, as the New Zealand Shark Alliance reported that the Air New Zealand was making shipments of shark fin. The airline's spokesperson Andrew Aitken told CNN: "Air New Zealand has taken the decision to suspend the carriage of shark fins while we undertake a review of the issue."

Changing attitudes

While shark fin soup, considered a delicacy in many parts of Asia, is still offered by many establishments in Asia, some of Hong Kong's hotels and restaurants are

removing the item from their menus. Airlines such as Hong Kong's main carrier, Cathay Pacific, have followed their example, stating last September: "Due to the vulnerable nature of sharks, their rapidly declining population, and the impacts of overfishing for their parts and products, our carriage of these is inconsistent with our commitment to sustainable development."

The anti-shark finning campaign continues to raise awareness of the importance of sharks in the fragile marine ecosystem and educate the public on the cruelty of the practice in which around 72 million sharks

are captured each year for their fins, which are removed followed by the dumping of the live shark back into the sea to drown a slow and horrible death.

Conservationists praise the airlines' decision. Claire Garner, director of Hong Kong Shark Foundation, told CNN: "We were delighted to hear that Air New Zealand is following suit of the

Cathay Pacific announcement." Garner added, "Airlines need to know what they're carrying and how they are impacting envi-

ronmental sustainability." Doug Woodring of the Ocean Recovery Alliance in Hong Kong said, "Decisions [like Air New Zealand's] can have a big impact on reducing consumption in Hong Kong." ■

SOURCES: WALL STREET JOURNAL, CNN

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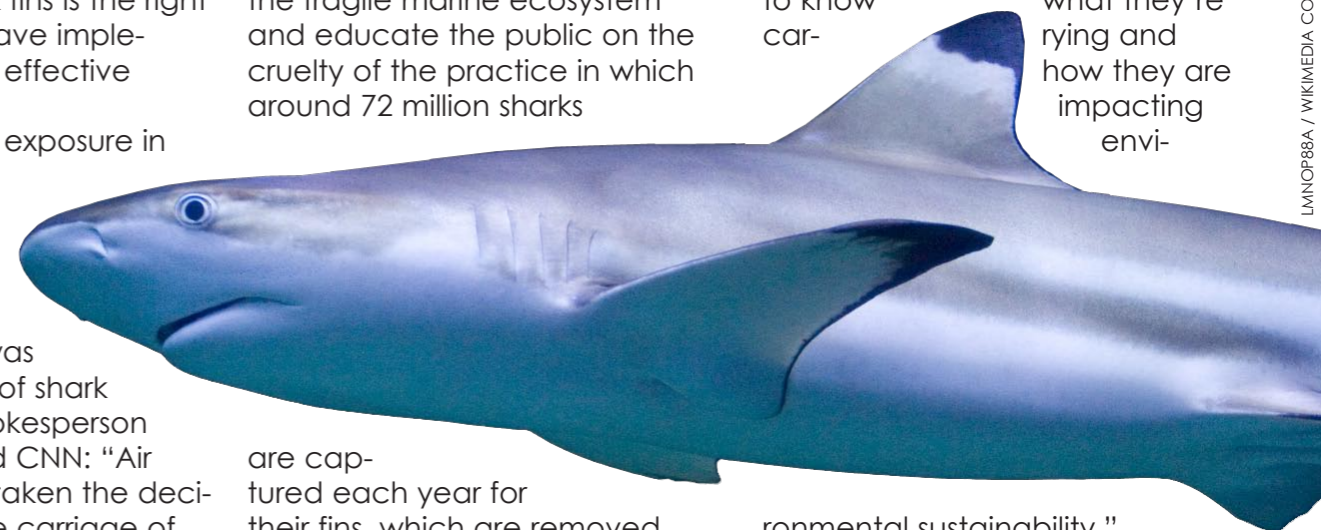
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Indonesia's
Raja Ampat
The Four Kings

Text and photos by Steve Jones



Close encounter with a manta at Blue Magic, one of many premier dive spots in the Dampier Strait

Swirling unicorn fish surround me and seem to have accepted me as one of their own. I can no longer see the surface nor anything else, save for a wall of fish. Only four minutes into the dive and it's already evident that this site is living up to its reputation, literally boiling with fish. Moments like this remind me why I dive.

All too quickly the fish blanket parts and the moment ends. Pressing on into

the current I'm distracted by a huge school of jacks tempting me to abandon my plan. I resist, reminding myself that something greater may await. I pass a wobbecong posing perfectly under an overhang filled with colorful soft corals. I rudely ignore it.

At last, I reach the end of the reef, alone, and stare into the blue while I calm my breathing down. As the minutes pass, doubt creeps into my mind as to whether I've made the right decision. Everyone is enjoying the busy reef behind me and I am missing it all! As I am about to give up, I glance a dark shadow before me in the blue, growing larger every second. I swim out from

the reef and am greeted by the largest manta ray I have ever seen. Welcome to Blue Magic, a dive site that typifies the wonders to be found in Dampier Strait, one of the hotspots in Raja Ampat.

Diversity!

Over the past ten years or so, Raja Ampat has often been described as having some of the best diving to be found anywhere, but what makes this area so special? From my perspective, it can be summed up in one word: Diversity! It is prevalent here, not only in the habitats to be found, which in turn support the myriad of species, but also

Schooling jacks at Blue Magic in the Dampier Strait (above); Crinoids and soft coral at Four Kings, Wayilbatan Island (top right). PREVIOUS PAGE: Four Kings dive site in the Misool area is typical of the stunning reefs to be found in the south of Raja Ampat



WHAT'S IN A NAME
 The name *Raja Ampat* (Malay for *Four Kings*) is derived from the four largest islands that make up this archipelago: Salawati, Misool, Batanta and Waigeo. These accompany over 1,500 smaller islands and islets found on the northwestern tip of the province of West Papua, which itself forms part of Indonesia's tenure of the west half of New Guinea, the second largest island in the world after Greenland. The eastern half of the island forms the mainland of the separate country of Papua New Guinea. ■



Red sea whips in the Fam Islands, which lie to the west of the Dampier Strait (left); Pair of scorpionfish at Cape Kri, in the Dampier Strait (right)



in the type of diving that can be experienced. Those who enjoy stunning fish-packed seascapes that explode with colour will struggle to find a better location anywhere on the planet. Thrill seekers can enjoy high octane drift dives in those same currents that bring in manta rays. Those that enjoy the smaller things in life, the critters, will find themselves in the most biodiverse area of the world. Indeed, there are no less than 42 species of mantis shrimp in the area!

By land or by sea?
 There are two ways to experience Raja Ampat. If you wish to concentrate on a specific area with a more laid back approach, then a resort will be a good choice. However, if you want to sample the full variety of seascapes here, then a liveaboard is the only way to sample what this huge 50,000 sq km area has to offer. Around 40 vessels currently operate here, yet given the size of the Raja Ampat, you will generally encounter

only a handful of other boats during your whole trip. Vessels also generally co-operate and avoid diving the same site at the same time as another boat, so your group will always have the reef to yourselves.
North or south?
 Shorter liveaboard itineraries will generally follow either a northern route taking in the reefs of the islands around Waigeo, or head south to Misool. Itineraries approaching two weeks will allow the

north and south to be sampled. These areas offer very different diving, so if you have the chance, make sure you visit both. Many cruise directors choose to round off the trips with dives in the current washed, spectacular reefs of the Dampier Strait.
 Incidentally, current is an ever

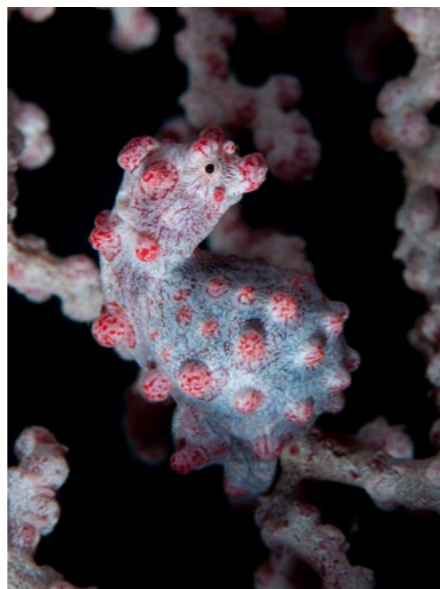


Stunning soft coral growth at Neptune Fan Sea, a channel full of sea fans in the south Raja Ampat

present feature of the dives in the region and of course, this is what makes the reefs so healthy. The common saying here is "no current, no life". However, with good timing and the right choice of site, you'll be able to see the reefs when they are at their best—that is



Pygmy cuttlefish in Anjui Bay—a haven for many critters



Pygmy seahorse on sea fans in Anjui Bay; Hawksbill turtle cruising the Farondi Islands, near Misool (lower right)

when there is a mild current, enough to concentrate all the fish upstream, but not so strong that you are swept away from the "sweet spot"—the point where the current splits around the reef and where the most dense fish life will be found.

The northern areas

Northern itineraries will often head towards the spectacular limestone lagoon of Wayag—without doubt the most photographed topside location in Raja Ampat. A 30-minute hike up the steep limestone cliffs will allow a spectacular view of this stunning lagoon and provide great photographic opportunities.

Wayag and the surrounding islands are part of the Kawe Marine Protected Area (MPA) and the local village clans that steward these reefs have adopted a traditional approach, known as "Sasi" where no-take zones are seasonally rotated, allowing marine life stocks to



Raja Ampat

Limestone islands of Wayag



recover between harvests. These traditional and effective stewardship techniques are ones that many western fisheries have been unable or unwilling to adopt. Furthermore, on the nearby island of Piiai, a guarded turtle rookery is helping the local populations of green and hawksbill turtle to

recover—all good indicators that conservation efforts in Raja Ampat are able to turn words into actions.

One of the most stunning dives in this northern region is Magic Rock. Head to the north west side and you will find a large archway that leads into a hollowed out

THE GLOBAL EPICENTER OF MARINE BIODIVERSITY
 Raja Ampat lies at the tip of a densely forested peninsula that juts out from mainland West Papua. The region is known as the Bird's Head Seascape and runs from Triton Bay in the south, encompasses Raja Ampat and rounds the northwestern tip of West Papua, deep into Cenderawasih Bay. Located at the convergence of tectonic plates, millions of years of geological upheaval have carved out diverse habitats—quiet sandy bays, undersea mounts, drop-offs, mangroves, fast-flowing channels, the list goes on, and these habitats, fuelled by nutrient-rich upwellings from deep water in turn support the incredible variety of marine species to be found in this area. Over 600 hard coral species and over 1,700 reef fish species have so far been documented in the Bird's Head area, which is more than in any other region of this size on Earth. This is the Global Epicentre of Marine Biodiversity. ■

COUNTER-CLOCKWISE FROM RIGHT: Giant manta ray at Blue Magic, Dampier Strait; Wreckage of a World War II P47 Thunderbolt at Wai Island; Wobbegong shelters under an overhang at Blue Magic; Sweetlips found at a bommie in deep water at Cape Kri



chamber. The floor here is filled with life and provides shelter from the current, allowing you to watch the masses of fish that gather just outside the archway.

Eagle Rock is another dive that typifies the northern Raja Ampat experience. This site is good for spotting manta rays, dogtooth tuna and humphead parrotfish. Large boulders that have broken off and rolled down to deeper water are alight with a dazzling array of orange

Dendronephthya soft corals. As you make your way back up the slope towards your safety stop, be sure to check under the many



overhangs, and you may be lucky to find a wobbegong.

Tranquil waters

A common overnight anchorage in the north is in the sheltered Aljui Bay which lies on the western side of Waigeo, the largest of the main

four Raja Ampat islands. The steep vegetation covered walls provide good shelter. However, this area is also an excellent location for critter spotting, so liveaboards will often spend a day here.



Wire coral shrimp found on the slopes of Anjui Bay

Raja Ampat

CENTER OF THE CORAL TRIANGLE
It was not until 2001 that the area's importance was fully realized when Conservation International sent an expedition to the region following lobbying by renowned ichthyologist Gerry Allen. This area lies at the center of the "coral triangle", the region noted for its supremely high marine biodiversity that covers the intersection between the Indian and Pacific Oceans and spans the rest of Indonesia, Malaysia, Papua New Guinea, Philippines, Timor-Leste and the Solomon Islands. Leading scientist Dr Mark Erdmann has described this area as a "species factory" for the rest of the Coral Triangle. The majority of fish species found throughout the Coral Triangle are present in the Bird's Head Seascape. ■



The nutrient-rich waters in the bay host one of the region's largest pearl farms, the pier and fuel dock making for great night dives.

Here, you'll see barchin scorpionfish, cockatoo waspfish and Berry's bobtail squid amongst a myriad of other species.



Mayhem is a stunning dive in west Waigeo; *Chromodoris annae* nudibranch grazing in Anjui Bay (below)

this area, after diver David Shem-Tov luckily survived an attack by a saltwater crocodile in 2009.

Even sightings of "salties" are rare since their numbers



have been put under huge strain by human expansion into their territories, and they are quite rightly now protected in some regions. Nobody with a true love of the natural world would want a predator exterminated to make it safer for visitors, so the live-boards have taken the pragmatic approach of now avoiding this

area.

Actually the majority of great diving around Misool is to be found in the reefs off the south-east of the island. Here, you will find sites such as Boo's famous Window Wall, an image of which adorns the cover of Burt Jones and Maurine Shimlock's, *Diving Raja Ampat*, which was the

White arrow is another splendid critter dive where the undersea terrain slopes steeply to 30 metres and beyond. Amongst the soft corals and sea fans you'll find yellow examples of the pygmy seahorse (*H. bargibanti*), ornate ghostpipefish and the unusual solar-powered nudibranch, which contains algae in its skin that helps feed the host nudi through photosynthesis.

The journey to the south

The journey to the south and Misool involves covering a fair distance, but on the way down there are some incredible dive sites around Gam island, which lies to the south-west of Waigeo. On the aptly named "Mayhem" I encountered some of the most dense and diverse fish schooling I have ever seen on a single dive; I struggled to count the species

before me. Fusiliers swarmed over the reef, intermingling with unicornfish, surgeonfish, snappers and batfish whilst Spanish mackerels, huge trevallies and tunas glided through the schools waiting for opportunities to feed.

From Gam, it is an overnight run down south. Well-known images from this region, of soft corals with a backdrop of mangrove, were taken in the Nampale blue water mangroves off the north west of Misool. However, most live-boards now avoid



Sweeper at Blue Magic, Dampier Strait; Crinoid and soft coral growth in the Misool Region (right)



Raja Ampat





definitive dive guide to the region, now superseded by an expanded version that covers the entire Bird's Head Seascape.

Exceptional reefs

The region is protected by the South East Misool Marine Protected Area, which administers most of the region's best dive sites (at least those that have so far been discovered—new dive sites are being found in Raja Ampat regularly and exploration is encouraged). Far out

east, the less visited reefs around Daram Island are wonderful with Andiamo regarded as one of the finest. This reef consists of a submerged pinnacle in front of two small islets. It was here that whilst I was diving amongst profuse sea fan growth on the north side, awash with fusiliers, that a juvenile



COUNTER-CLOCKWISE FROM ABOVE: Snappers grace the stunning reef that leads to Boo Windows; View towards Boo Windows near Misool; Juvenile spadefish under Arborek jetty in the Dampier Strait—the jetty is a stunning dive and no deeper than 5m; Exploring a cavern in the Farondi Island, near Misool

whale shark casually cruised by in the blue, unbothered by our presence.

Moving back towards Misool, there are dive sites that may well cause you to rethink your definition of a good dive. At No Contest, we descended down a near vertical coral-covered wall and were barely able to hold position with a mod-



TOURIST DESTINATION

Raja Ampat's growth as a tourist destination has only recently begun to accelerate, with marine tourism forming one of the strategic initiatives of the conservation programmes working to conserve the Bird's Head Seascape's unique heritage. Visitors to the area pay a park entrance fee of Rp.1 million (approximately US\$102), which is valid for a year. The money is split between conservation, community and tourism development programmes.

Even today, whilst Raja Ampat is possibly no longer true "frontier" diving, it is far removed from the popular resort destinations found in other parts of the world. As of 2013, there are seven resorts but the majority of operators use liveaboards, generally Pinisi sailing boats built in the traditional Indonesian way.

With West Papua being Indonesia's poorest province, there are many challenges for diving operators to overcome. Veteran operator Txus Reiriz has been operating the liveboard *MSY Seahorse* in the region for over eight years. "I heard about how good the diving was in Raja Ampat," said Txus, "but when I visited, I found it exceeded way beyond my already high expectations. The reefs, landscape and biodiversity are stunning, and even now, after over eight years operating in this area, we keep finding new dive sites on almost every trip. But the biggest challenge is it's a long journey for the guests to get here, and because of the remoteness, it's even harder for us to get the supplies we need. Logistics are hell, but it's completely worth it!" ■

erate current washing against the reef.

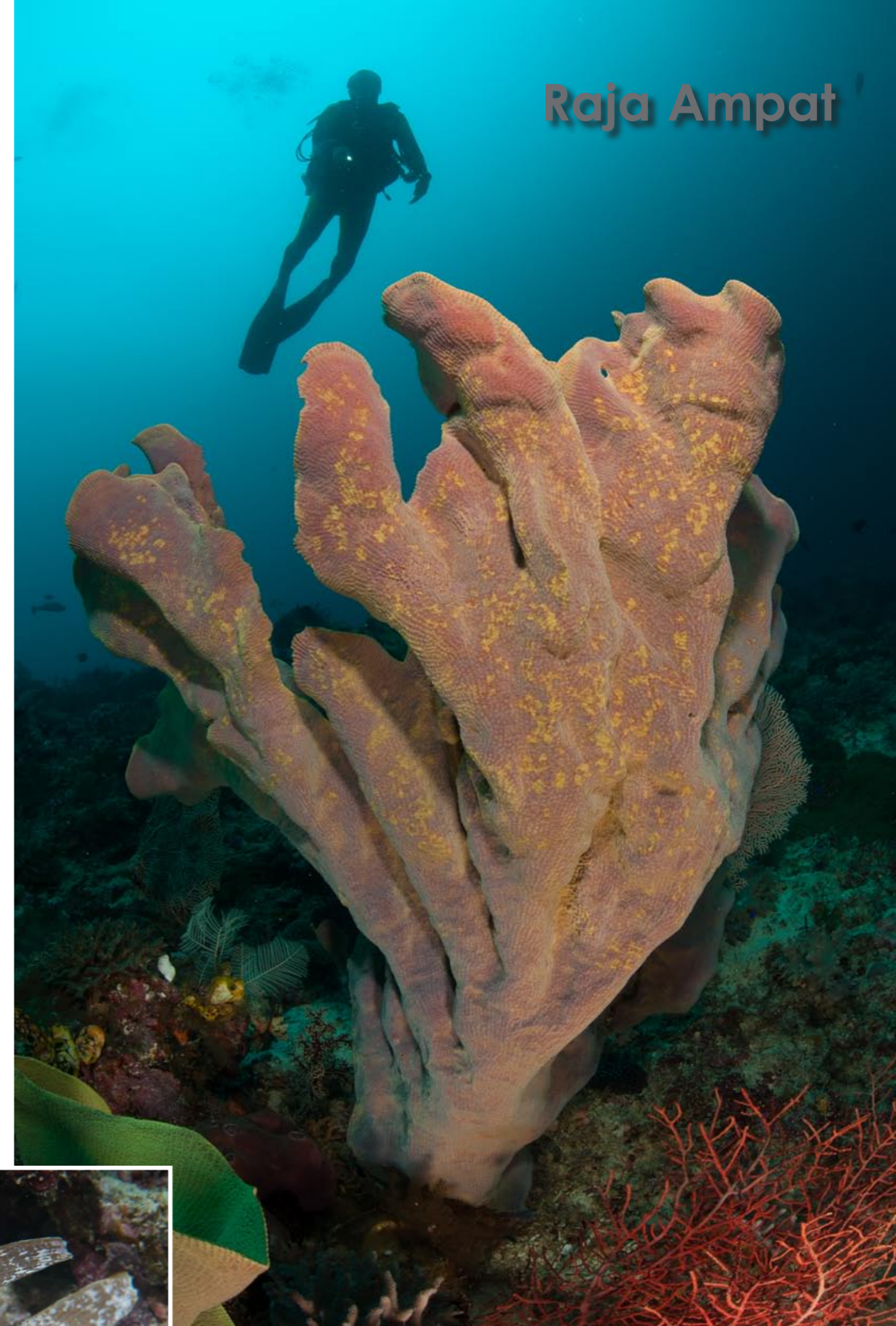
We were truly in the sweet spot—large schools of longfin spadefish were silhouetted against a scene of absolute chaos as thousands of fusiliers danced in the planktonic waters and two species of



Surprise encounter with a large pelagic manta at Blue Magic; Elephants ear sponge at Blue Magic, Dampier Strait (right); Soldierfish at Mioskon, Dampier Strait (lower left)

life—here also are some of the most exhilarating dives in West Papua.

Mike's Point, named after the son of Raja Ampat diving pioneer Max Ammer, has some of the best fish action in the area. The island above this reef (Kerupiar Island) was repeatedly bombed in World War II, since the U.S. Air Force thought it to be a camouflaged Japanese ship.



barracuda competed with baramundi cod for our attention. On the reef wall itself not a single centimetre was devoid of coral growth, with sea fans competing with Dendronephthya soft corals for a space on a reef that exploded with colour. Our ascent had to be done with care, as a downwash runs over the top of this thin long reef. To cap it all off, a sea snake accompanied me to the reef top.

There are currently over 25 described dive sites in this south east region of Misool, and that number is ever increasing. Leaving these behind and heading back north caused mixed emotions since the reefs here are so endearing, but I needn't have worried. The final chapter of our itinerary is the zenith of Raja

Ampat's high octane diving—The Dampier Strait.

The Dampier Strait

Baring the name of the British explorer William Dampier, this huge channel runs between Waigeo and Batanta, two of the four kings, and is not to be confused with the similarly named body of water in Papua New Guinea. Here, you'll find very strong currents, which is one of the reasons cruise directors leave this place until last, once the divers have settled in. However, it is these currents that bring the reefs to

When you see the wake coming off the island when the tide is running, it's easy to understand why.

Down in deeper water, there are large gulleys where a resident school of hump-



Mantas are not the only species to be found at Manta Sandy. These robust ghostpipefish were found amongst the coral

head parrotfish can often be sighted. However, it is on the up-current side where you will find the fish action, and here you can often find large schools of sweetlips with fusilier

and unicorn fish schools so dense they will often obscure the surface.

The strong nutrient-rich currents that run through the Strait also attract another visitor—manta rays. Manta Sandy and Manta Ridge are two sites where mantas can be reliably seen, provid-



CLOCKWISE FROM LEFT: Soft coral growth near Wayilbatan Island, Misool region; Giant barrel sponge at Four Kings, Misool Region; Exploring the caverns of Goa Farondi, Misool Region; Elephants ear sponge growing on the slopes of Blue Magic, Dampier Strait

is also here that you have a very good chance of encountering a reef shark.

One of the striking things about Raja Ampat's reefs in general is the absence of sharks. This whole region has in the past been heavily overfished by shark finners, and anyone who denies that shark overfishing is a problem should visit here and see if their views still reconcile with the visual evidence (or rather lack of it). Yet, shark numbers are now actually starting to climb back from the brink in Raja Ampat, with shark sightings increasing across the whole region. This has been helped by the conservation initiatives, and in December 2012, the area became legally protected as a shark and ray sanctuary, giving hope that one day the master of



ed there is a little current present. Although it should be said that you also have a chance of manta encounters at many other sites in Raja Ampat.

Manta Sandy has a small rubble wall that indicates the boundary that divers should not cross, to ensure they do not disturb mantas when they are at the cleaning station. Wait low on the sand bottom, and you may be blessed with a close encounter with one of the black mantas that frequent this site, complete with yellow

pilot fish dancing around their mouths.

Cape Kri rivals Mike's Point in terms of sheer fish density. You normally begin your dive on the west side and keep heading east on this sloping reef on the south of Kri island. As you approach the easterly point, the big fish action builds to a crescendo above the reef, with large snapper, emperor and barracuda hovering in the current whilst large trevally speed around picking off unfortunate fusiliers from the large schools. It



the seas will once again patrol the beautiful seascapes of Raja Ampat.

Getting there

To dive Raja Ampat, you need to get to Sorong in West Papua. Makassar Airport on Sulawesi has direct flights to Sorong, and Makassar connects with Singapore, Jakarta and Manado. ■

The author would like to thank Txus Reiriz of the MSY Seahorse Liveaboard (Indocruises.com) for his help and considerable support in preparing this article and Jay Monney and Eموke Vizhanyo for their ever patient modelling



*during the author's various visits to the region. For more information, visit: **Millionfish.com***

REFERENCES AND RECOMMENDED READING:
B. JONES AND M. SHIMLOCK, *DIVING INDONESIA'S BIRD'S HEAD SEASCAPE*

Mark Erdmann

Raja Ampat

Conserving the Planet's Heritage

Text and photos by Steve Jones
Portraits courtesy of Mark Erdmann

Dr Mark Erdmann is a coral reef ecologist and senior advisor for Conservation International-Indonesia's marine program, with a primary focus on managing CI's marine conservation initiatives in the Bird's Head Seascape in West Papua. Having lived there for over 20 years, he has dedicated the majority of his time to the conservation of Raja Ampat and the broader Bird's Head Seascape since 2004. Erdmann is also the regional coordinator of the Bird's Head Seascape marine conservation initiative, which is a multi-institutional initiative involving Conservation International, The Nature Conservancy, WWF-Indonesia, the State University of Papua (UNIPA), RARE, the Papua Sea Turtle Foundation, WWF-US, Sea Sanctuaries Trust and a variety of private sector marine tourism groups.

Mark Erdmann

SJ: You've been at the forefront of conservation efforts in the Bird's Head Seascape for many years, but what led to you realizing the richness and importance of the marine environment in this region? Why is it so important that this area is protected?

ME: My first trip to Raja Ampat was in 2002, when I was asked by the Nature Conservancy to join a small expedition to

"ground truth" the report that had recently come out from Conservation International that claimed that Raja Ampat was the global epicenter of marine biodiversity. Within a few dives in Raja, I quickly had the data from the perspective of mantis shrimp (stomatopod) biodiversity to wholeheartedly agree with these claims. Within a few years I had recorded 56 species of reef-associated mantis shrimp from

across the Bird's Head, which is far and away the highest diversity of anywhere this size in the world.

At the same time, what we also found on that first trip was that Raja Ampat was far from pristine, with abundant threats from blast and cyanide fishing, shark finning and turtle poaching. It was clear this was an amazing global heritage badly in need of conservation efforts.

SJ: Please tell us about the structure, strategy and guiding principles of conservation efforts in this region, including the Marine Protected Area Network.

ME: From a western perspective, one of the things that most stands out about Raja Ampat and the Bird's Head is its amazing marine biodiversity and spectacular beauty both above and below water. At the same time, it is also

very important to note that the Papuan people of Raja Ampat are of Melanesian culture that includes a strong tradition of marine tenure (wherein locals own not only land, but also the reefs and marine resources).

We knew from the outset that the key to preserving and sustainably managing these reefs would be to have the full support and involvement and in fact leadership of the local tenure

holders and traditional leaders in any conservation efforts. We knew that while these leaders would certainly be proud to be the custodians of the world's highest marine biodiversity, this alone was not going to be a strong enough motivator.

So instead, we consciously made the strategy to get to know these villages inside and out, and really get to understand what issues most mattered to



The islands of Wayag in the north of Raja Ampat (left); Mark Erdmann (below)



immoral, and rob coastal communities of the future of their fisheries and any tourism potential.

In any given community, it is only a minority few that are actively engaged in these destructive practices, and they should not be “rewarded” by being given special treatment to seek alternatives. This may sound harsh, but my views have been shaped by the very strong and angry words of the many coastal villagers who DON'T participate in destructive practices and are having their futures pillaged by these criminals.

Blast fishing and cyanide fishing are marine environmental crimes, and they need to be treated as such. Police are not expected to provide “friendly alternative livelihoods” to drug dealers or child traffickers, and in my opinion, bomb fishers fall into this same category. Quite frankly, one can NEVER come up with

an alternative that easily makes them as much money—this is a lost cause.

We prefer to focus on empowering and protecting those fishers engaged in sustainable practices, and the “bad guys” simply need to adapt or get sent to jail.

As Raja Ampat's reefs continue to improve in quality, there are many more opportunities for local villagers to derive benefits from marine tourism, aquaculture and sustainable fisheries—and those opportunities are available to all.

SJ: How are conservation efforts able to benefit local communities in the short term? Do you think communities see the link between conservation and these immediate benefits?

ME: As I noted above, the conservation

them, and then try to couch our marine conservation thoughts in terms that mattered to them.

What we found almost immediately was that the local communities were very concerned about their food security and the fact that outside fishers were pillaging their resources. So, when we introduced the idea of a network of marine protected areas, it was not as a tool to protect marine biodiversity, but rather as a way to legally strengthen their marine tenure claims and give them full management authority over their marine areas, restricting the access to outside fishers and thereby ensuring their long-term food security.

We then took the unprecedented step of recruiting the MPA managers and staff directly from these local communities—and while this meant that we were mostly getting staff with

2nd and 3rd grade educations, they were nonetheless intimately familiar with their resources, highly passionate about saving them, and we of course targeted local community members with strong leadership skills.

It meant we needed to invest a long time (five years or so) in training them in marine biology, marine resource management, and even basic computer skills, but the end result has been fantastic, and we are confident will mean that this initiative is truly sustainable, having built a strong local foundation.

We could have instead brought in outside talent comprised of well-trained Indonesians with university degrees, but not only would they likely not be very accepted by local communities, they also wouldn't have the intense passion to save their own reefs, and they would

over time of course want to return home to their families in Jakarta or wherever.

It took a bit longer to train local community members instead, but the result—we believe—will be ultimately more sustainable. Local communities therefore play the primary role in managing the reefs of Raja Ampat—this is a 100 percent local affair.

SJ: What alternatives exist for local fishermen and villagers currently engaged in destructive practices? What incentives are in place to help them pursue more sustainable practices?

ME: As for providing alternatives for local fishers engaged in destructive practices, if I may be blunt, I have learned over two decades in Indonesia that this is a romantic and foolish notion. Destructive practices like bomb fishing are illegal,



PHOTO COURTESY OF MARK ERDMANN





Fusilier schools are in abundance on Raja Ampat's reefs; Giant barrel sponge at Four Kings, Misool Region (lower left)

ME: One of our flagship programs in Raja Ampat has been the *Kalabia* program. You can also see more about it at the following link: blog.conservation.org

The *Kalabia* (named after Raja Ampat's endemic walking shark) is a converted 34m tuna longliner that now travels around Raja Ampat to each of the 130-plus villages, delivering a three-day customized experiential conservation education program for elementary school children. On board are six highly-dedicated environmental educators (again, local community members that we recruited and trained intensively)

who bring this program to the communities.

The climax of the three-day program is when the children are all taken snorkelling on their reefs, and they also do mangrove and seagrass bed walks and learn all about MPAs and their benefits, the ecological values of sharks, etc.

At night, the whole community comes down to the village dock to watch the videos shown by the *Kalabia* team. It is a fantastic program. The teachers from the local schools are all included in all activities, and we leave the curriculum materials with all the school teachers so that they can

continue to use them in their classrooms after the *Kalabia* leaves.

SJ: What are the notable successes so far and what remain the top threats to the region that will be focused on in future?

ME: I reckon the biggest success has been the setting up of this network of over 1.2 million hectares of the most biodiverse reefs on the planet, which are now being actively managed by local community members and strongly and passionately enforced. We've seen numerous outside bomb fishers and shark

program in Raja Ampat has been developed WITH the local communities to answer their most pressing concerns of food security and empowering their traditional rights of tenure and resource management. Protection of biodiversity is a handy side benefit, but this is not the primary goal of Raja Ampat's MPA network and conservation initiative.

The main aims are to ensure food security and long term sustainable livelihoods from the marine resources, and to provide additional legal support for them to exclude outside fishers from utilizing their resources. These benefits are more or less immediate and only continue to grow, and it is clear that the villagers of Raja Ampat "get it"—in that we continue to get requests to expand the boundaries of the MPAs or create



new MPAs in areas that are not currently protected.

SJ: Does conservation feature in the day-to-day education within

schools and do schools currently teach the value of the marine ecosystem for the long term well being of the Indonesian nation?



Crinoid and soft coral growth in the Misool Region



The spectacular colours of the south of Raja Ampat (left); Intense fish action at Mike's Point, one of the most spectacular dives in the Dampier Strait (below); Sweetlips school on the deep bommies at Cape Kri (lower right)

SJ: Given its position at the epi-centre of marine biodiversity, what will be the likely cascading impact to other regions, if the Bird's Head marine environment is not successfully managed?

ME: Raja Ampat and the Bird's Head act as a repository of a mind-boggling percentage of the Earth's coral reef biodiversity. With over 600 species of hard coral, this region alone is home to approximately 75 percent of the world's hard coral species! So it is imperative to protect and manage this.



finners actually put in jail, and the reefs, fish and sharks of Raja Ampat are actively recovering.

I also believe this is reflected in the dramatic increase in marine tourism development, which we've actively encouraged—going from one resort and one liveaboard and about 300 guests a year in 2000 to now 40 liveaboards, seven resorts and about 7500 guests a year.

The Raja Ampat entrance fee system is now raising over US\$350,000 per year. The Raja Ampat government now actually believes that marine tourism and sustainable fisheries can be the motors of its economic development, and has forsworn any further mining development. And we've cemented this in the West Papua spatial plan, which prioritizes Raja Ampat as a region for marine tourism, marine

conservation, and sustainable fisheries and aquaculture and NOT industry and mining as with much of the rest of Papua.

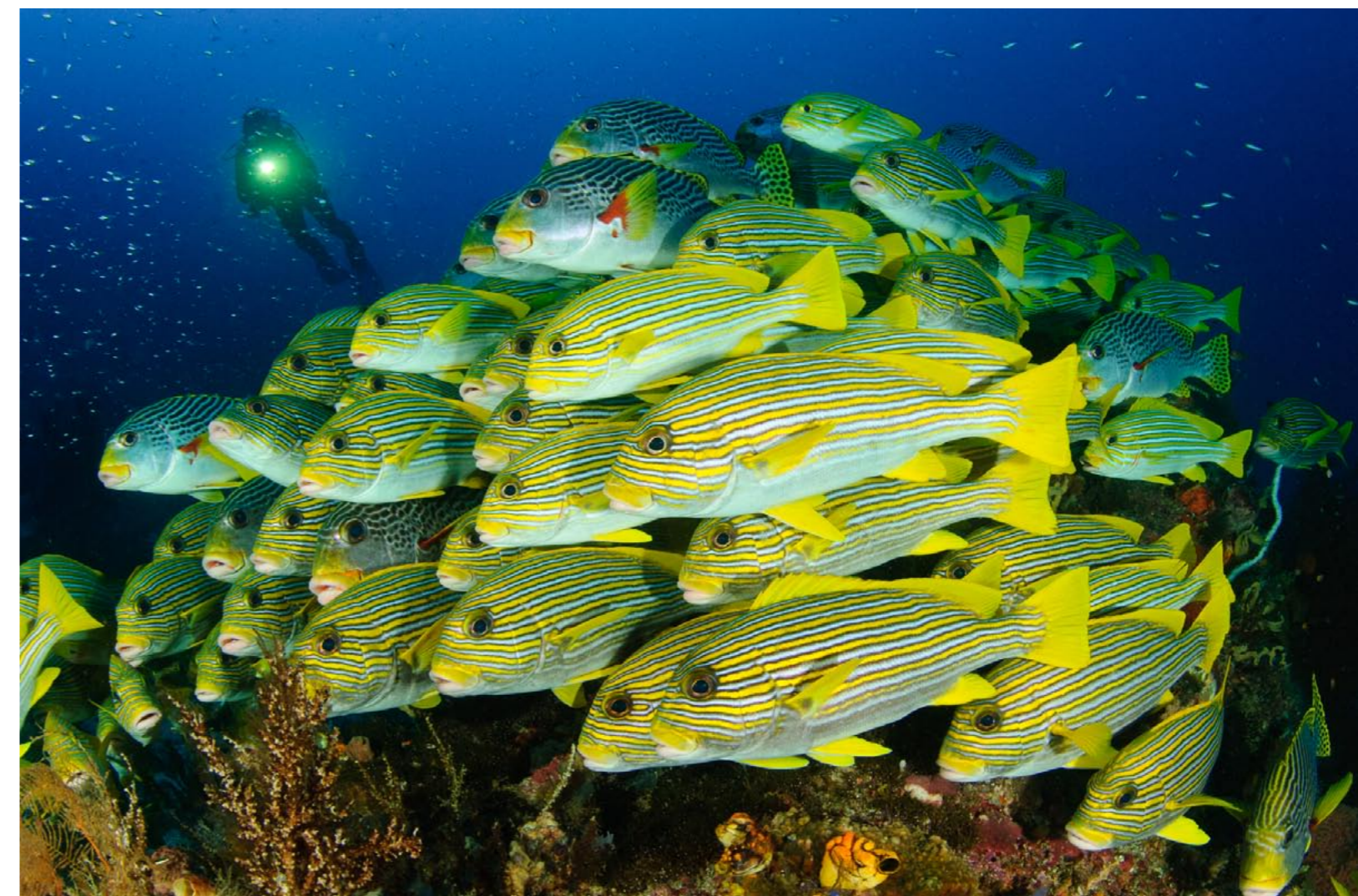
I also note that overall, incidences of blast and cyanide fishing have decreased dramatically. We've largely addressed turtle poaching (especially in the main nesting beaches) and the recent passage of the regency law declaring Raja Ampat a shark and ray sanctuary gives strong legal teeth to the ban on fishing sharks and rays.

In terms of ongoing threats, interestingly enough, they are now coming more from the land than from the sea. We continue to have the issue that as shark populations have stabilized and even started to increase in the best protected areas (Misool, Wayag), they are increasingly

a beacon to illegal shark fishers from across Indonesia. But this we can hopefully deal with.

More concerning though are the impacts of the ongoing land-based coastal development in Raja Ampat - especially road construction in Waigeo and various and other plans for airports and even transmigration camps on other islands. There is a major influx of immigrants into the capital city of Waisai, and this is a concern both in terms of carrying capacity as well as dilution of cultural traditions.

We've also seen a huge increase in plastic and other trash in the oceans, mostly coming from both Waisai city and Sorong—both of which are growing very rapidly with immigration. These are all new challenges that we are having to adapt to.





Soft corals at Citrus Ridge, near Waigeo in the north (left); Manta Rays at Blue Magic (above)

SJ: It is known this area has suffered heavily from shark finning practices. Do you think the region will ever be able to recover its shark populations, or have we passed the point of no return?

when I was doing my PhD work in the early 90's were actively finning around Raja Ampat even back then. However, Raja Ampat has now implemented the first shark and ray sanctuary in the Coral Triangle (across all of its waters), and the regency law #9/2012 (passed in December 2012 and announced in February 2013) provides serious legal sanctions (and NO LOOPHOLES!) for

ME: I am exceedingly positive about the situation with sharks in Raja Ampat. The area has indeed long suffered from shark finning; my neighbors in South Sulawesi

We moreover hypothesize that this region is, in fact, an active cauldron of evolution, or "species factory", which is, as we speak, still generating novel biodiversity. As diversity provides the building blocks for adaptation to global change (climate, etc), it is imperative to maintain as much diversity as we can to give reefs and, in fact, humans the best chance of surviving the coming changes facing our planet. If the Bird's Head is not properly managed, we'll lose this repository of diversity.

SJ: Conversely, how does the conservation programme in the Bird's Head Seascape benefit other regions in the Coral Triangle?

ME: Obviously, if we can properly

manage the Bird's Head, we'll keep this diversity available for adaptation to global changes.

But there are other benefits of proper management of this area as well. The Bird's Head continues to serve as an "incubator" region for testing new management approaches, including the strategy I elaborated above about heavily investing in building the capacity of local villagers to manage their own resources on a large scale.

But there are a number of other new initiatives being tested in the Bird's Head, including the first shark and ray sanctuary in Indonesia and the Coral Triangle, the most successful tourism entrance fee system in the Coral Triangle (in terms of annual revenues), the first real marine tourism management regulations in

Indonesia (including a licensing system that caps the number of liveaboards able to operate, etc), and the first attempt to gazette a comprehensive MPA network of seven MPAs within a single regency.

Besides serving as a management "classroom" (the lessons learned from which are now being shared around Indonesia), Raja Ampat's position at the top of the "Indonesian Throughflow" of waters from the Pacific towards the Indian Ocean means that having healthy populations of reef fishes and other organisms here can actively "seed" other reefs in eastern Indonesia due to the strong currents passing through Raja Ampat and towards the Maluku spice islands.



Limestone islands at Wayag



Hard coral growth at Jamur Boo, near Misool (left); Sunset at Wayag (below)

EcoResort, Cape Kri near Papua Diving, and the Kawe-Wayag MPA), we can already see significant recovery of shark populations. Max Ammer at Papua Diving has now several times tried putting down bait (minced tuna) off his dock and within five minutes has had up to 30 adult blacktip sharks racing around.

Around the reefs near Misool EcoResort, it is now possible to see silvertip sharks or sometimes three to five grey reef sharks—something you would never see even four years ago. It will take time, but recovery is underway.

SJ: Finally, what is your perspective on the overall outlook for Raja Ampat?

ME: Bright! There are still a

number of challenges facing Raja Ampat, but I strongly believe that because we were able to initiate these conservation programs before the current wave of development washed over Raja Ampat, that the communities are now sufficiently aware of the threats to their resources that much of this development poses, and they are now empowered to make their own decisions about the future management of these resources. We've done our best to train them to be good stewards, and I optimistically believe this will allow Raja Ampat to continue to improve its management and the quality of its marine environment.

— Dr Mark Erdmann has

published 107 scientific articles and four books, including most recently the three-volume set, Reef Fishes of the East Indies, with colleague Dr Gerald Allen. Erdmann was awarded a Pew Fellowship in Marine Conservation in 2004 for his work in marine conservation education and training for Indonesian schoolchildren, members of the press, and the law enforcement community. Erdmann lives with his wife Arnaz and three children in Bali, and maintains a deep personal commitment to do whatever is necessary to ensure his children will be able to enjoy the same high-quality underwater experiences that continue to provide the inspiration for his dedication to the marine environment. ■

anyone catching, injuring, transporting, molesting, or in any way exploiting sharks and rays in Raja Ampat.

We, of course, need to work hard to make sure this is broadly socialized and effectively implemented, but I am confident the government and communities

are up to this challenge as they understand how important sharks and rays are both to healthy reef fisheries but also for marine tourism.

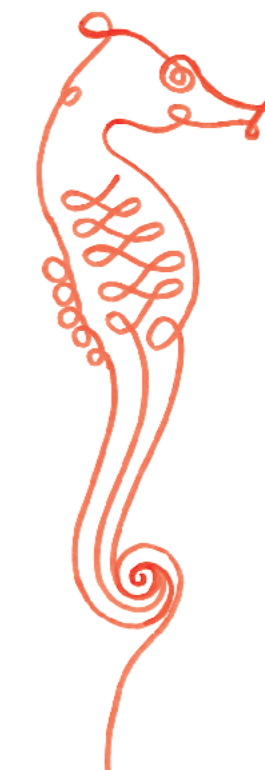
In the areas of Raja Ampat that have already been strongly protected for the past three to five years (e.g. around Misool



Erdmann



silver



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Indonesia's
Raja Ampat
Incredibly Rich Waters

Text and photos by Don Silcock

Arus kencang are the words you need to listen out for—you will hear them in the rapid interchange between the dive guides and the boat boys, as they discuss the practicalities of safely immersing a group of “bule” (slang for foreigners) in the waters of Raja Ampat. *Arus kencang* means strong current in Bahasa Indonesia, and the emphasis given to those two words will give you an instant insight into what awaits you below.

The incredible reefs and tremendous biodiversity of the Raja Ampat area have made this remote part of the Indonesian archipelago one of the hottest dive locations in the world, and those currents are the very lifeblood of the area. For they carry the rich nutrients from the deep basins of the Pacific Ocean to the northwest of Raja Ampat and have helped to create what are generally considered to be the finest coral reef ecosystems in the world.

The amazing biodiversity of the area, and the currents that flow through it, are two sides of the same coin, and a basic understanding of this mechanism is the key to truly enjoying one of the best diving experiences there is.



Location, location, location...

The remarkable landmass of New Guinea is the largest tropical island in the world, and it sits just below the equator along

the southern rim of the “Ring of Fire”—the belt of volcanoes and tectonic plates that runs around the edge of the vast Pacific Ocean.

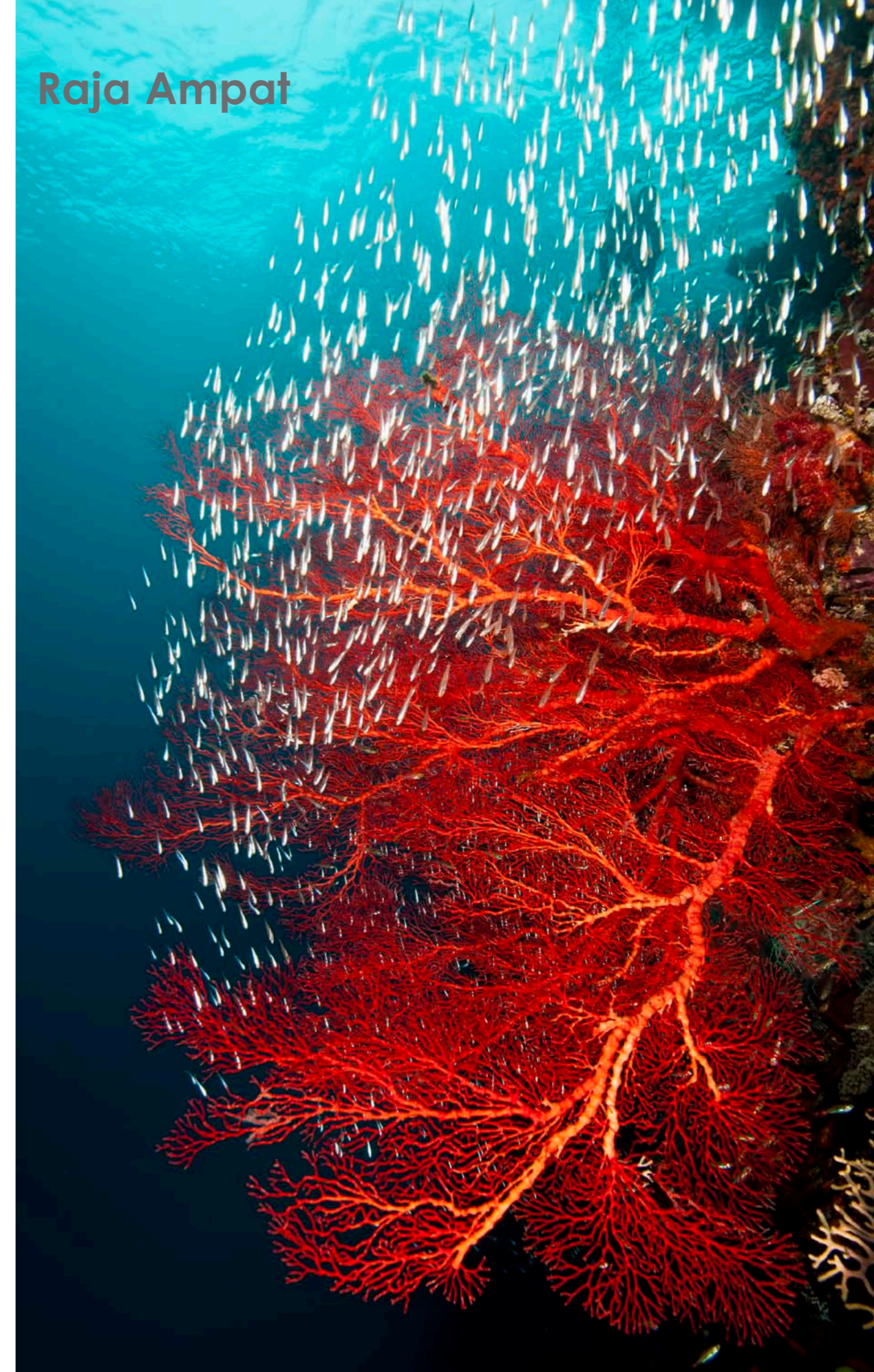
Divided by colonial legacy and cold-war geopolitics into two roughly equal halves, the eastern part of the island is the independent country of Papua New Guinea

(PNG), while the western half, which is now generally known as West Papua, became part of Indonesia in 1969. Although occupying less than half of 1% of the Earth’s



The Passage at Waigeo (above); Cuttlefish (left); Robust ghost pipefish (below)

Raja Ampat



Large red gorgonians decorate the reefs of Raja Ampat



Just ten years ago, your choices were limited to one dive resort and a couple of liveaboards, but now there are several well established resorts and up to 50 boats operating in the area at the peak of the diving season.

Thanks to the excellent work of Conservation International, The Nature Conservancy and WWF-Indonesia a network of 12 marine protected areas (MPAs) have been established in West Papua to counter the impact of tourism and over-fishing. These marine protected areas cover an area of almost 3.6 million hectares, or 25 percent of Indonesia's total national MPA coverage, and have played a major role in keeping the underwater environment in excellent overall condition.

More recently, in February 2013, the local government of Raja Ampat declared four million hectares of coastal and marine waters as a sanctuary for sharks, manta rays, dugongs, whales, dolphins and turtles—tacitly recognizing that these creatures are much more valuable alive than sold as by-catch.

The Four Kings

Raja Ampat means four kings in Bahasa, and the name comes from the local myth of a woman who finds seven eggs, four (ampat) of which hatch and become kings (rajas) and occupy four of the area's biggest islands, whilst the other three become a ghost, a woman and a stone.

Those four islands are Waigeo, Salawati, Batanta and Misool are surrounded by about 1,500 smaller islands and about 40,000 sq km of water. Surveys of the area have identified over 600 species of hard coral, which is nearly 75 percent of the world's total, and in excess of 1,700



surface, the island contains up to ten per cent of the planet's species and is a veritable storehouse of biodiversity.

The waters that surround New Guinea offer some of the very best diving in the world, with PNG long-established as a diver's Mecca, but it is Raja Ampat on the northwest tip of West Papua that has become the place to have in your log-book.



Diver on one of the many beautiful reefs of Misool



The incredible scenery in Waigeo area; Superb nudibranch, Black Beauty in Batanta (below)

species of reef fish—more than any other similarly-sized region on the planet. Raja Ampat truly is the global epicenter of marine biodiversity!

Diving Raja Ampat

There are three principal areas to dive in Raja Ampat: in and around the Dampier Strait that separates the main islands of Waigeo and Batanta; Waigeo itself; and the area around the island of Misool in the south. Triton Bay on the south coast of the main island is also technically part



Pipe fish with eggs at Szonc Jetty in the Dampier Strait

of the Raja Ampat area, but its remoteness means that it is treated as a separate trip.

All three areas offer spectacular diving and underwater experiences, which could fill a couple of books, but there are certain signature dives in each area that really should not be missed.

The Dampier Strait

The dives sites of the Dampier Strait are where most liveaboards start and finish their diving programs, because they are the closest to the town of Sorong and its airport, which is currently the point of entry to the Raja Ampat area.

For those of you familiar with fluid dynamics, the Dampier Strait can be thought of as a venturi, where a restriction in diameter automatically increases the velocity of the fluid passing through it.

For all the rest of us, think strong currents—because the Strait is the principal channel through which the flow of water from the Pacific Ocean passes through on its way south. These currents and the rich nutrients in the water have created some of the most spectacular reefs, bommies and encounters you are ever likely to experience.

Raja Ampat

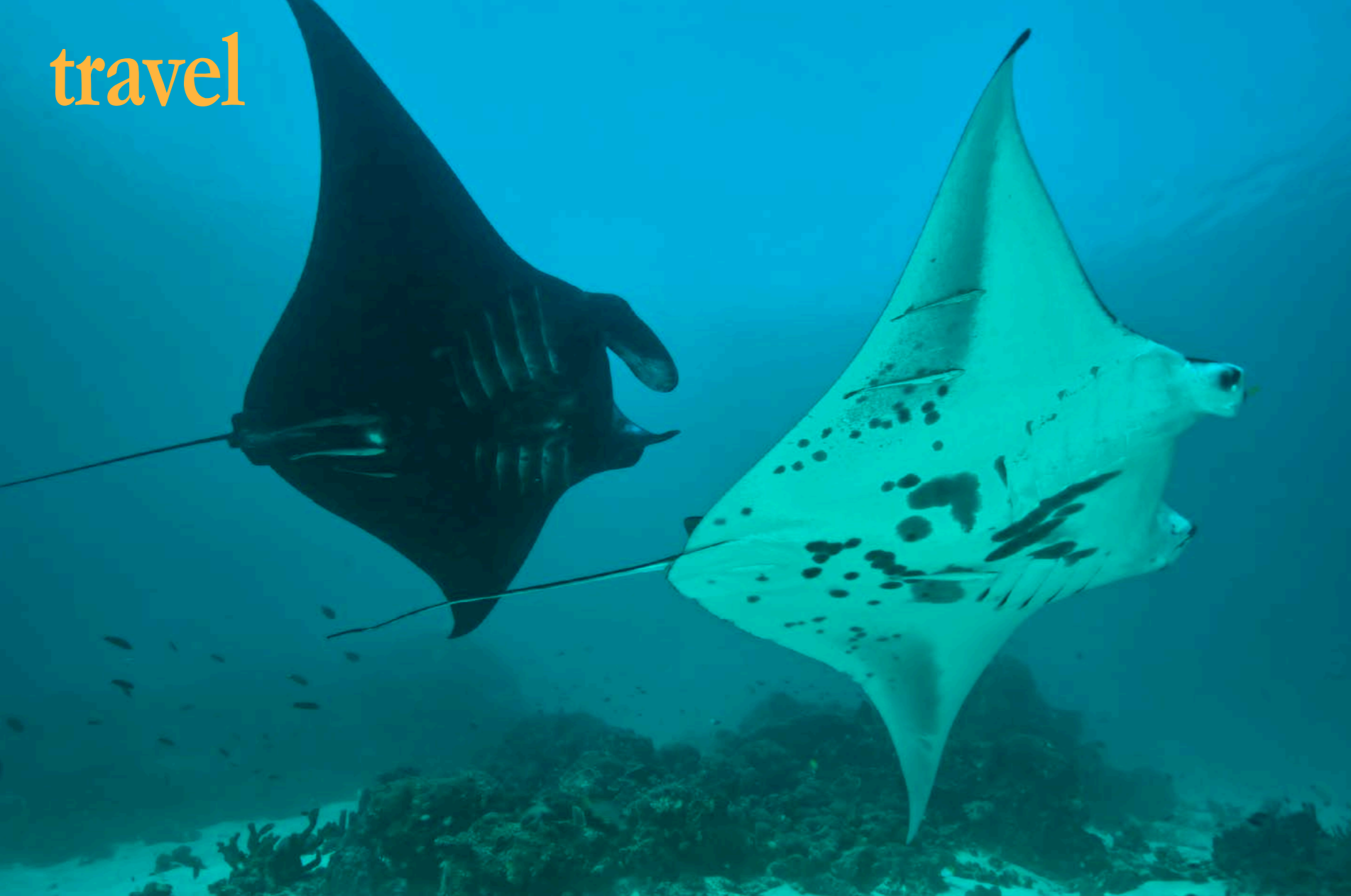
DIVING IN STRONG CURRENTS —*The Do's and the Don'ts*

The trick to diving in strong currents around Raja Ampat is to understand the basic mechanism and work with it, because you just can't fight it. Strong currents are the life-force of vibrant reefs systems, and they are at the strongest around the edges and at their most manageable in the center.

Picture a large submerged bommie or pinnacle that rises up from the deep and faces into the predominant current. Where that current hits the reef first is where its velocity is low, and the deeper you go at that point, the less that velocity will be. But as the current goes around the sides, the velocity increases dramatically, and where it goes over the top of the bonnie or pinnacle, particularly if it is shallow, the velocity is at its maximum.

So, when you enter the water, it should be upcurrent from the bommie, and you must get down on the front as quickly as you can, which is the sweet spot where the current is manageable and where the most prolific fish activity is. Miss the front, and you will think you are in a washing machine, as the currents sweeps you around or over the top. ■



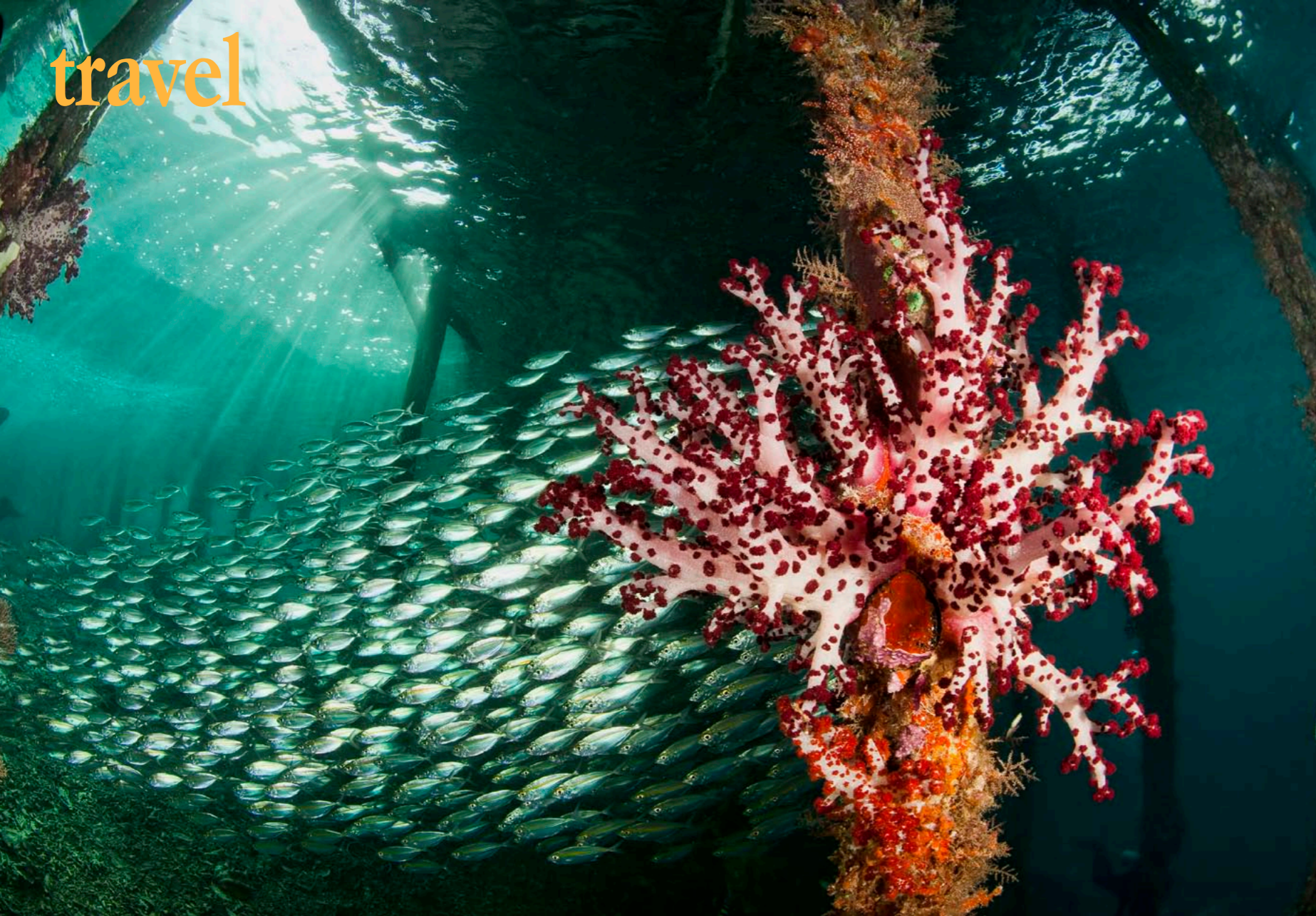


Manta Mantra. Various referred to as Manta Mantra, 3M, Manta Ridge and Manta Sandy, this site is a manta ray cleaning station on the southern side of the large reef that separates Mansuar

Island from the much smaller Airborek Island at the western end of the Dampier Strait. The cleaning station is a number of small bommies located in the channel between the main reef and a smaller one to the south. Strong currents run through the channel, which together with the numerous cleaner wrasse and butterfly fish on the bommies, have created the perfect conditions for mantas to come in and be cleaned of their parasites. As many as 30 mantas have been reported on the site, but on the days I dived it we saw between five and ten—but on every dive. The site is very popular, and to ensure the presence of so many divers does not

drive away the mantas, a strict demarcation code is enforced at the site. A line of rocks has been laid out in about 16m of water, close enough to the bommies so that divers can observe and photograph the mantas, but far enough away to allow them to be cleaned in relative peace. The thing to do at Manta Mantra is get yourself in position somewhere along the demarcation line where you can comfortably hold on against the currents and then wait. The site is fairly shallow, and so bottom time is not an issue. As the mantas complete their cleaning rituals, they often come and check out the waiting divers with some upfront and personal interactions. Altogether a tremendous dive site and not one to be missed!

THIS PAGE: Mantas visit the cleaning station at Manta Mantra



Airborek jetty in the late afternoon

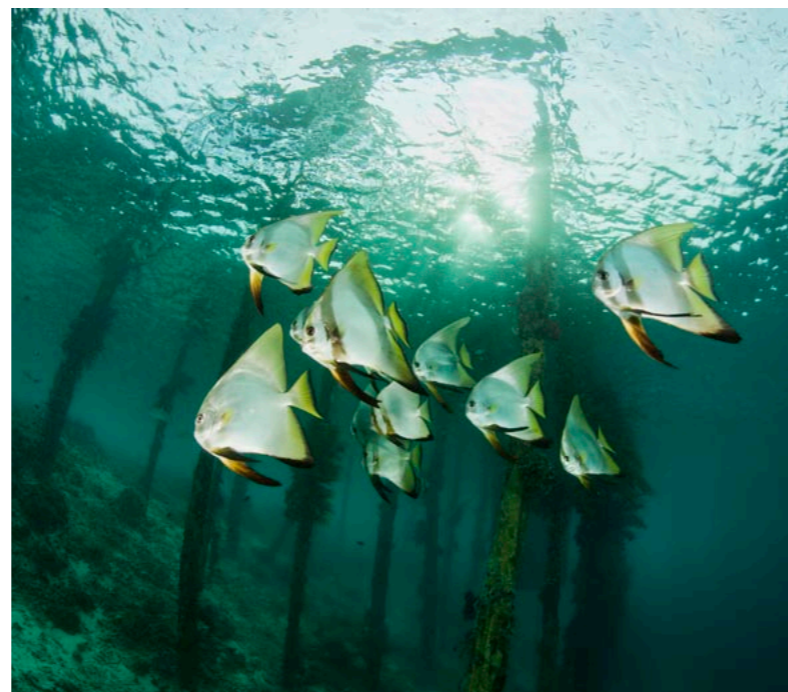
Airborek Jetty. Another signature dive site that should not be missed are the two jetties on the small island of Airborek. Here, the Dampier Strait currents flow around the jetties, creating a mini-ecosystem on the wooden structures, with rich growths of vibrant soft corals on the vertical piles and resident schools of jacks and batfish patrolling in between.

Late afternoon on a calm day produces a perfect setting for wide-angle photography as the sun's rays create stunning backdrops to the abundant subject matter under the jetty. Then, if

you tire of that, the local kids make excellent models as they swim down to pose for the camera.

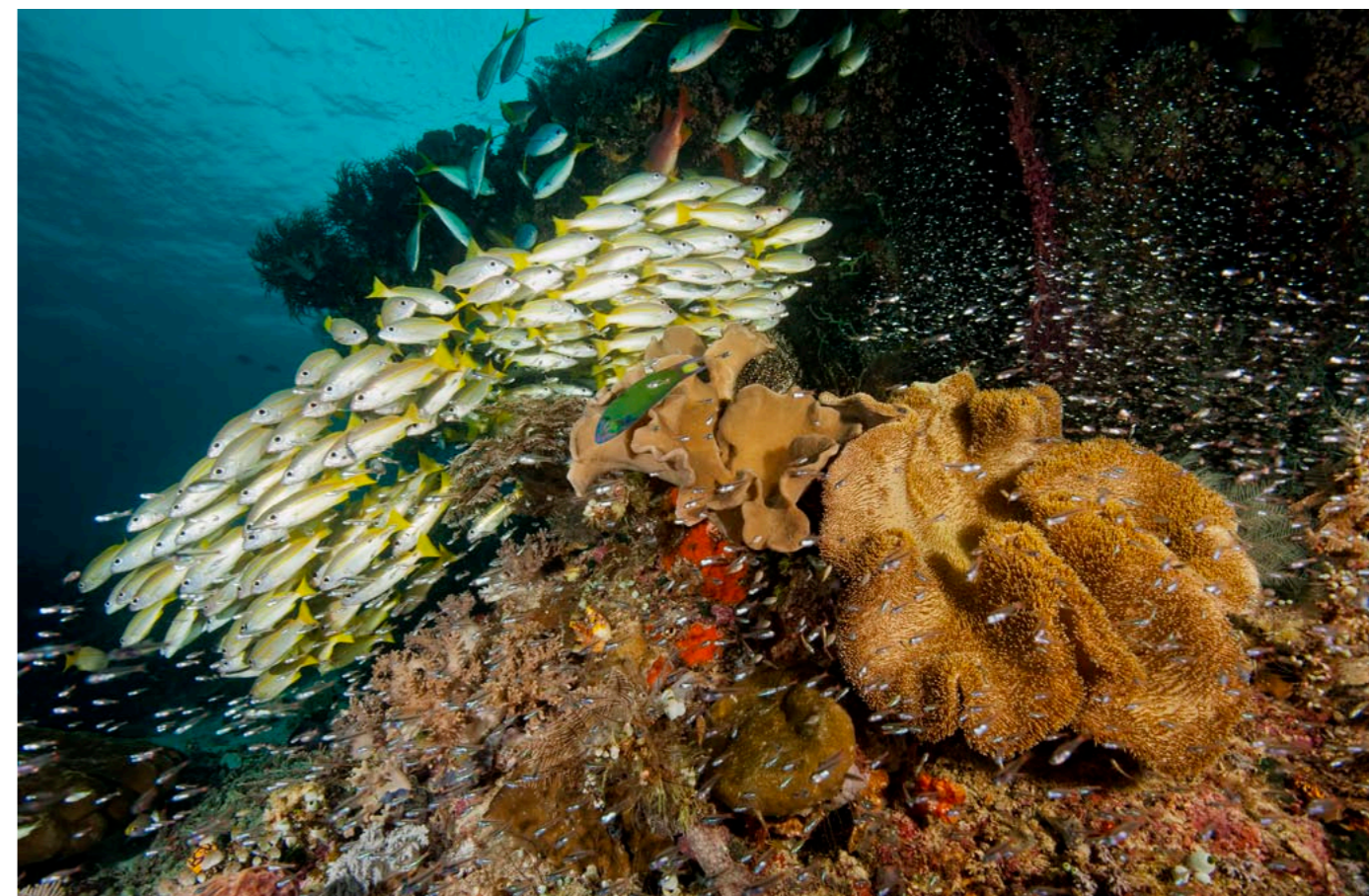
Down in the coral rubble on the slope around the jetties, you will find jawfish, pipefish and other critters, while the bommies at 18m are home to some schooling sweetlips and numerous critters.

Mioskon. This small island on the northern side of the Dampier Strait is near where the southern end of Kabui Bay exits in to the strait between the large islands of Gam and Waigeo. There are



Schooling bat fish underneath Airborek jetty

Raja Ampat



Mioskon reef in the Dampier Strait; Local kids from Airborek village pose underwater (top right)



Superb soft corals at Mioskon reef



Wobbegong shark and diver at Mioskon reef

several other superb dive sites in the area, such as Cape Kri, Sardine Reef and Mike's Point, but for sheer consistency the eastern side of Mioskon is hard to beat.

Known above water for its large population of flying foxes, below water you will find a superb reef with numerous bommies densely coated in soft corals and a resident school of yellow snapper patrol that sweeps up and down the reef in a flowing motion that adds to the very dynamic feel of the site.

Throw in the numerous wob-begong sharks to be found and the plethora of creatures and critters in amongst the bommies and soft corals, and



Raja Ampat



Late afternoon at Mioskon reef

this is one tremendous site that can be dived time after time without getting bored.

Waigeo—The Passage

In the northern area of Raja Ampat, around the western tip of the island of Waigeo are several good dive spots such as the critter site Waterlogged and the nearby Pearl Farm jetty in Alyui Bay. But the narrow channel that separates the islands of Gam and Waigeo is very much the signature dive in Waigeo.

The channel's proper name is Kabui Passage, and it connects the western side of Kabui Bay to the Halmahera Sea, but it is universally referred to as simply The Passage.

Roughly one nautical mile long, The Passage is about 60m wide and is subject to some really strong currents that can make the journey



Beautiful sponges (left) and superb soft corals (above) in Waigeo's Passage

through it feel a little bit like white rafting!

Although it looks just like a fast flowing freshwater river making its way through dense jungle, it is actually sea water, and in the many small

inlets along the side of The Passage, mini-ecosystems have been established. These are quite special, particularly the ones on the southern side near Kabui Bay where large sea fans, soft corals and colorful sponges

have grown in shallow waters under the overhanging jungle creating quite unique photo opportunities.

Diving The Passage around mid-day offers the chance to capture the sun's rays, as they pierce the overhead canopy and illuminate the colorful growth below creating a superb and mysterious effect.

Then, there are the mangroves and archer fish hunting their prey in their unique "spit-and-stun" technique and small schools of halfbeaks up in the inlets, but don't forget to look out into The Passage itself, as you will often see passing sharks, turtles and jacks—what a dive!

Local knowledge

The indigenous people of the Raja Ampat area predominantly live in small coastal colonies where the traditional tribal culture, which revolves around the sea, still prevails. Apart from tourism, there is virtually no industry, which means that the sea is the principal source of sustenance, but extracting that bounty from the rich waters of Raja Ampat requires a quite unique skill set—one which, when learned, is ideally suited to safely immersing "bule" (tourists).

Mikel Merin from Dome Island near Sorong has been the principal



Mikel Merin in his element!





Traditional mask (left); Misool Eco Resort (above); Fan corals on reef; Ornate ghost pipefish (lower right)



boat boy on all the trips I have done to Raja Ampat—which have been with Deb Fugitt's City Seahorse dive travel company.

Fugitt has been leading trips to Raja Ampat since 1999 and met Merin on that first trip, when he helped her find the best spots to dive safely.

Watching Merin study the surface currents and direct the cover boats is to observe somebody who is comfortable with these forces of nature and can intuitively understand what is happening under the water from the patterns above. Those skills are past down from generation to generation by the people

of Raja Ampat, as they learn how to take their canoes out in to the currents of the Dampier Strait, understand where the fish will be, how to catch them and (most importantly) how to get back to the village with that catch.

Merin sat with me one evening on my last trip to Raja Ampat and explained how his uncle had mentored him from an early age to do this by first showing him how to paddle his canoe with and against the currents, then how to interpret the state of the tide from the phase of the moon—no clocks or tide tables required.

Once confident on the water, the next steps were to read the surface patterns created when the currents sweep around a reef or large bommie, so that the canoe can be safely anchored in the sweet spot closest to the fish.

Merin also shared with me stories of what had happened to him when he got it wrong in the early days, as he started to go out by himself. One mis-

adventure he related had him caught in the fierce currents of the Sele Strait between the islands of Batanta and Salawati, as night was falling.

He managed to turn his canoe around and make it back to Dome Island by dawn the next day, but had he not, he would have been swept out into the Halmahera Sea with the next chance of landfall some 300km away—character building.

Misool

Some 130km to the south of the Dampier Strait area, and roughly halfway to Ceram in the Molluccas, is the large island of Misool and what are probably the very richest and most vibrant reefs in the world. This is a remote area in a remote area, and Misool's isolation has allowed it to become the epicentre of biodiversity in an area that is already recognised as the most biodiverse in the world.

It is hard to imagine a more pictur-

esque and inspiring area, both above and below the waters. But it is not like this by accident, and much of the credit for the current excellent status of the area's reefs and marine habitats are the results of the conservation work pioneered by the Misool Eco Resort. A superlative example of what can be done to arrest decline and convince local communities that the seas are not an inexhaustible resource, the resort has



THIS PAGE: The incredible corals and gorgonian fans at Fiabachet in Misool

really done a tremendous job and is to be applauded.

Fiabachet. Is this the best reef in the world? Hard to answer in a quantifiable manner, but subjectively, Fiabachet has to be in the top ten if not the top five—it is simply that good!

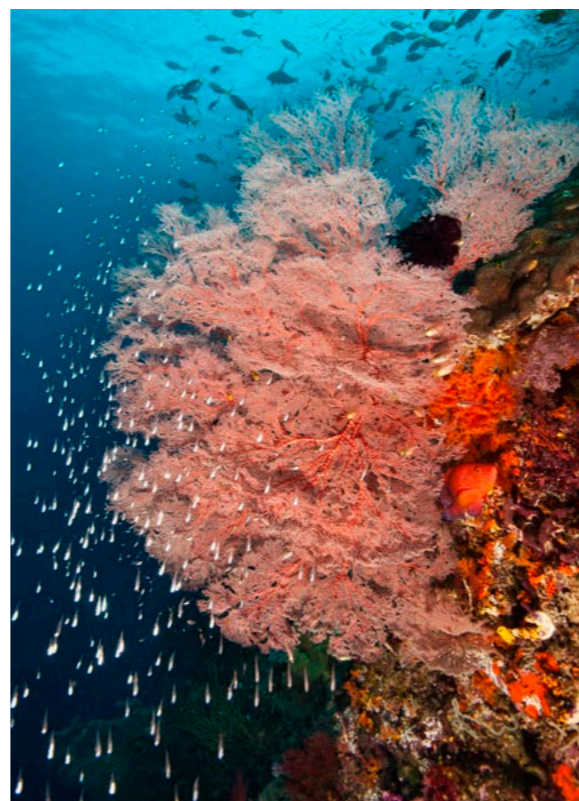
There are numerous other tremendous sites in a string of islands to the southeast corner of Misool, but Fiabachet is the jewel in the crown and a simply amazing experience. The actual site is a long underwater ridge that runs west to east and connects two rocky outcrops: Nudi Rock at the western end and Tank Rock at the eastern end.

The underwater area around Nudi Rock, which takes its name from the remarkable similarity its above water

shape bears to a nudibranch, is positively stunning and probably the best and most dynamic part of Fiabachet. The quality and quantity of the hard and soft corals, sponges, gorgonian fans, sea whips and general fish life will take your breath away!

But the area around Tank is phenomenal as well, and if you went there first, you would probably think it can't get much better than this, only to journey down the ridge to Nudi and find somewhere that takes it to the next level. Once upon a time there were many other places just like Fiabachet.

Batu Boo. It's hard to pick the next best dive site after Fiabachet, as there are so many to choose from, but nearby Batu Boo is quite something, too. It is also





Diver in Boo Windows at Batu Boo (above); School of balfish at Batu Boo (top right); Brilliant sunset over Raja Ampat (right)

known as Boo Windows because of the two large, shallow underwater holes in the main island that create excellent photo opportunities at certain times of the day when the sun streams through them. The site is a large underwater seamount that runs north to south, and at the northern end, there is a large oval shaped rocky outcrop, while at the southern end there is a small outcrop with a single tree growing on it—which has been christened Batu Jamur,

or mushroom rock, for obvious reasons. The two “windows” are at the southern end of the main rock and face west to east, making them perfect for the sun’s rays. Besides the windows, there is a great deal to see at Batu Boo, starting with the walls of the seamount that is richly covered in soft corals and gorgonian fans—many with pygmy seahorses. The blue water around the rock is host to numerous pelagic fish, and the

area around Batu Jamur is rich in soft corals and has a resident school of yellow snappers.

Conclusion

The Four Kings is without a doubt one of the top dive destinations in the world, and the danger is that its very popularity will severely degrade its tremendous biodiversity. While there are signs of degradation, there are also significant efforts being made to arrest the decline, and the work

done by Conservation International, The Nature Conservancy and WWF-Indonesia together with the very hands-on and proactive approach of the Misool Eco Resort is tremendous. The creation of the huge marine protected areas (MPAs) and shark sanctuary indicates that the local authorities are getting the message that a healthy and vibrant Raja Ampat is much more valuable than a plundered

one. The area’s spectacular above-water scenery would justify the long journey to get there in itself, but for divers, Raja Ampat offers a chance to see the underwater world at its very best and is something you simply should not miss! ■

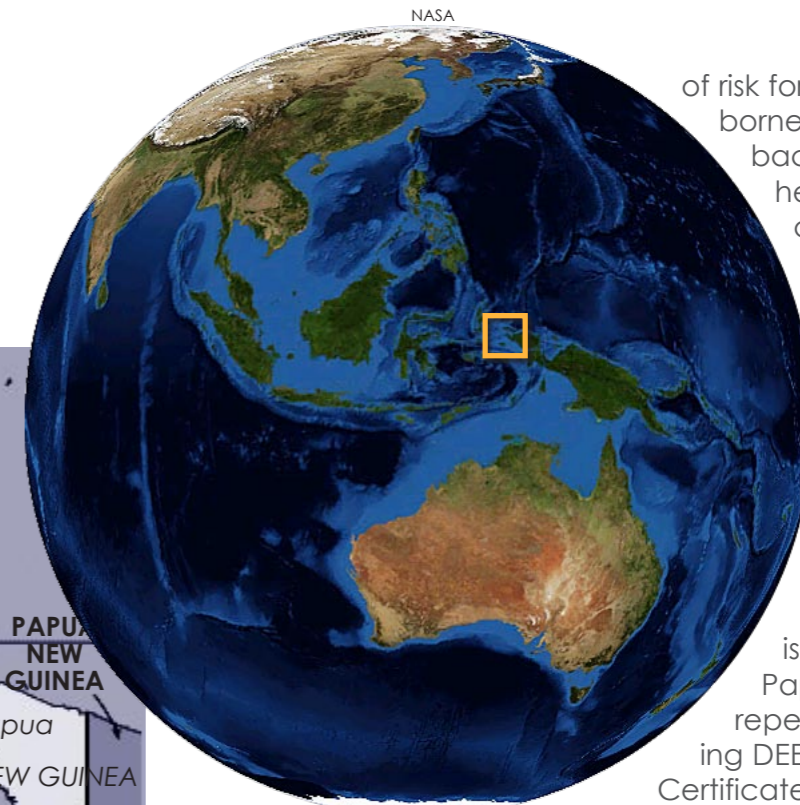
Don Silcock is a Bali-based underwater photographer and writer who focuses on the diving in Indonesia and Papua New Guinea. His images, articles and extensive location guides can be found online on his website: www.indopacificimages.com

fact file



SOURCES: U.S. CIA WORLD FACTBOOK, WIKIPEDIA, INDOCRUISES.COM, MARK ERDMANN

Raja Ampat, Indonesia



of risk for food or water-borne diseases, such as bacterial diarrhea, hepatitis A and E, and typhoid fever, as well as vector-borne diseases such as chikungunya, dengue fever and malaria. Check with WHO or your dive operator for prophylaxis recommendations. Larium is not effective in Papua. Bring insect repellents containing DEET. International Certificate of Vaccination required for Yellow Fever if arriving from infected area within five days.

Exchange rates:
1 EUR=12,723IDR;
1 USD= 9,737IDR;
1 GBP=15,127IDR; 1 AUD=
9,972IDR; 1 SGD= 7,908IDR

Population

251,160,124 (July 2013 est.) Papua Province: 2.5 million—1.5 million of which are indigenous people. Ethnic groups: Javanese 40.6%, Sundanese 15%, Madurese 3.3%, Minangkabau 2.7%, Betawi 2.4%, Bugis 2.4%, Banten 2%, Banjar 1.7% (2000 census). Religions: Muslim 86.1%, Protestant 5.7%, Roman Catholic 3%, Hindu 1.8% (2000 census). Note: Indonesia is the largest Muslim country in the world. Visitors are encouraged to respect local tradition and dress modestly. Internet users: 20 million (2009)

Language Bahasa Indonesian, plus 253 tribal languages. West Papua and its neighbour, Papua New Guinea, contain 15% of all known languages. English, Spanish and German are spoken on dive liveaboards.

Health There is a high degree

Decompression chamber

Raja Ampat has a new chamber at Waisai (capital city on south side of Waigeo near Dampier Strait). The next nearest chambers are on Sulawesi: Manado: Malalayang Hospital tel: +62 0811 430913 Makassar: Rumah Sakit Umum Wahidin Sudirohusodo tel: +62 0411 (584677) or 584675

Travel/Visa/Security

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. To enter Papua, you need a surat jalan, which is issued by the local police, and arranged by your dive operator. Although there is an active independence movement in Papua, tourists have not been impacted.

Web sites

Indonesia Travel www.indonesia.travel/en

toppled in 1998 following a round of riots, and in 1999, free and fair legislative elections took place. Indonesia is the world's third most populous democracy, Government: Republic. Capital: Jakarta. Note: Papua is one of 27 provinces with its capitol in Jayapura. As of late 2004, Raja Ampat has a separate district government.

Geography Located in Southeastern Asia, Indonesia is an archipelago situated between the Indian and Pacific Oceans. Coastline: 54,716km. Terrain consists primarily of coastal lowlands, with interior mountains on larger islands. Raja Empat is the most western district of the Indonesian province of Papua. Raja Empat consists of four major islands off the west coast of Bird's Head Peninsula of New Guinea Island, the western half of which is Indonesia and the eastern half, Papua New Guinea. The province was formerly called "Irian Jaya".

Climate Tropical, hot and humid, with more moderate climate in the highlands. The water

temperature is normally 28-29°C (84-86°F) year round, with an occasional "chilly" 27°C (82°F) spot. Most divers use 1mm neoprene suits. However, some people prefer 3mm.

Environmental issues

Challenges include industrial waste water pollution, sewage, urban air pollution, deforestation, smoke and haze due to forest fires. Logging—the rainforests within the combined West Papua/Papua New Guinea land mass are second in size only to those of the Amazon, making it 'the lungs of Asia'. In 2001, there were 57 forest concession-holders in operation around the country and untold other forest ventures operating illegally. Mining—tailings from copper, nickel, and gold mining are real threats.

Economy A vast polyglot

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

Currency Indonesian rupiah (IDR). Visa cards, Euros and U.S. Dollars (large bills issued after 1999) are widely accepted. ATM machines in tourist areas offer the best exchange rates, Travellers cheques are becoming quite difficult to use except at banks.

THE FACTS AND VIEWPOINTS IN THIS SECTION ARE NOT NECESSARILY THE VIEWS OF X-RAY MAG. EQUIPMENT PRESENTED IN THIS SECTION HAS NOT BEEN TESTED BY X-RAY MAG STAFF, NOR ARE THE ITEMS WARRANTED. INFORMATION PROVIDED IS CONDENSED FROM MANUFACTURERS' DESCRIPTIONS. TEXTS ARE USUALLY EDITED FOR LENGTH, CLARITY AND STYLE. LINKS ARE ACTIVE AT THE TIME OF PUBLICATION

POINT & CLICK ON BOLD LINKS



Equipment



Edited by Rosemary 'Roz' E. Lunn



Aqualite Eled

The U.K. Aqualite eLED is a small format video light. It is capable of producing up to 600 lumens at a 90° angle, making it a useful light source for wide-angle or fisheye type cameras such as GoPro and the Intova SP1. The batteries provide useful burn times: 600 lumens / 1.3 hours, 340 lumens / 2.3 hours, 220 lumens / 4.2 hours and 115 lumens / 8.8 hours. Other features include double o-rings on the front and back rotary seals, anodized machined aluminum power head and rotary switch, high impact ABS anti-corrosion body and stainless steel thread attachments.

Uwkinetics.com

W4

Waterproof has augmented their signature anatomical wetsuit range with the launch of the eye-catching 'W4'. This high quality gender specific cut suit replaces the W2, and is available in both 5mm and 7mm. It is no surprise that the W4 is a bit of a stunner. Waterproof has earned a much deserved reputation for their thorough research, design and attention to detail. We don't think the W4 will disappoint. Benefits include double seals, moulded rubber kneepads, Wave Flex panels in the hollow of arms and legs, 10mm spinepad and a comfort neck zip. It also has computer anchor straps built into each wrist—simply thread your strap through to secure against the anti-slip surface.

Waterproof.eu



Aeris Jetpack BCD

This game changing one-size-fits-all fully functional back inflated BCD was designed with the future dive traveller in mind. The Aeris Jetpack morphs into an airplane hand luggage, adventure-style backpack, thus saving you the agony of lost luggage and checked baggage fees. Simply mate the 42-litre travel bag with the Jetpack BCD, and you create a bag capable of carrying your regulator, mask, fins, snorkel, wetsuit, toiletries, swimwear, diving qualifications, flip flops and cuddly toy. Once in resort, you simply unzip the bag and dive the 1,000 Denier Cordura BCD. It has 30lb of lift and comes with a unique completely adjustable harness system and dumpable weight pockets. CleverAeris.com

Leonardo

The Leonardo is Cressi's first take at designing and making a computer entirely in-house. It has updated and cleaned up a basic classic concept and compact design. A hi-def screen with large numerical display makes all the essential information easy to read even at glance. The single button interface makes settings easy. It has modes for air, nitrox (up to 50%) and gauge. For the advanced divers it also comes with a PO2 alarm that can be set between 1.2 bar and 1.6 bar, a CNS oxygen toxicity graphic indicator and user-selectable Deep Stop function. Cressi.com



Aqua Lung Ava

Making a male glove smaller for female divers doesn't really work. Ladies have longer hands and narrower fingers, and the Ava glove from Aqua Lung's 'Details' collection has been cut accordingly, to give a better fit. It utilises thicker super stretchy neoprene on the back of the hand for warmth, whilst ensuring dexterity is retained because the palm has a thinner neoprene. These gloves come in two thicknesses 3 / 2mm and 6 / 4 mm. The longer tab on the back of the gloves makes donning and doffing a pleasure, and the rubberized palm and fingers provide decent grip. Aqualung.com



Finn Light Short

This natty little light can produce up to 1,400 lumens for 2.5 hours, thanks to three high efficiency Cree XP-G LEDs. These LED diodes

are awfully bright—6300°K to be exact—and the colour

of light they produce is akin to what you would see on a sunlit ski slope. If 1,400 lumens are too dazzling for you, the Finn Light Short 1400 Smart has two other power settings: 700 lumens for

4.5 hours and the 'safety mode' of 100 lumens, with a 24-hour

burn time. Finn recommends that

you specifically use this mode on the surface when prepping gear, or entering the water. It is probably because this

light produces quite a lot of heat. Other

features include a 10° focus beam, discharging and overcharging

protection, an anatomical Goodman handle and an operational depth of up to 200 metres. Finnsub.com



BlueHeat

DUI launched 'BlueHeat™'—a one piece battery-powered heated garment system—at the 2012 DEMA show. You can either wear BlueHeat as is, beneath your suit, or augment your thermal protection by donning additional layers on top of the BlueHeat suit.

Dui-online.com



Dual format

Ever got confused over units used overseas? Enter Scubapro's new compact all-metal analogue pressure gauge. Its dual bar/psi scale makes it ideal both for travelling divers and resorts with international clientele. Scubapro.com



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Red Sea Wrecks

Hurghada, Egypt

Diver on
wreck of the
SS *Carnatic*

Text and photos by Brandi Mueller

The Red Sea, its reputation precedes itself. The beautiful red-orange desert mountains stand over the unexpected and contrasting blues of the water. The calm and clear waters hide much below. Under the water is a rainbow of colors, and among the fish and corals, are the remains of many ships.

The Red Sea has been deceitful to many captains over time. The beautiful reefs that divers dream about here have also caused many a ship to meet its end. Sailors thought they were safe after clearing the challenging and narrow Suez Canal only to run aground or hit reef just outside the canal. Misjudgment and bad weather as well as numerous wars have laid the stage for the demise of many ships.

Although a popular dive location for Europeans, I (coming from the United States) knew very little about what I would find. I had always heard about its fantastic reputation and was excited to discover there were so many wrecks (which I happen to like very much).

Not only are there wrecks, but there are wrecks with really great stories behind them. Gold coins, wars, motorcycles and even toilets—who knew? I love nothing more than a good story and a good dive to create more diving stories to tell over a few drinks back on the boat. Lucky for me I had a week on Emperor Diver's MV *Superior* liveaboard and a fantastic group of Finnish and Irish dive buddies.

The hardest part was that there were so many wrecks with so much to see on



THIS PAGE:
Scenes from the SS *Thistlegorm*; City of Hurghada (right)



Red Sea

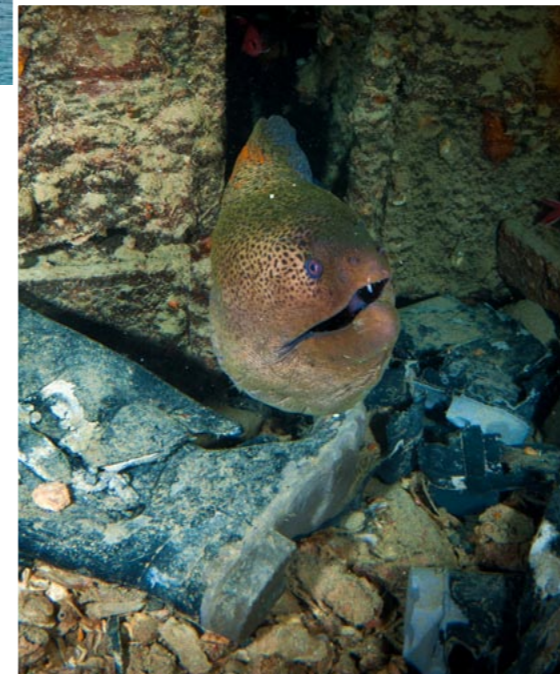


and Italian forces in the Mediterranean, she made the long trip around via Cape Town, South Africa, refueled and headed up through the Red Sea towards the Suez Canal.

Passage through the Suez was dependent

Thistlegorm, two ships had collided blocking the entrance of the canal, forcing her to wait before continuing. She was moored at Safe Anchorage F in September, awaiting the call to continue up the canal.

The *Thistlegorm* waited for two weeks and on October 6, in the middle of the night, two bombs were dropped on her, both hitting a hold with stored ammunition caus-



ing a huge explosion and sinking the ship. Two Heinkel He-111 aircrafts had been dispatched by the Germans from Crete to find and destroy a rumored ship carrying 1,200 British troops, and these aircraft

were headed back after an unsuccessful hunt. They spotted the *Thistlegorm* at anchor in the moonlight and decided to release the unused bombs. The explosion almost tore the ship in two, and towards the stern, the ship seems to have peeled away leaving a distinct missing section of the ship.

While passing through Cape Town, the HMS *Carlisle* had joined the *Thistlegorm* and was anchored nearby also awaiting passage. The *Carlisle* rescued what crew it could, but nine of the 48 didn't survive.

Launched in 1940, the *Thistlegorm* was built as a steam, single screw cargo ship. She only had four voyages, the fourth being her last. Her completed journeys were to North America to bring back steel rails and aircraft parts, Argentina for grain, and the West In-

each one. I wanted to dive them over and over again. The dive guides correctly assured me that the next one would be just as good, if not better.

Diving out of Hurghada in March, the water temperature, frosty 22°C (70°F) was a bit colder than I expected (I hadn't done my research before arriving). My first giveaway that the water would be chilly was when my boat mates were unpacking their drysuits!

Luckily the diving was so good that I didn't notice I was cold until the safety stop. With so much to look at and so many things to take photos of, I hardly had time to notice I couldn't feel my toes.

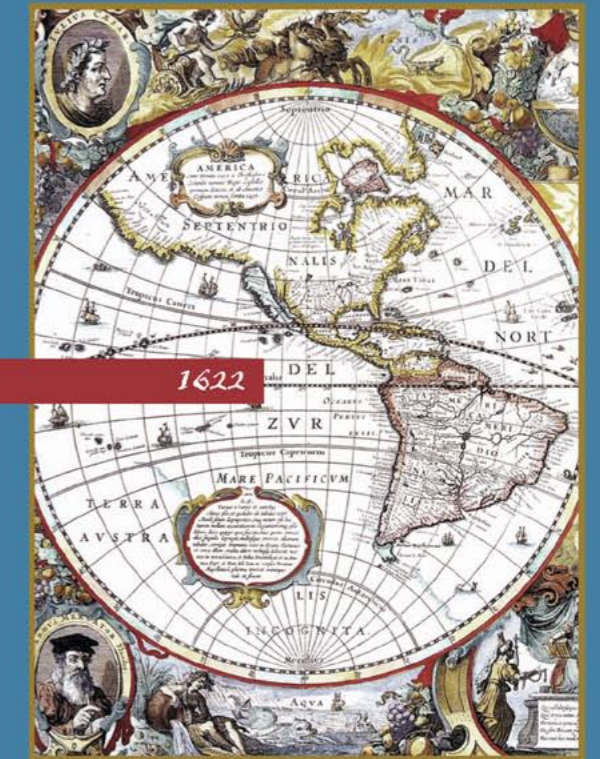
Diving the wrecks

SS *Thistlegorm*. The World War II British Supply Ship, *SS Thistlegorm*, had left Glasgow, England, on 2 June 1941 loaded with military supplies headed for Alexandria, Egypt. Due to German

on how many other ships there were, enemy activity, and in the case of the



Treasure Coins of the *Nuestra Señora de Atocha* & the *Santa Margarita*

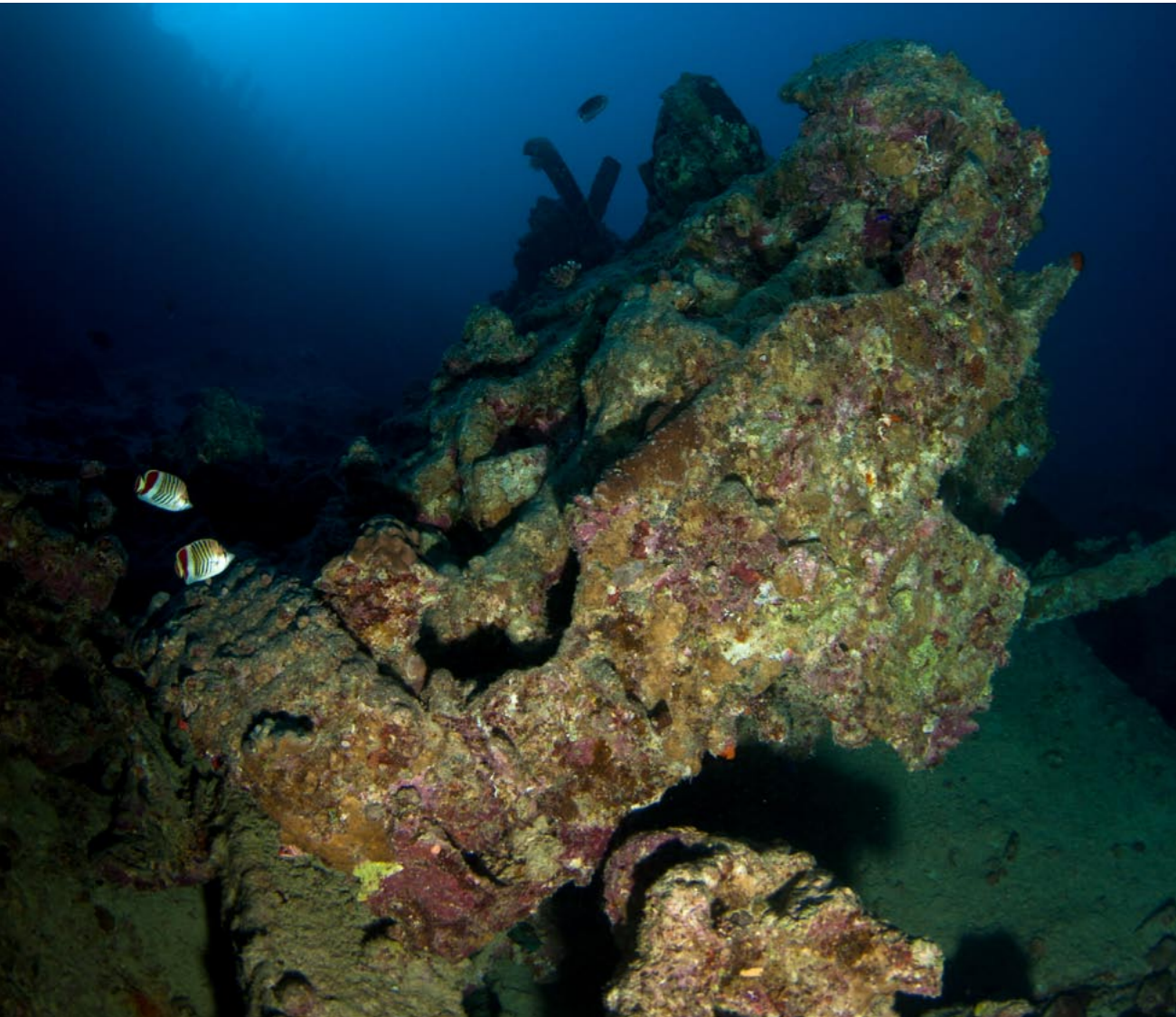


Carol Tedesco

In 40 succinct pages, *Treasure Coins of the Nuestra Señora de Atocha & the Santa Margarita* answers all the most frequently asked questions, including what the coins look like when first discovered, the meaning of the various markings, how they are cleaned, conserved and graded, what they were worth in the 17th century, and the most up-to-date information on the names and periods of office of the men who made them. Of particular interest to 1622 fleet coin enthusiasts is a section devoted to the exceedingly rare Old World minted coins discovered on the *Atocha* and the *Santa Margarita*.

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THIS PAGE: Scenes from the wreck of the *Thistlegorm*; Motorbikes stacked in the beds of trucks on deck (right)



bow and entered the interior of the ship to visit holds #1 and #2. The first thing I noticed inside the ship was motorbikes upon motorbikes stacked in the beds of trucks. Three bikes to each truck and with many of the trucks you could see through the roof of the cab to the driver's seat, clutch, pedals, and a few steering wheels.

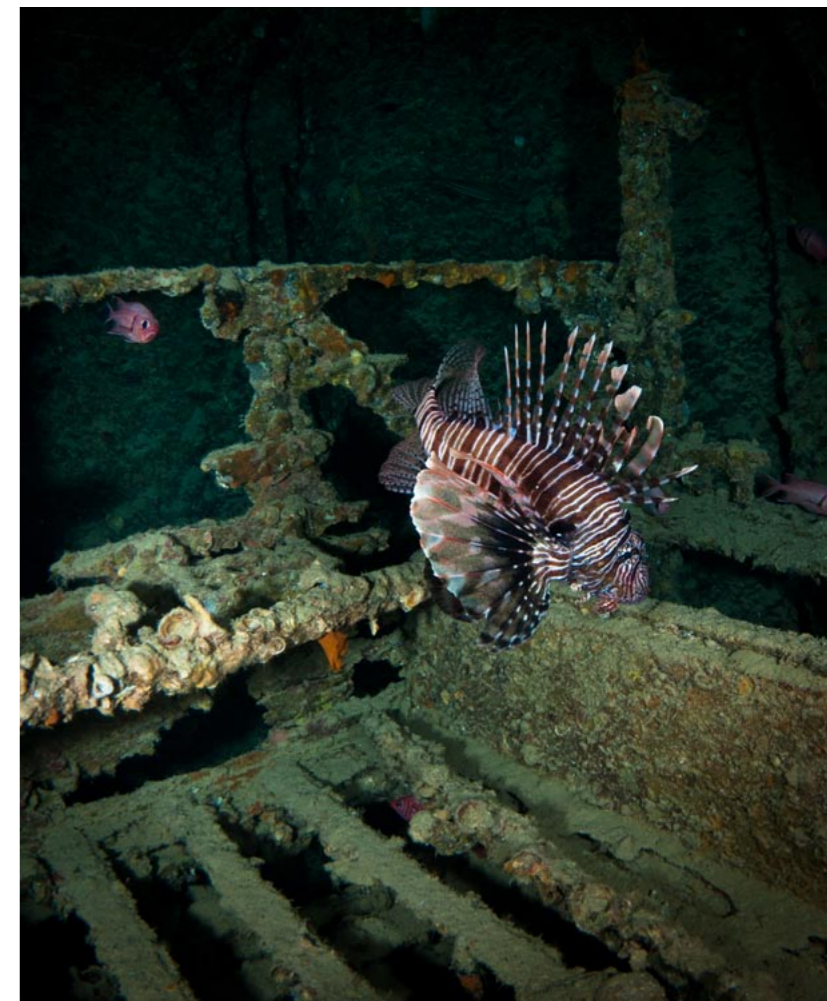
Continuing over the trucks there were stacks of tires in any extra space in front of and behind the trucks. Schools of squirrelfish seem to have made their homes in the 'tween decks of the ship, and they hovered above the trucks and motorbikes. A diver was waving his flashlight at me frantically summoning me over and pointed out a massive green moray eel coming out of a crack between a truck cab and bed. Upon closer inspection, the eel seemed to be guarding a Wellington boot.

The trucks and motorbikes seemed to never end, and in the back of

one truck, our dive guide pointed out a battery which divers had rubbed clean of algae to show its brand. It is stamped with "Lucas, 1941, Birmingham England, Lead Acid". Swimming through the holds, there is a lot of outside light and quite a few exits if one wants to get out of the ship.

On a second dive, we dove the outside of the wreck first visiting one of two LMS Stanier Class 8F steam locomotives, destined for Egyptian Railways, that had been carried on the deck of the ship. Both were hurled off the ship in the explosion, landing one on either side of the wreck. On our way back to the ship towards the stern, there was an upside down tank on which one could clearly make out the caterpillar tracks.

On the stern, the *Thistlegorm* was armed with a 120mm (4.7inch) anti-aircraft gun and a machine gun (the latter being attached after the construction of the ship). Both of these guns are still intact, the forward gun pointing toward the sea floor and the machine gun outward



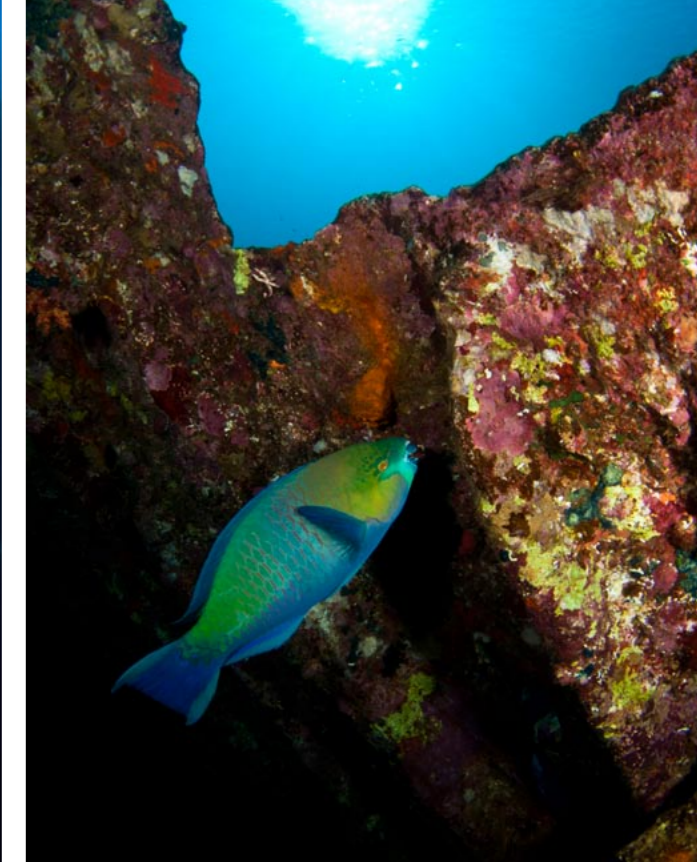
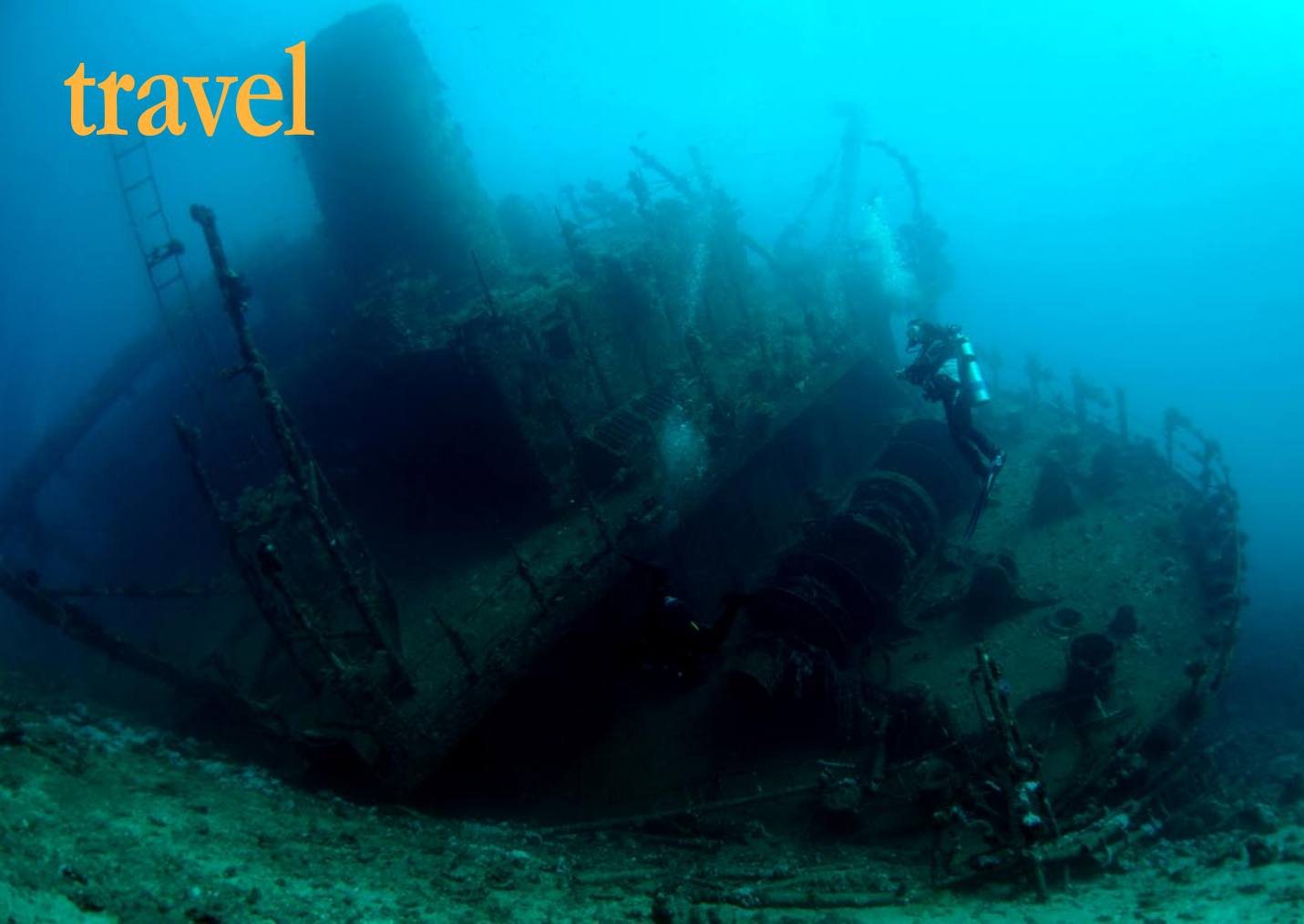
horizontally.

Aside from all the exciting artifacts and historical WWII relicts, the *Thistlegorm* is

dies for sugar and rum. To Alexandria she was carrying Bedford trucks, BSA 350 and Norton 16H motorbikes, boxes of rifles, aircraft parts, ammunition, tires, Wellington boots, torpedoes, tanks, two locomotives and other military supplies.

On our first dive there was some current, which is common, and we used a surface line to pull ourselves up to the bow mooring and decent line. We descended forward of the ship's bomb destruction towards the





teeming with marine life. We saw several crocodile fish lounging on the deck, the holds were filled with colorful reef fish, batfish patrolled the decks, and pink and orange anthias guarded the soft coral-covered winch.

The *Thistlegorm* is one of the most popular and most dived sites in the world, and it's easy to see why. The cargo it contains makes for an exciting treasure hunt with unsuspected war artifacts found around every corner. Its max depth is around 30m (100ft) making it easy for recreational divers and allowing for a fair amount of bottom time. Jacques Cousteau was the first to lo-

cate the wreck in 1956 using knowledge from local fisherman, but it was not found again and dove until the early 1990s.

Unfortunately, time and extensive use is taking its toll on the wreck. Rusting from more than 70 years in saltwater as well as many boats mooring directly to it in weak spots have caused collapses. Sadly,

many artifacts have been removed from the ship as well; Cousteau, himself, took a motorcycle, the captain's safe, and the ship's bell. Divers have removed many of the small objects such as steering wheels and parts of the motorcycles over time.

Even with the wreck pillagers and dive boats and saltwater taking its toll, the *Thistlegorm* is a fantastic wreck dive. Multiple dives are needed to see the majority of it, and even after many dives it would be tough to get bored. Liveboards frequent the dive site. Being close to Sharm el-Sheikh and Hurgada, day boats can easily get there.

Giannis D. Shab Abu Nuhas is a reef that is just below the surface near the Straits of Gomal, a very busy shipping lane. This hidden reef has been the demise of more than one ship. In fact, the wrecks of five ships can be dived off Shab Abu Nuhaus:

the *Giannis D*, the *Carnatic*, the *Chrisoula K*, the *Kimmon M*, and the *Marcus*.

The *Giannis D* had left the Croatian port of Rijeka in April 1983, carrying wood to Jeddah, Saudi Arabia, and continuing on to Hodeidah, Yemen. Having made it through the Suez Canal, the captain thought they were in the clear and

Scenes from the wreck of the SS *Carnatic* (above and left)

went to sleep, handing the vessel over to his officers and giving the orders of "full speed ahead". Shortly after, the ship hit the reef and sank.

Having originally been launched as the *Shoyo Maru* in 1969, the 99m (325ft) long and 16m (52ft) wide cargo vessel was built in Japan. She was sold and



Scenes from the wreck of the *Giannis D* (right, top left and top center)

Historical image of the SS *Carnatic*



WIKIMEDIA COMMONS



Lush coral growth on the wreck of the SS Carnatic



Anthias on coral; Pair of chevron butterflyfish (right); Diver at Carnatic wreck site encounters wild dolphins (lower right)



renamed the *Marcos* in 1975, and sold again in 1980 to Dumarc Shipping and Trading Corporation and named the *Giannis* and *D* for Dumarc.

Sitting at a 45 degree angle on her port side between 6-27m (20-90ft) our dive guide took us through the interior of the stern. The slight tilt made it feel as if we were swimming through an underwater fun house. There isn't too much in the way of artifacts inside the ship, but the engine room is easily accessed with machinery, gauges, handles and levers still

intact.

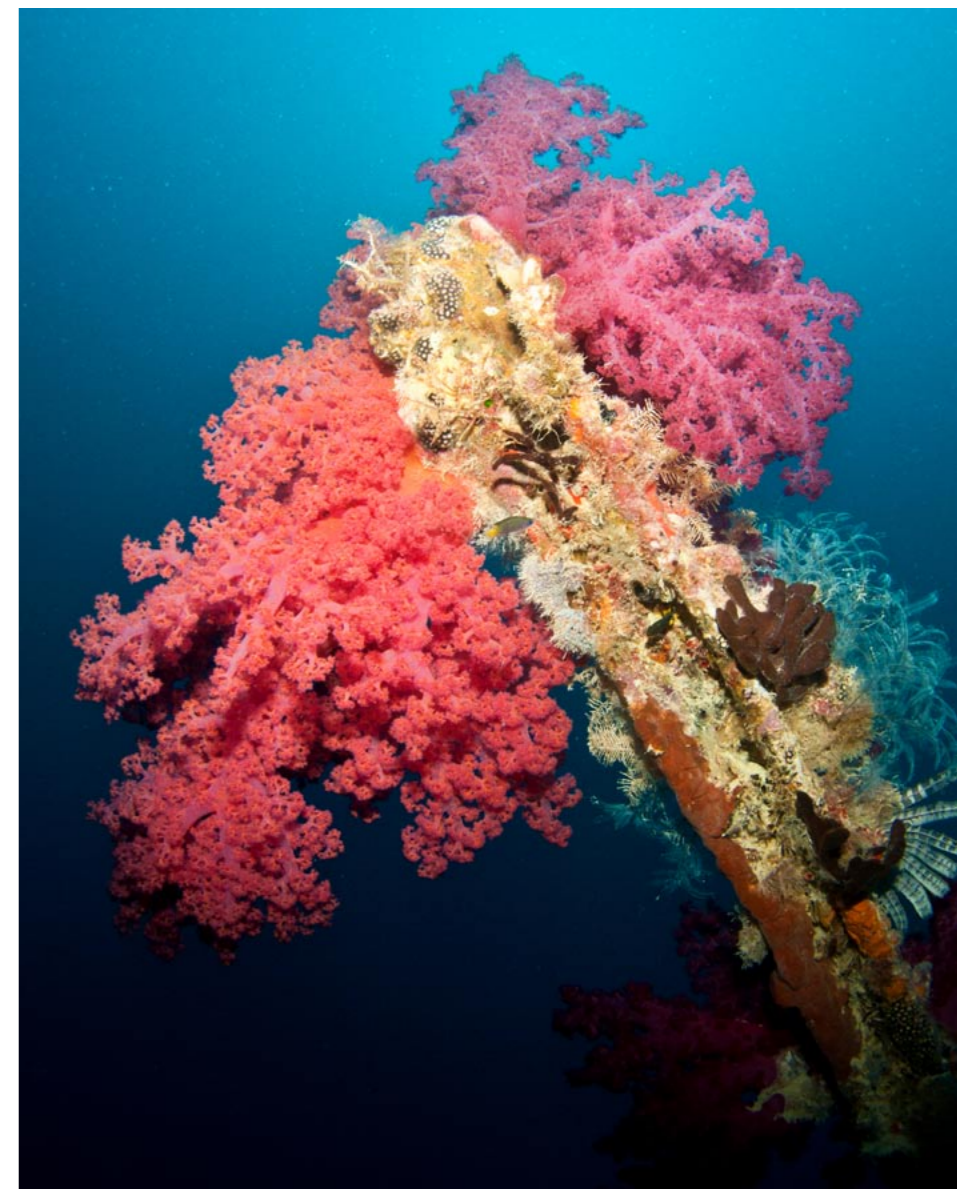
The fish life is prolific with many species of reef fish calling the shipwreck home. A large mast extends horizontally from the ship and is covered with hard and soft corals. It appears to be its own little mini reef, and I saw emperor anglefish and parrotfish there. Hanging down from the mast are the original rigging lines, also growing pink soft corals. The collapsed midsection harbors batfish and crocodilefish.

SS Carnatic. Another casualty of Shab Abu Nuhas reef, *SS Carnatic* was sailing to Bombay from Suez with 34 passengers and 176 crew, carrying cotton bales, copper sheeting, Royal Mail and



Curious dolphins at the Carnatic wreck site

GB£40,000 of gold coins. In the dark early hours of 16 September 1869, the ship hit Shab Abu Nuhas. Captain Jones assessed the damage and decided the ship was okay for the time being. He knew the P&O Liner *Sumatra* would be passing by soon. He decided to keep all passengers on board and continue business as usual



THIS PAGE: Scenes from the wreck of the *Rosalie Moller*; Glassfish (left)

until the *Sumatra* showed up to rescue them. Passengers were told not to worry and instead to prepare themselves for dinner.

Passengers asked the captain multiple times to take them to Shadwan Island some three miles away by lifeboat. All requests for transport were denied, as he kept hoping for the *Sumatra* to pass by. Becoming more persistent as time

went on, the captain finally gave the okay for passengers to be put into the lifeboat.

It had been a day and a half since they ran aground. As the first four passengers were being put in the lifeboat (woman and children first) the *Carnatic* suddenly broke in half. The aft section of the boat sank quickly with five passengers and 26 crew. Soon, the rest of the ship fell onto its

port side sending everyone into the water. With many heroic efforts, the remaining passengers were rescued and transported to Shadwan. Eventually, the *Sumatra* passed by and rescued those left.

Today, the wooden decks of the 90x12m (300x40ft) ship have rotted away leaving only the steel hull, with its iron supports and cross-members. The shallowest part of the ship is at 17m (55ft) and the deepest at 27m (88ft). It is lying on its port side.

The iron ribs were extensively draped with soft coral probably due to lots of water, nutrients and sunlight being able to pass through the beams. The bow area was packed full of glass fish, which hardly even tried to move out of the way when a diver swam through. Near the bow, dozens of small pipefish were free swimming just off the beams in search of breakfast.

The middle section has mostly collapsed but the stern is intact and the prop sits in the sand. A very photogenic davit encrusted with corals extends out from the stern section, and as I was framing a photo with the davit and the sun behind it, a group of four large spotted dolphins swam by our group of divers.

Because of the large quantity of gold

and copper on the boat, Lloyds of London sent one of their best salvagers to the wreck. All the gold was reported found as well as much of the copper and mail, although there's still a rumor that gold coins may be found around the ship. I had a quick look, but sadly, didn't find any.

Rosalie Moller. Another loss of WWI, the *Rosalie Moller* was built in 1910 in Glasgow by Barclay Curle & Co under the name *Francis*. The 108m (355ft) ship was sold in 1931, renamed, and started sailing in China. When the war broke out, she was moved back to Liverpool and placed under the command of Captain James Byrne, transporting goods for the Royal Navy.

In July 1941, she was carrying Belgian

coal, highly coveted during the war because it was supposed to burn longer and created less smoke, to Alexandria.

With the Mediterranean off limits because of German and Italian forces, she sailed the long way around via South Africa. Having gotten near the Suez Canal, just like the *Thistlegorm*, the *Rosalie Moller* took anchor to wait its turn to go up the channel. This ship's passage was also affected by the collision that made the *Thistlegorm* wait.

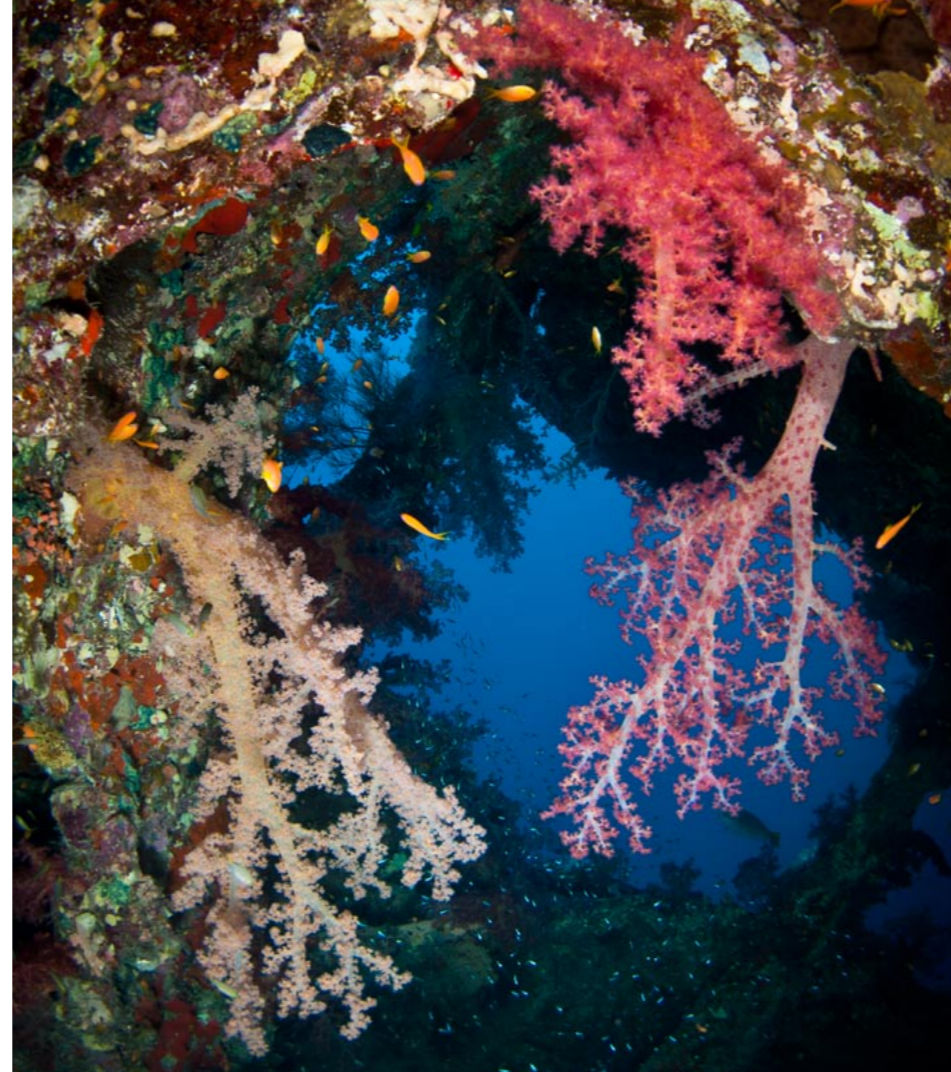
Anchoring in Safe Anchorage H, the *Rosalie Moller* had no idea about the loss of the *Thistlegorm* two days earlier, when during the night of October 8, two more twin engine Heinkels flew overhead and released two bombs, one hitting the *Rosalie Moller*, and she sank in less than an hour. Only two lives were lost, the rest of the crew were able to get to the lifeboats.

Sitting between 17 and 50m (55-165ft), this is one of the deeper wrecks we dived. With technical diving training and equipment, this ship is known for its penetrations particularly to the engine room, but we only



explored the exterior, which is still very much intact and sitting upright. Visibility was a little murky, which is often normal, making the ship a little eerie and mysterious. We had no current, and that combined with the bottom composition probably led to the decreased visibility.

Descending from our boat, our first view was of one of two still upright masts wrapped with soft coral. Headed further down to the ship deck, we swam towards the bow. I looked into some of the deckhouse windows, and the interior was packed full of cardinalfish, glassfish and other juveniles. Near



the bow, the deck gear was all still in place, and a crocodile fish was lounging in front of the winch.

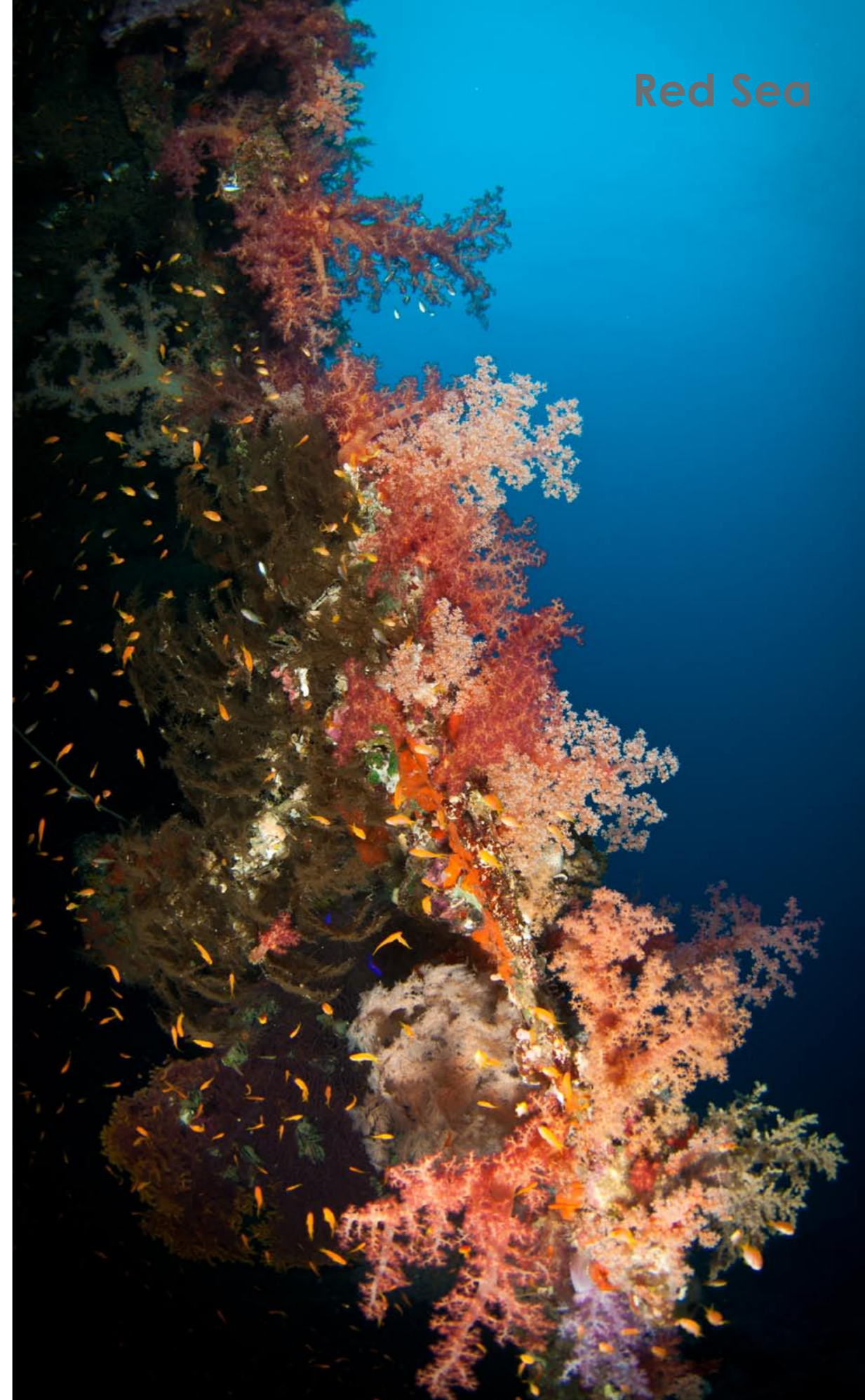
This site is a popular place for a tiny, but very pretty purple flabellina nudibranch. We found three of them during our short dive on the *Rosalie Moller*. Running short on bottom time, I headed back to the forward mast to ascend and saw several large tunas hunting around the wreck.

Dunraven. Sometimes the story of the finding of a wreck can be just as exciting as the account of its sinking. In the case of the *Dunraven*, in the 1970s, Howard Rosenstein was looking for a shipwreck to dive. Local fishermen provided him with the "GPS coordinates" of a site described cryptically: "There is a place out in the Gulf

in the direction of the setting sun, far from land and at least three cigarettes from Ras Mohammed. Here, there is a reef which comes out from the sea to break the surface at low tide. Go to the end of this reef coming from the south east."

Pulling out some charts, Howard Rosenstein got quite lucky guessing the exact spot. The ship wasn't identified as the *Dunraven* for another two years, when engraved porcelain had been found with the name.

Launched in 1873, the *Dunraven* was capable of being powered by sail or steam. In 1876, the ship was on its way to Newcastle from Bombay carrying spices, timber and cotton. In good weather, the ship sailed straight into the reef near Ras Mohammed in the dark. The crew tried for 14 hours to get the ship off the rocks, finally



THIS PAGE: Scenes from the wreck of the *Dunraven*





THIS PAGE:
Scenes from
the wreck of
the *Kingston*

Red Sea

most of the wreck from the reef. Many fish have made the wreck their home including many anthias and several schools of glassfish. Some of the more notable remains include four tall posts near the bow area standing straight up. At the deepest point, 19m (62ft), the propeller sits encrusted with coral and fan corals are growing on the hull.

The *Kingston* was a 78m (255ft) by 10m 32ft rigged iron hull screw steam ship sailing from London through the Mediterranean and the Suez Canal to Aden, Yemen, with a crew of 25. Once getting through the treacherous canal, Master Thomas Rich-

ard Cousins went to bed to sleep. Near midnight, the ship hit Shag Rock. In an attempt to save the vessel, the crew dumped a large quantity of the coal cargo. The ship was still afloat when the captain asked the passing steamship *F.W. Ward* to help pull her off. They declined but offered passage for the crew, which the captain denied.

Later the *Columbian* came alongside and tried to help pull her off, but couldn't. A full day had passed when the ship started taking on water and the captain decided to have the crew abandon ship. Seventeen crew were given passage on the

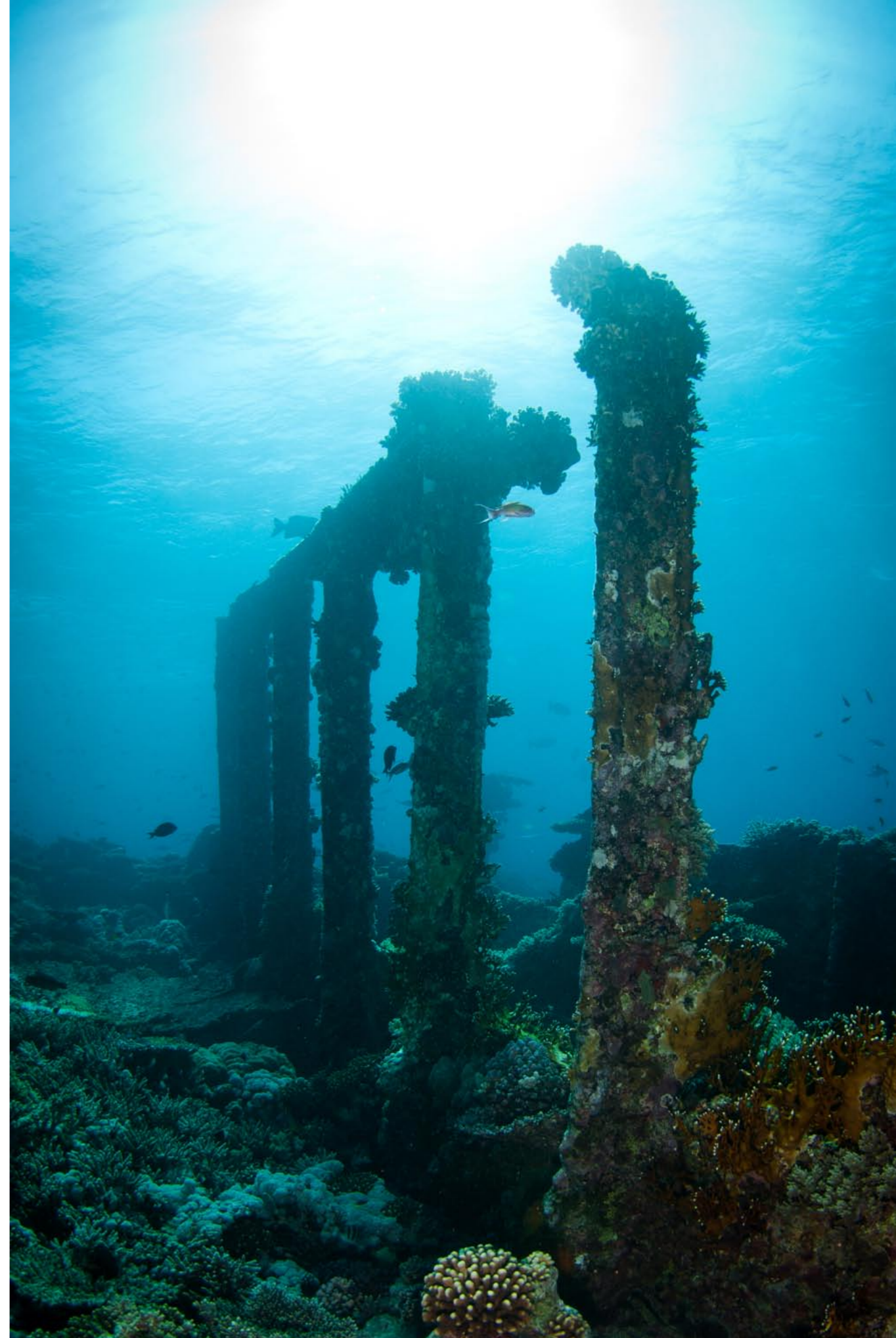
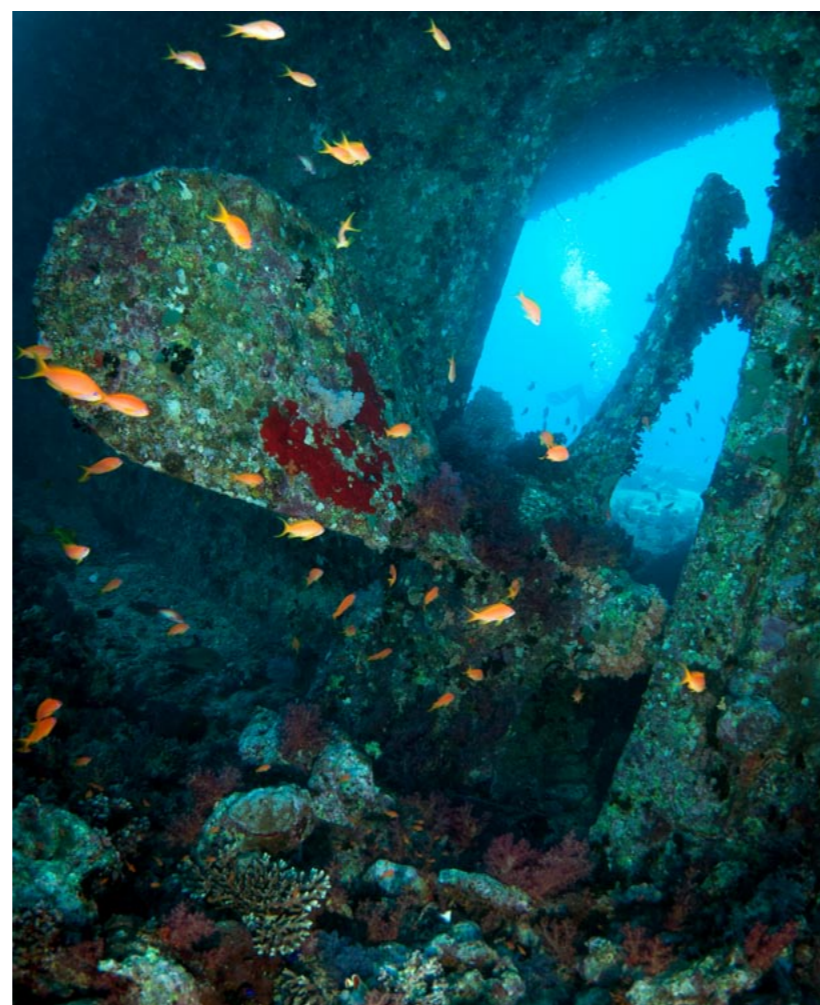
succeeding, but it still capsized, sinking quickly. The 25 crew were rescued by local fisherman.

Mostly upside down and lying on her port side, the propellers are the shallowest point at 17m (55ft), and the ship deck sits in the sand at 27m (88ft).

With several entrance points into the interior, the *Dunraven* made for a fun dive swimming inside most of the upside down hull. We started the dive outside the wreck near the propeller (one of the shallowest points) which still has three of the blades intact. Coming around the starboard side, we entered the ship near the sand, which

almost felt like entering a large dome. Light made its way in through the lower sides near the sand, with the ship overhead. Squirrelfish and goatfish schooled inside the wreck, and after exiting, a large napoleon wrasse paid us a visit. The area around the wreck was very nice reef with hard corals, sea fans, and lots of reef fish.

SS Kingston. All that remains of the *Kingston*, which sank in 1881 after running aground on Shag Rock, are the metal beams and hull. Sitting upright with its shallowest point at 4m (13ft) the ship remains are so overgrown with corals it's hard to differentiate





Remains of the *Jolanda*; Diver and fan coral in the Red Sea (right)

Red Sea

abyss. Coming up on the *Jolanda* cargo, I first saw one lone white porcelain toilet sitting upright, as if it were waiting to be used. Continuing on they littered the sea floor sometimes stacked on top of each other and scattered in all directions. A small bit of metal ship structure was left as well, with the beams decorated by soft coral, and fish taking up residence underneath, in the shadows.

The ship was relocated in 2005

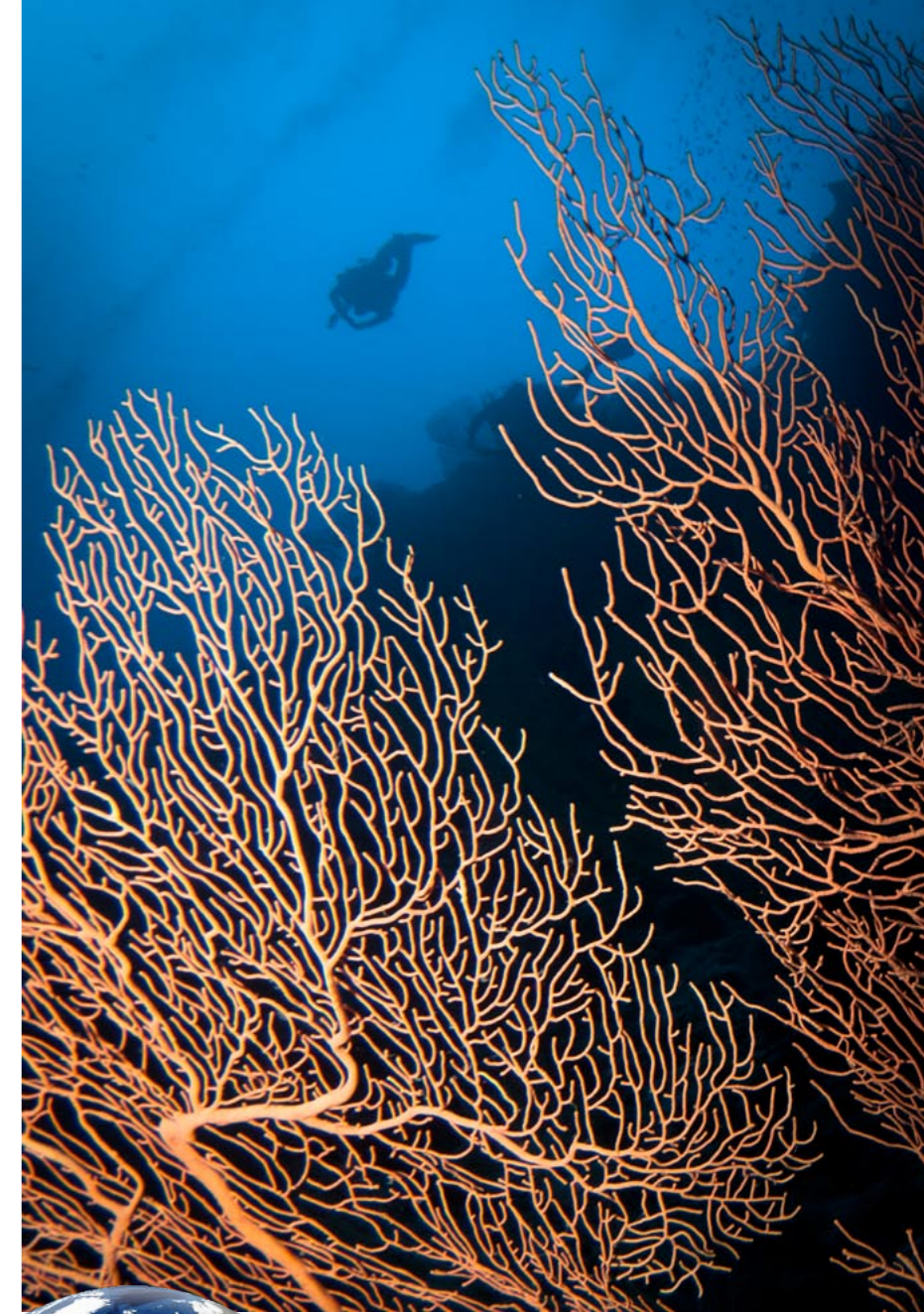
between 145 and 200 meters deep, but for me, the cargo was just as interesting, even without the ship.

Afterthoughts

The history that lies beneath the Red Sea makes it a playground for any wreck diving enthusiast. With so many ships having sunk for different reasons over many years, it has become an underwater museum decorated with the gorgeous and colorful corals and fish of the Red Sea. Tales of destruction and loss, wars, bad weather and just bad luck are as numerous as the abundant marine life of the Red Sea. As my week came to an end, I was already planning my return trip to see it all again and maybe check out the Southern Red Sea wrecks. ■

Brandi Mueller is an underwater photographer based in Honolulu, Hawaii. She is a PADI IDC Staff Instructor and 100ton USCG Captain. See: smugmug.siren-photography.com

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passing *Almora*, but the rest of the crew stayed onboard for another day and then moved to Gobul Island, staying four days before being rescued.

Jolanda. Often incorrectly spelled Yolanda, the *Jolanda* was a 75m (245ft) Cypriot freighter sailing from Piraeus to Aqaba with a cargo of toilets, wash basins and bathtubs. She ran aground near Ras Mohamed during a bad storm on 1 April 1981. After four days, the ship rolled onto the port side sitting at the edge of a wall. Until 1985, she was completely in recreational dive depths, but then the ship fell over the edge leaving only the toilet and bathtub cargo behind on the reef between 10 and 30m (32-100ft).

Close to the popular dive site Shark Reef, the *Jolanda* cargo is an unexpected sight underwater. We started our dive at Shark Reef drifting along in a slight current. The hard corals cover the sloping wall, which extends off into the



Cargo of ceramic toilets litter the wreck site of the *Jolanda*



Location of Hurghada on map of Egypt and global map





Aging under pressure: Divers maneuver a crate filled with bottles of wine into position on the sea floor of the Mediterranean off Costa Brava, Spain

Text by Larry Cohen
Photos by Larry Cohen and Olga Torrey

So what makes a perfect glass of wine? Wine experts use words such as toasty, tight, tannic, buttery, jammy, opulent, earthy and deep to describe wine. Many wine producers in Europe and California are bringing new meaning to the word deep. Some wine experts believe that aging wine underwater has many advantages. Conditions that impact aging include temperature, pressure, humidity, pressure motion, darkness and oxygen. Ideal conditions can be found underwater.

Taking Winemaking **Underwater Vintage** *To Greater Depths*

LARRY COHEN





Deep Wine



LARRY COHEN



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CLOCKWISE FROM LEFT: Lift bag filled with air so crate can be pulled to drop location; Espelt winery's lab; Espelt winery has over 600 acres of vineyards in Costa Brava, Spain; Wine being aged in barrels; Wine bottles on the beach getting ready to be put into crates; Inflatable boats and divers are needed to position the wine



LARRY COHEN

There are other reasons for storing wine underwater. A winery in Italy began aging wine underwater because they did not have adequate cellar space. When wine submerged underwater is compared to the same wine stored in a cellar, there is definitely a difference. The underwater wine seems older and intense. It is also more complex, with softer tannins according to many experts.

Espelt is a family-run winery in Spain near Hotel Cala Joncols, home to the Euro-Divers operation in Costa Brava. A number of years ago, the Espelt family, Cala Joncols and Euro-Divers decided to try underwater wine storage. The Euro-Diver staff sank a number of crates. They discovered if they sank the wine too deep, pressure would push in the corks, ruining the wine. After some experimentation they found 33ft (10m) to be the perfect depth. The wine was retrieved eight months later and tested. Both expert wine tasters and lab testing showed the very young wine matured faster under the Mediterranean Sea.



LARRY COHEN



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Deep Wine



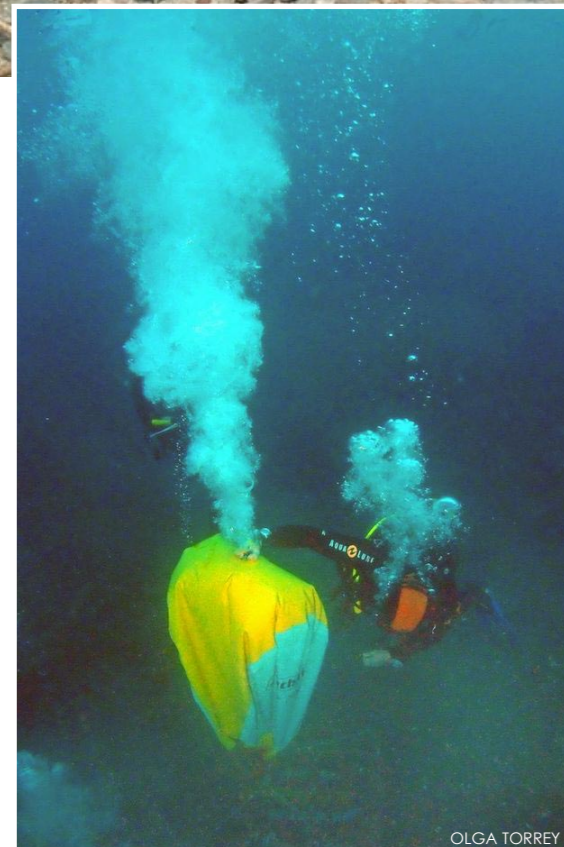
OLGA TORREY

Cala Joncols and Euro-Divers continue to sink wine every year. Huge locked crates are filled with bottles of Vailet (white), ViDivi (red) and Escuturit Brut Cava (sparkling) wine. Lift bags are attached to the crates so they will float, while boats drag them into position. Once over the spot, divers carefully removed the air from the lift bags lowering the wine to the bottom of the Mediterranean Sea. Then a small amount of air is added to the bags, and the crates are moved into the exact spot.

If there is a small group of divers at the hotel when it is time to retrieve the wine, Euro-Divers runs a scavenger hunt. The locks are removed, and any diver that finds the crates can take one bottle of wine. Cala Joncols, does sell the wine at a premium price. Is the wine better? Not being a wine expert I would say it is at least different. But as a diver sharing a weathered bottle of wine with marine growth attached to it, is definitely worth the price! ■



LARRY COHEN



OLGA TORREY

Divers release air from lift bag to gently lower wine to the sea bottom

THIS PAGE: Divers attach lines to the crates so they can be dragged by boat into 33ft (10m) of water; Eight months later the weathered wine bottle is sold at a b b. premium price (left)



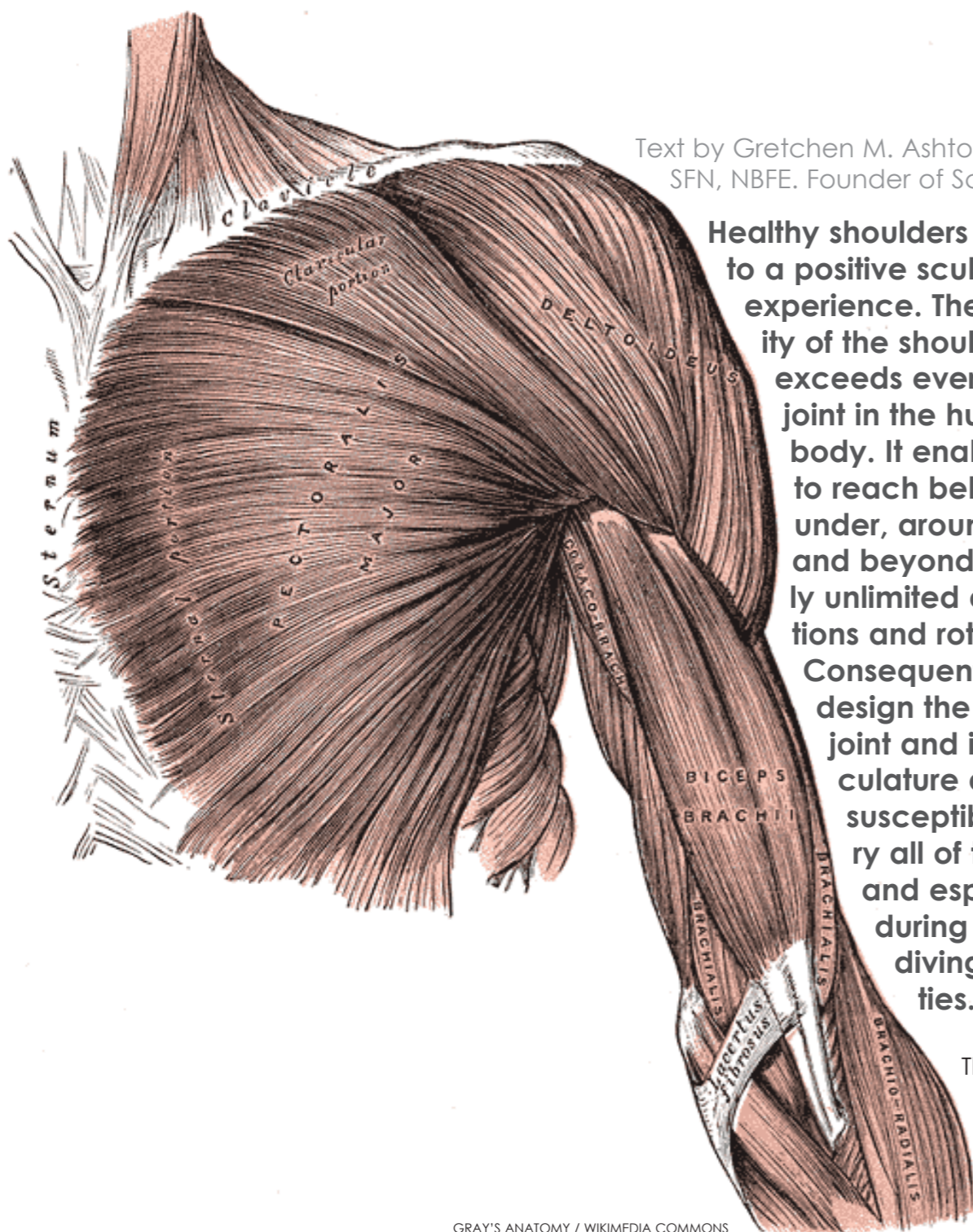


ED.— ALWAYS CONSULT A PHYSICIAN FIRST BEFORE BEGINNING ANY EXERCISE OR FITNESS PROGRAM.

Scuba Shoulders



FILE PHOTO: PETER SYMES



GRAY'S ANATOMY / WIKIMEDIA COMMONS

Text by Gretchen M. Ashton, CFT, SFT, SFN, NBFE. Founder of ScubaFit®

Healthy shoulders are vital to a positive scuba diving experience. The mobility of the shoulder joint exceeds every other joint in the human body. It enables divers to reach behind, under, around, above and beyond in nearly unlimited directions and rotation. Consequently, by design the shoulder joint and its musculature are highly susceptible to injury all of the time and especially during scuba diving activities.

The ball and socket joint of the shoulder, unlike the hip joint,

is more like a cup and saucer as the ball of the upper arm bone (humerus) is larger than the socket (glenoid) of the shoulder. Stability of the shoulder is dependent on the rotator cuff, which is comprised of tendons and small muscles that keep the cup in the saucer during movement.

To keep things moving smoothly, the joint is padded with two sacks (bursae) of lubricating fluid (synovial fluid) that reduce rubbing between the muscles and tendons and help protect the rotator cuff from other bones (like those of the acromion joint).

Developing and maintaining healthy shoulders can be tricky. Preventing injury is best accomplished with an individualized exercise program, but certain training activities required to protect the shoulder also present some risk of injury especially, if performed incorrectly.

Divers may best begin by knowing the current condition of their shoulders and working forward at an appropriate level of rehabilitation, stretching and strengthening. Divers should avoid exercises that are clearly not suitable for their current shoulder status. If an

injury exists, depending on the type of an injury, some therapeutic exercises may also be precluded.

Options may include strengthening assisting muscles, (i.e. biceps and triceps) to help carry the load for the shoulders, but if nearby muscle groups improve too far beyond that of the shoulder, (i.e. the chest) the shoulder may become more susceptible to injury. Other solutions include, always working with lighter resistance than other muscle groups, creating methods for stabilizing the shoulders, and allowing more time in training regimes





for shoulder muscles and connective tissue to adapt.

Allow the shoulder to improve in response to training, but never force it.

It is also important for divers to consider posture and shoulder function. Good posture goes beyond sitting up straight. The shoulder blades (scapula) are best pulled down and toward the center of the back to aid in good posture and especially during exercise.

Common injuries

Dislocation of the shoulder can occur when extreme outward pulling and/or rotation pops the cup out of the saucer (head of the humerus out of the glenoid socket).

Separation between the collarbone and the shoulder blade usually occurs as a result of bracing with an outstretched hand during a fall or a hard impact to the shoulder. Ligaments of the shoulder may be torn partially or completely.

A **rotator cuff tear** may be caused by impact or a fall on an outstretched arm and/or the result of wear and tear, lifting strain, repetitive use and aging.

Broken bones can occur in the shoulder as a result of injury.

Impingement is a compressing of the rotator cuff usually caused by a combination of factors from mild injury, wear and tear, and aging, to tendonitis where the tendons of the rotator cuff and sometimes biceps become inflamed, and bursitis when the bursa sacs become inflamed and swollen.

Frozen shoulder is when, usually because of pain, a diver doesn't move the shoulder for extended periods of time allowing adhesions (type of scar tissue) to



Shoulder press with dumbbells, in seated position (left), and with alternating arms (below)



build up preventing both movement and lubrication of the joint.

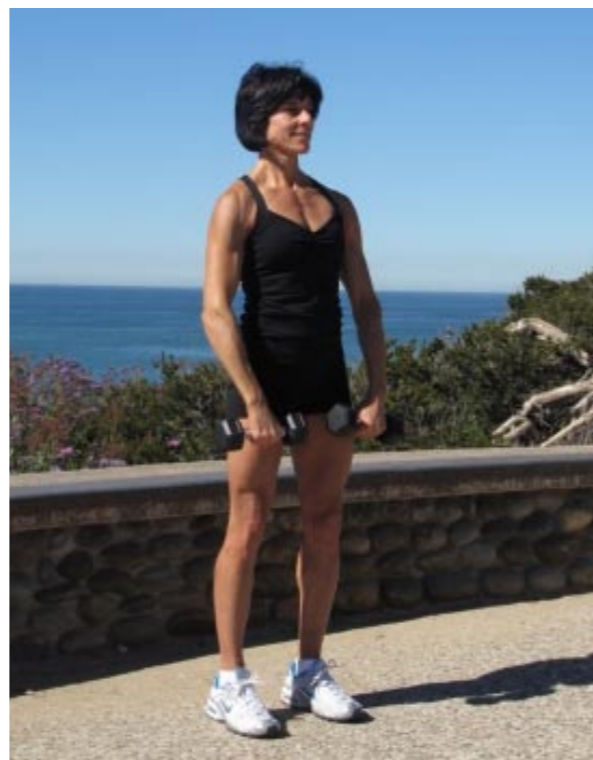
Arthritis of the shoulder can occur as in many other joints of the body.

Shoulder pain may be constant, intermittent, localized or referred to other areas of the body. Injured divers may experience aching, swelling and immobility. Sleeping, daily activities, exercise and, of course, diving can be interrupted for extended periods of time because of shoulder conditions.

Physicians often prescribe medications to treat inflammation and pain, but these treatments should be considered short-term options as they introduce additional potential complications and side effects. Whenever possible, divers are encouraged to pro-actively seek treatment, physical therapy and, as a last option if necessary, surgery, to resolve shoulder injuries as quickly as possible so they can return to normal living. Extended periods of shoulder disuse or compromised shoulder function can have long-lasting impacts to the overall health of the diver.

Exercises for healthy shoulders

Divers will get the best results by avoiding overuse of the shoulders, training muscles in a balanced fashion for strength and flexibility, and performing all exercises with safe and proper form.



Shoulder Press with Dumbbells

The seated shoulder press is a primary exercise for the shoulders. It directly targets the deltoid muscle, which has three sections (anterior, medial and posterior). These muscle sections can be seen in the vertical lines or definition of well developed shoulders. In contrast, when there

is little muscle development of the shoulder the outlines of the bones of the shoulder joint can be seen. Notice that in the start position, the elbows are at shoulder height with the bottom of the upper arms parallel with the ground. Never drop below this point when performing overhead shoulder exercises. This goes for machines as well. Many fitness center machines do not allow enough adjustment for a safe starting point for shoulder exercises. Inhale at the start of the exercise and when lowering the weights. Exhale during the press while lifting the weights. Contract the abdominals for



torso stabilization. This exercise may be performed with both arms at the same time or by alternating the press left and right. The idle arm gets great static contraction while waiting to press again.

Front Shoulder Raise – Standing

The front shoulder raise does exactly as described and along with working the entire deltoid targets the front (anterior) deltoid. Even more emphasis can be placed toward the front of the shoulder by rotating the arm to a “thumbs up” position. Inhale at the starting position and exhale while raising the weights. Inhale while lowering the weights and repeat.

Front shoulder raise in the standing position—starting position (far left) and ending position (left)

Diver releases surface marker buoy during a dive in the Adriatic Sea



Shoulders

FILE PHOTO: PETER SYMES





Shoulder 90's or Cheerleaders

In lieu of a true side lateral raise with both arms at the same time, combining a front raise with a side lateral raise greatly reduces the stresses on the shoulder joint that occur with the traditional side lateral raise. It is important to work both sides equally. Divers have the option of performing all repetitions on the same side or alternating from side-to-side. Inhale to begin and while lowering the weights. Exhale while raising the weights.

Shoulder Rear Deltoid Fly

The rear deltoid shoulder fly requires good concentration and control to ensure it is performed correctly and safely. The photographs demonstrate three positions for performing the rear deltoid fly, which targets the posterior section of the deltoid and recruits other small mus-



cles of the back and shoulder. To begin, position the arms in front of the body as if hugging a tree. Raise the arms until the elbows are in line with the shoulders. Do not force the elbows beyond the range of motion of the shoulder. The torso will begin to lift and neck strain can occur when trying to perform this exercise too high. It may help to imagine a lobster claw opening and closing or that there is a hinge on the center of the back. Inhale to start and while lowering the weights. Exhale while raising the weights.

Tips and Precautions

When performing overhead shoulder exercises, beginners should always sit in a chair or bench with support for the back.



Divers with certain back conditions, in particular bulging discs, should avoid pressing weights overhead or any exercises that compress the spine.

When performing side and front shoulder raise exercises, it is usually best to stand. There is some additional isolation that can occur from being seated, but it comes with added risk of injury.



Shoulder Rear Deltoid Fly in seated position—starting position (left) and raised position (above); in standing position—starting position (right) and raised position (far right); and in lying down position (upper right)

Shoulder 90s or Cheerleaders starting position (far left) and raised position with alternating arms and with both arms (left)

While divers can develop great strength in the shoulders that allow for handling significant resistance, when training the shoulders for diving it is prudent to use moderate weight and work at higher repetitions.

The exercises shown here are sequenced with purpose and best results are accomplished if they are performed in this order.



Shoulders

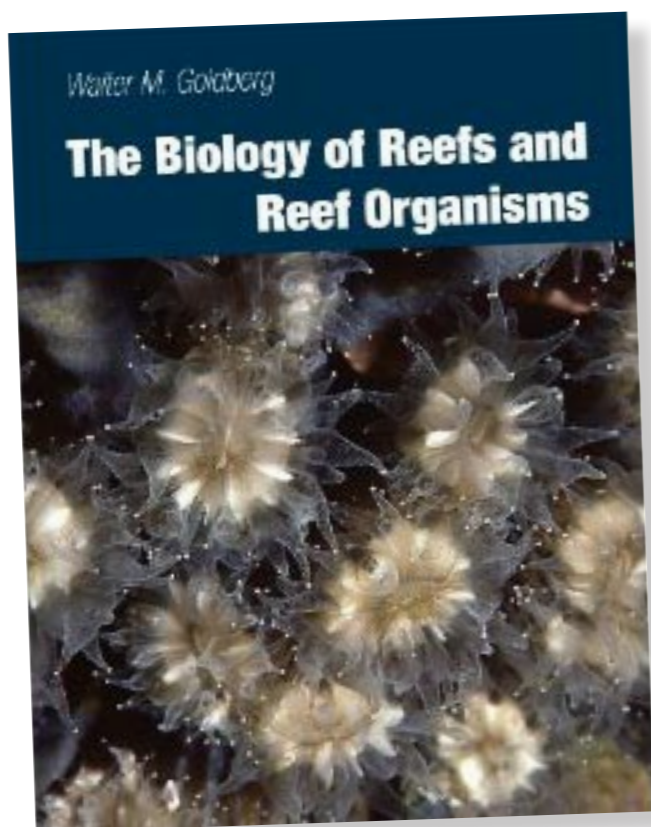
Contract the abdominals, keep the knees soft, not locked, and both feet placed flat on the ground when performing shoulder exercises.

Gretchen M. Ashton is registered with the National Board of Fitness Examiners. An advanced diver, International Sports Sciences Association Elite Trainer, and world champion athlete, Ashton developed

the ScubaFit® program and the comprehensive FitDiver® program, which includes the first mobile app for scuba diver fitness. Ashton is the co-author of the PADI ScubaFit Diver Distinctive Specialty course. For more information, visit: Scubafit.com



Edited by
Catherine
GS Lim



Biology of Reefs

The Biology of Reefs and Reef Organisms by Walter Goldberg. Welcome to Reef Biology 101. If you are keen on reefs, check out this book. It is the result of years of teaching and research into this topic. Besides the quintessential coral reef, the book also covers sponge reefs, worm reefs and oyster reefs.

Areas covered include reef construction, ecology, paleontology, biogeography and conservation, as well as the factors that influence their growth, structure and distribution. Even the organisms that interact with the reefs are depicted. Illustrations are found throughout the book, which promises to be a comprehensive introduction to this fascinating topic.

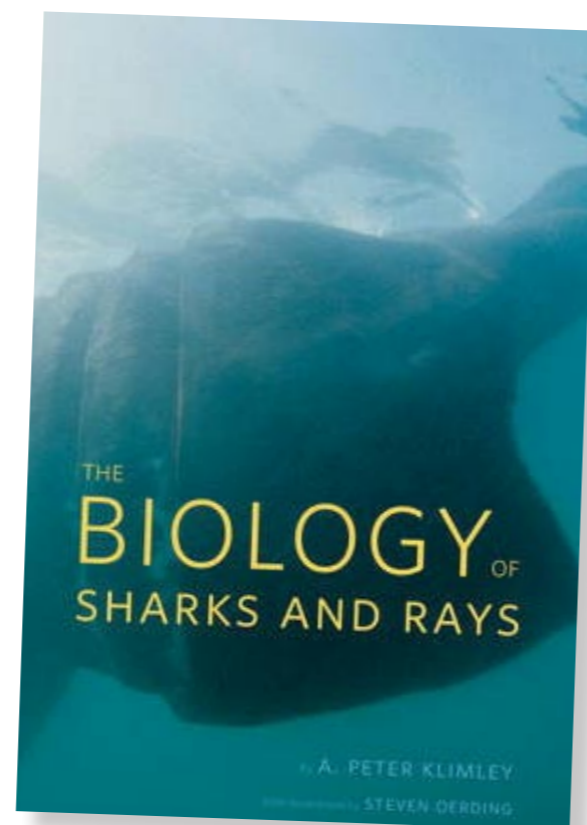
Hardcover: 424 pages
Publisher: University of Chicago Press
Publication Date: 15 July 2013
ISBN-10: 0226301672
ISBN-13: 978-0226301679



Shipwrecks

England's Shipwreck Heritage: From logboats to U-boats? by Serena Cant. Published by English Heritage, this book shares the stories behind the shipwrecks along the English coast and the territorial waters, dating back from the Anglo-Saxon times to 1945. The shipwrecks range from logboats, Roman galleys, medieval cogs to fishing boats, ocean liners and warships. To give readers a proper perspective, the shipwrecks are depicted within the archaeological, social, economic and naval context, particularly in relation to England's broader historical landscape. Backed by solid research and illustrations, this book is ideal for anyone keen on England's maritime history.

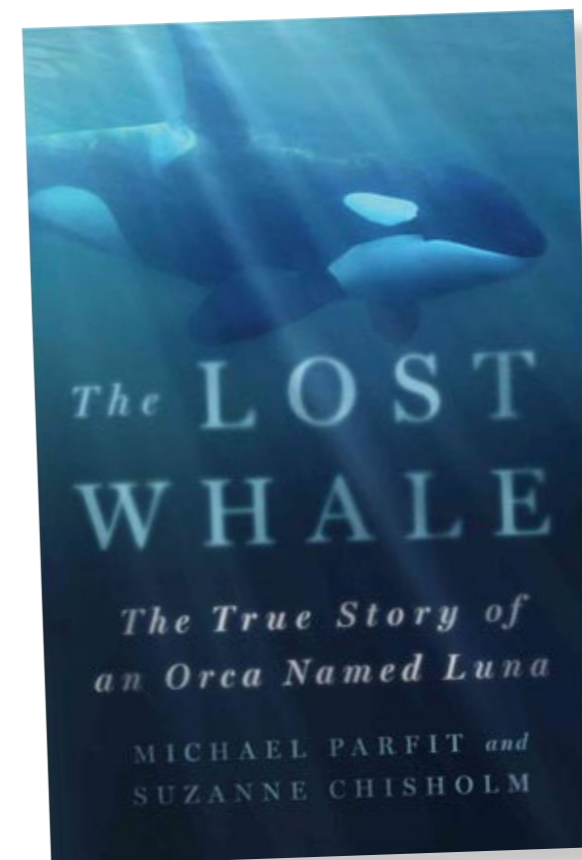
Paperback: 320 pages
Publisher: English Heritage
Publication Date: 31 July 2013
ISBN-10: 1848020449
ISBN-13: 978-1848020443



Sharks & Rays

The Biology of Sharks and Rays by A. Peter Klimley. Once upon a time, cartilaginous fishes swam in the oceans over 455 million years ago. These species evolved to become the sharks, rays and chimaeras of today. In this book, A. Peter Klimley explores the myriad of information concerning the biologies of these creatures. His extensive knowledge fills up 16 chapters, covering the taxonomy, morphology, ecology and physiology. In addition, each chapter contains snippets of the author's personal experiences, thought-provoking questions and recommended readings. In all, this book looks set to be an extensive reference text for anyone interested in ichthyology.

Hardcover: 488 pages
Publisher: University of Chicago Press
Publication Date: 29 July 2013
ISBN-10: 0226442497
ISBN-13: 978-0226442495

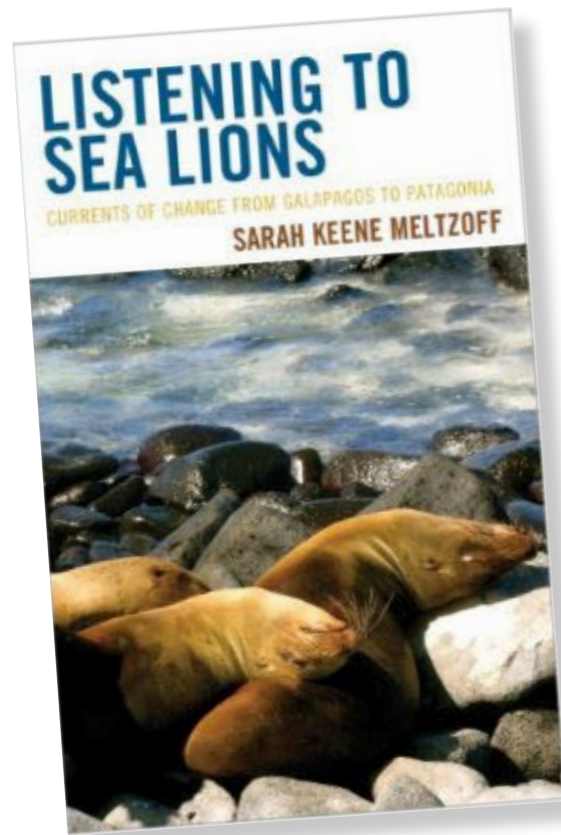
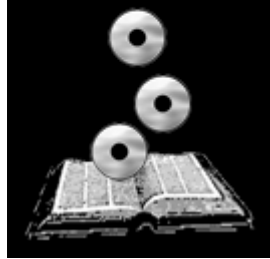


Luna

The Lost Whale: The True Story of an Orca Named Luna by Michael Parfit and Suzanne Chisholm. Once upon a time, in Nootka Sound, on the west coast of Vancouver Island, a friendly young orca got separated from his pod. Lost and alone, he tried to make friends with people instead. He hung around boats and docks, squeaking at the humans on top. Over the years, many people responded positively. They named him Luna

and regarded him with affection. Others wondered if the young orca might be happier living with his own kind, and they constructed a big net. Based on actual events, this book chronicles Luna's story, an orca who even today continues to enchant those who learn of his story.

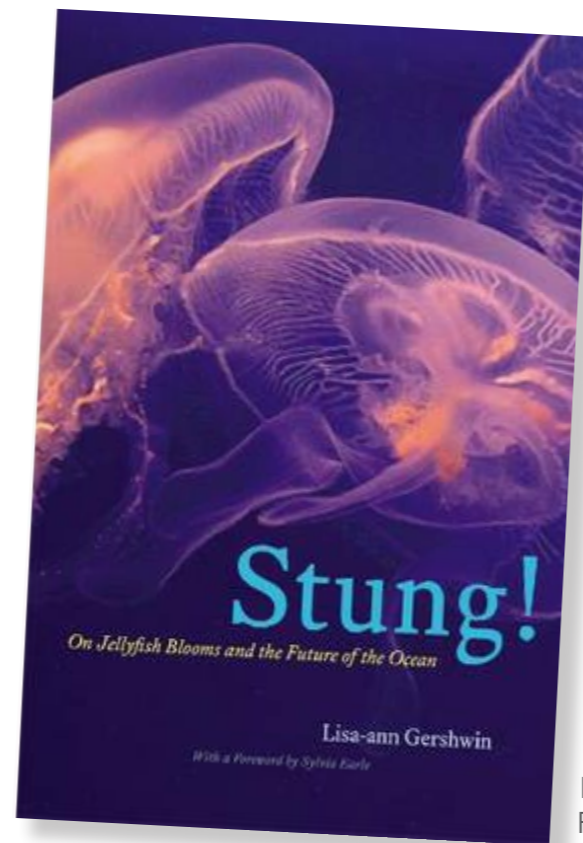
Hardcover: 336 pages
Publisher: St. Martin's Press, First Edition
Publication Date: 25 June 2013
ISBN-10: 0312353642
ISBN-13: 978-0312353643



Sea Lions

Listening to Sea Lions: Currents of Change from Galapagos to Patagonia by Sarah Keene Meltzoff. This book relates the author's experiences originating from 17 years of ethnography in Chile, the Galapagos Islands and Peru. In it, we read about fisheries booms, subsequent management decisions, the survival strategies of the coastal people and the competition that exists in fisheries, tourism and conservation. Her interactions with the people involved, together with her jargon-free narrative, gives us a glimpse into the lives of the various communities—human and animal—living there.

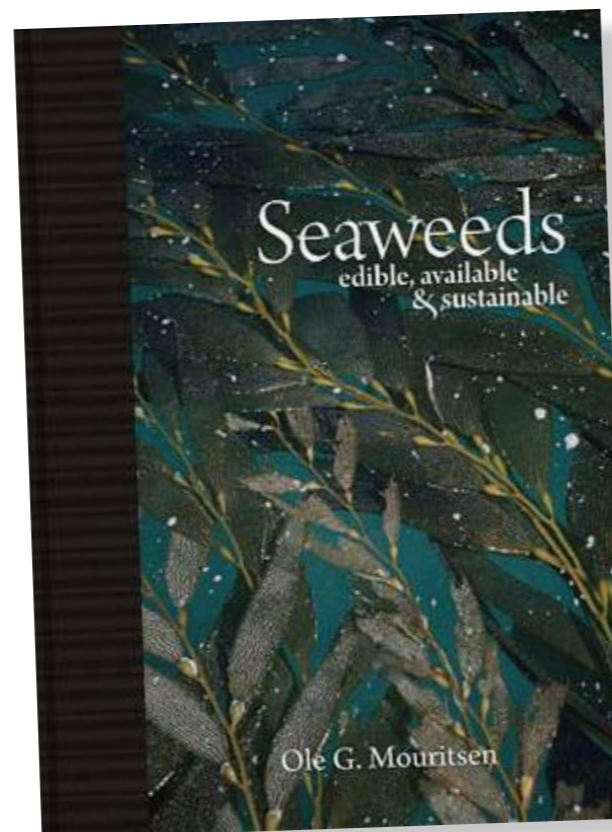
Hardcover: 292 pages
 Publisher: AltaMira Press
 Publication Date: 14 December 2012
 ISBN-10: 0759122350
 ISBN-13: 978-0759122352



Jellyfish

Stung!: On Jellyfish Blooms and the Future of the Ocean by Lisa-ann Gershwin; Forward by Sylvia Earle. What an appropriate title for a book on jellyfishes—though that's not to say it describes a desired outcome of an encounter with these creatures! While jellyfish are without doubt beautiful and enigmatic, the warmer temperatures of today have encouraged their rapid growth, leading to more incidences of jellyfish swarms invading fishing grounds and harbours. Evidently, these resilient creatures thrive in those very conditions brought upon by climate change, pollution, habitat degradation and mechanised trawling. Instead of painting the jellyfish as the bad guy, author Lisa-Ann Gershwin celebrates their existence, by taking readers back to the Proterozoic era, when they were the ocean's top predators. Interesting and unusual characteristics about their behaviour are highlighted, giving readers a glimpse into the fascinating and unique creature that is the jellyfish.

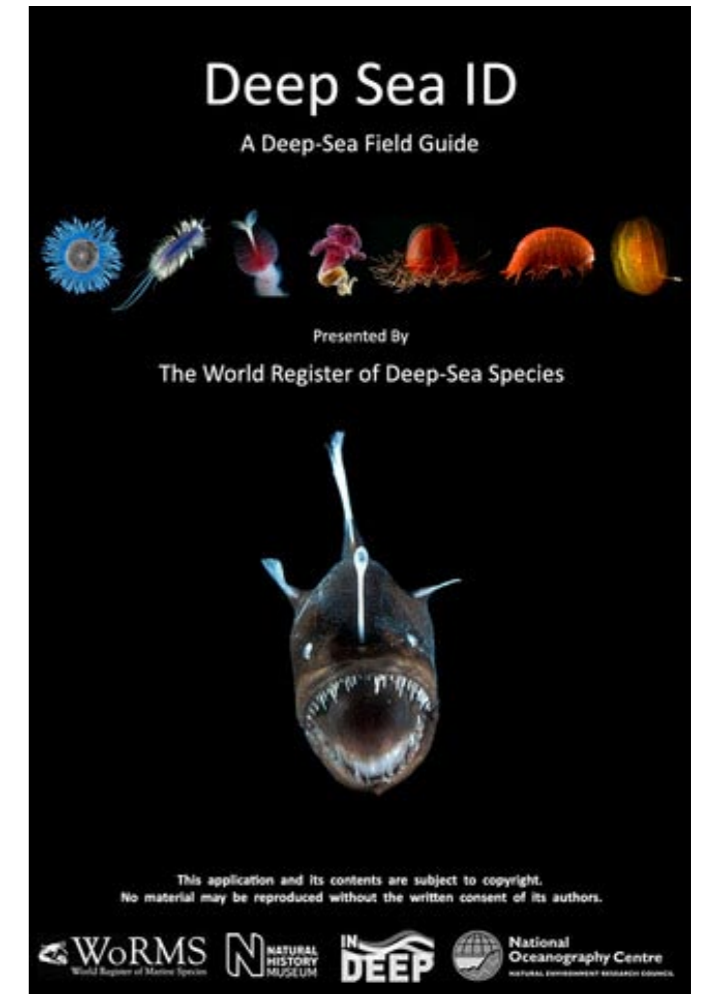
Hardcover: 456 pages
 Publisher: University Of Chicago Press
 Publication Date: 7 May 2013
 ISBN-10: 022602010X
 ISBN-13: 978-0226020105



Seaweeds

Seaweeds: Edible, Available, and Sustainable by Ole G. Mouritsen. Far from being just the 'grass' on the ocean floor that occasionally washes ashore and causes a mess, seaweed is much, much more than that. For starters, it's an aglae (not a plant) that's been used in many cultures since the prehistoric times. Although this book prominently showcases seaweed as food (in sushi, salads, snacks, soups, dessert, seasoning, drinks, etc), this versatile aglae is also used in construction, glass-making, medicine and even the textile industry. Along the way, the author describes the biology, ecology, cultural history, gastronomy and nutritional value of seaweed, alongside hundreds of illustrations showing the different species of seaweed. With more than 10,000 species and a history dating back at least 500 million years, this book is sure to provide hours of engaging reading.

Hardcover: 304 pages
 Publisher: University of Chicago Press
 Publication Date: 5 June 2013
 ISBN-10: 022604436X
 ISBN-13: 978-0226044361



Deep Sea ID app

By the Natural History Museum. With the handy Deep Sea ID app installed in your iPhone, you would have access to the taxonomic data of more than 20,000 deep-sea creatures literally at your fingertips. Its high-resolution photos, together with links to online taxonomic tools, sources and references, are an aid to species identification. Although designed for the scientific community, this free app allows anyone interested in deep-sea creatures to take a peek into this alien world. Get it at [iTunes.apple.com](https://itunes.apple.com).

marine mammals



Humpback whales are able teach each other hunting techniques

Scientists believe their results strengthen the case that cetaceans—whales and dolphins—have evolved sophisticated cultural capacities.

A team of researchers, led by the University of St Andrews, has discovered that a new feeding technique has quickly spread to 40 percent of a humpback whale population.

Humpbacks around the world herd shoals of prey by blowing bubbles underwater to produce 'bubble nets'.

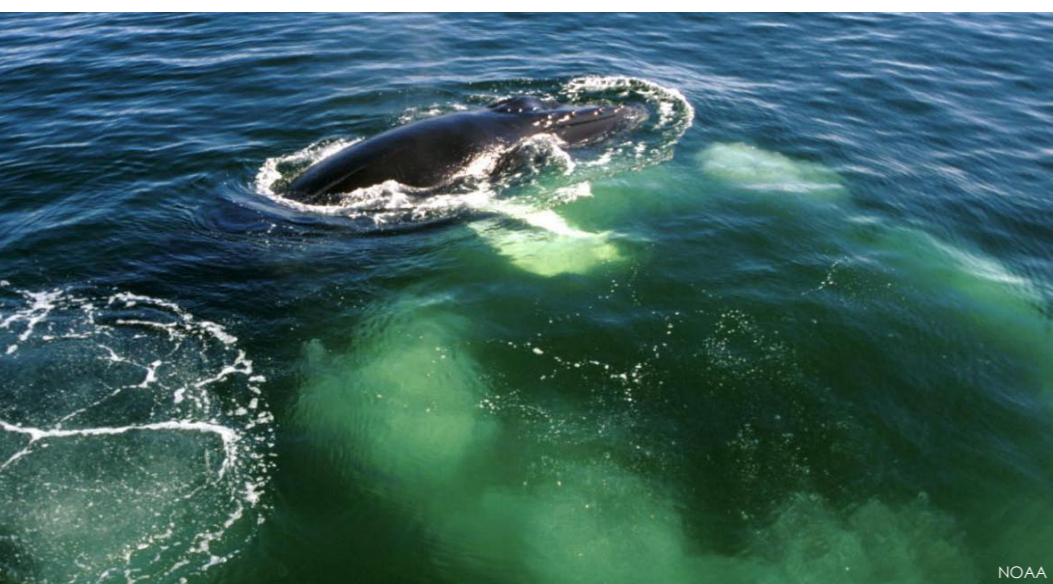
The feeding innovation, called 'lobtail feeding', involves hitting the water with the tail before diving to produce the bubble nets. Lobtail feeding was first observed in 1980, after the stocks of her-

ring, previously the main food for the whales, became depleted.

Cultural transmission

The scientists used a new technique called network-based diffusion analysis to demonstrate that the pattern of spread followed the network of social relationships within the population, showing that the new behaviour had spread through cultural transmission, the same process that underlies the diversity of human culture. ■

SOURCE: SCIENCE



NOAA

Humpback whale with bubble net

Evolution of baleen whales and penguins possibly triggered by sea-ice ecosystem

Around 33 million years ago, our planet was quickly cooling, leading to a huge ice sheet covering a formerly sub-tropical Antarctica. Consequently, the marine ecosystem changed, and ocean plankton diversity suddenly collapsed. Only plankton species adapted to temporary sea-ice cover remained, present in large numbers (algal blooms) only when the sea-ice melted in spring and summer.

Marine animals, such as baleen whales and penguins, that fed on these plankton adapted to the change in plankton diversity, according to a new study by an international team of scientists from the Goethe University and the Biodiversity and Climate Research Centre in Frankfurt, Germany. The study, published in the journal *Science*, showed that further adaptation and evolution of baleen whales and penguins were possibly triggered by the development of the sea-ice ecosystem.

The key to the discovery was the tracking of algal blooms of a specific species of dinoflagellates through the examination of sediment samples in drill cores on the ocean floor. "The sudden turnover in the dinoflagellate assemblages indicates clearly that the entire plankton ecosystem of the Antarctic waters had changed," said study co-author Professor Jörg Pross, paleoclimatologist at the Goethe University and the Biodiversity and Climate Research Centre (BiK-F) in Frankfurt, Germany. "Our data suggest that this change may have promoted the evolution of modern baleen whales and penguins." The study findings draw attention to the role of major climate change in rapid biological evolution. ■

SOURCE: SCIENCE / PHYS.ORG

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'Morally unacceptable'— Captive dolphin shows banned in India

Dolphins can no longer be kept in captivity for entertainment purposes anywhere in India. In a landmark decision, the country's Ministry of Environment and Forests has forbidden dolphin shows, stating that such practices are "morally unacceptable".

In the ministry's new policy, state governments are advised to reject any proposal for the building of a dolphinarium "that involves import, capture of cetacean species to establish for commercial entertainment, private or public exhibition and interaction purposes whatsoever."

Stress in captivity

Authorities have recognized that dolphins and other cetaceans do not fair well in captivity. "Confinement in captivity can seriously compromise the welfare and survival of all types of cetaceans by altering their behaviour and causing extreme distress," said the member secretary of the

Central Zoo Authority of India, B.S.Bonal, in the ministry's statement.

In addition, the ministry noted the importance of protecting the endangered species of India such as the Ganges River dolphin and the snubfin dolphin, both of which are protected under the Wild Life Protection Act of 1972 along with all other cetacean species.

"Whereas cetaceans in general are highly intelligent and sensitive, and various scientists who have researched dolphin behavior have suggested that the unusually high intelligence; as compared to other animals means that dolphin should be seen as 'non-human persons' and as such should have their own specific rights and is morally unacceptable to keep them captive for entertainment purpose," said the ministry.

Praise

Conservationists in India praised the decision. A spokesperson

for the grassroots organization, the Federation of Indian Animal Protection Organization (FIAPO), Puja Mitra called the decision "a huge victory for the dolphins!" FIAPO led the campaign in India to ban dolphinarium in the country, gaining support from local communities at the grassroots level and meeting with key officials of the ministry.

"India has become a beacon of hope for the global movement to protect cetaceans from captivity, and we thank Minister Jayanthi Natarajan for setting the benchmark in animal protection for the world," said Mitra.

Other groups working with FIAPO over the past year to ban dolphin shows include the Born Free Foundation, Global Green Grants Fund, Wildlife Rescue and Rehabilitation and Earth Island Institute's Dolphin Project. Praise for India's action was heard from other parts of the world.

"This is a huge win for dolphins," said Ric O'Barry, director of the U.S.-based Earth Island Institute's Dolphin Project and former dolphin trainer. "Not only has the Indian government spoken out against cruelty, they have contributed to an emerging and vital dialogue about the ways we think about dolphins – as thinking, feeling beings rather than pieces of property to make money off of."

■ SOURCE: ENVIRONMENT NEWS SERVICE

Navy dolphin uncovers 19th century torpedo

There you are, a Navy dolphin, looking for mines off the coast of San Diego, minding your own business, when suddenly you stumble upon an object on the seafloor that turns out to be a rare 130-year-old torpedo of which only 50 were ever made.

That's what happened to one special dolphin who found one of

filled with 100 pounds (45 kg) of gun cotton, said military officials.

"It was the first torpedo that could be released into the ocean and follow a track," said Christian Harris, operations supervisor for the SSC Pacific Biosciences Division. "Considering that it was made before electricity was provided to U.S. households, it was



STE ELMORE / WIKIPEDIA COMMONS

the first self-propelled torpedoes employed by the U.S. Navy in the 1880s. In a statement, operations supervisor Braden Duryee of the SSC Pacific Biosciences Division said, "Dolphins naturally possess the most sophisticated sonar known to man. They can detect mines and other potentially dangerous objects on the ocean floor that are acoustically difficult targets to detect."

The brass-coated weapon was a so-called Howell torpedo with 132-lb (60 kilogram) flywheel that was spun before launch. With a range of 400 yards, it could reach 25 knots and had a warhead

pretty sophisticated for its time."

Only one other example of this type of torpedo has been found and is currently housed at the Naval Undersea Museum in Keyport, Washington.

While the dolphin's finding shows off its amazing sonar ability, cetaceans are susceptible to injury from high-powered naval sonar employed during military exercises. Last year, Navy officials said that the U.S. military will retire its dolphin program in 2017 and move towards the use of less expensive mine-hunting robots instead. ■

SOURCE: DISCOVERY/LIVE SCIENCE



NOAA

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turtle tales



Edited by
Bonnie McKenna

Sea turtle found that pooped plastic for a month

The turtle was rescued in 2009 after marine biologists at Melbourne Beach in the U.S. state of Florida noticed that it seemed to be having problems digesting food. After dislodging a large piece of plastic from the animal's gastrointestinal tract, the turtle proceeded to defecate 74 foreign objects over the next month. Some of those objects included four balloons, five pieces of string, nine types of soft plastic, four types of hard plastic, a piece of carpet-like material and two large tar balls.

This turtle represents a growing problem for sea turtles around the world. According to a report, about half of all surveyed sea turtles have ingested plastic.

As single-use plastics increase in use and are mindlessly discarded, they gather in the eddying currents of the world's oceans. It is estimated that more than 1 billion single-use plastic bags are given out every day. Though the report estimates that only about 0.2-0.3 percent of plastic production eventually ends up in the ocean, it accumulates at an alarming rate. In the 1960s, less than 1 percent of our waste was plastic, but today it makes up to 80 percent of all waste that accumulates on land, shorelines, the ocean surface or seabed.

"Last year I counted 76 plastic bags in the ocean in just one

minute while standing in the bow of our sea turtle research boat at sea in Indonesia," said Dr Wallace J. Nichols. "The science is becoming crystal clear: sea turtles and plastic pollution don't mix well. Sea turtles have spent the past 100 million years roaming seas free of plastic pollution, and are now sadly the poster animal for impacts of our throw-away society on endangered species."

Plastic debris ensnares other marine mammals like seals, and plastics are commonly discovered in the stomachs of whales, dolphins and fish. Micro-plastics have also been found to be accumulating in mollusks and crustaceans.

In an effort to work on solutions to these problems, the Fifth International Marine Debris Conference is bringing together marine debris researchers from around the world. The conference hopes to heighten global understanding and appreciation of the threats posed by marine debris, highlight recent advances in marine debris research, and provide an opportunity for the development of collaborative solutions to these problems. ■

The green sea turtle below, named Tripod, lost one of her rear flippers because it was caught in a plastic cola-keeper which cut off circulation to the flipper and killed it

A conservation success story

Green sea turtles have inhabited the Pacific coast of Mexico for millions of years, for the past few decades the turtles have struggled to survive a relentless onslaught of hunting. In the early 1980s, there were still some 25,000 nests found along the coast of Mexico. By the mid-1990s, poaching, fishing nets and habitat destruction cut the number of nesting females to less than 500.

A doctoral student named

animal had been tracked swimming across an ocean.

"These turtles are big, strong and wild—yet gentle," said Nichols. "And you can get close to them and interact with them. There aren't too many creatures that big that you can do that with in the wild, and on their own terms. My goal was to share that sense of wonder, not to preach."

Nichols invited dozens of turtle-hunting fishermen to a meeting to talk about their knowledge of local turtles and the possibility of their extinction. In time, many of the poachers agreed to catch and eat fewer turtles—which are traditionally prized for their red-meat-like flesh—and soon began working with Nichols to monitor local turtle populations.

Twenty years later, Grupo Tortuguero, the grassroots network that Nichols helped found, is active in 50 coastal communities. Hundreds of local volunteers, many former poachers, work to protect and promote an appreciation for and pride in these gentle animals.

This year, there were some 15,000 green turtle nests on the beaches of southern Mexico. ■



ROY NISWANGER/MARINE PHOTOBANK

Wallace J. Nichols proposed studying the biology and conservation of sea turtles in northwestern Mexico for his thesis, but he was told that cultural inertia was too great to overcome. Undeterred, Nichols and a colleague travelled Baja California to study five species of sea turtle that congregate on both sides of the peninsula's 1,900 miles of coastline to feed on crab, jellyfish, sea sponges and algae.

With the help of a local fisherman and a Mexican biologist, Nichols attached a transmitter to a loggerhead's shell. The turtle, named Adelita after the fisherman's daughter, swam 7,000 miles from Baja to nesting grounds in Japan, marking the first time any

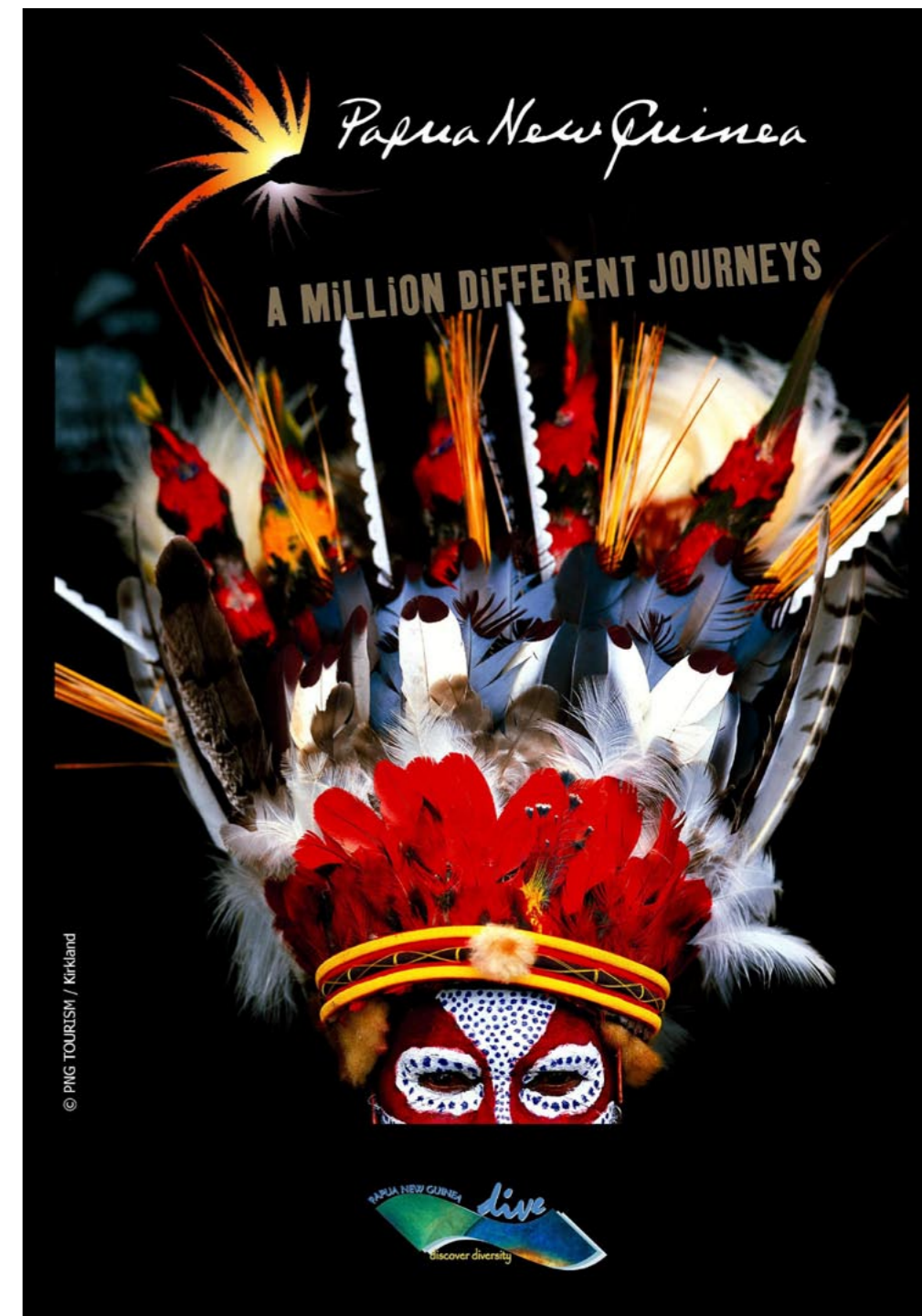
Fishery rule could benefit marine turtles

The leatherback sea turtle's wide ranging migratory patterns overlap those of other severely threatened and depleted ocean wildlife. Surface longlines fishing for tuna and swordfish also catch and kill more than 80 other marine species. More than half of the catch is thrown back, and the vast majority of the discarded catch is dead.

In an effort to protect bluefin tuna spawning grounds in the Gulf of Mexico, scientists are working with fishermen to determine if two selective fishing methods can provide an alternative to longlines. To date, research indicates that 87 to 90 percent of the catch on the alternative fishing gear is comprised of targeted tuna and

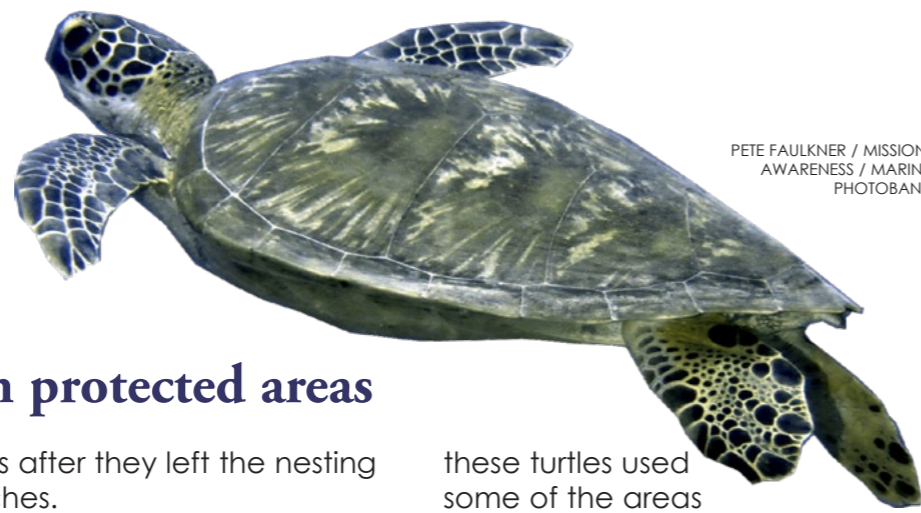
swordfish. Oil spill money made available by BP could help pay to transition Gulf surface longline fishing gear.

Marine turtles stand to benefit greatly, if these new measures are implemented. The rule would eliminate, annually, 169 harmful interactions with endangered leatherback and loggerhead sea turtles. ■



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PETE FAULKNER / MISSION: AWARENESS / MARINE PHOTOBANK

Sea turtles benefiting from protected areas

In the Dry Tortugas National Park of the U.S. state of Florida, nesting green sea turtles are benefiting from marine protected areas by using habitats found within their boundaries. The forays of green turtles, listed as endangered in Florida and threatened throughout their range, after nesting has long remained a mystery.

The U.S. Geological Survey researchers confirmed the turtles' use of the protected area by tracking the turtles with satellite tags and analyzing their move-

ments after they left the nesting beaches.

"Our goal was to better understand what types of habitats they use at sea and whether they were in fact putting these designated areas to use. This study not only shows managers that these designated protected areas are already being used by turtles, but provides insight into the types of habitat they use most," said Kristen Hart a research ecologist for the U.S. Geological Survey.

"We are thrilled to find that

these turtles used some of the areas already under 'protected' status. The ultimate goal is to help managers understand where these endangered turtles spend their time both during the breeding period and when they are at feeding areas. Given the worldwide declines in seagrasses—one of the most important habitats they rely on for food—has already been documented, this type of data is critical for managers," said Hart. ■



Logs block leatherback turtles nesting in Gabon

Abandoned logs on the beaches of Gabon are keeping leatherback turtles from nesting, according to a study in the journal *Biological Conservation*. Timber is big business in Gabon. As the logs move down river,

many get loose and end up on the beaches trapping turtles. Despite log exports being banned, the ban has not improved the turtles' situation. It is estimated that logs block 17 percent of the turtles' move-

ments. The journal stated that the problem is persistent and has the potential to remain unless remedial action is taken to remove the logs. ■

Mediterranean Association to Save the Sea Turtles celebrates its 25th anniversary

It all began in 1983 when Lily Venizelos realized that sea turtles were nesting in Laganas Bay on the island of Zakynthos in Greece. Five years later, she officially founded MEDASSET, and now it is a fully-fledged and highly professional U.K. registered charity and an independent NGO registered in Greece.

Since its inception, MEDASSET remains the only organization working exclusively on sea turtle conservation throughout the Mediterranean.

Venizelos surveyed almost 8,000km of the Mediterranean coastline, identifying new nesting sites and confirming the absence

of turtles in key areas; MEDASSET has made a major contribution to the legal framework that protects sea turtles in Greece, Egypt and Albania.

In May 2012, MEDASSET joined forces with OCEAN2012, a coalition of more than 170 European NGOs to ensure the E.U. Common Fisheries Policy (CFP) stops overfishing, ends destructive fishing practices and ensures the equitable use of fish stock for local communities. By-catch kills an estimated 44,000 turtles every year in the Mediterranean.

Prior to February 2013, MEDASSET delivered numerous letters prior to critical votes on

the CFP reform to the Greek and Cypriot fisheries and members of the European Parliament asking for the right decisions to be taken to help populate our seas.

The campaign peaked as members voted for the reform. By an overwhelming majority, amendments were passed to ban discards, restore fish stocks by 2020, and apply strict fishing capacity assessments.

All of this is good news for fish, small-scale fishermen, sea turtles and marine biodiversity. The next step by MEDASSET is to make sure the European Council does not water down the reform. ■

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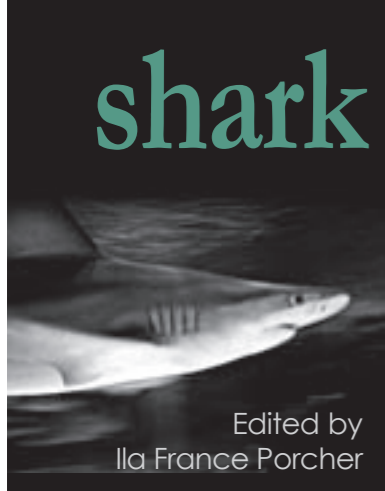
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Bruce & Kathy Malasky



Edited by
Ila France Porcher

What are sharks doing when no one is looking? —On the Ethology of Reef Sharks

Text and images by Ila France Porcher

In my last article, *When Sharks Really Attack (X-RAY MAG #52)*, I described an unusual series of events indicating that sharks experience subjective states, or emotions. This follow-up piece provides further information about the reef sharks I studied closely underwater for seven years.

A difficulty in obtaining information about the natural behaviour of wild animals is that detailed observations of the activities of different individuals is necessary over long periods of time. This is especially hard to achieve with sharks.

Fortunately, in the wide lagoon near my home in French Polynesia, which averages a depth of two meters, it was possible to observe the sharks easily for long periods and collect a large amount of data on their movements and behaviour. The blackfin reef shark, (*Carcharhinus melanopterus*) was especially easy to observe. Over the years, I identified six hundred individuals and could recognize three hundred on sight.

Ethology is a field of zoology, and one of its major principles is to “know your animal!” by observing its behaviour

over an extended period of time. Such observations take so long in today's rapid pace of science that it's far easier to place tags on them. There are excellent advantages in accomplishing studies of numerous animals by such means, and the field of behavioural science can well use such information. Its popularity is without question, but it cannot often

explain, except in the broadest sense, why animals do what they do, since individuals often don't do what others around them do. That's why the work of ethologists will always be valuable.

Following the ideas of Konrad Lorenz, Nikolaas Tinbergen, Arthur Myrberg, Donald Griffin, and others, I identified the sharks by drawing the markings on both

sides of the dorsal fin, and found that observing them as individuals revealed a whole new dimension of behaviour. One of the most surprising things was the degree and variety of individual differences that they displayed.

Individuality

Each shark's behaviour was unique and

seemed flexible from day to day. Not only was their behaviour towards me unique, but so was their use of time and their patterns of roaming. Sometimes a shark passed the same coral formation at almost exactly the same time each evening for several nights in a row, then disappeared from the area for a year. Sometimes, day after day, a shark could





be found in exactly the same place in her home range at the same time, then the following day she was roaming on the outer slope of the reef at that time. There were some days that all the females left the study area, and others when it was filled with visiting neighbors.

Study

Once a week I brought them some scraps from local fishers so that I could identify the sharks in the area that evening, and I visited at random times to observe them and to accompany them when possible while they roamed. Eventually, they became so used to my presence that they treated me as they would another shark. (One cannot expect an animal to treat one in a brand new way because one is a different species). Thus I was able to witness their intimate social and emotional behaviour as if no one was watching them. For all the years I knew them, I kept seeing new behaviour patterns, some which would have been unbelievable to me in the beginning.

The study area was seldom visited by other people, so observations could be obtained without disturbance, and the sharks were relatively unaffected by other human encounters.

Home range

The lagoon was the domain of the female blackfin reef sharks, each of whom spent much of her time in a favoured region called a home range; the pups were born and matured in those sheltered waters. Beside the resident females, others whose home ranges were farther away came from time to time, and there were many juveniles. The youngest were two to three years old, since they remain in hiding until

they grow enough to mix with the rest of the community. While most of the males lived in the ocean on the outer slope of the barrier reef, a very few ranged through the lagoon. These male sharks were smaller than the females, lithe and muscular, most being less than four feet long. They seemed less attached to a home range and roamed much farther afield during their daily travels.

In the mating season, bands of males from the ocean would arrive at nightfall, to the excitement of the females. The largest females were close to six feet in length, and maternally heavy with a more rounded silhouette.

The residents of the study area soon recognized the sound of my kayak crossing into the lagoon from the adjacent bay, and anchoring at my usual place, and when I slid underwater, they were waiting, no matter what time I came. But the one I had dubbed "Bratworst" would always arrive two minutes after me. This began to puzzle me so much that I decided to investigate and anchored and slid underwater without a pause on my next visit. Not a shark was visible. So I drifted silently with the current and found Bratworst lurking behind a coral, just beyond visual range of my boat. It was my first clue that sharks listen from beyond the visual range, and come when they decide to.

Senses

I had learned years before, when first observing them and learning to move swiftly and silently, that sharks can hear a person swimming long before he or she comes within visual range. The shark usually vanishes before the person sees that it is there, but the possibility that members of such an ancient line of animals could use the limit of visibility as a



veil behind which to conceal themselves, was new.

I often observed sharks following each other beyond the visual range. The shark I was with would catch up to the one she was following, and swim nose to tail with her or side by side. Then, after resuming her arcing path for a time, she often caught up to another shark and briefly swam beside her. The sharks generally roamed in circular or oval paths of various diameters which crossed at the centre and formed rough figure of eights or cloverleaves. Such patterns likely brought them repeatedly into contact

with each other's scent trail, allowing them to keep track of each other while travelling in circling paths, out of visual range of each other much of the time . Curious sharks also followed me, always remaining hidden behind the veiling light except for an occasional pass into view. Apparently they listened and used their lateral line sense to monitor my actions, instead of eye-sight. I began regularly checking to see who was following me by stopping and drifting with the current, whereon the sneaky sharks behind soon came into view.

Shark friendship

These sharks knew each other as individuals, and it was soon clear that they had preferred companions with whom they liked to travel. Some companionships were so strong that I never found one shark without the other. Some friends separated on occasion and travelled with different companions for a time, reappearing months later together again, while some sharks always travelled alone.

At times groups of sharks, all from a particular region, and often accompanied by specific males,

shark tales



travelled together. They moved in loose contact along the fringe lagoons of the island, and were joined temporarily by local residents as they went. But their tendency to roam out of visual range of each other complicated the problem of figuring out who was with who.

Kimberley and Twilight

One of the elderly female visitors was nearly black, with two pure white markings symmetrically placed, one on each side of her head. It looked as if someone had stuck two large snowflakes on her. Arriving always at dusk, she was a dramatic sight with the twin white points

glowing bright. I called her "Kimberley".

She remained in the area for an entire lunar cycle, and when she left, another very similar shark appeared. Not only was the patterning of their colour lines and dorsal fins alike—the opposite sides were nearly identical—but this shark, too, had pale markings placed precisely the same way on her head. She also arrived just at nightfall, and I called her "Twilight". Since none of the other sharks had such white markings, I speculated that the two were sisters.

It was months before either of them returned to the area, but there came an evening when the twin snowflakes

approached again through the gloom. Kimberley glided in, and the following week, I saw Twilight. For three years I watched these sharks come and go every few months, only occasionally together. Was it chance? Or could there really be an association between them?

One night it was so late that the sharks were just movements in the darkness when I put the anchor in the boat, and began to drift with it. But after only five metres, Kimberley appeared in the gloom. I waited. A minute passed. Then Twilight approached, following Kimberley's trail. The two sharks were not within visual range.

Trailing the kayak, I finned toward Twilight and was able to approach and swim with her. She went toward the feeding site but turned to pass down current from it. Had I been at my usual location, she would not have been visible. Then she turned back.

Kimberley appeared, equidistant on my other side. She had apparently already crossed the site and circled back. The two immense sharks curved onward as though following arcs of the same circle. They met in front of me, passing close by each other. I took in every detail, but saw no signal from either of them, and wondered whether something more was exchanged between the old friends than what a human eye could discern.

Twilight languidly cruised back and forth in large figure of eight patterns. Time after time, she overtook another female shark, apparently by pursuing her trail of scent. Had she been targeting the other shark's vibrations, it was unlikely that we would always have joined her by coming up behind her. Each time, the two big females passed close beside each other, and continued on their

Portrait of a shark name Martha, by Ila France Porcher (right); The shark named Kimberly (lower left)



separate ways. When I left, the visitors were still socializing with the residents down current from the feeding site. Often they came only to visit, and not to eat.

Gleefully concluding that I had been right—that there was a companionship between the two sharks after all—I left. Kimberley and Twilight arrived swimming together on their next three visits, months apart, and on several more occasions before Kimberley died, confirming what had taken years to verify.

Visual range

There were other ways in which the various species of sharks on the reef used the limits of visibility. Their pattern of approach, for example, generally involved just a single pass into visible range, often repeated within a few minutes. This pattern is so common that it is easily seen on any shark dive. Though I initially analysed the pattern in reef sharks, it was clear to see when I dove with tiger sharks, too. Shyer individuals intermittently passed at the limit of the

visual range, never approaching.

If the shark was very interested or curious, it would come closer on each pass until it swam straight in, but shy sharks would not approach at all unless there was a group present, and if anything was different about my routine, even the resident sharks would retreat beyond their curtain of blue, only passing into view from time to time. This was especially problematic when the BBC came to film them for Shark Week. Mike DeGruy didn't believe me at first when I assured him, as we surveyed the empty coral landscape, that 30 sharks were hiding just out of sight.

Whenever a second person came with me, the sharks remained behind the visual limit for up to ten minutes before approaching. Sometimes when they appeared they approached in long lines, led by the boldest ones, and went straight to the stranger. This reaction never happened when I was alone, and demonstrated the sharks' ability to recognize changes in routine, and to



shark tales



Illustration of author's interaction with a shark named Madonna, by Ila France Porcher

make rapid decisions to stay or leave depending on unfolding events. It is closely associated with learning, which has been experimentally shown many times in elasmobranchs.

Awareness

Sharks are also aware of the direction a person is facing and may respond instantaneously when the person of whom they are nervous puts his or her head above the surface, or even looks the other way; a common move is to approach from behind.

Once I was swimming through the study area with my step-son when he climbed on a coral to look around above the surface. The shark accompanying us instantly glided over to him and, unseen by the boy, sniffed his legs.

The sharks indicated their awareness of whether the person was able to see them or not in many ways, and used this awareness to their advantage. Other species of reef sharks in the community, including white-tip reef sharks (*Triaenodon obesus*), and sicklefin lemon sharks (*Negaprion acutidens*) displayed the same awareness and general behaviour with regards to hiding in the veiling light. They also would often approach from behind, when a person was looking the other way, or had raised his or her head above the surface.

Thus the best thing to do when with sharks, is to face them eye to eye, and they will respect you. Its useful to look around often too!

Sharks party

When there were many visitors in the study area, there was much excitement and socializing. The most dramatic

feeding sessions that I mentioned in my former article, *When Sharks Really Attack*, occurred when there were many visitors and the moon was full. Since their roaming correlated with the lunar phase, I began to think of the thrilled shark tornadoes that developed as the full moon rose as "partying behaviour."

An old lady shark who normally never accelerated would suddenly shoot vertical, shake off her remora, and streak away out of sight so fast that the eye could scarcely follow her. Then she would rocket through the scene again, with many others shooting with her out of view in the opposite direction.

The resident sharks were always more excited when the moon was full, especially when visitors had joined them. The incidents described in my former article, when the sharks unanimously slammed the boat and leaped out of the water to snap at whatever fish-scrap they could reach, happened at such times. Sharks of this species do not naturally put their heads above the surface to eat nor to look around, so this was a completely new foraging behaviour. It was initiated by specific individuals, and was instantaneously adopted by the others present. This finding of a new foraging technique occurred in two different locations, years apart, with different groups of sharks, and presents examples of social learning.

Lunar connection

That sharks timed their travels according to the lunar phase was clear to see when watching them. For example, two elderly female sharks appeared in my study area during the period of the dark of the moon at the end of April four years in a row, staying in the region about two



weeks, until the moon waxed bright, when they left. They came at no other time. Presumably they chose the study area in which to wait through the dark period, and left when they would have two weeks of bright nights to facilitate their travels.

I observed their visits each year until the sharks were finned in 2004, after which no elderly sharks ever appeared. One visiting male's first four visits, though months apart, occurred precisely at sunset, four days before the dark of the moon. Visitors tended to stay in the region for half or a whole lunar cycle, and residents often left during the period of the full moon, returning in ten days to

two weeks as the moon waned and the light at night faded.

Most birthing and mating events also took place during the period of the full moon. The resident females left their ranges about a week before, and generally returned about two weeks later, when it was waning. Perhaps it was because of the need to travel, sometimes many kilometers or even to another island (Mourier, J. & Planes, S. 2013), that such a high percentage of births took place during the full moon. Since the tides on the islands are solar, it seems that the light at night is the important factor—sharks use both sources of planetary light for travelling, not just the sun.

When the sharks I had come to know so well were finned by a company in Singapore, I wrote down the story of what it was like to get to know them, what they were like, and what happened, in an effort to get their story out of French Polynesia. The name of the book is *My Sunset Rendezvous: Crisis in Tahiti*. ■

CITATION:
MOURIER, J. & PLANES, S. (2013). DIRECT GENETIC EVIDENCE FOR REPRODUCTIVE PHILOPATRY AND ASSOCIATED FINE-SCALE MIGRATIONS IN FEMALE BLACKTIP REEF SHARKS (*CARCHARHINUS MELANOPTERUS*) IN FRENCH POLYNESIA. MOLECULAR ECOLOGY 22 (1): 201-214.





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(File photo) A great white shark at Isla Guadalupe, Mexico

Pacific Great White Shark not endangered NOAA finds

Northeastern Pacific Ocean population of great white sharks does not warrant listing under the Endangered Species Act, NOAA announced Friday.

Scientists of the U.S. National Oceanic and Atmospheric Administration (NOAA) concluded that the white shark population is a distinct genetic group with a low to very low risk of extinction now and in the foreseeable future.

NOAA had been investigating the great white population since last year, when the environmental groups Oceana, Shark Stewards and the Center for Biological Diversity filed a petition calling for endangered species protection.

The petitioners were reacting to the first ever census of great whites, which was conducted by University of California-Davis and Stanford University researchers, and published in the journal *Biology Letters* in 2011. The cen-

sus estimated that only 219 adult and sub-adult great whites lived off the Central California coast, and perhaps double that many were in the entire northeastern Pacific Ocean, including Southern California.

A joint statement from Oceana, Center for Biological Diversity, Shark Stewards and WildEarth Guardians said federal authorities ignored studies that listed less than 700 sharks off the California coast.

"Our team felt that there were more than 200 mature females alone, an indication of a total population of at least 3,000," countered Heidi Dewar, a fisheries research biologist at NOAA. NOAA's analysis, which will be made public Monday, was based

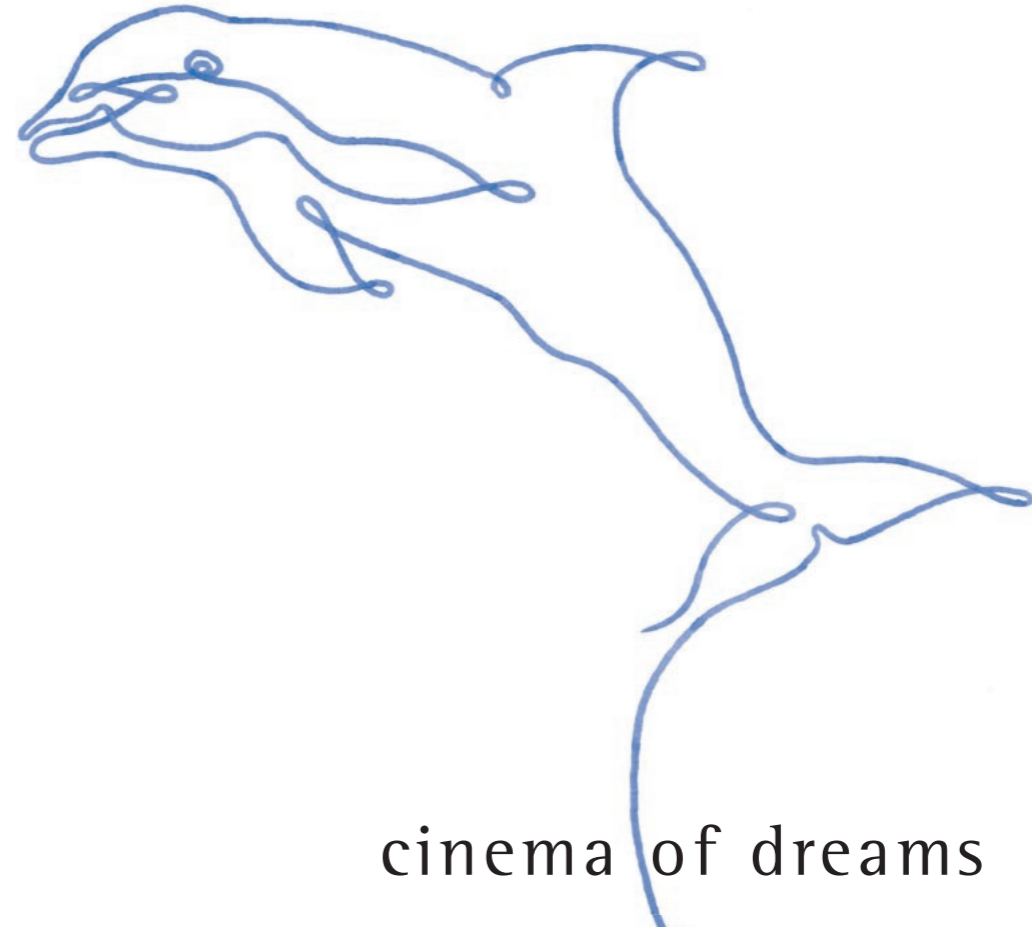
on a comprehensive review of threats to the population, direct and indirect indicators of abundance trends and analysis of fisheries by catch in the United States and Mexico, Dewar said.

Margaret Spring, vice president at Monterey Bay Aquarium for conservation and science, said in a news release the organization appreciated the "thorough review" by the National Oceanic and Atmospheric Administration.

"We are fully committed to supporting rigorous science, public education efforts and ocean policy reform," she wrote, "to ensure that great white sharks do not become more vulnerable in the future." ■ SOURCE: NOAA

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Edited by
Michael Menduno

Cave Diving & CCR Training

—The Issue of Bailout Gas

Text and photos
courtesy of Steve Lewis

Remember the first rule of scuba diving that you were taught in your basic open-water class? I believe it goes something like: “Keep breathing!” Simple advice and unarguably the best advice possible for *any* diver, not just those entering the sport for the first time.

For example, the same first rule is true for technical diving. Gas management 101 starts off by stating something like: “Always have a sufficient volume of appropriate gas to breathe throughout the whole dive!” More wordy—and there are other nuances to a gas plan such as having gas to share with your buddy—but the message to the tech crowd is essentially the same as it is to the new diver. And unless I’ve missed a memo somehow, that message applies

to all technical divers without exception.

Given all that, what’s difficult to understand, is why some folks seem to lose the plot when they strap on a rebreather... even more baffling is when they strap on a rebreather and then swim into a cave while seeming to ignore the primary directive... always have something to breathe.

You may already know about rebreathers, and you may also be a cave diver. But for those of you who are only one or the other—or neither—here is the Coles Notes version of your CCR cave class. A rebreather offers divers the ability to get a long, long way from fresh air without much effort. Unlike an open-circuit cave diver who generally has to carry many stage bottles of gas to extend her foray into the deepest regions of a cave, way back from the exit, a CCR diver *can* push many hundreds even thousands of meters without making any allowances at all.

Here’s one reason why. On a rebreather, the exhaled gas is recycled and the carbon dioxide is removed by a little chemistry set carried in the unit’s scrubber. Apart from a few litres of diluent gas used up now and again, all the gas that needs to be added regularly to “the loop” (the breathing gas going round and round in the unit) is the oxygen metabolized by the diver as she swims. A working average for this is about 1.5 litres per minute, and this does not significantly change with depth. In other words, a three-litre bottle charged to 200 bar with oxygen can last for up to 400 minutes.

What that means is that if we were to say that the average cave diver on an easy outing swims at a speed of between 15 to 20 meters a minute, that volume of oxygen could translate into more than 6,000 metres of distance round-trip!

Now here’s the problem. Everything on that six kilo-meter

journey might be fine as long as the diver’s CCR continued to function as it should. But what if it did not?

Sense-check

OK, sense-check time. I have more than a few dives in caves on a rebreather and have yet to have my unit fail on me. *I have* run out of diluent during a dive—operator error because I was playing silly buggers—and I have had a couple of incidents that required me to take the initiative and fix something on the fly—operator error or intentional skills testing—but

What to do when things go pear-shaped...



the truth is that I have not had to bailout in earnest in a cave while diving a CCR. Put it down to luck or using a checklist before every dive, but my CCR cave dives have gone remarkably smoothly... thus far. I have probably jinxed myself now.

Bailout

Beginning CCR divers doing entry-level CCR programs are often taught that if *anything* goes wrong with their unit, they should bailout. In other words, switch to open-circuit and get the heck back to the surface and sort things out there. One might argue that with all the various options that a rebreather gives its operator, bailing out is not always the best option, and teaching users to react this way as a default does not take full advantage of a CCR's strong points. *But* for the sake of brevity here, let's assume that bailing out to an independent open-circuit gas is "best-practice" for a cave diver with a problem. It follows then that to be ready for a dive where things fall off the rails, a CCR cave diver needs to carry some bailout gas so that she always has a sufficient volume of appropriate gas to breathe throughout the whole dive. So far so good.

I have heard CCR divers talk about a technique called "Buddy Bailout" or "Team Bailout". This essentially means that each diver does not bother to carry the gas he or she would need to swim out of the cave from the furthest penetration point to the exit. They would perhaps carry half of the volume required, and will "get the rest" from their buddy. I am not sure how you feel about this, but it gives me the willies.

Here's an outline of another technique, which doesn't have an official name, but

let's call it "sufficient volume bailout" for the time-being.

Dive buddies

When things go pear-shaped underwater and stuff hits the fan, the simple solutions are generally the most effective and safest. On occasion a solution involves or requires the help of a dive buddy. Technical diving is a team-oriented sport and when things go wrong on a technical dive—and everything is aligned perfectly—we have one or two buddies to help out. All this aside, we are also taught that a diver should be capable of finishing her dive on her own and that the safest team is built around individual members who are perfectly capable of self-rescue should the need arise. This becomes particularly true in an overhead environment, and in the vast majority of cases, self-rescue (perhaps under the watchful eye of a companion ready to help out if needed), is the simplest, most effective and safest solution in a cave.

While it's fine to believe in the tooth fairy, Santa and the Easter bunny, my advice is to be very skeptical that the gas pixie will show up when you are in desperate need of a lung-full of something nice to breathe—especially in a cave. Even though we teach air-sharing in open-circuit cave programs, there is little in the skill as practiced by most divers that will help out in a real OOA event fuelled by panic and desperation. Added to this, and informed by experience, is a pretty solid opinion that operations such as handing a bottle off to a companion, while in a small passage with silt for a floor, and with one of the party fighting for air, will not end well.

Taking all this into consideration, the



best practice would seem to be for every CCR cave diver to carry enough gas to get themselves out solo. It would be nice to think that when a CCR diver is an hour's swim from the cave's exit, and they discover that they have no option but to bailout, that their dive buddy is within arm's reach and not swimming away blissfully unaware of the problem.

It's wonderful to have a buddy's gas as a backup, but primacy dictates that you have sufficient gas to exit without their help if possible. Which brings us to a word about how to calculate how much gas is enough.

SAC to RMV

The process of converting a personal SAC rate (Surface Air Consumption) to a RMV (Required Minute Volume) is as straightforward in CCR cave diving as it is in open-water open-circuit diving... with one added step.

SAC (the volume of gas a diver breathes each minute) is a constant and is influenced during a dive by several other factors such as depth, workload, stressors such as water temperature and visibility. The simple conversion for SAC to RMV is to multiply SAC by depth, and then multiply that number by a dive fac-

tor to account for the workload, etc, for the dive.

Here's a simple example. Let's use a SAC of 15 litres per minute and a cave dive on which the average depth is 25 metres. Let's also say this cave is familiar to the diver, has light current (out-flow) and the water is relatively warm and clear (21 degrees and more than 30 metres of vis). For this dive, we might use a dive factor of 1.50.

So here's the arithmetic: 15 X 3.5 (25 metres expressed in absolute pressure) X 1.50. The result is an RMV of approximately 80 litres per minute (78.75 l/m).



ABOVE The author using his AP rebreather at Jackson Blue Springs, Florida, USA

So far so good. If we are planning a dive to swim into the cave for 40 minutes before we turn, we will need approximately 40 minutes-worth of gas if our unit fails us at maximum penetration. That equals 3200 litres... or a 16 litre cylinder pumped to 200 bar... or one and a half 11 litre tanks filled to 200 bar.

Now this assumes something critical, and something that is different for a CCR diver compared to an open-circuit diver. The critical difference—the additional step that separates this type of calculation for a CCR diver as opposed to an open-circuit diver—is hidden in the nature of the possible events that would cause a CCR diver to bailout in earnest and completely from her rebreather's loop. One of

these events could be carbon dioxide break-through, and this might influence the respiration rate of the diver... dramatically, and for several minutes. In other words, the 3,200 litres that we calculated to get a diver from maximum penetration to the surface might not be quite enough. We might need to revisit the Dive Factor and change it from 1.5 to an even greater number.

Of course, back-of-a-napkin calculations such as these are fine discussion points while chatting with friends someplace warm and dry with a plate of olives and a glass of wine on the table in front of you. However, the only truly safe numbers come from what is euphemistically called "field-tested data". And these you need to collect yourself.

If the first rule of technical diving is: "Always have a sufficient volume of appropriate gas to breathe throughout the whole dive!" then perhaps the first rule of CCR cave diving should be: "Never take a CCR into a cave that you have not swum out of using open-circuit."

Final word: take notes... read them often! ■

Steve Lewis regards himself as a cave diver, primarily. He is a technical instructor-trainer with ratings from TDI and PSAI, and among other foibles, teaches divers to have fun and stay safe on two very different CCR units, neither of which lends itself, in his opinion, to team bailout.

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Fluoro Diving

• *And Photography*

Text and photos
by Kevin Deacon

As day turned to night, two Australian icons—Sydney Harbour Bridge and the Opera House—were silhouetted on the skyline. In the fading light, we prepared our equipment for another excursion into Australia's temperate seas to discover and prove the existence of fluorescing marine life forms in environments other than tropical oceans.

As our fluoro lights probed the stygian black void, splashes of emerald green revealed fluorescing corals among the rock—a vision that complemented the bright pinpoints of harbour lights above. After 50 years exploring the oceans, I had come full circle. This dive would complete a quest I started in my home town 47 years ago.

The dive was the culmination of many dives over the past six months together with Cherie, my wife and dive buddy, as we explored Sydney Harbour and other dive sites along the shores of our New South Wales coastline making new discoveries on every dive. Many

There are many varieties of tropical morays but we have only found one species that fluoresces, so far





Kevin and Cherie Deacon prepare fluoro lighting and camera equipment for an exploratory dive in search of fluorescent marine life in Australia's Sydney Harbour. Photo by Josie and Jason Ruth

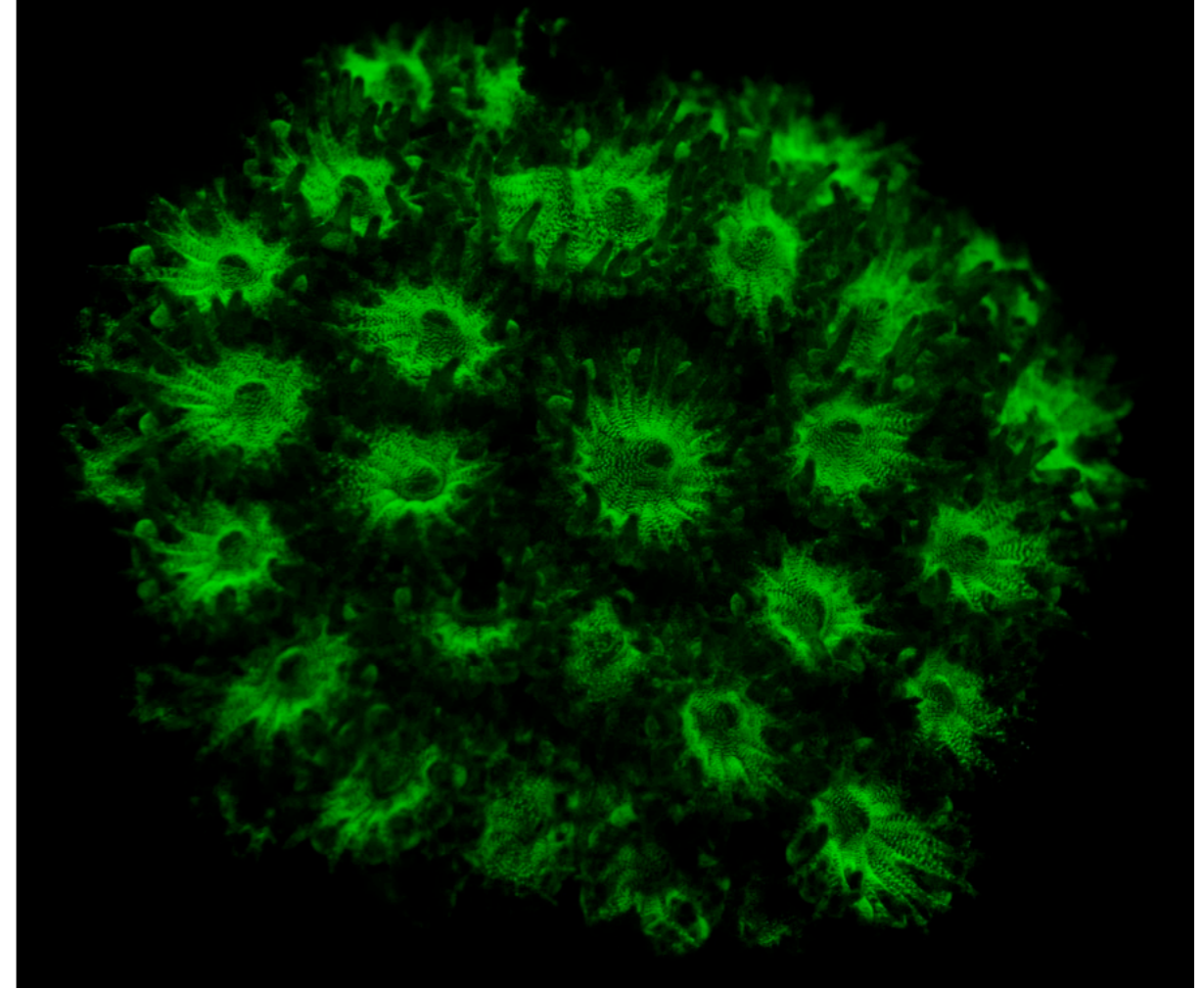
Fluoro Diving

are world first, revealing fluorescent behaviour in species never before seen, or captured, fluorescing.

I have been fascinated with the concept of fluorescence in corals since 1966 when I first gazed upon a beautiful portfolio of fluorescent coral images in a coffee table book by Dr Rene Catala, director of the Noumea Aquarium in New Caledonia, the man who revealed fluorescent coral to the world via his specimens in aquarium tanks bathed in Ultra Violet light.

Inspired by this, I waterproofed a 12-volt UV Fluoro light powered by a limited length of cable attached to a car battery on the surface. Descending to shallow depths in Sydney Harbour, I managed to reveal fluorescence in our local temperate species of coral but the light emission was weak so it was all rather uninspiring.

That was in 1966, and as an 18 year old just starting out in underwater photography, there was a wealth of other subject matter that would attract my attention over the next 47 years. But the fascination of fluorescence and the potential for new discoveries never really left my mind, especially as it seemed by the 21st century that new discoveries



In the shallow cold waters of Australia's Sydney Harbour, in sight of the Harbour Bridge and the Opera House, the cold water coral species *Plesiastrea versipora* fluoresces

underwater seemed elusive.

For a brief moment in recent years fluorescence in corals was once again revealed to the world in a spectacular portfolio by famed *National Geographic*

photographer David Doubilet. But once again, this was a limited exposure, as corals were collected randomly and brought to a UV light source at a jetty so they could be photographed on site underwater. The images were excellent

Our first temperate ocean fluoro diving discovery was the presence of tiny ascidians (sea squirts) in their thousands glowing like fairy lights guiding us deeper into the darkness of the depths

and once again, inspiring, but the process had not made a major leap in four decades.

New technology

Imagine if we could be free of such limitations and take the light to the animals, free to roam the seven seas and reveal all the fluorescent life forms that I was certain must exist. This would require a whole new technology, and fortunately, it was ultimately developed by Dr Charles Mazel of Nightsea.

A number of underwater photographers had already embraced the technology and begun capturing a few amazing images of fluorescing marine animals in tropical seas. It was my goal to pursue and capture even more tropical species fluorescing, but more importantly, to be the first to capture and prove the existence of such species in our cold temperate Australian seas south of the Great Barrier Reef.





The green moray eel (left) common in Australian temperate seas, is a night predator. We wonder if fluorescence is a link to other night predators' behaviour; Bristle worms (right), also known as fire worms, scurried about in the darkness giving the illusion of emerald jewels in motion

Fluoro Diving



were treated to multiple examples of tube anemones displaying their range of fluorescent colours, each one reminded me of a miniature display of fireworks, as their tentacles flowed in the current.

Sponges covered every rock, but we could barely see them in the darkness. Much of the marine life carpeting the seafloor did not fluoresce, but incredibly, just one sponge glowed in the darkness. On closer inspection, I found it was spawning, and the spawn was fluorescent. What would be the purpose of that? So many questions like this will keep marine

Temperate water

As total darkness fell on the dive site, Fly Point at Nelson Bay Port Stephens, Cherie and I descended to the seafloor using white light to find our way. Once we were settled, we switched to the Blue wavelength created by Nightsea Excitation filters and flipped our yellow barrier filters over our dive masks. Now everything went black, as only subjects that fluoresced would be seen, so it required good buoyancy control and the use of our probes to feel our way around the dive site.

We scanned the darkness with our lights, and ahead, a carpet of fairy lights was revealed, as hundreds of tiny ascidians, sea squirts, fluoresced like Chinese lanterns. This was a good start, but I was hoping for something more exciting than sea squirts.

Hovering amongst the fairy lights, our eyes caught a sudden movement, slithering through the darkness—a moray

eel fluoresced in bright yellow-green. Then, here and there on the sand, goatfish hunted for food, their tentacles glowing bright, their bodies and fins displaying alternating degrees of fluorescence, as if they had a dimmer switch controlling the intensity. Who would have imaged fish could do that?

Elsewhere on the sand, tiny emerald jewels roamed. On close inspection, these were bristle worms also known as fire worms due to their nasty sting. Why do they fluoresce? Are they communicating, "Don't touch"?

Floating along in a gentle current, we



science busy for decades.

Then out of darkness emerged the largest nudibranch I have ever seen in temperate seas, a Major Armina—at 90 centimetres, it is a giant among nudibranchs. They are rarely seen, as they only emerge from under the sand to hunt and feed on sea pens and soft

corals.

This specimen was glowing powerfully in a vivid display of fluorescing stripes, so powerful in fact it was lighting the sand around it as it hunted. Trailing close behind, a second Major Armina

caught up to the first, and they began to entwine in a courtship dance of dazzling fluorescence.

My heart beat faster, as I fired shot after shot of a display never seen or even imagined before. I was so excited by them that I couldn't tear myself away



Blue-spotted goat fish hunt in the darkness with their tentacles fluorescing, perhaps providing illumination for them? We also discovered these fish could control the intensity of fluorescence on their body and this ranged from almost dark, to bright patches, to full fluorescence

Painted lizardfish, yellow fluorescent eyes staring, haunts the night

to attempt more discoveries, even though my camera monitor confirmed I had the pictures. But the decision was eventually made for me, as the pair parted company and crawled off into the darkness in different directions.

Probing the dark night underwater in almost total blackness in an estuary that was also a known haunt of bull sharks and young great white sharks requires a certain mindset that would not come naturally to many. One must also be very careful to move slow and gentle, as you will not see the many stingrays, scorpionfish, sea urchins and other species that could cause harm to the unwary or careless diver.

Fluoro zen

Strangely enough both Cherie and I found the sensation of darkness guided only by emerald jewels of marine life soothing, almost a Zen like

experience interspersed with moments of excitement with each new discovery. On many dark dives we could only feel, not see, many marine animals, as they bumped us in their desire to flee when we inadvertently disturbed them. We would sometimes wonder what animal it was, or for that matter, what the next

one would be!

As we probed the night seafloor on more exploratory dives, we revealed even more fluorescent creatures of the night. In general most fish do not fluoresce, so we only glimpsed dark shadows, as they morph into the night.

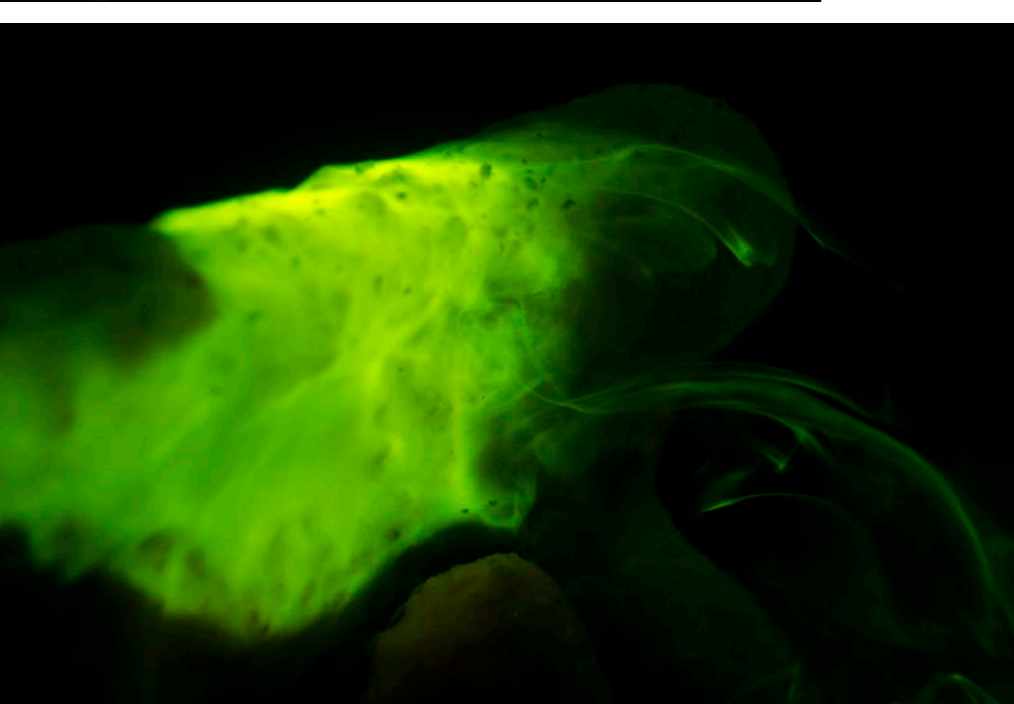
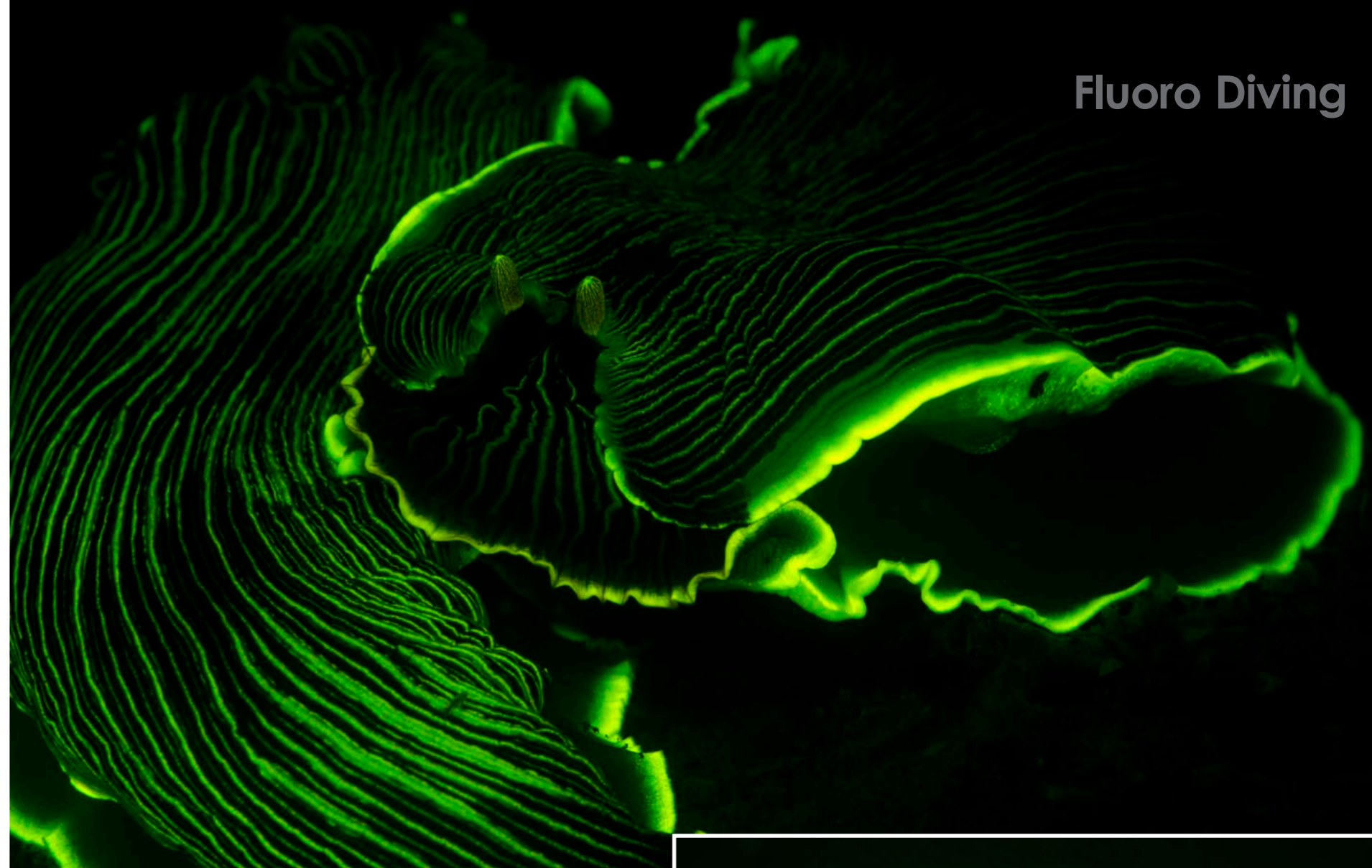
However, with fluoro, exception is the rule. Just at the edge of my fluoro dive light range, I caught a glimpse of a thumb-sized object glowing in the sand. Moving closer, I noticed it had an eye, and once the subject filled the frame magnified by my 60mm macro lens, I could detect the mouth of razor sharp teeth typical of a lizardfish.

Before long, it wriggled out of the sand revealing itself glowing in emerald greens and haunting yellow eyes—a serious ambush predator. But why announce itself in such a spectacular way at UV wavelengths?

Equipment

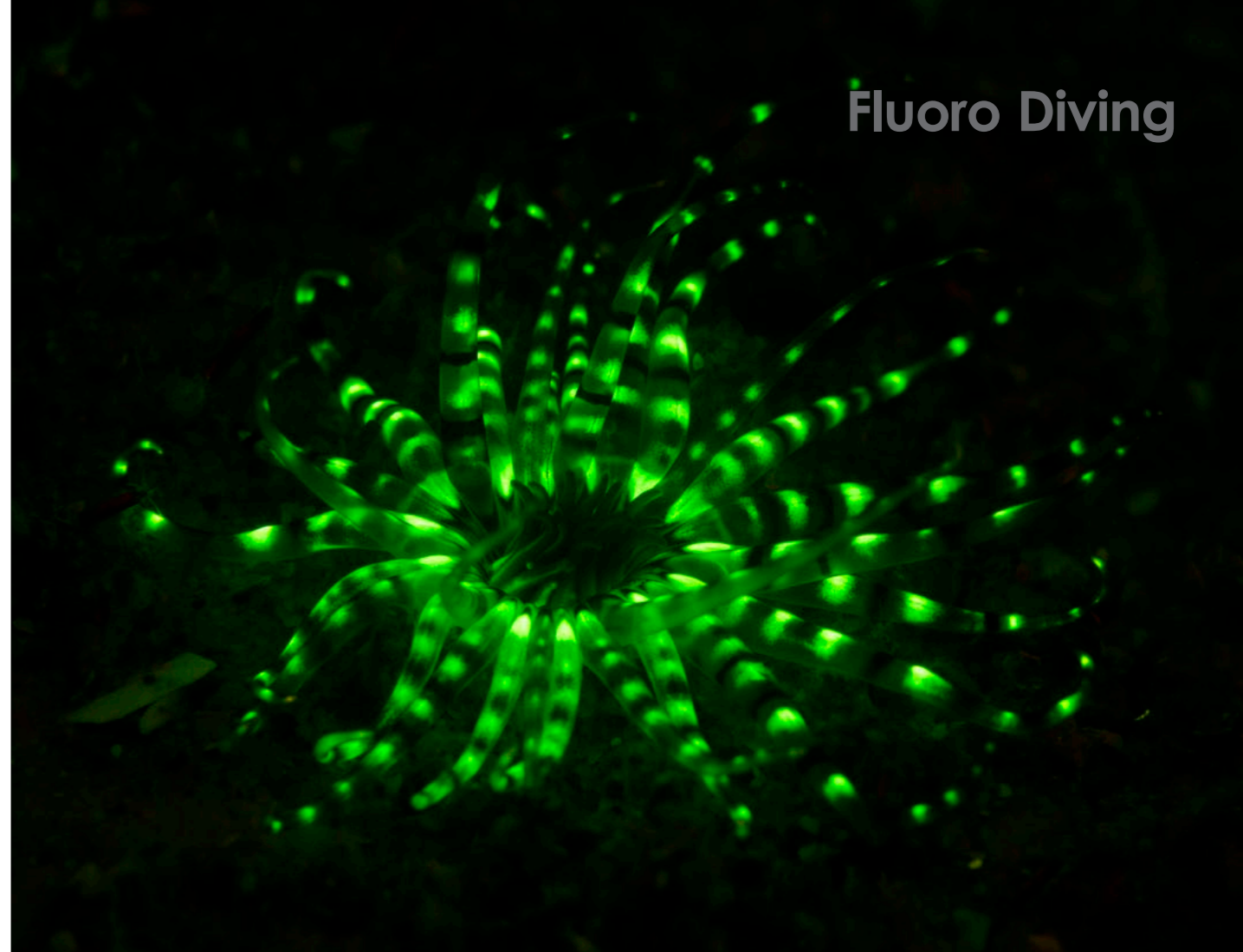
Equipped with 12-litre dive cylinders filled with nitrox and dry suits to keep warm, we would spend 90 to 100 minutes underwater on each dive.

Exhausted and low on air, we completed a safety stop in the shallow kelp gardens near the shore. Suddenly, another glimpse of something glowing in the dark. Clawing



Another amazing discovery was a sponge spawning in fluorescence but only the spawning section of the sponge fluoresced

Two Major Armina nudibranchs (top) swirl together in a slow motion courtship ballet illuminated by their own fluorescence; Blackface Armina with its prey, a sea pen, also fluorescing. Even more remarkable is the fact that none of the other sea pens we have encountered fluoresced. Could this be a reaction to the presence of the fluorescing predator?



THIS PAGE: Some species of tube anemones fluoresce while others do not

known to me, was fluorescing in greens, oranges and burgundy. The algae bed it rested on was glowing dark red. My excitement knew no bounds, as I struggled in my ungainly position, mask leaking due to being inverted, and the slight swell rocking me back and forth.

I was determined to capture yet another image showing evidence of the diversity of temperate water marine life fluorescing. After several shots, I gave up. I could only hope, I got it.

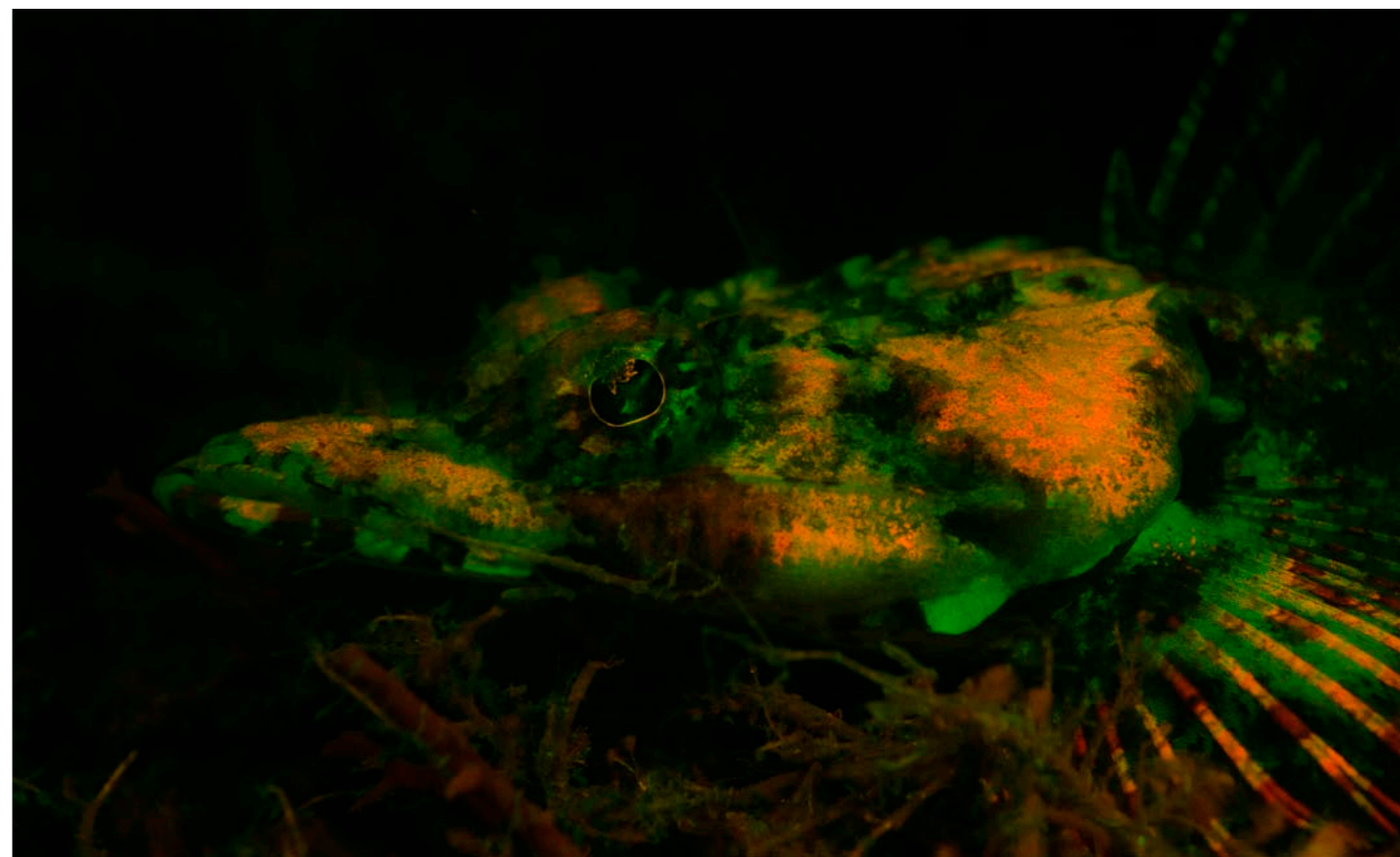
As Cherie and I emerged out of a calm moonlit sea, not another soul was in sight. The night was still and

completely quiet. The stars were the only witness to our endeavours. We were elated, we were inspired, and best of all, I felt vindicated.

Tropical fluoro diving

Our first fluoro dives were conducted in a traditional coral environment among the pristine reefs of Wakatobi Resort in North Sulawesi. Wakatobi Resort is a pioneer of the fluoro diving experience, and all guests have the opportunity to try it there.

Although one has an expectation of what it might be like to fluoro dive a coral reef, nothing prepares you for the reality. The variety of



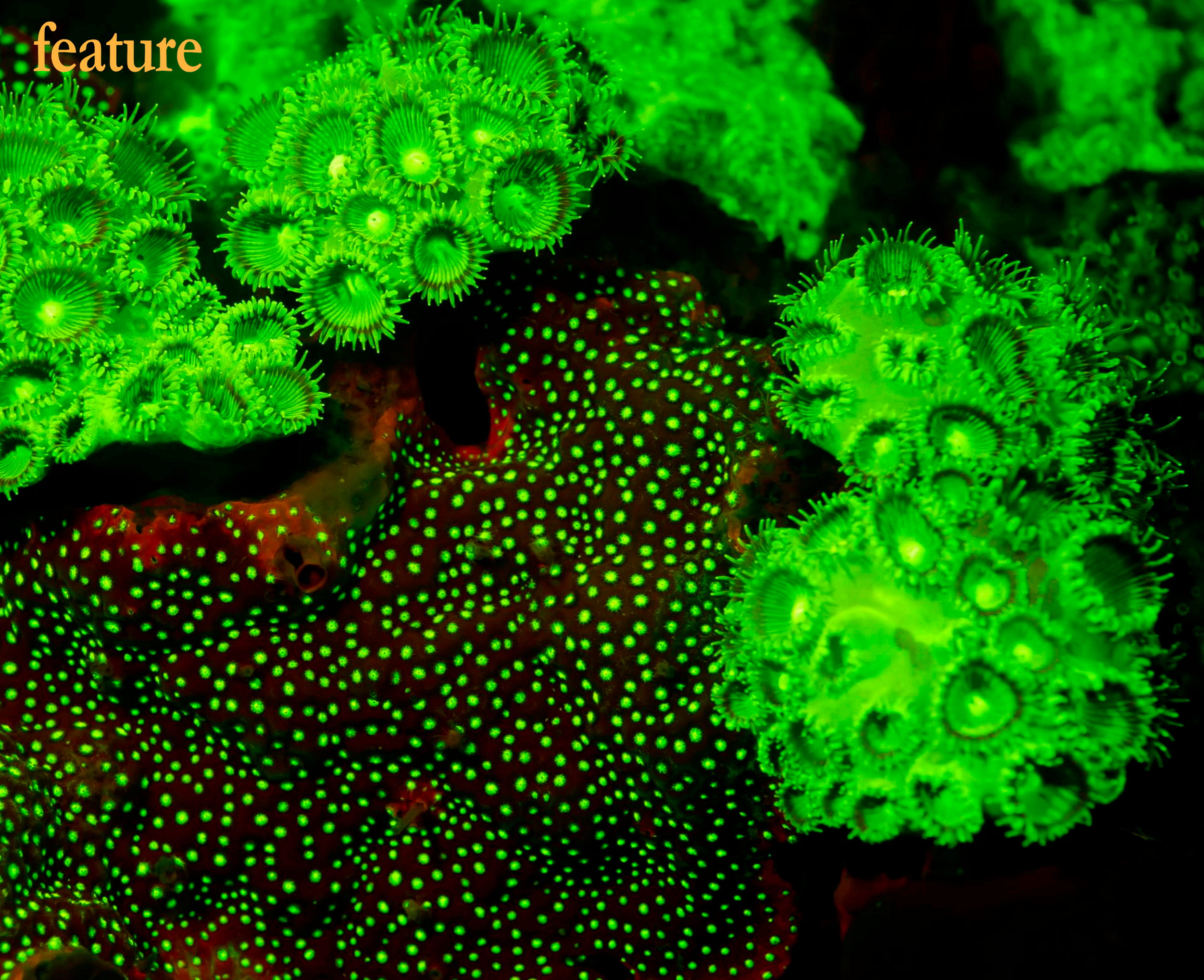
Few fish fluoresce but this tassel-snouted flathead is a spectacular exception to the rule

my way down into the kelp head first with my dry suit boots filling with air, I was struggling to maintain control.

To my amazement a large tassel-snouted flathead, a species well



feature



DivePhotoGuide.com



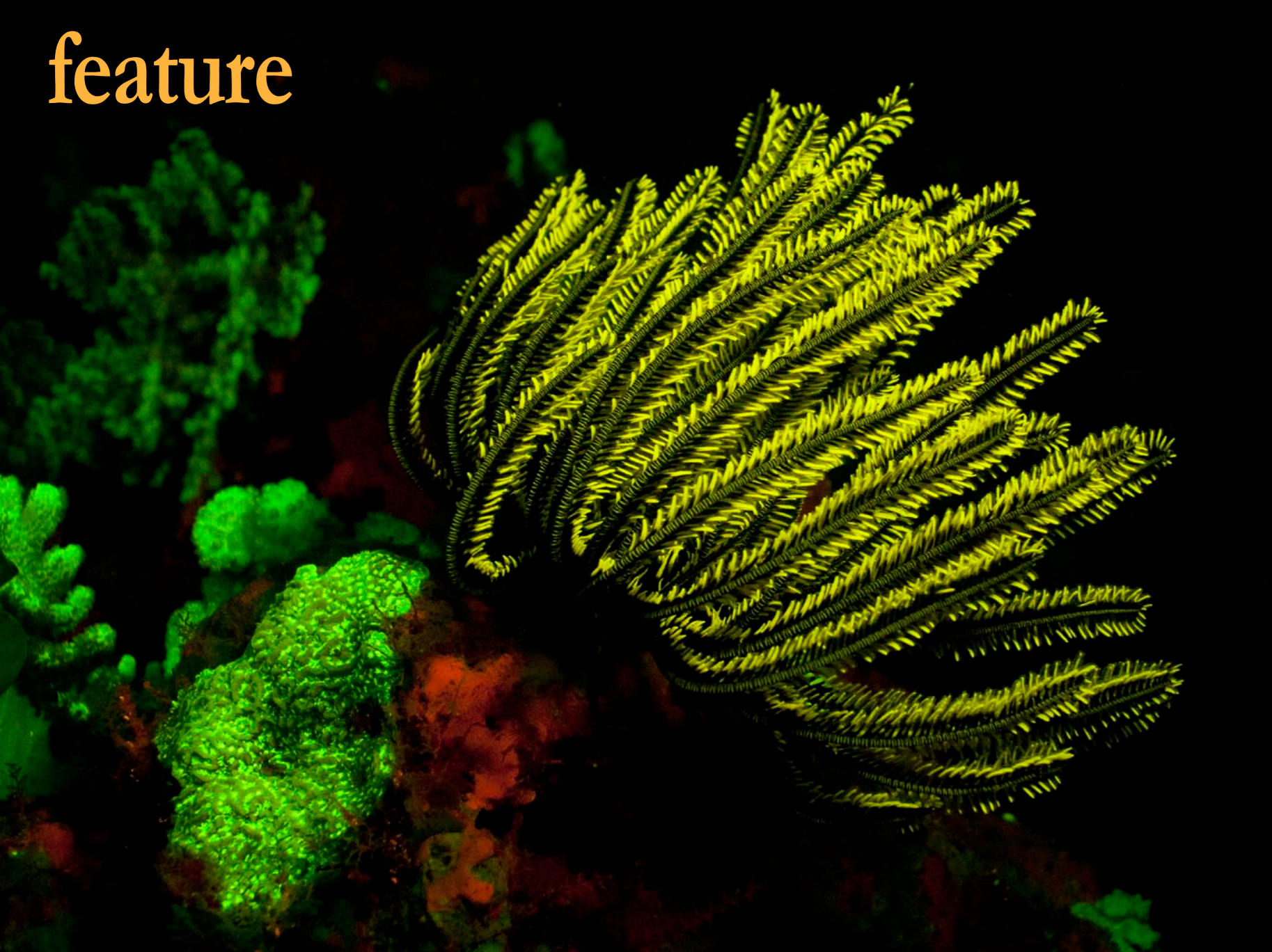
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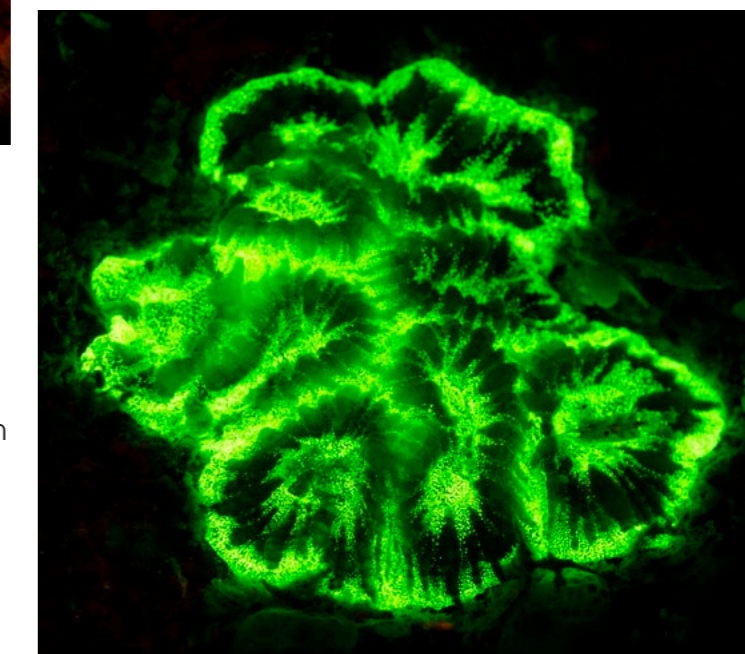
Multiple species of tropical corals fluorescing





CLOCKWISE FROM FAR LEFT: A drab brown crinoid feather star fluoresces bright yellow; Goby fluorescing in metallic orange and red against emerald green fluorescing coral; Fluorescing tropical coral polyps; Tiny mushroom coral, polyps extended, fluoresces

converting it into a very versatile dive and photography tool, especially if one is using the Sola photo light with the option of white and red nocturnal light, plus the Nightsea swing filter.



lens to block out all visible light other than the fluorescent reaction.

Light and Motion, a company that makes a superb range of dive, photo and video lights in the Sola Dive series in conjunction with Nightsea also produces a dedicated Sola Light that produces the correct blue wavelength with a clip-on filter to convert it back to white light when desired.

Our company, Dive 2000, has also engineered a very convenient swing filter that fits any Sola dive light, thus

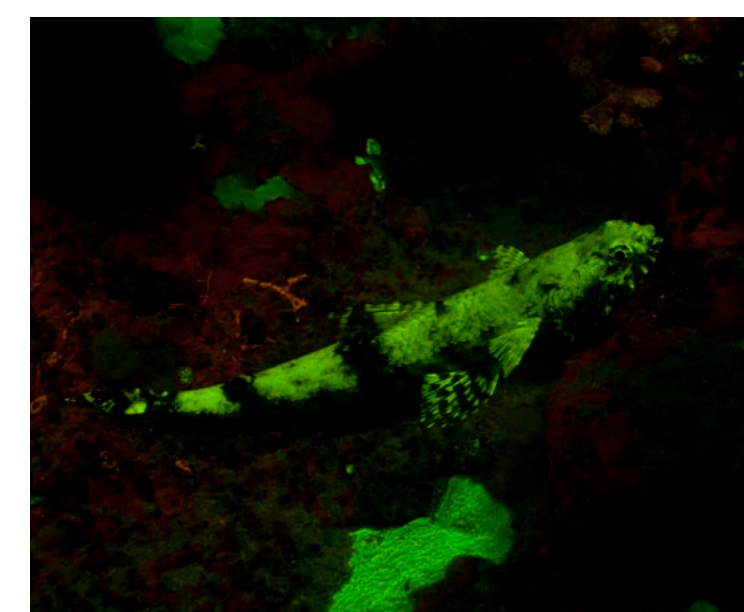
corals in the region of the Coral Triangle, which includes Wakatobi, is incredibly diverse. The moment you descend and scan the reef with fluoro wavelength, the corals light up like a carnival. There is in fact so much fluorescence in the corals, that you have no trouble with navigation or orientation. The vista of an entire reef glowing in the dark will change the way you think about corals forever.

Hunting for new subjects in coral reef environments is in stark contrast to temperate water environments. The fluorescing coral reef is so vivid, it's distracting, and hunting for life forms other than corals is difficult.

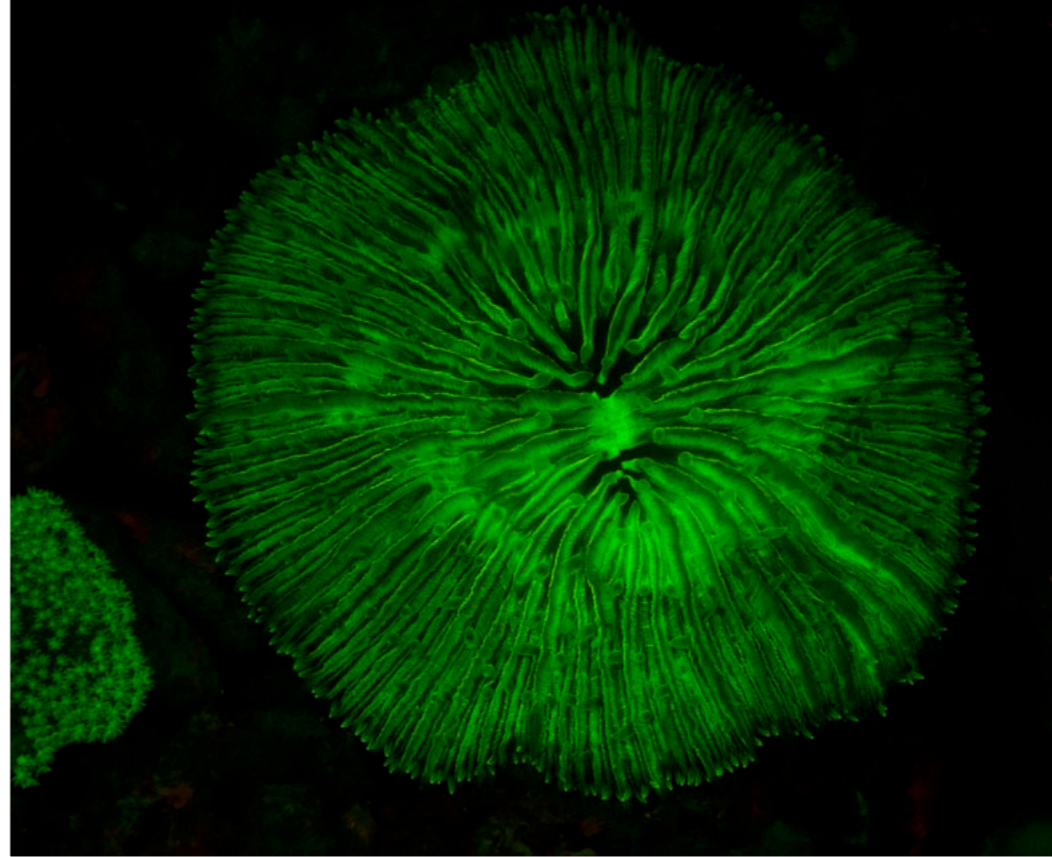
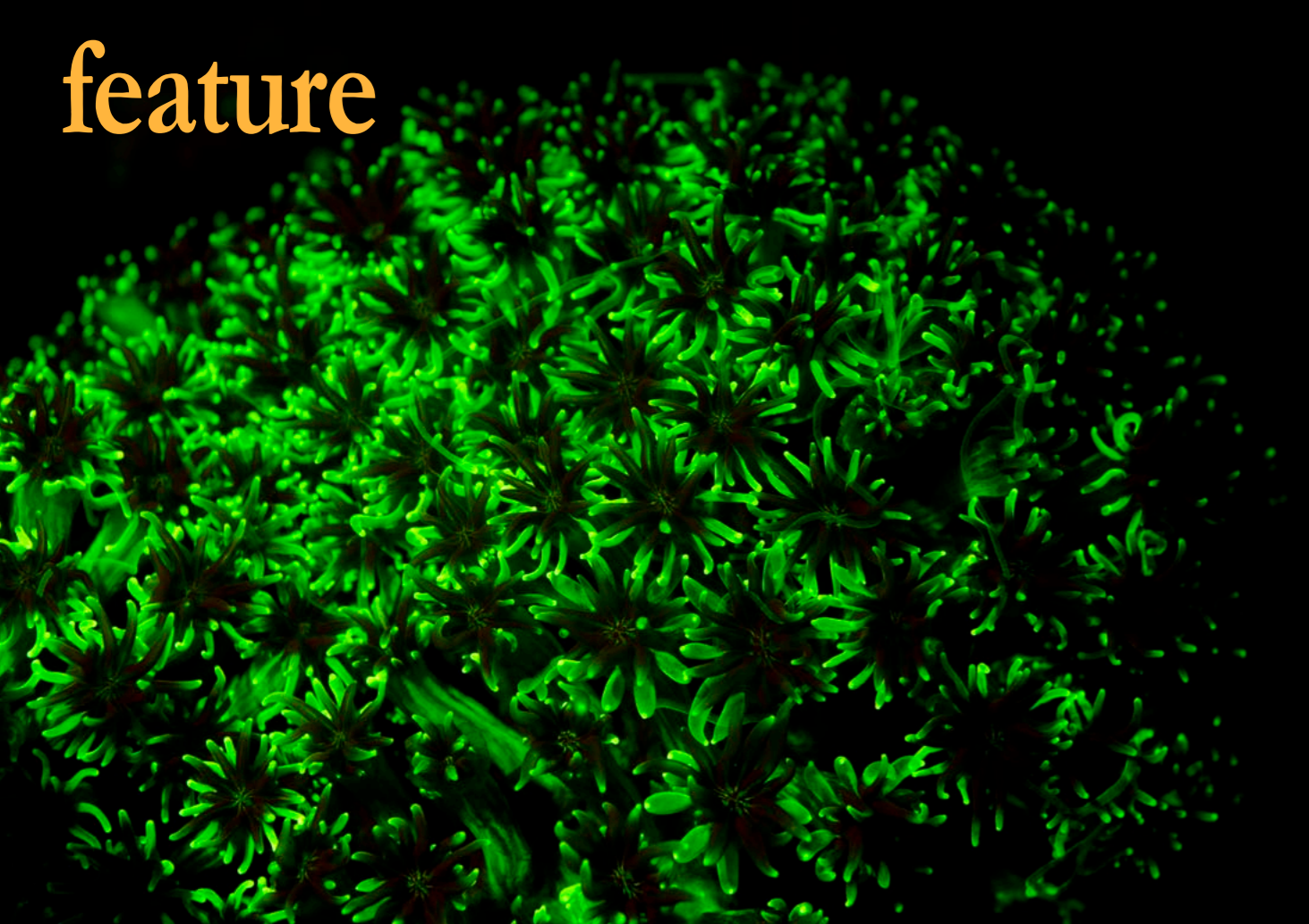
Diving the pitch black environment of temperate water sites is more challenging, but any life form that fluoresces readily stands out.

Fluoro technology and photography

Charles Mazel of Nightsea developed special filters for dive lights, video lights and strobes. These are referred to as Excitation filters. They convert white light to a wavelength close to the blue spectrum. This wavelength reveals fluorescence in marine life and algae provided a yellow barrier filter is worn by the diver and used on the camera



Lizardfish fluorescing



Tropical
mushroom
coral
fluorescing

Fluoro Diving

Kevin Deacon is one of the pioneers of underwater photography in Australia. His images have been published worldwide in prestigious books, magazines and advertising media. Kevin and Cherie Deacon along with their team of scuba and photo instructors, dive masters and tour guides operate Dive 2000 in Sydney, Australia's most experienced dive, travel and underwater photographic equipment centre. Dive 2000 is also the Australian Importer and Distributor for Nightsea Fluoro accessories and Dive 2000 Fluoro Products, Seacam Housings and most Underwater Photography equipment. See: www.dive2000.com.au

Fluorescing tropical coral polyps (left); The Sola Nightsea Light (right) provides a dedicated fluoro light wavelength. The Seacam strobe is fitted with a general purpose Nightsea Fluoro Excitation filter. These are available in a range of sizes to suit many strobes including Ikelite DS160/161



I have not found fluoro photography difficult. With powerful fluoro light, the lens autofocus works quite well. However, ISO settings need to be high, as the wavelength of light via the filters on your strobes is weak compared to white light. Aperture settings need to be wider for macro images. I found 800 ISO at F8 – F11 provided an effective exposure with most strobes, but depth of field is reduced at these

Camera lenses also need a yellow filter to 'see' and capture fluorescence



apertures, so focusing on the key part of the subject is really important.

Strobes or video lights can be used much closer to the camera lens and subject matter, as there is no problem with backscatter, since it does not fluoresce, it will not be revealed!

Buddy contact is difficult, as divers don't fluoresce, so we are invisible to each other in the darkness. Cherie and I could easily get

separated, so we made a point of always wearing chemical Glow Sticks, which helped to reveal our position, as we individually hunted for subjects. Cherie would also carry extra Glow Sticks as markers for any subjects she found, so she could guide me to them. We also found Glow Sticks useful as

navigation way points when we would retrace our path back to the exit area.

The future

Our limited explorations in our local temperate waters, the Tasman Sea off the southern Australian coast, has already revealed many new discoveries and raised many more questions for marine biologists to unravel. As we help equip others and collectively explore even more of our global ocean realm, we are certain a great number of new fluorescent discoveries will come to light. As photographers, we are also excited knowing we have a whole new genre of art to inspire our creativity.

I would not have imagined that 50 years after entering the ocean with black and white film, 12 shots on a roll and flash bulbs, I would still be finding new subjects to capture and new marine life behaviour to discover. The future is still ours. ■



Dive 2000 custom designed Swing filter fitted to any Sola light allows instant switch from white to red to fluoro light wavelengths. Inon strobe fitted with Nightsea Inon Excitation Filter



Dive 2000 designed swing filter visor that hinges from the mask frame and semi locks at three positions



photo & video



Nauticam GH3 Housing

Nauticam has officially announced the release of their housing for the Panasonic Lumix DMC-GH3 camera. The NA-GH3 housing was "pre-released" on the China Nauticam site and then exhibited at the NAB show. Nauticam USA has now confirmed that it will be shipping the NA-GH3 housing from the end of May at a retail price of US\$2,250.

Nauticam Canon EOS-6D Housing

Nauticam has announced that the release their new NA-6D housing for the Canon EOS 6D camera at a U.S. retail price of \$3,300. The NA-6D housing features the multi controller pad used on their Nikon housings and provides access to the EOS 6D's 8-way controller. Plus Nauticam have also provided a dial that controls the camera's rear command dial on the right hand side of the housing.



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Ikelite GH3 Smart Housing

In an interesting development Ikelite has launched a new Smart Housing for the Panasonic Lumix DMC-GH3 Mirrorless Micro Four Thirds camera. Ikelite has previously been largely absent from the mirrorless market, so its decision to develop a new housing for the Panasonic GH3 appears to indicate that they are back. The new housing is classic Ikelite and shares the TTL flash control and polycarbonate design of other Smart housing from the company, but also moves the video and AF lock controls onto the side of the housing for thumb activation. The Ikelite GH3 Smart Housing is available from the end of May at a U.S. retail price of \$1,500.

Sea & Sea's MDX-6D Housing

Sea & Sea has announced the release of their housing for the Canon EOS 6D SLR—the MDX-6D. The new housing is made from black anodized aluminum alloy and gives access to almost all of the camera's essential underwater functions, apart from the depth-of-field preview button. The MDX-6D housing can be fitted with an internal version of the YS Converter/C TTL convertor by Sea & Sea dealers—enabling switching between TTL and manual strobe exposure from the housing. Other key features of the MDX-6D housing include: shutter lever tension that can be adjusted with a spring; a port lock that can be accessed without opening the housing; a new grip design with threadless fixings; a tripod socket on the centre underside of the housing; Optical Viewfinder 0.5x as standard; the use of other interchangeable viewfinders; a built-in leak sensor that immediately alerts you to water ingress; and a depth rating of 100m (330ft).





MyShot Photo Contest 2013

Sponsored by ScubaPortal.it, MyShot Underwater Photo Contest 2013 is open to all photographers to compete for valuable prizes in four categories: Reflex Macro, Reflex Wide-Angle, Compact Macro, Compact Wide-Angle. Registration is free. Deadline for submission is midnight (CET) 31 October 2013. A jury will decide the winners of each category, and there will be a public vote for the best three images out of the top 100 pictures (25 in each category). Judges include Marco Daturi, Cristian Umili, Francesco Turano, Adriano Penco, Marco Milanesi and Roberto Sozzani. A closing ceremony and party will celebrate the end of the contest. For info and updates, visit: **Myshot.it**. For any information and to submit entries, email: **info@myshot.it** ■

DivePhotoGuide/Wetpixel hold exhibit at United Nations

Internet underwater photography sites, DivePhotoGuide and Wetpixel, in affiliation with Blancpain, the Swiss watch company, have created an exhibition of underwater images entitled, "Oceans", on display at the Visitor Center in the United Nations building in New York City, USA. The exhibition celebrates World Oceans Day (June 8) and features 30 underwater photographs and two high-definition videos of various ocean ecosystems around the planet, captured by an international group of accomplished photographers.

"I was extremely excited when the Department of Ocean Affairs approached us about doing a photo exhibition at the United Nations in connection with World Oceans Day," said owner of DivePhotoGuide, Matt Weiss, in a statement. "Beautiful underwater imagery is the perfect medium to convey the importance of

Ikelite Housings for Nikon P330 and S9500

Ikelite has announced the release of two new housings for the popular Nikon P330 and S9500 compact digital cameras. Both housings are manufactured from Ikelite's proven special polycarbonate blends which are clear, light and strong. Access is provided to the majority of both cameras' main functions, and the S9500 housing can be fitted with Ikelite's WD-4 dome to enable wide-angle photography underwater. Both housings have a recommended retail price of US\$400.



Ikelite Housing for Nikon S9500



Ikelite Housing for Nikon P330

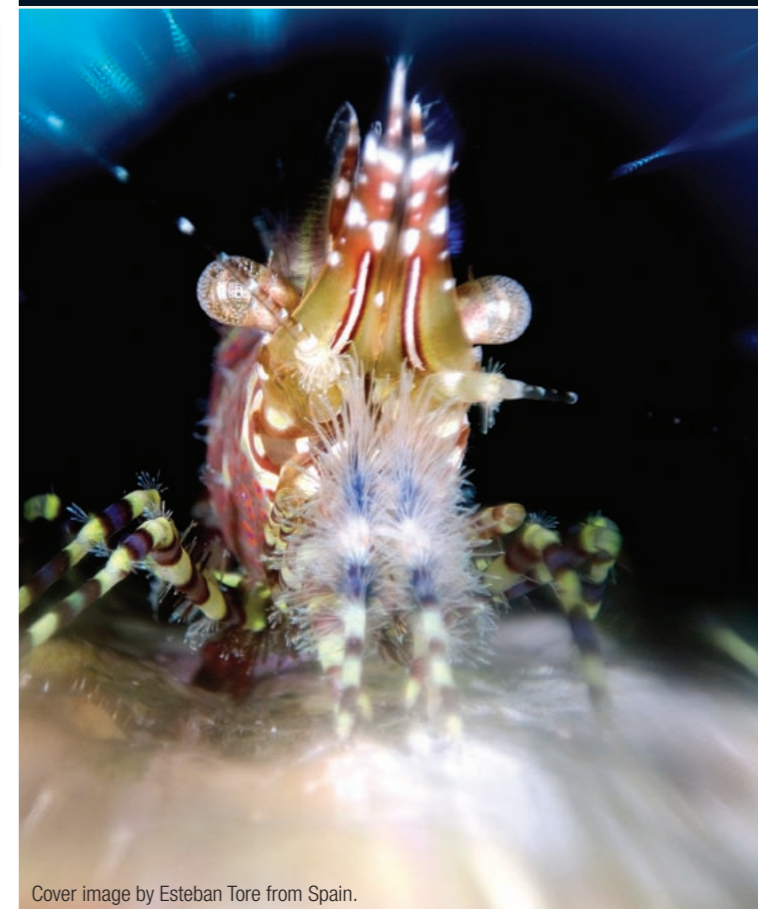
Aquatica AD600 Housing

Canadian manufacturer Aquatica has announced the release of their new housing for the popular Nikon D600 "entry level" full-frame FX DSLR camera.

The Aquatica AD600 is machined from a single aluminum block and is fitted with their standard double o-ring seals on the knobs and levers so that it can withstand pressures exceeding 100m. The AD600 provides access to the camera's Fn control, which can be customized for a variety of functions, via a button on the rear. It also has a thumb lever for ISO adjustment and three ports for accessories such as monitor or vacuum bulkheads. The AD600 housing will retail at \$3,199 in the U.S.A.



The HP Red Sea and World Shoot-Out 2012 competition album is now available!



Cover image by Esteban Tore from Spain.

Stunning images submitted by HP Red Sea & World Shoot-Out 2012 nominees and winners were all gathered into one album, featuring color and creativity at their best.

The album consists 176 Chrome pages. It's the perfect gift and a must-have for any underwater photographer, diver, fan of the sea or fan of art.

Special Introductory Offer:
25 Euro (instead of 39 Euro)

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Lauren Kussro



P O R T F O L I O

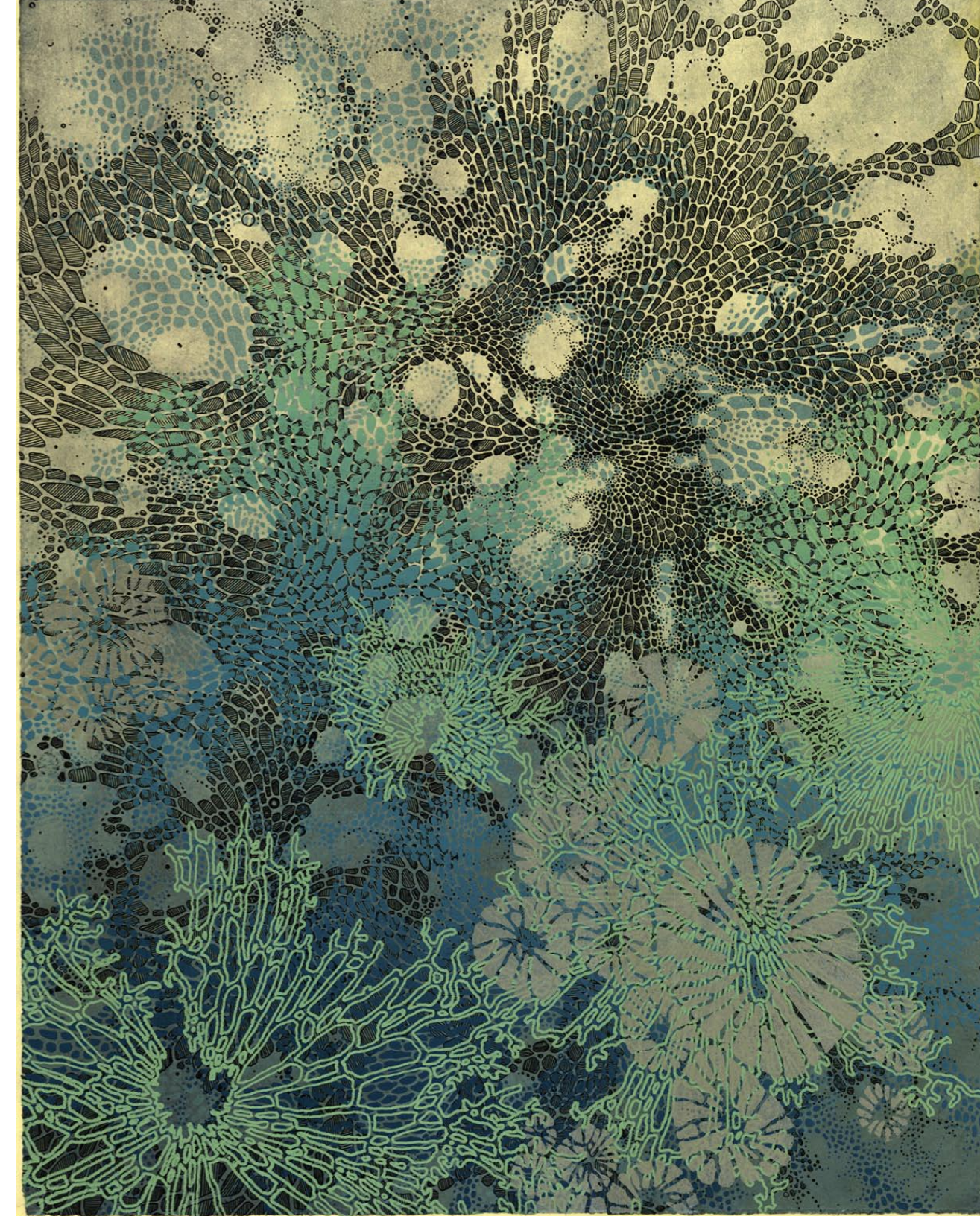
American artist, Lauren Kussro, has been inspired by the sea to create work that is extraordinary, unique and meticulous, capturing in printmaking and printinstallations the intricate beauty and poetry of marine creatures and

underwater life forms, which divers know and love so well. **X-RAY MAG** interviewed the artist to find out more about her mesmerizing work and artistic vision.

Text edited by Gunild Symes
Photos courtesy of Lauren Kussro

X-RAY MAG: Tell us about your print-making and printinstallations. How did you come up with the concept and how are the art works made or constructed—what is your method?

LK: Most of my subject matter is based in nature, so typically my process begins with some general research, mainly image searches on existing organisms



PREVIOUS PAGE AND LEFT:
Coral Confection
Installation by Lauren Kussro. Etching, monotype and silkscreen on paper and wood, paint, cut paper and beads

ABOVE: *Deep Calls to Deep*
by Lauren Kussro. Etching, monotype and silkscreen on paper, 11x14 inches

We held to each other so tightly, we became as one, installation by Lauren Kussro. Monotype and silk-screen on paper, glue, beads, thread



graduated from high school. I then went on to earn my Bachelor of Fine Arts degree at the Herron School of Art in Indianapolis in 1998 and went on to earn my Master of Fine Arts degree at the University of Tennessee in Knoxville in 2003.

As a printmaker, I'm intrigued by multiplicity. In my art I tend to be very attracted to items in nature that occur in clusters or groups because it allows me to investigate the multiple. There is also something in the detail and inherent design contained in the natural world that I find profoundly humbling, and wonderful to explore as an artist. As far as subject matter, I've been interested in things like plants/leaves, flowers, cells, fungi, fossils, etc. Many sea forms such as coral, shells, kelp and barnacles can be found in the multiple as well, and those have been a lot of fun to incorporate.

from nature that give me ideas and inspiration on what I might like to start attempting to make in paper or wood. From there I do a lot of experimenting with paper, to see what kinds of forms will work and will be effective as multiples.

Often at the same time I'll be working on drawings that are also based in that same research and that end up becoming the patterns on the paper I use. All the paper that I use, I print on first to give it the color and visual texture I want. Initially, I print flats of color, using a monotype technique with

oil-based ink, and then print the patterns using silkscreen. When the paper is ready and after I've settled on a sculptural form or model that I am pleased with, I'll start to make the actual piece.

Printstallation to me means a large print-based sculptural piece or installation. Being able to figure out ways of making this kind of art is exciting to me. I love the idea that art could take over a space and be more engaging for the viewer. I find most art in galleries to be very static—people are often separated from it by glass. Sculptural

work that is visually very engaging, that has a variety of texture and is surprising in its presentation can be very fun for viewers to experience.

X-RAY MAG: Tell us about your background, training, experience and how you developed your artistic process in connection with themes of the sea or the underwater world.

LK: I grew up in Indiana and was home-schooled all the way through until I



Detail of art work above entitled, *We held to each other so tightly, we became as one*, installation by Lauren Kussro



X-RAY MAG: What about the ocean and its creatures inspires you?

LK: I find the ocean world to be somewhat mysterious. It is a bit more difficult to explore than many above-water locations, and I'm sure there are a lot of creatures and organisms yet to be discovered. I think one of the reasons I like ocean life is that it looks really familiar to us but also extremely alien in a way. Coral is so

similar to above water plant forms, but is so bizarre and weird at times! I love that.

X-RAY MAG: What is your artistic mission or vision?

LK: I see my mission as an artist being both the pursuit of beauty and the sharing of that beauty. Through the time I spend in the process of creating art I affirm that beauty

has worth and value. Through the sharing of that art I invite the viewer to participate in investigating and enjoying the beautiful.

X-RAY MAG: Are you a scuba diver? If you do not dive or snorkel, what sources do you use to inspire or inform your art works related to the marine environment and ecosystem?

LK: I'm not a diver, but when I was



ABOVE: *We held on so tightly, we got stuck there*, installation by Lauren Kussro. Silkscreen on paper and wood, glue

LEFT: Detail of *We held on so tightly, we got stuck there*, installation by Lauren Kussro



LEFT: *Our Ocean*, by Lauren Kussro. Coral pieces are made out of monotype/silkscreened paper and wood, thread and wax. Larger backdrop pieces are made with wood, paint, and silkscreen. Seven pieces total, made for a space roughly 6x18 feet

BELOW: Detail of *Our Ocean*, by Lauren Kussro



young I was fascinated by the ocean and read a ton of books about the different types of ocean life. I think that fascination is still with me today, and I'd love to eventually have the chance to do some diving. As far as sources, I do a lot of image searches online for organisms I am already familiar with (such as barnacles) and learn information that often leads me to look at other types of creatures. I also make use of the public library

and check out books on coral reefs, shells, etc.

X-RAY MAG: What are your favorite underwater subjects?

LK: Right now I'm mainly intrigued by coral and barnacles. As a printmaker they both appeal to me because of their variety and multiplicity, and the way they often cover a large area. They also seem very related to plant

forms, which have been a previous subject matter for me.

X-RAY MAG: How does your art relate to conservation or environmental issues facing our oceans and reefs?

LK: I think it can raise people's awareness of the beauty of the natural world, and perhaps a greater appreciation of it.

X-RAY MAG: What upcoming projects, if any, related to the ocean or marine environment are you working on?

LK: I'm actually getting ready to start some new work, and I'm not entirely sure what that will be yet!

For more information, visit the artist's blog at laurenkussro.wordpress.com

