



GLOBAL EDITION
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British Columbia
Critter Connection

Wrecks of
Bikini Atoll

Indonesia's
Ambon

Thailand's
Koh Tao

Profile
**Stig Åvall
Severinsen**

Switching to
Rebreathers

PACIFIC PARADISE
Galápagos

DIRECTORY

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COVER PHOTO: Nudibranchs, Koh Tao, Thailand,
by Nick Shallcross

Octopus, Ambon, Indonesia. Photo by Don Silcock



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Biased reviews

In the early days of my diving career there was a marked difference between a bad and a good regulator. When I got my first dive training with a local dive club, it had an assorted bunch of school regulators, some of which were nice top-of-the-line models and others were—uh—less fancy, shall we say.

The good ones were easy to breathe and delivered plenty of air even at depth. The cheaper ones, which we always dreaded, were like sucking through a straw filled with cotton at depth. Going deeper than 20m became hard work just trying to suck air. It certainly put limits on our ventures.

Needless to say, as we dreamt about purchasing our own regulators and painstakingly saved for it, we pored over magazine reviews and tests and whatever other information we could get our hands on. In those days, it was often commonplace that reviews included objective tests and measurements and had graphs on performance, so we could compare numerical data.

We haven't seen that kind of data in reviews for quite some time and for good reason. Regulators have become so much better, as they have had to adhere to quality standards—such as the CEN 250—in order to be marketed in the first place.

Nowadays, a badly performing regulator is most likely just a badly maintained specimen in dire need of a fix.

And, just as we seem to care a lot less about a car's top speed and horsepower—they can all break the speed limit these days—and more on the practicality, economy, look and feel of a car, our choice of diving equipment has also become a matter of other and often more subjective criteria such as taste, or bias, if you will.

So, how do we go about reviewing not just equipment but also destinations and operators today? We are no longer occupied with objective performance tests and data in a test rig. By virtue of being CE-marked, crucial tests have already been passed, and there is rarely much we could add as far as testing is concerned. Instead, we look into how well the equipment fulfills its design criteria and whether it is a good purchase for its intended target group—in other words, its value for the money.

Like comparing a VW Bug to a Rolls Royce when asking which car is the better design makes little sense (unless you specify the yardstick) it makes little sense to make direct comparisons of small family-driven dive operations to five star facilities run by upscale multinational corporations.

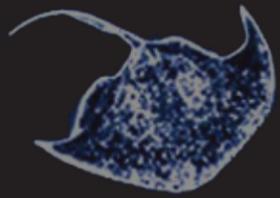
A family-run dive operation will probably offer a more relaxed and affordable holiday, thus being a better value for the money for many divers, compared to what one might get at a posh resort or on a fancy liveaboard, which would be the obvious choice for the well-off, busy executive looking for big pelagics.

And this is exactly why our travel reports are much longer and in-depth than the norm. We want our stories to help readers—divers of all levels—make informed choices. We therefore always ask and require our reporters and reviewers to give their honest opinion and not to shy away from possible less-favourable reviews or conflicts. It needs to be told.

Is it subjective, or possibly even biased? Yes, by virtue of human nature, the individual perspective always will be—we are not robots. But, by asking our contributors—many of whom have been with us for several years and have developed a recognisable style and standard upon which they elaborate and argue their cases—we aim to make our reviews as transparent as humanly and practically possible.

With that, we wish all of our readers a terrific, fun-filled season of happy diving.

—The X-RAY MAG Staff



News edited
by Peter Symes

from the deep NEWS

A Vaccine for Corals

Inoculation of corals with virus can protect them against white plague disease.

White plague disease is caused by the marine bacteria. It progressively destroys coral tissue, leaving an expanding area that appears bleached. It has been epidemic in the Caribbean.

'White syndrome' is a name given to a number of diseases exhibiting similar symptoms, such as white pox, white band and white plague disease. The causes of white syndrome are in many cases unknown.

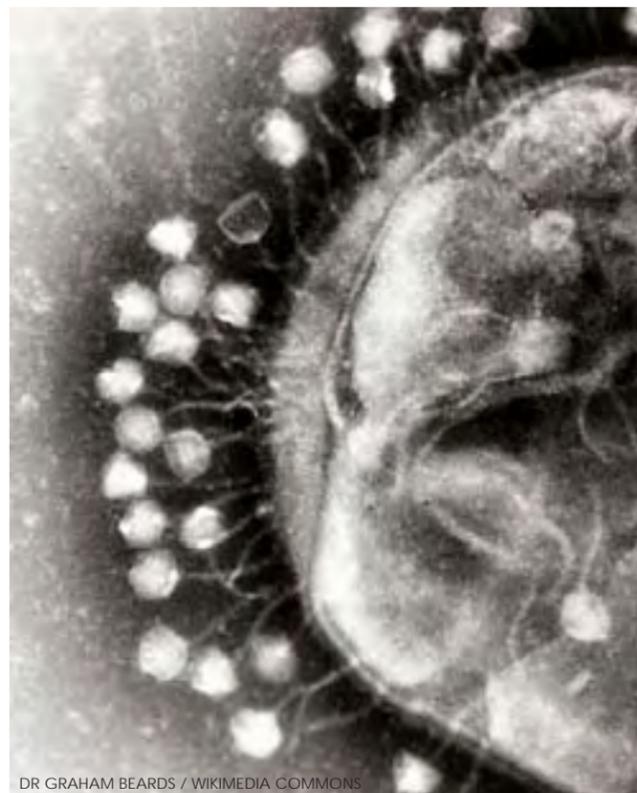
White syndrome has increased in abundance 20-fold in the last five years, with increases on inner, mid-shelf and outer-shelf reefs along the length of the Great Barrier Reef. It also had a major impact on Caribbean reefs.

In areas of the Great Barrier Reef surveyed, white syndrome, along with skeletal eroding band, was the most common disease.

Testing a cure

Eugene Rosenberg of Tel Aviv University in Israel and his group have now found a potential cure—a virus named BA3.

To test its usefulness, they inoculated corals living next to infected ones with BA3. The odds of infection dropped to 5



DR GRAHAM BEARDS / WIKIMEDIA COMMONS

percent. Doing the same to infected corals stopped the disease in its tracks. Rosenberg is now in talks with the Israeli government to treat large parts of the Gulf of Aqaba with BA3 by artificially introducing the virus to reefs.

The virus exists naturally in the Red Sea, so they think it's unlikely to have adverse effects. ■

The whitens of *Leptoseris troglodyta* is no anomaly. This species has no zooxanthellae, the symbiotic photosynthesizing algae that delivers nutrients.

The newly described coral species lives on the ceilings of caves in Indo-Pacific coral reefs. Its distribution range overlaps with the Coral Triangle, an area that is famous for its high marine species richness.



This new coral species lives on the ceilings of caves in tropical coral reefs

Healthy White Coral

Coral without symbiotic algae dwells in holes and ceiling of caves where almost no light occurs.

Most reef corals generally do not occur over 40m depth, a twilight zone where sunlight is not bright anymore, but some species of the genus *Leptoseris* are exceptional and may even occur much deeper. At greater depths, seawater is generally colder, and corals here may be

less susceptible to bleaching than those at shallower depths. Despite the lack of zooxanthellae and its small size, the skeleton structures of the new species indicate that it is closely related to these *Leptoseris* corals, although it has not been found deeper than 35m so far.

The species is named *Leptoseris troglodyta*. The word *troglodyta* is derived from ancient Greek and means "one who dwells in holes", a cave dweller. The discovery sheds new light on the relation of reef corals with symbiotic algae. The new species has adapted to a life without them. Consequently, it may not grow fast, which would be convenient because space is limited on cave ceilings. ■

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Seagrass may help revive endangered coral reefs

Who would have thought that the simple seagrass may be the solution to saving endangered coral reefs around the world? This is the promise brought to light by researchers from Swansea University, Oxford University and James Cook University in Australia.

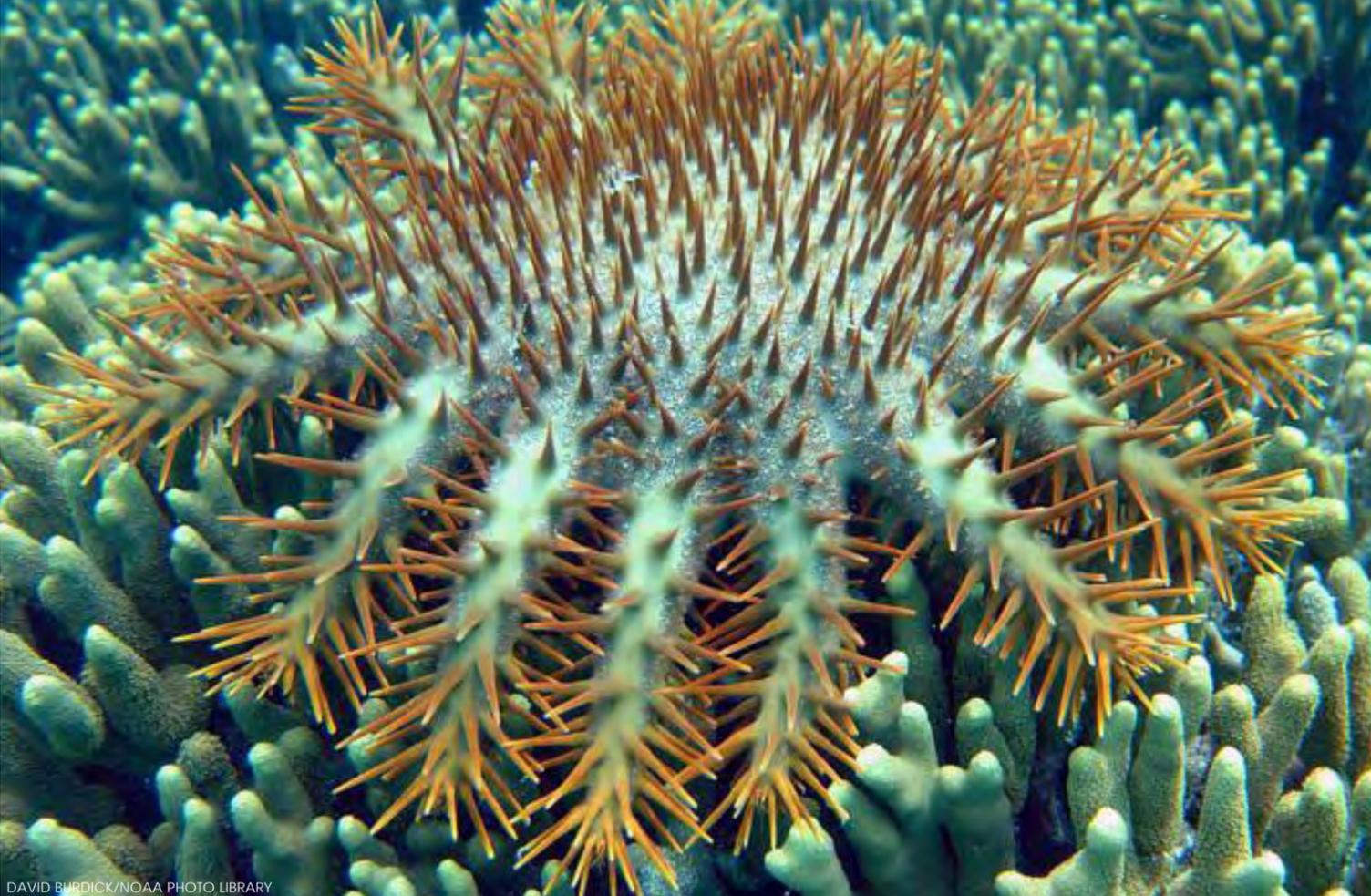
Headed by Swansea University's Richard Unsworth, the team discovered that some varieties of seagrass could reduce the acidity of the water around coral reefs by photosynthesising carbon dioxide quickly and efficiently into oxygen.

Elaborating on this, Dr Unsworth said, "Highly productive tropical seagrasses often live adjacent to or among coral reefs and photosynthesise at such rates you can see the oxygen they produce practically bubbling away".

This new oxygen can help to combat the increased acidity of the oceans caused by the raising levels of atmospheric carbon dioxide, which in turn has caused coral reefs to become eroded at an unsustainable rate.

The results of the research have been positive, showing that in shallow water reef environments, coral calcification downstream of seagrass had the potential to be 18% greater than in a place without seagrass.

However, Dr Unsworth warned that unless action is taken to protect them, the seagrass itself could be under threat from overfishing, chemical pollution and climate change. ■



DAVID BURDICK/NOAA PHOTO LIBRARY

Crown of thorns starfish are thought to be a major cause of coral destruction on the Great Barrier Reef

Half of Great Barrier Reef coral lost in 27 years

A study published in the journal *Proceedings of the National Academy of Sciences* shows that in the past 27 years, Australia's Great Barrier Reef has lost over half its coral cover. Data on the condition of 217 individual reefs were analysed by researchers who found that coral cover has declined from 28 percent in 1985 to 13.8 percent in 2012.

The cause for this decline is attributed to three factors: severe storm events; an invasive starfish, which eats coral; and coral bleaching, which is linked to climate change. There were 34 tropical cyclones since 1985 that caused 48 percent of the damage to the Great Barrier Reef, according to Glen De'ath from the Australian Institute of Marine

Science (AIMS) and colleagues. Outbreaks of crown-of-thorn starfish caused another 42 percent of the damage. In addition, there were two coral bleaching events—one in 1998 and another in 2002. Bleaching occurred due to ocean warming and had "major detrimental impacts" on the central and northern areas of the reef, putting its cost at 10 percent of the total damage.

"This loss of over half of initial cover is of great concern, signifying habitat loss for the tens of thousands of species associated with tropical coral reefs," wrote the authors of the study.

The study is a result of the world's largest ever reef monitoring project, compiling data from 2,258 separate surveys over 27

years. One of the researchers, Hugh Sweatman, said that the findings suggested that coral could recover from trauma but that recovery takes some 10-20 years. "At present, the intervals between the disturbances are generally too short for full recovery and that's causing the long-term losses," Sweatman said.

While storms and bleaching events may be difficult to control, researchers could help reduce the devastating effects of the coral-eating starfish, said John Gunn, head of AIMS. As crown-of-thorn starfish larvae feed on algal blooms, which are caused by agricultural run-off, improving water quality would be critical in controlling the starfish's outbreaks, the study authors s. ■ SOURCE: BBC

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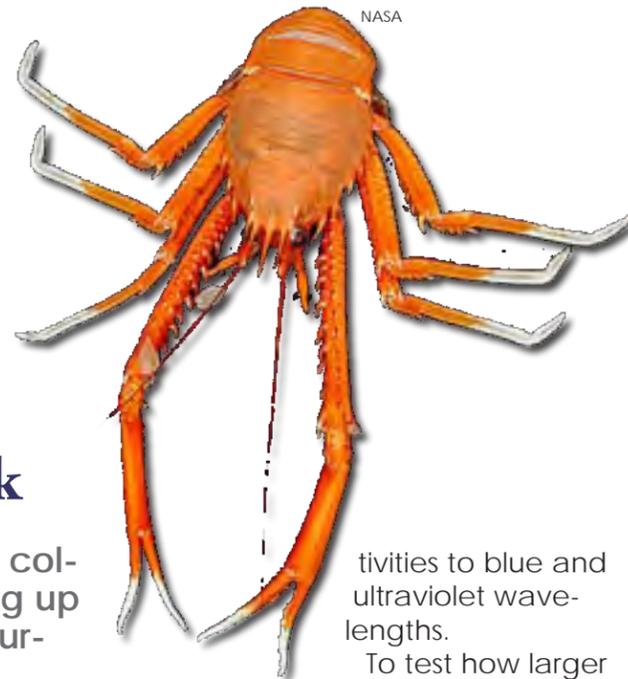
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They can see blue in the dark

Deep-sea crabs have colour vision despite living up to 1,000m below the surface, scientists find.

Measuring the spectral sensitivities of crabs' retinas, sensitivity peaks were in the blue region of the visible spectrum.

Investigating deep waters off Bahamas, U.S.-based researchers recorded the glow of tiny bioluminescent species using a submersible vehicle.

Descending to sites between 600 and 1,000m down, the scientists observed flashes of bioluminescence where plankton collided with boulders and corals.

The team also studied how crustaceans react to this light, and found previously unknown sensi-

tivities to blue and ultraviolet wavelengths.

To test how larger species perceive

their environment despite the lack of sunlight, the researchers used a specialist suction arm on the submarine to carefully collect crustaceans living at the sites. Of the eight species studied by the team, all were sensitive to blue light and two also reacted to ultraviolet (UV) wavelengths.

According to the marine expert, the species with the ability to detect two channels of colour could be using this to tell the difference between the green-glowing, often toxic, corals they live on and the blue-hued plankton they eat. ■

Animal movement mixes our seas to life

A study published in the journal *Biogeosciences Discussions* suggests that the movement of whales and other marine species is key to the health of the oceans. The researchers said that world-wide all that splashing around moves several tons of nutrients up through the dark layers of the oceans to surface waters.

In specific terms, the study stated that just 80 sperm whales near Hawaii can move 1,100 tons (1m. kg) of nitrogen per year through the pycnocline, a layer of the ocean below which it is too dark for light-loving plants to survive. This number may not appear to be very large at first glance, but multiply it by all the movement of all the creatures that live in the world's oceans, and it amounts to quite a lot.

In fact, it is suggested by a 2006 study by William Dewar of Florida State University that animals and other organisms cause one-third of the mixing of nutrients that goes on in the world's oceans. If they did not do this, the sea would stagnate and die within a few thousand years,

according to Dewar.

It was previously thought that winds and tides were responsible for moving nutrients around, but Dewar told NBC that marine animals play just as important a role in mixing the seas. Nitrogen and iron are the two most important elements for plants to convert solar energy into food. These elements are abundant at depth but limited at the surface. Big animals such as whales and little animals such as krill moving in groups do a lot to transport the

good nutrients up and down the column of ocean layers throughout the day and night.

Indeed, according to marine biologist Stephan Nicol at Australia's University of Tasmania (unrelated to either study), groups of krill can create a collective updraft with the wakes from their tiny limbs, shifting nutrients along their migration.

Unlike large events like storms, which are less frequent, animals move continuously all day long, every day. ■



FILE PHOTO: PETER SYMES

Mantas affected by moon



MICHAEL AW

Manta rays are more likely to gather together under either a new or a full moon, according to new research published by researchers from the University of Queensland. The research by Fabrice Jaune and colleagues identifies environmental factors that predict the abundance and behavior of manta rays at Lady Elliott Island in the Great Barrier Reef.

The authors commented that knowing these factors is important for conservation efforts, "especially in the context of a changing climate and with targeted fisheries increasingly

threatening manta ray populations in various parts of the world."

Enlisting the help of volunteer scuba divers and tour operators on the island for a 'citizen science' approach, the authors monitored the relative abundance of manta rays indulging in three types of behaviour—foraging for food, cleaning by smaller fish and cruising—and correlated these with various environmental factors.

Their results show that manta rays visit specific sites around the island for specific activities. Aside from clean-

ing at dedicated 'cleaning stations', known to be an important activity for manta rays, foraging was the predominant activity at five of the seven sites surveyed and was the only activity during which large groups of 80 or more rays clustered together.

At other sites, rays were more likely to indulge in cleaning or cruising behaviors in addition to foraging. The overall number of manta rays at the island was higher in autumn and winter, around the new and full moon, and when wind speeds were lower, according to the study. ■

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Blind cave fishes, oceans apart, are closely related

Through comprehensive DNA analysis, researchers from Louisiana State University and the American Museum of Natural History determined that eyeless fishes from Madagascar and Australia descended from a common ancestor nearly 100 million years ago before being separated by continental drift.

The study, appearing in the journal *PLOS ONE*, identifies new species that add to the existing biological evidence for the existence of the prehistoric supercontinent of Gondwana. Cave fishes normally lack pigment, a substance that gives an organism its color and provides protection from ultraviolet radiation. The absence of eyes combined with enhanced sensory capabilities allows cave fishes to survive in complete darkness. As the fishes

have very restricted distributions within isolated limestone caves, the newfound genetic relationship between the trans-oceanic groups is a profound discovery.

"This is the first time that a taxonomically robust study has shown that blind cave vertebrates on either side of an ocean are each other's closest relatives," said Prosanta Chakrabarty, an assistant professor and curator of fishes at Louisiana State University's Museum of Natural Science. "This is a great example of biology informing geology. Often, that's how things work. These animals have no eyes and live in isolated freshwater caves, so it is highly unlikely they could have crossed oceans to inhabit new environments."

One of the new species discovered by the researchers is

unique, as it is fully and darkly pigmented. Analysis conducted for this fish's tree of life revealed it evolved from a pigment-free ancestor, indicating that some subterranean forms can "reverse" themselves. "Only two specimens of the new pigmented form were recovered from the first cave we searched in Madagascar, despite the fact that we spent hours in this sinkhole," said Chakrabarty. "Even the locals hadn't been inside of it before."

Because remote locales with caving opportunities exist worldwide, the researchers are eager to pursue other opportunities for discovery. "Conducting this research really developed my love for caving," said Chakrabarty. "You don't always find something exciting. But, when you consider how isolated many of these caves are, especially in places like Madagascar, and how unaffected they have been by the passage of time, you know that the fish in there are going to tell a really good story." ■

Typhleotris pauliani (top), a previously known species of Malagasy cave fish, and the newly discovered pigmented species (bottom)



AMNH/J. SPARKS



Ocean and climate change could lead to smaller fish

In a new study conducted by fisheries scientists at the University of British Columbia (UBC) and published in the journal *Nature Climate Change*, the first-ever global projection of the potential reduction in the maximum size of fish in a warmer and less-oxygenated ocean is provided.

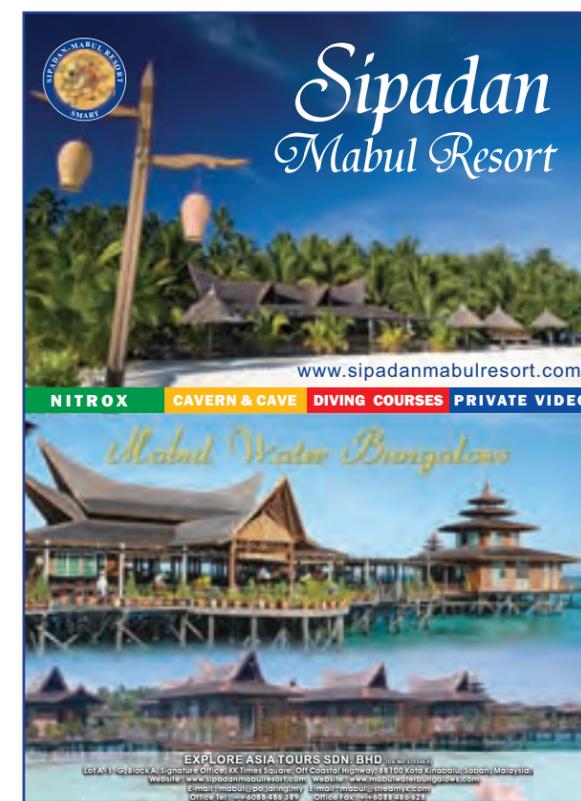
Researchers utilized computer modeling to analyze more than 600 species of fish from oceans around the world and found that the maximum body weight they can reach could decline by 14-20 percent between years 2000 and 2050, with the tropics being one of the most impacted regions.

"We were surprised to see such a large decrease in fish size," said study lead author William Cheung, an assistant professor at the UBC Fisheries Centre. "Marine fish are generally known to respond to climate change through changing distribution and seasonality. But the unexpectedly big effect that climate change

could have on body size suggests that we may be missing a big piece of the puzzle of understanding climate change effects in the ocean."

This is the first global-scale application of the idea that fish growth is limited by oxygen supply, which was pioneered more than 30 years ago by Daniel Pauly, principal investigator with UBC's Sea Around Us Project and the study's co-author.

"It's a constant challenge for fish to get enough oxygen from water to grow, and the situation gets worse as fish get bigger," explained Pauly. "A warmer and less-oxygenated ocean, as predicted under climate change, would make it more difficult for bigger fish to get enough oxygen, which means they will stop growing sooner."



This study highlights the need to curb greenhouse gas emissions and develop strategies to monitor and adapt to changes that we are already seeing, or we risk disruption of fisheries, food security and the way ocean ecosystems work. ■

World's biggest geoengineering experiment 'violates' U.N. rules

Controversial American businessman Russ George has sparked outrage after dumping 100 tonnes of iron sulphate into the Pacific Ocean off Canada's west coast in July. Part of a geoengineering scheme he calls the "most substantial ocean restoration project in history", the act has been labeled a "blatant violation" of two international moratoria by lawyers, environmentalists and civil society groups.

Satellite images appear to confirm the Californian's claim that the iron has spawned an artificial plankton bloom as large as 10,000 square kilometres. A geoengineering technique known as ocean fertilization, the intention is for the plankton to absorb carbon dioxide and sink to the ocean floor.

George claims his scientists have been monitoring the results with equipment from U.S. agencies like NASA and the National Ocean and Atmospheric Administration.

"We've gathered data targeting all the possible fears that have been raised [about ocean fertilization]," George said. "And the news is good news, all around, for the planet."

Scientists are concerned iron fertilization can irreparably harm ocean ecosystems, produce toxic tides and lifeless waters, and worsen ocean acidification and global warming. "It is difficult if not impossible to detect and describe important effects that we know might occur months or years later," said John Cullen, an oceanographer at Dalhousie University. "Some possible effects, such as deep-water oxygen depletion and alteration of dis-

tant food webs, should rule out ocean manipulation. History is full of examples of ecological manipulations that backfired," he added.

The dump occurred 200 nautical miles west of the islands of Haida Gwaii, one of the world's most diverse ecosystems. George convinced the local council of an indigenous village to establish the Haida Salmon Restoration Corporation to channel more than US\$1m of its own funds into the project. Haida nation president Guujaaw said the village was told the dump would environmentally benefit the ocean, which is crucial to their livelihood and culture. "The village people voted to support what they were

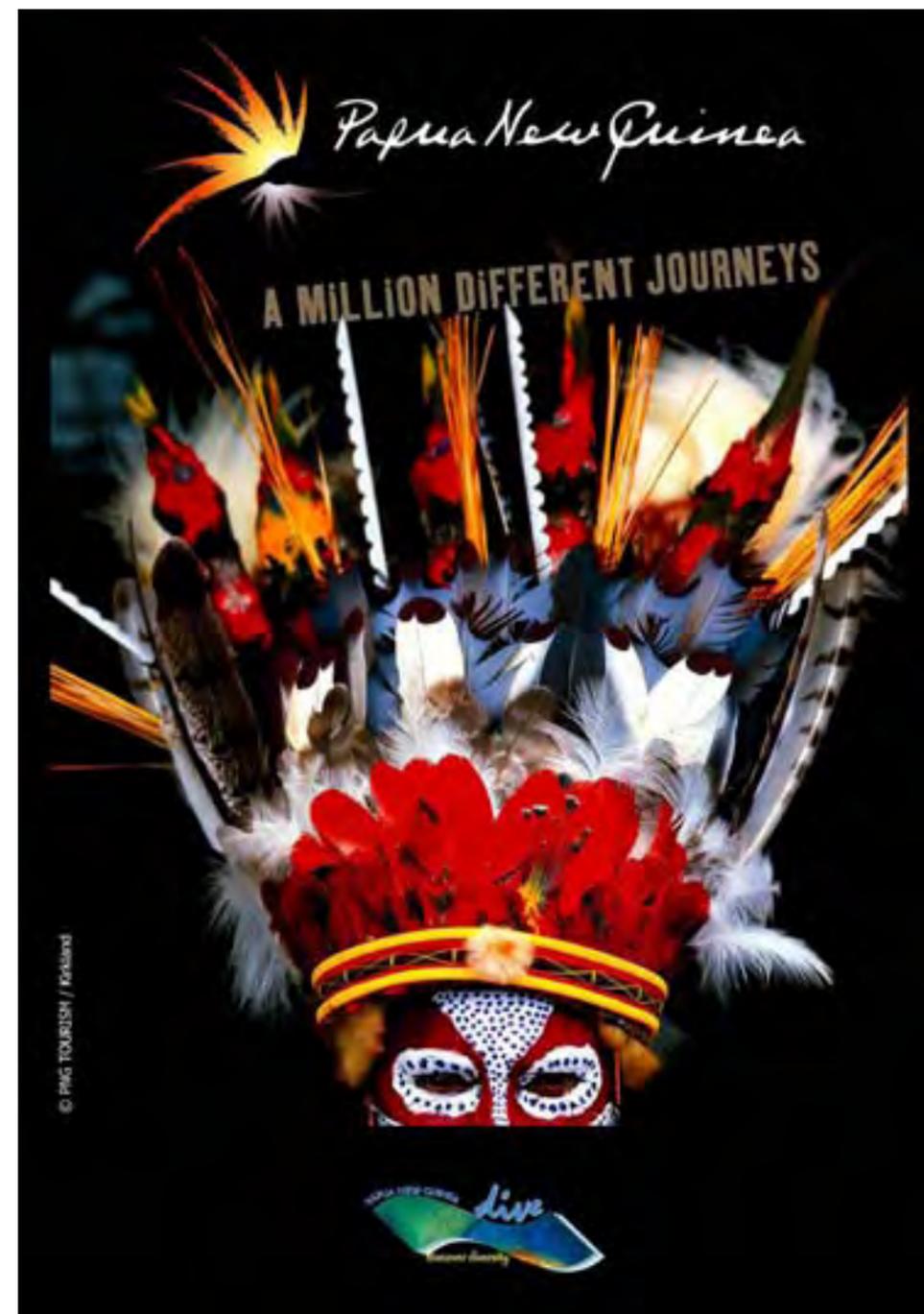
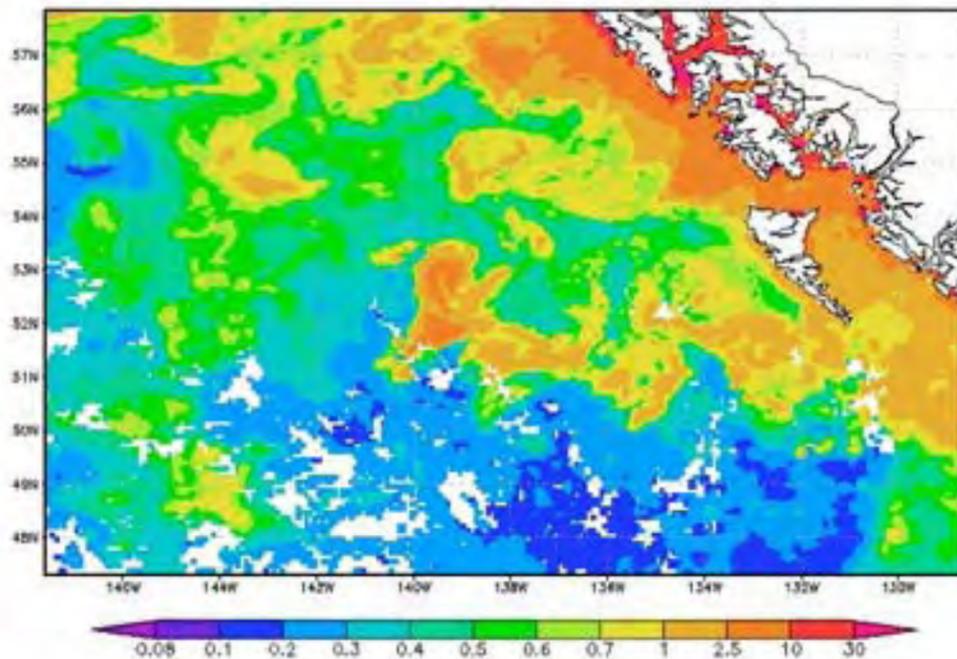
told was a 'salmon enhancement project' and would not have agreed if they had been told of any potential negative effects or that it was in breach of an international convention," Guujaaw stated.

International legal experts say George's project has contravened the United Nations's convention on biological diversity (CBD) and London convention on the dumping of wastes at sea, which both prohibit for-profit ocean fertilization activities.

"It appears to be a blatant violation of two international resolutions," said Kristina M Gjerde, senior high seas adviser for the International Union for Conservation of Nature. "Even the placement of iron particles into the ocean, whether for carbon sequestration or fish replenishment, should not take place, unless it is assessed and found to be legitimate scientific research without commercial motivation. This does not appear to even have had the guise of legitimate scientific research." George dismissed the two moratoria as "mythology" and do not apply to his project.

"If rogue geoengineer Russ George really has misled this indigenous community, and dumped iron into their waters, we

Yellow and brown colours show relatively high concentrations of chlorophyll in August 2012, after iron sulphate was dumped into the Pacific Ocean as part of a controversial geoengineering scheme. Photograph: Giovanni/Goddard Earth Sciences Data and Information Services Center/NASA



hope to see swift legal response to his behavior and strong action taken to the heights of the Canadian and U.S. governments," said Silvia Ribeiro of the international technology watchdog ETC Group. "It is now more urgent than ever that governments unequivocally ban such open-air geoengineering experiments. They are a dangerous distraction

providing governments and industry with an excuse to avoid reducing fossil fuel emissions."

A former chief executive of Planktos Inc, his previous failed efforts to conduct large-scale commercial dumps near the Galapagos and Canary Islands led to his vessels being barred from ports by the Spanish and Ecuadorian governments. ■

wreck rap



Diver
inspects
torpedo
tubes in
the mid-
ships of
the *USS
Lamson*,
Bikini Atoll

Text and photos
courtesy of Pete Mesley

Bikini Atoll—without a doubt—is the undisputed top wreck diving destination on the planet. I remember when I first started diving back in 1989, I would sit around the table and listen to members of our dive club in South London, salivating at the concept of diving Bikini Atoll's *Saratoga*, an aircraft carrier and one of the world's largest dive-able wrecks. Only a brave few divers ever ventured to this remote place deep within the Marshall Islands. Costing a small fortune to get to, Bikini was only a destination for the elite (and stinking rich!!). It was a place every diver dreamed of getting to.

This was my third trip to Bikini but this didn't lessen my enthusiasm to getting back there. Traveling to this Atoll, deep within the Marshall Island group, takes some doing. Getting there from Auckland, New Zealand, I flew to Cairns, then Guam, then

onto Kwajalein via an island hopper, which stopped at four other Micronesian islands. Some 27 hours later, getting into Kwajalein meant that we were only half way there. Kwaj is an American Ballistic Missile testing base, so you can imagine that the Americans just don't want peo-

ple to be there, but under the Marshall Island agreement, they have to offer through fare for travelers.

We were met by Brian and Eddy from the charter boat at the ferry terminal where we loaded all our gear onto a water taxi. Within 20 minutes, we were

alongside the *MV Windward*—our home for the next two weeks.

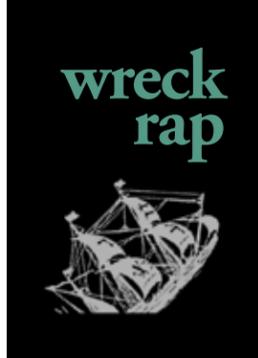
We had two guys who were coming in the following day via Honolulu. This gave us the perfect time to do our check-out dive on the German heavy cruiser, *Prinz Eugen*. The 18,700 ton ship

served an impressive career in WWII with direct conflicts with the *HMS Prince of Wales*, *Bismark* and *HMS Hood*. The vessel was later handed over to the British as part of the German surrender. The *Eugen* remained in drydock until January 1946 when she was handed over to the



Wrecks of Bikini Atoll





Map of our route from Kwajalein to Bikini (left). A diver looks over the 8-inch turret of the German heavy cruiser, *Prinz Eugen*, which had numerous engagements with the *Bismark*. She sits completely upside down (below)

Americans. Later, she was allocated to the target fleet for Operation Crossroads. She survived the Able and Baker tests (July 1946), but was too radioactive to have leaks repaired. In September 1946, she was towed to Kwajalein Atoll and capsized on 22 December 1946 over Enubuj reef.

This massive 212-meter wreck sits upside down in 32 meters of water, stern sitting out of the water with the bow at the

way, we sailed past Wothe Atoll. This was a short distance away from Rongerik Atoll. This is where the Americans relocated the entire

deepest section. What an impressive introduction to the trip!

Once everyone was on board, we stopped everything down and set sail for Bikini. It took us a little over 28 hours steaming to cover the 240 miles to our destination. On the

way, we sailed past Wothe Atoll. This was a short distance away from Rongerik Atoll. This is where the Americans relocated the entire population of 167 Bikinians in March 1946, in preparation for Operation Crossroads.

Rongerik was originally uninhabited because the Bikinians believed it to be too small to live on (it is one sixth the size of Bikini), and there wasn't enough food and water on the island to sustain life.

Well, they were right. By July that same year, medical officers from the United States visited the islands. They were shocked to find that the people were critically malnourished and literally starving to death. Immediate prepa-

rations were made to transfer them 300 miles west off Bikini to an atoll known as Ujelang.

It just so happened that the Americans chose another nuclear testing ground in Enewetak Atoll, 120 miles north east of Ujelang. Even after all the buildings were erected for the Bikinians to move into on Ujelang Atoll, it was decided that the Enewetak people would, instead, be moved to Ujelang Atoll. It took two years of suffering on Rongerik until the Bikinians were finally moved to Kwajalein. They were housed in tents beside an airstrip until an island was finally found for them to live on.

Diving the wrecks

We arrived in Bikini in the late afternoon the next day. On the way, we dragged a couple of lures over the side. On the last attempt, I got a massive dogtooth tuna. This time, I ended up hooking a 100kg black marlin.

It was taking over an hour and a half to get the fish close to the boat, so we decided to release it once we could get it close enough to unhook it. But just as we got the massive fish close to the stern of the boat, a shark promptly removed the tail section of the fish.

Bugger! We didn't have much choice then but to eat it. This is what it's all about with expeditions like this to far corners of the Earth. Just being here, sitting in 4,000 meters of water with no sight of land anywhere to be seen—I just loved it!

HIJMS Nagato. The first dive was on the *HIJMS Nagato*. Launched on 9 November 1919, the *Nagato* was the jewel of the Imperial Japanese Navy. She was the lead ship of her class and the only battleship in history to mount 16.1-inch guns on her decks. She displaced 42,850 tons, and was 221m long, 34m wide and capable of doing 27 knots.

Descending onto this historical ship was very humbling. Knowing that this was the ship that Admiral Isoroku Yamamoto gave the order to lead the attack on Pearl Harbor back in December 1941 made history more tangible. We got our first sight of the ship with its huge hull and four props as we descended into the crystal clear water. We dropped over the port side of the ship and under the hull. There, looming out of the darkness, were two massive 16.1-inch guns. My dive buddy, Nick, swam up towards the barrel ends. His body was dwarfed by its massive size.



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We came back out and swam along the port side of the hull at deck level at a constant 45m depth. Then, as we swam along, the bridge came into view. What used to tower above the surface of the ocean, some 30m high, now sits perfectly placed along the sand to one side of the ship. I swam forward towards the bow section, turned around and just hung there in the deep enjoying the view of the entire bridge section.



Penetration is possible but extreme care must be taken. All the wrecks are over 60 years old and very brittle, so with all the heavy gear above your head, you

tend to take care when venturing down passageways. The areas that we penetrated were not as spectacular as the vistas around the outside of the ship—a massive propeller, breathtaking bridge section and impressive bow section.

USS Saratoga. The majority of our afternoon dives were spent on the *USS Saratoga*. She is the shallowest of the ships in the atoll. The top of the bridge ranged in depth from 14m of water down to 50m on the sand.

The *Saratoga*, first commissioned in 1925, was a 40,000-ton, 268-meter-long aircraft carrier. She did tours in the Pacific, Nicaragua, San Diego, Hawaii, Guadalcanal and the Marshall Islands.

In 1944, she was commissioned to train aviators for night operations. In February 1945, she carried night fighters during the Iwo Jima invasion and raids on the Japanese home islands. After the war in 1945, she transported servicemen back home to the States, was then decommissioned and brought in for target duty for atomic testing in Bikini.

Diver at bridge of the *Nagato*

Diver (left) with massive 16-inch gun of the *HIJMS Nagato*, the pride of the Japanese High Seas Fleet. Diver (below) at the bow of the massive *USS Saratoga*, 267m long!

The interior of the ship is vast, to say the very least. Permanent lines have been laid in some areas from a past operation and still hold well after six years of inactivity. With seven decks of passageways, rooms, storerooms, accommodations, galleys, etc, you could spend the rest of your diving career on this ship and never

was covered in the finest red rusty silt, probably highly radioactive if you dug deep enough into it.

The wreck is just so impressive. Countless planes, bombs, artifacts, plates, bowls, jugs, etc, lay untouched since 1946. Even Mk 5 standard dress helmets sit alongside each other in one

Bikini Atoll

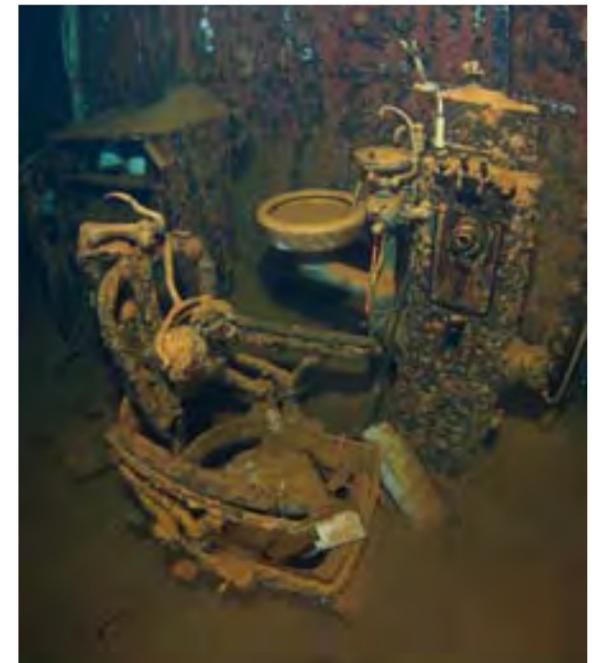


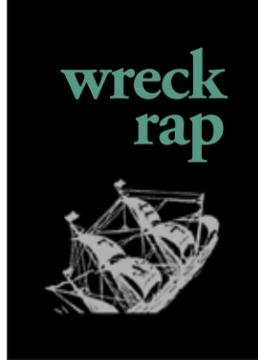
grow tired if diving her.

One of the dives that totally blew my mind was the dentist's surgery and sick bay. We entered through the bomb loading door situated on the starboard side of the ship just forward of the bridge area, dropped two decks into the middle section, swam 50 meters down long corridors, then dropped down a staircase into the second and hangar decks. We then back tracked and swam another 15 odd meters, passing the sick bay on our right. Then, finally, we entered the dental office.

Three dentist chairs sat in the room, completely kitted out with drills, rinse bowls, even head phones for the patients. Perfectly preserved. Everything

Dentist's chair in the *Saratoga* (bottom right)





Fat Man Bomb (left)—one of the atomic bombs used for Operation Crossroads

The Baker nuclear blast (below). The dot on the right of the water column is the vertical hull of the *USS Arkansas*

Bikini Atoll

of the hundreds of store rooms in the ship.

Saratoga, along with another 20 odd other ships, sank as a result of nuclear testing after the abrupt end of the Second World War, with the United States dropping atomic bombs on Hiroshima (6 August 1945) and then on Nagasaki three days later. These were the second and third atomic bombs ever detonated on Earth. So little was known about atomic warfare.

Atomic history

The U.S. president at the time, Harry Truman, issued a directive to army and navy officials that joint testing of nuclear weapons would be necessary "to determine the effect of atomic bombs on American warships". This project was to

be held in Bikini Atoll named Operation Crossroads. Two hundred forty-two ships (150 support and 95 detonation ships), 42 thousand men, 156 airplanes and hundreds of thousands of tons of equipment, ordinance and materials were shipped to Bikini Atoll.

This was to be the most public and most reported nuclear tests ever undertaken. Even though there was considerable interest by scientists excited about assessing the full effects of atomic energy in the field, it was still undertaken for the sole benefit of the military. Their main goal: to make stronger, deadlier nuclear weapons.

Ninety-five ships were to be prepared for the blast, four battle ships, two aircraft carriers, two cruisers, 11 destroyers, eight submarines, numerous amphibious/auxiliary vessels and three surrendered German and Japanese vessels. Twenty ships would be placed in square mile clusters from the drop zone.

The initial 23 kiloton bomb, named Able, was to be detonated 158 meters above sea level. This test was to assess the effects of pressure, impulse, shock wave, velocity, optical radiation and nuclear radiation of this particular bomb. This air burst was meant to duplicate the conditions of the Hiroshima bomb drop, this time, over water. With an air burst, the radioactive matter would rise high into the stratosphere and become part of the global environment with little significant local fallout. Many of the closer ships received doses of neutron and gamma radiation, lethal to anyone onboard the ship during the blast, but the ships themselves did not become radioactive.

Within a day, all the surviving target ships had been re-boarded by personnel for inspection and data analysis. Able sank five ships, *Gilliam*, *Sakawa*, *Carlisle*, *Anderson* and *Lamson*.

The second explosion, Baker bomb, was detonated 24 days later on 25 July 1946. This bomb was suspended 27 meters underwater. The underwater fireball took the form of a rapidly expand-



ing hot "gas bubble" that pushed against the water, generating a supersonic hydraulic shock wave, which crushed the hulls of nearby ships as it spread out. On the surface, the shock wave was visible as the leading edge of a rapidly expanding ring of dark water. Close behind the slick was a visually more dramatic, whitening of the water surface.

At the bottom, it started digging a shallow crater, 9m deep and 610m wide. At the top, it pushed the water above it into a "spray dome", which burst through the surface like a geyser.

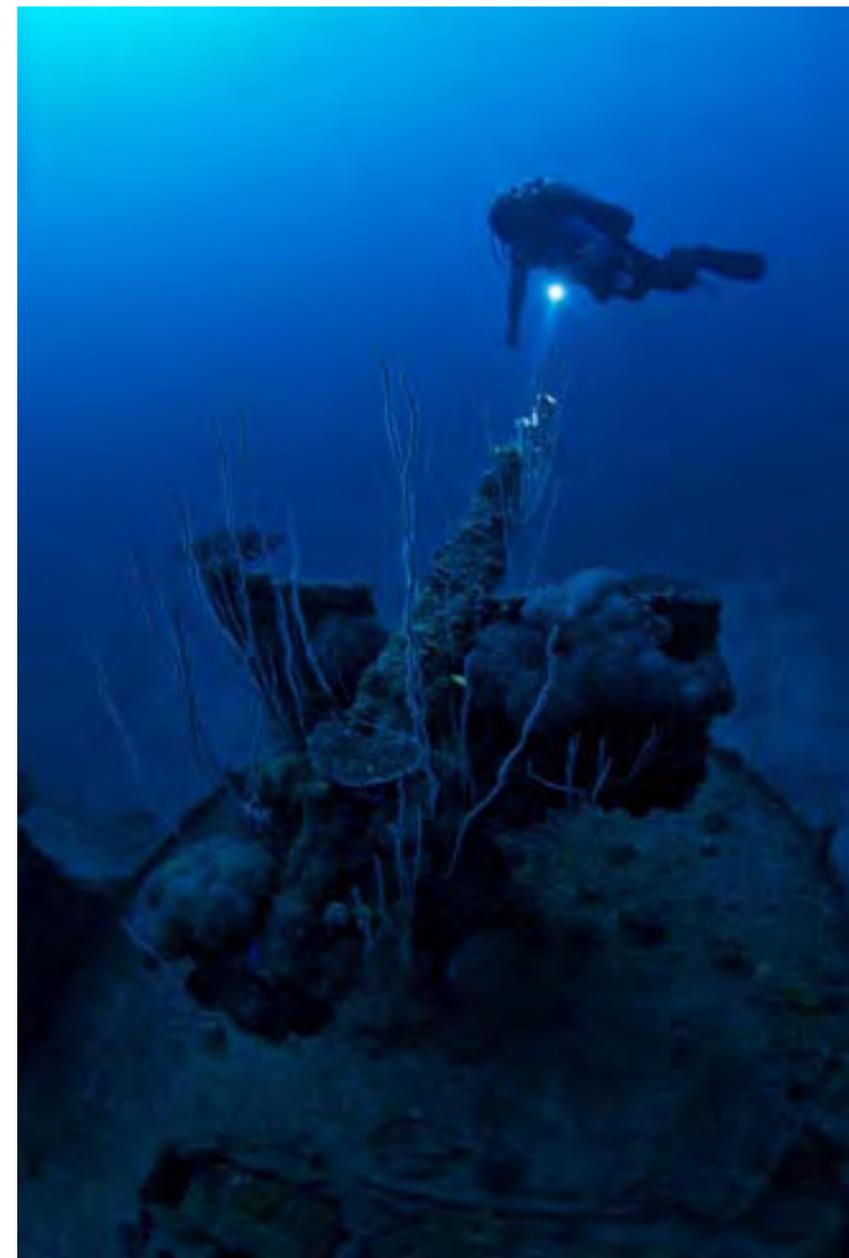
During the first full second, the expanding bubble removed all the water within a 150m radius and lifted two million tons of spray and seabed sand into the air. As the bubble rose, it stretched the spray dome into a hollow cylinder or chimney of spray 1,800m high, 610m wide, and with walls 90m thick.

As soon as the bubble

reached the air, it started a supersonic atmospheric shock wave, which, like the crack, was more visually dramatic than destructive. Brief low pressure behind the shock wave caused instant fog, which shrouded the developing column in a "condensation cloud", obscuring it from view for two seconds. The Wilson cloud started out hemispherical, expanded into a disk, which lifted from the water revealing the fully developed spray column, then expanded into a doughnut and vanished. The Able shot also produced a Wilson cloud, but heat from the fireball



Standard dress helmets can still be easily seen within the *Saratoga*



Diver inspects anti-aircraft gun on the *USS Lamson*





Propellers (right) of the *Nagato* wreck; Diver (far right) at the stern of the *Lamson* wreck; A *Saratoga* Hellraiser rests in the sand (below)

dried it out more quickly.

Ten ships were sunk as a result of Baker bomb. They were *LSM-60* (the ship that the bomb was positioned under), *Arkansas*, *Pilotfish*, *Saratoga*, *YO-160*, *Nagato*, *Skipjack*, *Apogon*, *ARDC-13*.

USS Lamson. Another outstanding wreck that we dived was the *USS Lamson*. A 1,500-ton, 104m-long Mahan Class destroyer, first launched on 17 June 1936. The *Lamson* did tours in the Caribbean, Pacific and Hawaii.

On that ill-fated day on 7 December 1941 when Pearl Harbour was attacked, the *USS Lamson* was returning from patrol duty out at sea during the Japanese attack. After an unsuccessful search for the Japanese task force, the destroyer patrolled Hawaiian waters, departing Pearl Harbor on 6 January 1942, later



heading to Guadalcanal, moving onto doing tours in Papua New Guinea, New Britain and the Philippines. After fighting off numerous suicide plane attacks and being patched up after being badly damaged, she spent the rest of her term on patrol and air-sea rescue work off Iwo Jima Island. She would soon participate in Operation Crossroads in Bikini.

With consistently good visibility in the Lagoon, the *Lamson* could be seen as we descended down the shotline. Secured in the midships, I made my way

down towards the stern

of the ship. First landmarks that burst out into view were the amazing 21-inch torpedo tubes. The ship had a total of 12 torpedo tubes on the deck of the ship. Moving on, I came across two Oerlikon

20mm AA anti-aircraft guns, mounted on each side of the narrow destroyer. It was easy to see that in this ship's heyday it could hold its own with all the armament it carried.

Heading further towards the stern I swam past two 5-inch/38 Cal dual purpose anti-aircraft guns. Their dual purpose allowed them to shoot not only low angle, surface targets but also high angle aircraft targets.

I finally got to the stern of the ship—she was an awesome sight alright. The depth charge racks were still fully intact with even a few depth charges still laying on the deck. The wreck was silhouetted perfectly against the talcum powder-like white sand.

Over the following days, we made numerous dives on the *Saratoga* and

Nagato, *Anderson*, *Arkansas* and *Sakawa*. We also dived a submarine, one of the three sunk during the blasts, the *USS Apogon*—a 95m-long, 2,390-ton, Balao-Class submarine first launched in March 1943. She sits perfectly upright on a lifeless sandy bottom. Not a lot of life is encrusted on the wrecks, just long sea whips and tight sponges, which give the wrecks a little colour. Here, my dive buddy, Eddy, looked at one of the stern torpedo tubes with a loaded torpedo in the spout.

Afterthoughts

Bikini Atoll, was everything I ever dreamed of and more. But the wrecks are starting to show their age. More and more parts of the ships are collapsing, so if you want to see these wrecks in all their

glory, I suggest you start planning your journey here in the near future. During the trip, we completed over 38 hours in the water over nine days, diving seven of the 16 odd wrecks in the lagoon. A place certainly worthy of multiple trips. ■

Pete Mesley is a prolific wreck diver and seasoned photographer, who organizes specialized trips to some of the most spectacular and out-of-the-way locations, globally. His excursions offer full technical support for rebreather and open circuit divers. Not to mention, he is one of the only dive operators who brings qualified hyperbaric physicians with him as medical support on all of his trips. For more information about his "Lust for Rust" diving excursions visit his site www.lust4rust.com.





New Zealand wreck may pre-date Cook

While speculation remains as to the identity of a North Island shipwreck discovered 30 years ago, recent radio carbon dating reveals it to be New Zealand's oldest shipwreck. Preliminary findings indicate the ship sank around 1705, pre-dating Captain Cook's voyages by some 65 years. Speaking at the Dargaville Museum, dendrochronologist, Dr Jonathan Palmer cautioned the findings required additional work before his research could be confirmed and published.

The wreck was discovered in 1982 by a local team led by Kaipara shipwreck explorer Noel Hilliam. A portion of a cross-member and rib was salvaged,

before the wreck was lost to the sea under 30 metres of sand. The wood has been confirmed to be teak and crepe myrtle, tropical wood likely used for refitting at either Genoa or Java, which suggests the possibility of the area being visited earlier than previously thought.

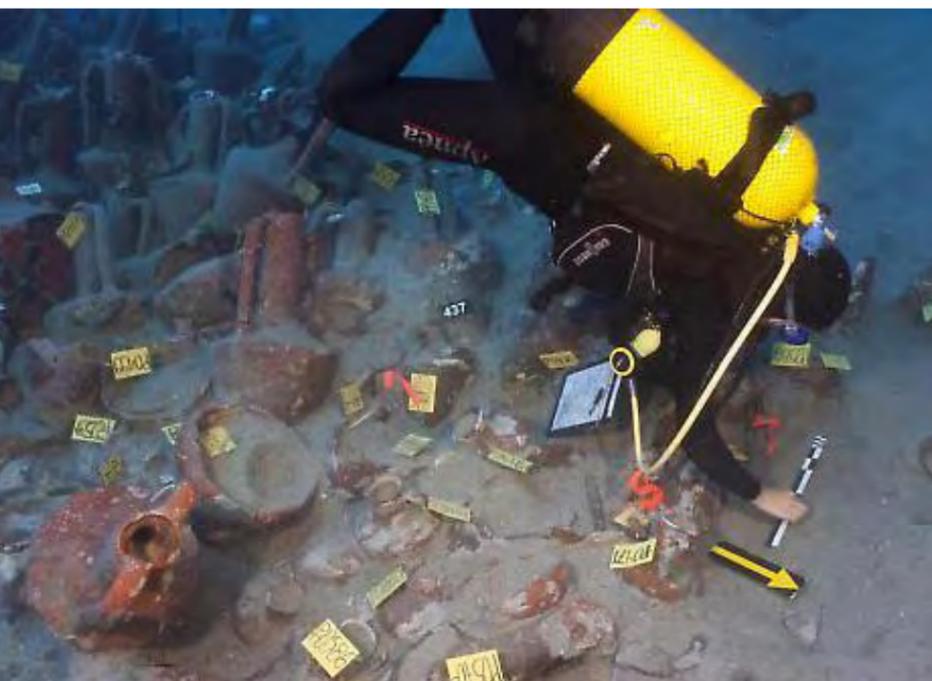
It is widely accepted that Dutch explorer Abel Tasman discovered New Zealand in 1642. Palmer said bitter competition for discovery during the 16th-18th centuries meant voyages were kept secret, with many ships sailing with hidden or documented evidence. British Admiralty maps of 1803 refer to New



Zealand being known to the Portuguese in the 1550s. A Spanish helmet discovered in Wellington Harbour and a Tamil bell used by a Maori tribe as a cooking pot in the mid 1880s suggests other tantalizing possibilities.

Hilliam, who was present at the meeting, believes the vessel to be the

Portuguese Cicilla Maria, but ongoing research of the Spanish and Portuguese archives is ongoing. Palmer argues the wood's age suggests it is not the Cicilla Maria, which had sailed a century earlier. Once Palmer's findings are confirmed and published, a display will be erected at the Dargaville Museum. ■



ous field seasons, indicate that the keel and a considerable part of the ship's

Mazotos shipwreck shed new light on ancient shipbuilding

The excavation of the Mazotos shipwreck sheds light on very important issues such as seafaring in Cyprus in antiquity, commerce between the Aegean and Cyprus, the types and sizes of the period's cargo ships. According to the press release, this year's results, in combination with the findings of previ-

ous field seasons, indicate that the keel and a considerable part of the ship's

planking is preserved to a length of at least 15 meters. The Mazotos ship was a late classical period (mid-4th century B.C.) merchant ship that was located in the sea of the modern village of Mazotos, at a depth of 45m.

The ship was carrying wine amphorae mainly from Chios but also from other north Aegean islands. Previous research at the site, which began in November 2007, focused on the photographic and drawing documentation of the shipwreck.

This year's findings are of prime importance, as it places this wreck among the very few in the Mediterranean that can provide information on shipbuilding during the Classical period.

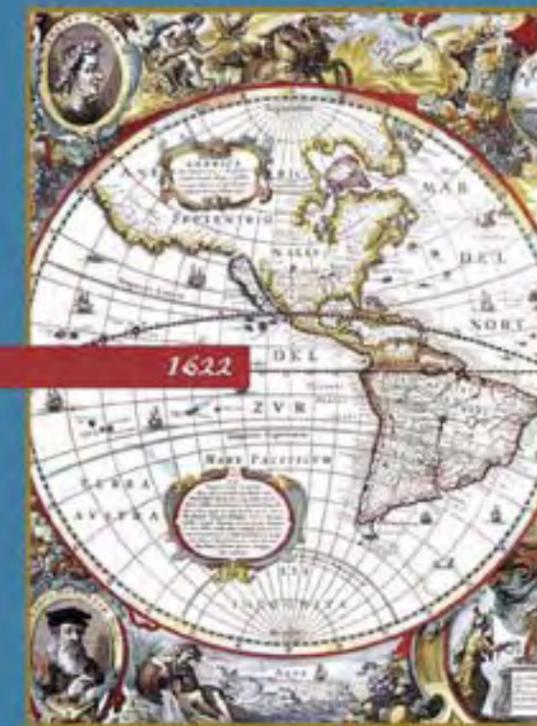
Together with the Chian wine ampho-

rae, the ship's main cargo, a secondary type was also transported on the Mazotos ship: wine jugs, which were stowed among the amphorae found in the aft part of the hold.

Furthermore, small fine ware pottery was recovered from the stern cabin, which was also partly excavated. These vessels must have belonged to the crew or the passengers of the ship; one of them bears two inscribed letters, most probably the initials of someone's name.

An interesting piece of evidence which provided information on the conditions under which the sailors of antiquity lived, are the large numbers of olive pips that were found during excavation, since these pips must have been part of the crew's food supply. ■

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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Ex-NRP Oliveira e Carmo sank in less than three minutes

Text and images by Barb Roy

A new record was set when two ships were scuttled as artificial reefs in one long day. On Tuesday, 30 October 2012, the ships were placed in Algarve off the coast of Portimao in southern Portugal as the first of four ships, part of the Ocean Revival Project. The 85-meter-long Corvette Ex-NRP Oliveira e Carmo went down in less than three minutes without a problem, and the Ex-NRP Zambeze, a 44-meter-long patrol vessel, slipped under the surface not long after. Both ships were donated by the Portuguese Navy.



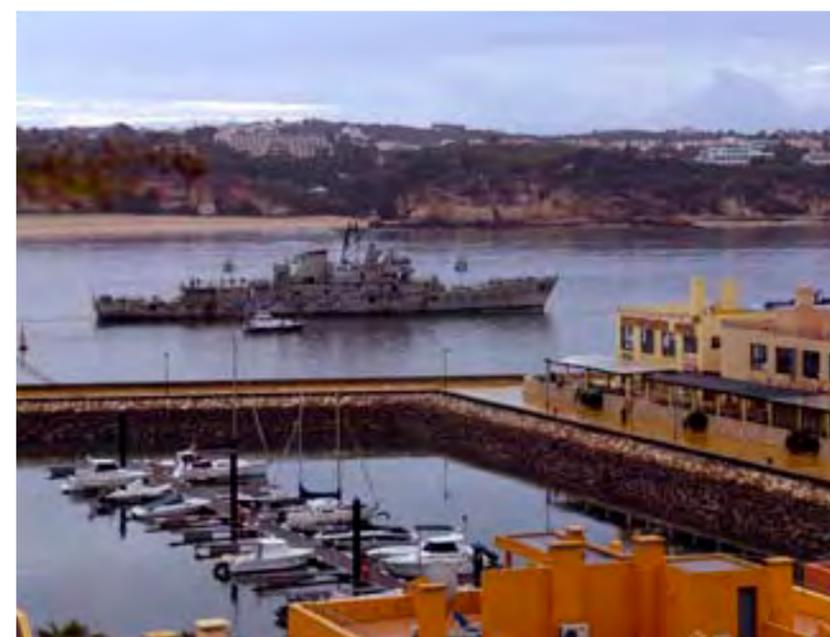
Portugal A Tale of Two Ships

A first for sinking in one day

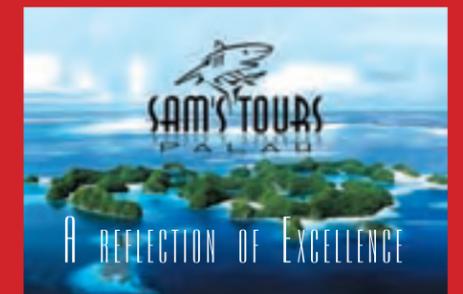


Demolition teams from CARC and the Portuguese Navy

To help prepare the ships for sinking, Luis Sa Couto of Sub Nauta Dive Center and coordinator for the Ocean Revival Project solicited the assistance of the Canadian Artificial Reef Consulting company from British Columbia, Canada, which has prepared over a dozen ships around the world. Together with the help of several Portuguese Navy Demolition Instructors and a few local key recruits, the first part of the project (five years) took only six months in the actual ship preparations. After both ships were resting on the ocean floor and the okay was given by the Navy Clearance Divers, visiting divers eagerly jumped in to check out the new site. The second part of the project will take place in the Spring of 2013. It involves the scuttling of a frigate and a hydrographic ship. All ships will be placed parallel to one another and the beach.



Ex-NRP Oliveira e Carmo as it passed the port of Portimao on the way to the sinking site



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The Zambeze with its stern in the air, as the demolition crew looks on (top); A large fireball lifts off the back of the Ex-NRP Zambeze (bottom); Bruno Freitas, a dive instructor for Sub Nauta dive facility in Portimao, Portugal (right)

For more information on the project and diving in Portugal, see: Sub Nauta, www.subnauta.pt Ocean Revival Project www.oceanrevival.pt Canadian Artificial Reef Consulting www.artificialreefs.net



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Edited by
Scott Bennett



Organised crash of unmanned Boeing 747 reveals cheap seats could be safer

Budget conscious travellers will be reassured to hear the cheap seats could be safer. As part of an experiment, a Boeing aircraft was fitted with cameras and crash-test dummies to help scientists determine the safest seat location. While none of the first-class passengers would have survived, it was concluded those sitting furthest from the cockpit would have the greatest chance of survival.

To experiment with the safest sit-

ting position during impact, three dummies were placed in different positions. The dummy in the classic 'brace' position with seat belt fastened would have survived; another with just the belt fastened would have suffered severe head injuries. The third dummy, which had neither, would have died.

"Planes are sold entirely on comfort, food, entertainment systems, space in your business class seat. They are never sold on the

safety indications," stated Sanjay Sighal from production company Dragonfly, which produced the programme. On a more positive note, he added, "It's never been safer to fly."

If economy seats begin to adopt premium price tags for safety, Business Class comfort might just be in the realm of affordability for the average traveller. However, Boeing's own site states that one seat is as safe as another. ■

Sleeping with the fishes in Sweden

For those who have tired of beaches, a floating hotel in Sweden offers a room with a decidedly different view: ten feet beneath the surface. Situated on Lake Malaren, the Utter Inn features windows on every wall revealing a lake teeming with fish.

In operation since 2000, the 'floatel' is the brainchild of artist Mikael Genburg, known for his unique hotel designs including one in a tree in a city centre park tree house and another in a sunken villa. Designed in the style of a traditional Swedish cottage, the little

hut features an above-surface kitchen with the sleeping quarters below.

"It's like a reverse aquarium—the fish like looking in at the guests and are fascinated by them," said Genburg. "I don't think there is an experience quite like sleeping underwater, and many people have come to find out if they like it."

After being taken out to the floating hut by Utter Inn staff, visitors can relax on the deck or use the hotel's inflatable dinghy to explore one of the lake's uninhab-



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Oman to build luxury underwater hotel

A new underwater luxury hotel is going to be built in Dubai by a Swiss-based consulting, engineering, and brokerage firm, BIG InvestConsult. It's called the Water Discus Hotel (WDH) and has a revolutionary design with patent-protected concept and technology, which is new to the hotel and tourism industry, developed by Deep Ocean Technology of Poland.

The ground-breaking structure consists of two parts -- a residential disc underwater and a water leisure disc above water, which has two satellite extensions. The hotel of 21 luxury rooms ten meter below sealevel will offer guests a chance to live among the reefs and fishes in a magnificent tropi-



cal ocean environment. Stunning views of the flora and fauna can be seen through huge windows.

So, what if there's an emergency and you have to get out quick? Well, the underwater disc can surface immediatly, as rescue boats always at hand speed in to assist. There's also a helicopter pad on the top of the above water disc, which can transport guests and crew to safety.

Sustainability

But is it sustainable? Bogdan Gutkowski, President and CEO of BIG InvestConsult, told the Observer that the Sultanate of Oman is an ideal location for the underwater hotel and assures that the building has been con-

ceived to protect the marine environment. "Oman has been chosen precisely because of its natural underwater life. Of course, the exact location of the Water Discus Hotel will be a considerable distance from coral reefs in order to safeguard them from any impact. BIG Invest Group is experienced in the delivery of investments with respect for the natural environment. We are experts in this and we take care of environmental issues with the greatest attention."

In fact, in line with the company's commitment to the environment, they are in the process of developing an international program for coral reef restoration and protection. In this plan, the hotel could be modified into an underwater lab and become a base for coastal marine studies for scientists and research students.

Diving

But can we dive there? Yes, and there's more. Gutkowski said, "What is important is that the Water Discus Hotel will make it possible for all guests (even those who do not go diving) to observe life in an Animal Coral Garden (that will be created around the underwater disc of the hotel). The WDH will be equipped with a Diving Centre (located in the bot-

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tom disc) as well as other equipment for marine life observation, for example, three-person submarine vessels that enable (non-diving) hotel guests to travel underwater a few miles from the hotel and admire the natural underwater environment. WDH will also be a place for diving courses, starting with the swimming pool on the sundeck. Indeed, the Water Discus Hotel will be a fantastic showcase of Oman's living marine treasure," he said.

However, marketing is still an important ingredient. Gutkowski said that the project with its immense scale and appeal could have a positive effect on Oman's tourism industry. "Today, we are aware of the huge global interest in the Water Discus project. We expect the Water Discus Hotel will arouse great interest in the media as well as among the tourists, when it will be constructed. In the opinion

of the marketing specialists of BIG InvestConsult AG, the Water Discus Hotel may become a symbol or signature of the city, region or country where it is built."

So, when will the Water Discus Hotel project in Oman com-

mence? Gutkowski said: "The project is still in the conceptual stage. However, we have planned to find an exact location within 3-4 months. Then we will start to develop the project and look for a co-investor." ■



DEEP OCEAN TECHNOLOGY

DEEP OCEAN TECHNOLOGY



Where the Big Things Are
Galápagos

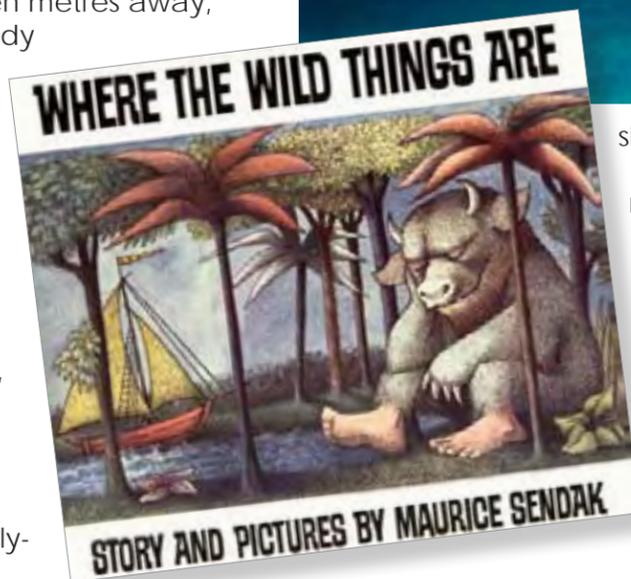
Text and photos by Christopher Bartlett

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Unlike Max in the children's book by Maurice Sendak, *Where the Wild Things Are*, I hadn't worn my wolf suit, or made mischief of one kind or another. I hadn't been sent to my room before it transformed into an island of magical monsters only reachable after a year of sailing. I wouldn't want to spend that long on a boat, so I behaved(ish) and looked forward to being on Galápagos and spending my nights tucked up on dry land.

My dive buddy Simon's left arm shot out, index finger extended, and he clenched his right fist and stuck it on the side of his head. I quickly scanned left and right, peering through my mask into the milky blue water. "Where?! Where?!" my brain implored. "There!!!" my eyes answered. "At last," I smiled to myself with relief, bringing my camera up to eye level, as the school of scalloped hammerhead sharks cruised past ten metres away, swaying over the sandy bottom of the underwater caldera in the middle of the site called Gordon Rocks off Santa Cruz Island in the Galápagos archipelago.

I now knew what Gordon certainly did, providing me and many other divers over the years with their first sightings of this oddly but brilliantly-



shaped fish.

In the past, I'd searched for hammerheads in the Red Sea and in South Africa—five blue dives there, with a solitary, faint blur as my sole reward. Upon arrival in the Galápagos, they were on the top of my fish wish list. They are one of the emblematic Galápaguan species after all. The T-shirt shops of Puerto Ayora on Santa Cruz—the most inhabited island of the archipelago—were draped with them, along with the giant

tortoise, which constitutes the logo of the Galápagos National Park.

Yet, I had been on Galápagos for a week now (with Gordon Rocks still to come) investigating land-based diving and nature tours on offer by Red Mangrove's suite of luxury lodges, and all I'd seen were some tacky miniatures and gaudy prints of the elusive hammerhead. In terms of diving, the best had definitely been saved for last—at Gordon Rocks. Not that the rest of the diving had been poor; we'd just been a bit unlucky with the hammerheads.

On Red Mangrove's land-based island-hopping diving itinerary, Gordon Rocks is normally the first or second dive destination. But due to a last-minute flight cancellation, my partner, Imi, and I missed Gordon Rocks on what should have been our first day of an eight-day tour. Still, we planned to have plenty of days to spare on Santa Cruz later, so we set off to explore diving from Puerto Ayora and arranged to catch up with Gordon Rocks at the end.

At the time, I also thought that I was on a bit of a lucky streak; I was randomly upgraded to first class on the flight to Guayaquil to meet up with Imi, and we were both upgraded for the two-hour A320 Tamé flight to Isla Baltra. Then, we were greeted with cool water and chilled face towels by our escort. This certainly enhanced the good vibe, as did the friendly banter with our guide on the 200m ferry ride and 42km drive across Santa Cruz Island. By the time we had checked into our funky room just metres from Puerto Ayora's gently lapping bay, we had seen marine iguanas basking on the restaurant deck, photographed a sea lion snoozing in the shade



Marine iguanas, *Amblyrhynchus cristatus*, are found only on Galapagos





CLOCKWISE FROM LOWER LEFT: A welcome lunch of tender calamari and chicken with perfectly steamed veggies at Red Mangrove Lodge, Puerto Ayora, Santa Cruz Island; Sea lion resting on a coffee table at the lodge; Galapagos barracuda at Tortuga Island; Satellite map of Galapagos Islands



on a coffee table, and eaten some tender calamari and chicken with perfectly steamed veggies. Naturally, we were feeling pretty positive.

A post-lunch trip to snorkel with some sea lions resulted in a couple of half-decent shots. Then, a boat ride to the white sands of Tortuga Bay on

Santa Cruz Island and a guided nature walk to see the marine iguanas, Sally Lightfoot crabs and large cacti growing from volcanic rocks kept us happy and did nothing to dampen the feeling that everything would just fall perfectly into place—the late flight cancellation and re-jigged schedule being just a minor blip.

After a brief meeting with our dive guide for the following day and a candlelit dinner, I was rocked to sleep by the wash of the ocean, dreaming about big fish with funny heads.

Diving

Sante Fé Island. The next morn-

ing, we left the busy cargo ships, numerous moored liveboards and plentiful small craft of Puerto Ayora behind. On the boat ride out to Sante Fé Island, we were regaled with the previous day's missed sightings at Gordon Rocks of a manta, eagle rays, stingrays, whitetip reef sharks, and of course, hammerhead sharks. Then, a reef manta breached to one side of the boat, as if to say, "Come on, jump in, we're waiting for you!"

Except they weren't. Nature, of course, works on its own schedule. Even so, on our first dive of the trip, there was a six-meter cave swim-through as well as a group of silvery grunts and a school of barracuda in the distance. "Never mind," I thought, "It was fine for a return to the water."

But I was a little disappointed. I had expected the 10-15m visibility and the bare rocky underwater landscapes. (The Galápagos are located on the Equator in the Pacific Ocean, but due to the cold waters of the passing Humboldt current coming up from the south, the water temperature drops to the low 20s, which is too cold for much coral growth.) But, I had also expected more action.

I guess it comes down to individual expectations. Maybe I'd misread the hype. I was expecting the big stuff: sharks, big schools of

fish and classrooms of rays, turtles, sea lions and marine iguanas. Yet, our boat companions—two fellows from Quito doing Discover Scuba dives and their two open water dive buddies—naturally thought the whole experience had been grand.

La Loberia, San Cristobal Island.

During the surface interval, we motored back towards Puerto Ayora and dived at a shallow site called La Loberia (*lobo del mar* is a sea lion in Spanish). The viz was at most ten metres and full of fish poo, but we soon saw why we were here. This was the site of a sea lion colony and nursery.

Two sea lions dived down from

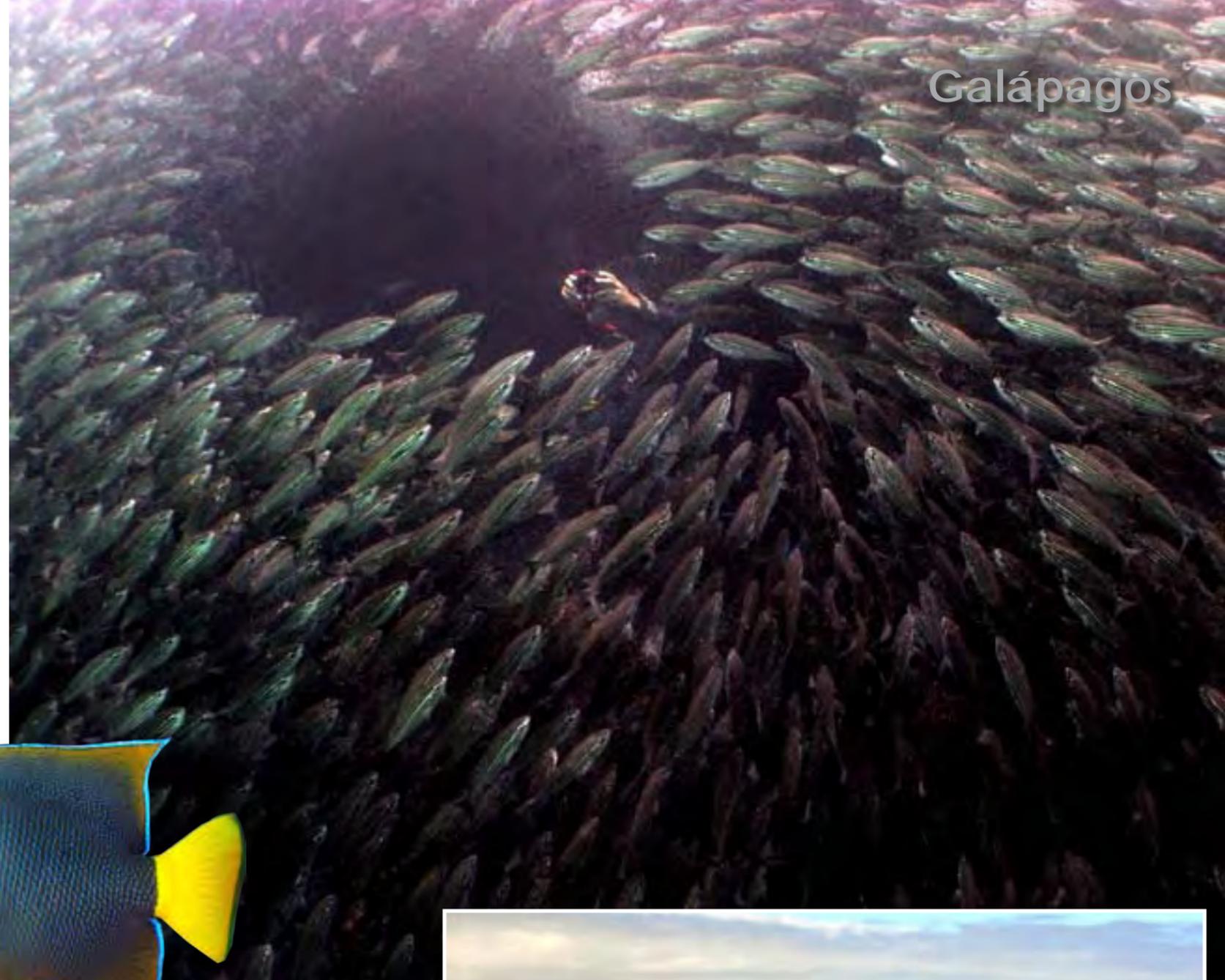


Sally lightfoot crabs, Santa Cruz Island

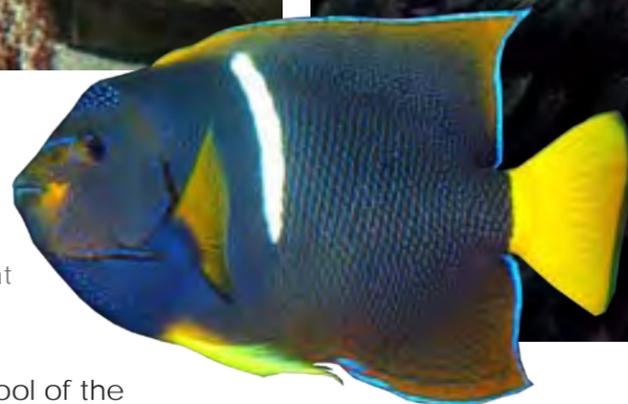


SATELLITE IMAGE: NASA





CLOCKWISE FROM LEFT: Puerto Villamil, Isabela Island; Pacific green sea turtle resting at Elfinado, Isabela Island; King angelfish (inset); School of black-striped salema with diver at La Loberia, Santa Cruz Island



that it was in fact a huge school of the endemic black-striped salema porgy, a species of bream.

Where was everybody? I moved forward. The fish parted a little, but stayed inches from me. I went in some more, and it got dark. I looked around and saw that the fish had surrounded me; I was engulfed in a giant, amorphous blob of fish.

I could hear the dive master rattling his shaker, trying to guide me to him. I tapped back on my strobe arm. I swam on, and we met up—four divers in a zillion sardine-sized fish. Incredible. When we emerged back into daylight, more sea lions came to play briefly, then sped off—no doubt to get a stripy snack.

Puerto Villamil, Isabela Island.

In the afternoon, we were escorted to a small cruiser and sped off towards Isabela Island—the largest of the four inhabited islands. As the cabin looked pretty full with 16 passengers, we asked to sit on the flybridge with some cargo. We chatted to the skipper in dodgy Spanish, as he opened up the twin 300HP four-stroke engines for the two-hour crossing.

Approaching Puerto Villamil, we slowed to little more than an idle, as the skipper skirted the boat around the inside of the bay formed by lava rocks. The contrast with Puerto Ayora was considerable. With little more than 3,000



Isla Tortuga, the uninhabited remains of a volcanic crater

the surface, spinning and turning with incredible agility, zipping around us like underwater break-dancers, as we approached a dark shadow in front of us.

The other divers were ahead and, as I turned to take a shot, went into the shadow and disappeared. As I approached, I saw





CLOCKWISE FROM LOWER LEFT: Largebanded blenny; Razor surgeonfish, Santa Fé; Pacific green sea turtle

guide for the morrow, Paco, seemed to think so. "There's a 95 percent chance of

were plenty of king angelfish (which are partial to cleaning sharks), eagle rays and stingrays on the second dive (more shark food), four green turtles and three schools of razor surgeonfish.

The current was fun, and the diving was good despite mediocre viz, and back in the aquamarine bay, we saw more turtles and stingrays, and the world's smallest and only tropical penguin—the cute Galápagos penguin.

Los Tuneles, Isabela Island. After a dry day spent walking up Sierra Negra on Isabela Island—the world's largest active volcano crater, spanning an impressive 11 kilometres from side to side—we set off along the coast for Los Tuneles. As we bumped along in the boat dodging the sea swells, we passed more than 20 turtles and five mantas on the 30-minute ride. Skipper



Spotted eagle ray at Los Tuneles, Isabela Island

inhabitants, our home for the next four days was sleepy and quiet under the afternoon sun. Our small boat was the largest in the port. As soon as our feet hit the wooden pontoon of the port, we were guided to a *panga*—a narrow speedboat—and taken out for a snorkel dive in the shallow lagoon. The tide was going out, lifting up the silt of the sandy bottom, but not enough to obscure a spotted eagle ray and a small whitetip reef shark. I thought the tide of my luck might be swinging back the other way.

Over a gourmet dinner, our dive

hammerheads at Isla Tortuga," he stated confidently before drawing a map of the dive site. It would be a fast drift dive around the outside edge of a crescent-shaped island that was once a volcano. There would be a few interludes in the dive, hiding behind outcrops of cooled lava, to hopefully watch the hammerheads go by, breaking my streak of bad luck. Alas, it didn't.

However, we were accompanied by a huge school of Galápagos barracuda (which are good food for sharks) for most of the first dive. There





CLOCKWISE FROM LEFT: Los Tuneles, Isabela Island; Sea lion; Whitetip sharks, Elfinado, Isabella Island; Frigate bird roosting, San Cristobal Island

San Cristobal Island

After a fun 90-minute flight on a 10-seater Norman Britten Islander to San Cristobal Island, we dropped our bags off and were whisked away for a short walk up to a water-filled crater to learn more about frigate birds and then down to another beach popular with sea lions, before sorting out our gear at the dive centre for the next day's diving with dive master Jimbo.

Over dinner, he told us about Kicker Rock (a.k.a. El Leon Endormido—The Sleeping Lion), talking up our chances of seeing hammerheads and the endemic Galápagos shark.

Kicker Rock. On the way to Kicker Rock off San Cristobal Island, we stopped at Lobos Island for a quick check dive, as Imi had decided to put on some additional neoprene. While we suited up, a rather cheeky



sea lion hopped onto the boat and started checking out my gear for me. He followed us into the water for a quick play around on the sandy bottom of the bay.

The next stop was Kicker Rock. Alongside the lion-shaped rock, we rolled in and entered the channel formed by a 20-metre gap towards its western tip. Sheltered from the sun's rays, the sea was grey, as we



Julio displayed admirable skill getting us through some rough surf before threading us through the treacherous lava rock formations to an astonishing haven.

Los Tuneles is a maze of arches formed by lava tunnels in some of the most beautiful water I have seen. There were turtles galore to snorkel with, as well as juvenile eagle rays, stingrays and the odd barracuda. By the time we were done, we estimated that we had seen at least 50 sea turtles either from the boat or in the water.

Julio's prowess wasn't just limited to tricky boat manoeuvres. At the Elfinado dive site, he donned mask and fins and found two arches occupied by close to a dozen whitetips and then led us to the mangroves to show us his secret seahorse. Tail wrapped around

a branch, with the sunlight filtering through the film-covered surface, the view was ethereal. Just below, a turtle snoozed, half-under a ledge on a bed of leaves in an almost autumnal composition.

To cap a great day, he pointed us to a narrow, shallow channel close to the port and told us to snorkel carefully along the top. The incoming tide made the water murky, but a couple of metres below us, we made out first one, then two, then another now familiar whitetip shark. As we pulled ourselves along the sides of the 100-metre-long, one-metre wide channel, we could see that the bottom was carpeted with sharks. My notes said, "Photography value zero, thrill value high." On a slack tide with some viz, it would have been amazing.





CLOCKWISE FROM LEFT: Hawkfish at Kicker Rock; Gringos, or Pacific Creolefish; The Sleeping Lion or El Leon Endormido is what the locals call Kicker Rock; This cheeky sea lion played with a dive torch and then gave it to me, Lobos Island



hovered above the sand, peering ahead into the gloom. A couple of stingrays were resting on the bottom, and a third flitted past.

We kneeled in the sand and waited. Shortly, three Galápagos sharks swam through the 25-metre deep channel. A first, they seemed quite small, but then I saw that they were beautifully-shaped creatures, which moved with natural predatory grace. I couldn't help wondering whether they would be followed by hammerheads. A couple more Galápagos sharks swam by, followed by a couple of blacktip sharks. "Martillo, martillo, aqui martillo," I sang in my head, but none came.

The vertical wall along the outside flank of the rock was madly mottled with blue and orange sponges,



Galapagos shark is not big but has graceful lines

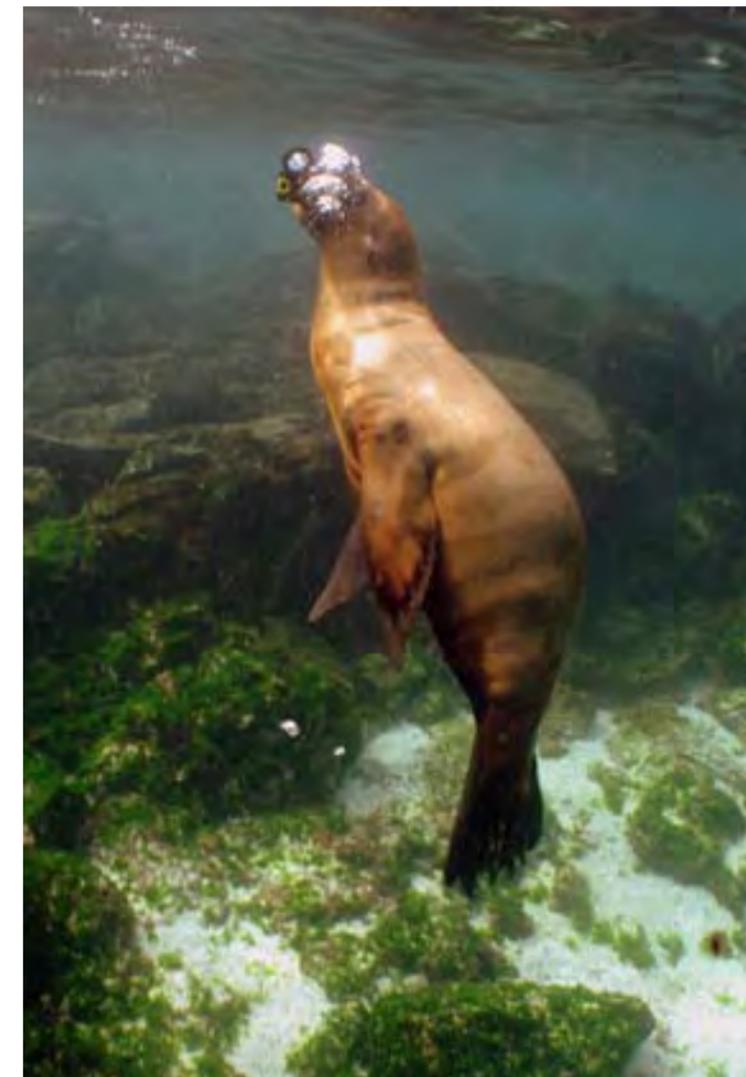
Galápagos



pencil urchins resting wherever they found a nook, often with a small hawkfish or a stunning blue and red endemic whitetailed damselfish juvenile. The sea was full of fish; king angelfish were in abundance as well as streamer hogfish and gringos (Pacific creolefish).

We returned to the wall for a second dive after going to the far end to look for hammerheads (Obsessed? Me?) in the current, and were rewarded with more fish soup and five green sea turtles, no less. Despite being hammerless that morning, The Sleeping Lion was certainly awake underwater.

After lunch back in the sheltered waters of Lobos Island, Jimbo took us for a snorkel dive along the rocky edge to look for marine iguanas. We weren't disappointed. In addition to more damselfish and razor surgeonfish, we quickly found an iguana trying to escape the playful attentions of a sea lion, which was pulling its tail in what seemed to be a slapstick wrestling contest. Once that act was





Diver (left) in school of pompanos, Sante Fé Island; Hammerhead shark (above) at Gordon Rocks, Santa Cruz Island; Juvenile southern white-tail damselfish, Kicker Rock (lower left)

bird hill for more great views and wildlife information before a quick dinner with our host, Daniella, and a deep sleep.

did nothing to make me think that I'd come away with much.

How wrong I was. More than a dozen hammerheads cruised past just above the sandy crater bottom as soon as we had

San Cristobal Island had been pretty action-packed, so the next day, we chilled out firstly on the boat transfer back to Puerto Ayora on Santa Cruz Island, and then by walking around the Charles Darwin Research Station in Puerto Ayora, attempting to slow down to the same pace as the Galápagos giant tortoise—the most



Sea lion plays with a dive torch, Lobos Island

over, a pair of sea lions popped up, darting and whirling in random directions like a fireworks display run by delinquent kids.

As a finale, yet another smooth, brown underwater puppy whizzed into view, a black object with a shiny end in its mouth. Like a Covent Garden juggler, it tossed it up, watched it sink a few metres, flitted down to catch it, before doing it again. But what was it juggling? After a few minutes, our entertainer swam right up to my

lens, looked at me and placed the object on the sand below me before swimming off. I dived down and picked up an immaculate, but battery-less, \$120 dive torch. Amazing. Was this the same curious and cheeky chap from this morning who had borrowed a toy from another diver?

That wasn't the end to the day, though. No sooner back on shore, we were greeted by our guide who took us to the island's visitor centre and up to a frigate

well-known of them being the century-old, Lonesome George, the last survivor of a species decimated by human activity.

Gordon Rocks. And so, we finally found ourselves doing day one on day eight, about to roll into the small volcanic crater that makes up Gordon Rocks off Santa Cruz Island. The overcast day and choppy seas





COCKWISE FROM LEFT: Pelican on Isabela Island; Endemic blue-footed booby; Galapagos giant tortoise, this one close to 100 years old and 200kg; Endemic marine iguanas on Santa Cruz Island



descended the 28-odd metres to get there. BINGO!

As we did a circuit around the inside of the crater (through some crazy thermoclines that went from 21°C to 17°C) there were whitetip reef sharks and turtles, as well as large schools of king angelfish and razor surgeonfish again, basslets and butterflyfish—all good cleaner fish for large species.

Gordon Rocks really did rock. It was a fitting finale to a most excellent first week.

For the final six days of our trip, we

moved into budget accommodation in the centre of town, a street back from the sea. For US\$35 a night, we got a double room with air-conditioning of sorts (it was either on freezing or warm), private bathroom and breakfast. There were plenty of restaurants serving main courses from \$8, small stores selling fruit and snacks, a small supermarket down by the port, and lunch is provided on dive boats.

The following day, we returned to Gordon Rocks and saw more hammerheads, whitetips, friendly turtles and

even a sea lion.

The vertical currents and surge can definitely be quite a challenge for inexperienced divers, and the cold currents can be core-chilling. It's quite common for divers to come up after 30 minutes, as the combination of the temperature challenges and going down to 30 metres sucks up their air. One fellow diver—an out-of-practice yet ex-commercial diver with 2,000+ dives—was done in 19 minutes.

For those who can hang around and check out the outside walls of the

Galápagos

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ful creatures also put in a brief appearance on another visit to Santa Fé Island, as did a massive school of pompanos [ed.—a species of *Carangidae*, which includes jacks and trevally], which encircled us in a silvery, fishy cylinder. And then, there were yet more Galápagos barracuda.

North Seymour. We managed to get to North Seymour with Galápagos Sub-Aqua dive centre. There, we found more stingrays, marbled rays, eagle rays, a manta silhouetted above us in the gloom, and several pairs of whitetip sharks resting under overhangs. It all culminated in some exciting, fast drift dives over shallow water during the safety stops.

Afterthoughts

Whenever I think about Gordon Rocks, my mouth curls into a smile. It epitomises the Galápagos for me. Even on a gloomy day, it reflects the unique and enchanting nature



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of the archipelago's diverse nature, its strong currents symbolising the challenges ahead, and its diverse life reminding us of what we have to lose. ■

Christopher Bartlett is a dive writer and underwater photographer of British and French descent. He is based in France and coordinates excursions to various dive destinations around the world. For more information, visit: www.bartlettimages.com

Chocolate chip sea star

crater, the rewards are excellent. Although my camera had already fogged up, I got to marvel at a huge, slow-moving school of countless one-metre-long snapper, at ten metres. Then, I saw a wahoo—or scombrid fish, prized in game fishing—as we surfaced.

On another safety stop, I saw over a hundred golden cownose rays cruise past. These beauti-



CLOCKWISE FROM ABOVE: Julio's secret seahorse in the mangroves at Elfinado; Whitetip reef sharks resting at North Seymour; Blue sea star





Galápagos'

Isabela Island

Text and photos by Pierre Constant

The Last Mirage



Text and photos by Pierre Constant

View of Puerto Villamil from the air

Seen from space, Isabela Island—the largest island of the Galápagos archipelago—reminds me of a giant sea-horse facing the great blue yonder of the Pacific Ocean. As one approaches land, the cap of thin white clouds dissipates. Isabela’s majestic landscape is a perfect alignment of shield volcanoes, rising above 1,000 metres, which stretches from the southeast to the northwest. Among them, Wolf Volcano reaches 1,700

metres. Straddling the Equator, it is the highest summit of the Galápagos group. Over the last 700,000 years, the six volcanoes of Isabela Island—Cerro Azul, Sierra Negra, Alcedo, Darwin, Wolf and Ecuador—have evolved into gigantic calderas. Following successive rises and falls of magma, the rim of a volcano collapses into the crater. With a diameter exceeding 10km, Sierra Negra is by far the largest of the island’s calderas.

The Galapagos are a renowned hotspot of the east Pacific, and Isabela is the most active volcanic island. The last eruption dates back to 2005. An incandescent lava flow filled the crater and turned into a fascinating experience for the locals, who witnessed the show at sundown.

Daily flights on EMETEBE’s Twin Otters from Baltra to Puerto Villamil take only 30 minutes. Upon final descent, the small propeller airplane flies over Los Islotes Cuatro Hermanos—aka The Four Brothers. These tuff cones of pale brick red color have been eroded by wave action of both the South Equatorial Current and the Cromwell Current. Two of the islets have been chiseled into moon crescents gaping towards the south. Easily accessible by boat from

Gargonians. PREVIOUS PAGE: Los Islotes Cuatro Hermanos (The Four Brothers) and Isabela Island





Puerto Villamil, the '4 Hermanos' islands—as they are called locally—offer a number of good dive sites.

On the port side, one marvels at another huge crescent fringed by a ring of white surf. Tortuga Island, also known as 'Brattle', is a refuge for seabirds. Nazca boobies, tropicbirds [ed.— family of tropical pelagic seabirds of the *Phaethon* genus!] and large frigate birds nest on the outer slopes of the crater.

A stone's throw away to the north, La Viuda (The Widow) juts out of the ocean like a grim stoney finger pointing to the sky. That is all that is left of a tuff cone totally destroyed by the elements. In its formidable solitude, it doesn't look like much, but somehow, it is one of the best dive sites—only 20 minutes away from port. A resting place for blue-footed boobies, it also attracts a few sea lions basking lazily in the golden light of the afternoon sun.

1 SOURCE: WIKIPEDIA

As the *avioneta*, or light aircraft, does its final loop above the bay of Puerto Villamil, one is thrilled by the pastel green and emerald colors of the waters, fringed by the black lava. Successive trains of waves come towards the shore only to fall apart into snow white foam upon this tormented coastline. A long sandy beach stretches west towards the dark hills, once the site of an infamous penal colony (1946-59). This is an arid, hostile landscape where the vegetation is composed of palo santos trees, opuntia and candelabra cacti, and spiny shrubs.

Everything here forecasts extreme conditions, a sharp contrast with the idyllic *cliché* found on Isabela Island. Welcome to the 'Enchanted Islands' where the hidden side of paradise reminds one of the ruthless reality a world apart and its fabled history.

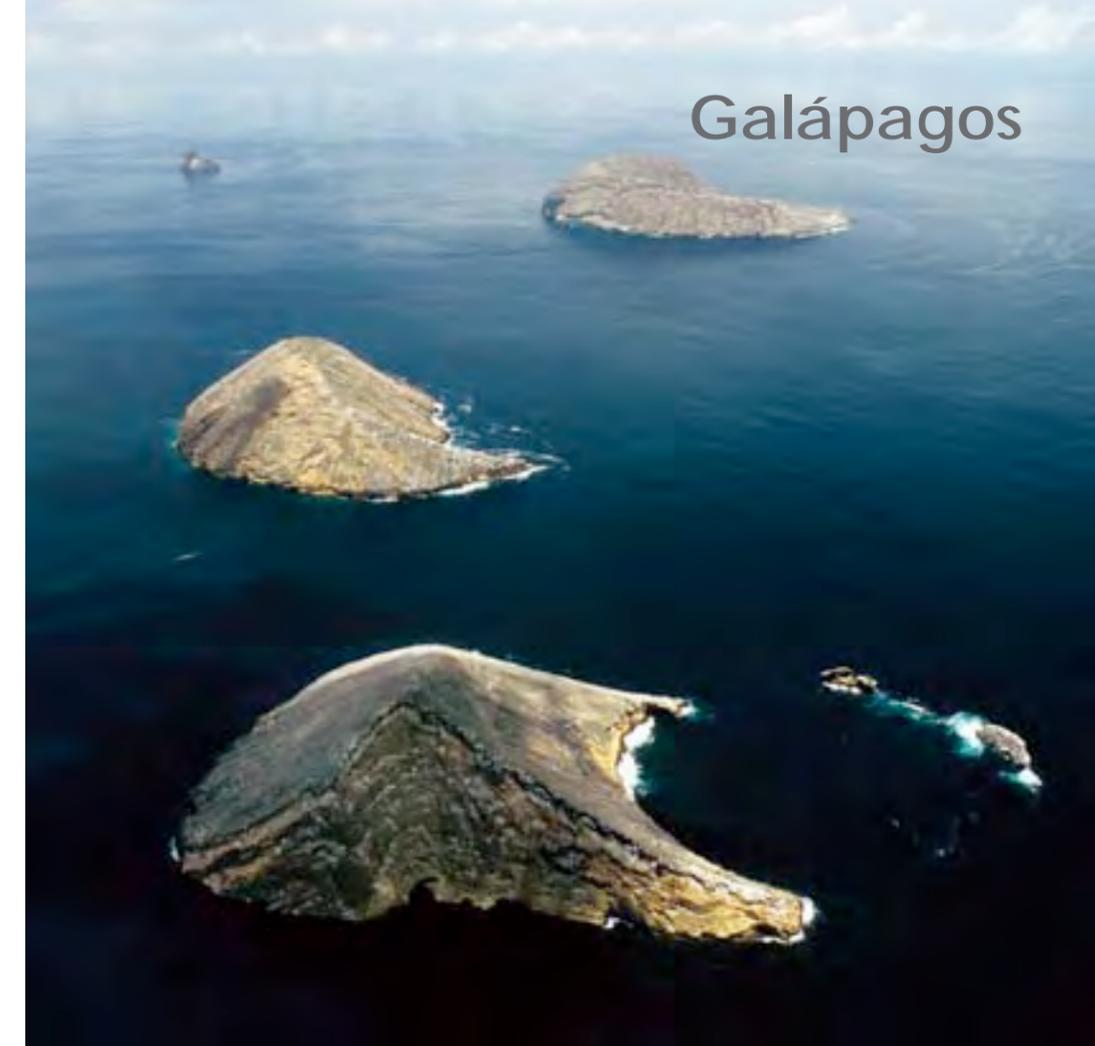
History

In 1897, Don Antonio Gil Quezada built

a hacienda in Santo Tomas in the highlands of Isabela Island. He had earlier made the unfruitful attempt to establish a colony on Floreana, an island further south, which had the advantage of a freshwater spring. In the old days, sulphur deposits of the Sierra Negra Volcano were exploited and brought to the coast on the back of donkeys.

After WWII, the Ecuadorians retrieved the installations of the U.S. Army, who had created a radar base behind Cerro Orchilla. One morning in 1946, the penal colony, Colonial Penal de Isabela, opened its gates to 300 convicts who disembarked from the *BAE Abdon Calderon* of the Ecuadorian Navy, escorted by 20 policemen and ten officers. These men were sentenced to hard labour under the hot sun in what would become known as the harshest prison of the Galapagos. Criminals, political prisoners, petty thieves and other unwanted citizens assembled under the unforgiving

Nudibranchs, orange spotted doris (above) La Viuda (top right)



Galápagos

Los 4 Hermanos (The Four Brothers)

from diving Santa Cruz or San Cristobal islands. Isabela is the 'far west' of the archipelago in every sense of the word. The islets south of Puerto Villamil are at the crossroads of two major currents, meeting each other head on. The South Equatorial Current (also known as the Humboldt Current) moves from east to west during the dry season, with the help of the southeast trade winds, which blow from May to December. These cool waters have mean temperatures ranging from 18°C to 22°C.

Originating from the Central Pacific, the Cromwell Current flows along the Equator, from west to east, at a depth of 300 metres. With a core temperature of 13°C, it creates an upwelling on the west and south coasts of Isabela and Fernandina islands. Nutrient-rich waters come up from the deep to the surface attracting a profusion of fish and gorgonians, 66 percent of which are endemic



Nudibranch, *Glossodoris*

whip of the guards. The convicts were forced to build a stone wall of volcanic dry blocks, which grew to 80 metres long, 8m wide and 8m high. It would eventually close the perimeter of their confinement. Many were said to have died in the building of this wall. Later, two camps were established in the highlands.

One morning on 9 February 1958, 22 convicts, who were bringing supplies to Camp Alemania on the slopes of the Sierra Negra Volcano, fooled the guards, getting them intoxicated with sugar cane alcohol. They took their guns and then attacked Camp Alemania and Camp Santo Tomas. They did the same at Camp de la Playa.

The mutineers were under the com-

mand of Pate Cucu who had declared: "I want an escape with no death." Nevertheless, they did commit a number of rapes on their way to Puerto Villamil. "All that we want is to be free and leave these infamous islands and this dreadful prison," the convicts said.

Finally, they seized two fishing boats and went on to James Bay on Santiago Island where they hijacked the American sailing vessel, *Valinda*. From there, they sailed to Esmeraldas on the Ecuadorian mainland. The penal colony was closed in 1959 to celebrate the 100th anniversary of Charles Darwin's publication, *Origin of Species*.

Diving

Diving Isabela is a different experience



Leather bass (above); Diver with school of surgeonfish (top)



THIS PAGE: Endemic species. CLOCKWISE FROM ABOVE: Galápagos hornshark; Harlequin wrasse; Tigris; Galápagos sheephead wrasse

species. Consequently, the area is a playground for whales, mantas and orcas.

The Cromwell Current comes around the northern and southern tips of Isabela and meets the South Equatorial Current in the centre of the archipelago, triggering another upwelling. This current is responsible for the introduction

of the giant freshwater eel (*Anguilla marmorata*), which has established itself in the lagoons of Puerto Villamil.

A notable amount of endemic marine fauna is found west of the archipelago, with unique species such as the small Galapagos hornshark, which is cream-coloured

with black blotches, and the harlequin wrasse (*Bodianus eclancher*), which displays a chromatic variation from orange to white and black.

Discovered by Darwin in 1835, the Galápagos sheephead



wrasse (*Semi-ossyphus darwini*) is recognized by a brown to purple color with a yellow blotch on the sides. Deep and compressed, the white-spotted black tigris (*Oplegnathus insigne*) belongs to a unique family. Marlins, spade-fish and sawfish are common pelagics in the area. In addition, the south of Isabela Island is an important nesting ground for the Pacific green sea turtle, which frequents a number of lagoons and beaches.

Los Islotes Cuatro Hermanos, or The Four Brothers, are tuff cones vigorously weathered by wave action. Three of them have been

carved into moon crescents. It takes 45 minutes by *fibra* (short for Fishermen's Fibrafort boat) to get there from Puerto Villamil.

Pyramid Island has a conical shape, with two rocks emerging southwards, left over from the original crater rim. A wall drops

vertically on the outer slope, which is covered with brown gorgonians, yellow bushes of black coral and soft corals. At times,





here—just 25cm tall—which swam near the bottom. In the shallows, hidden under an overhang bedecked with light brown and purple gorgonians, 15 spiny lobsters were

on patrol with antennae fully deployed. A mouth-watering dish for sure, however, fishing with a scuba tank is strictly prohibited in the Galápagos!



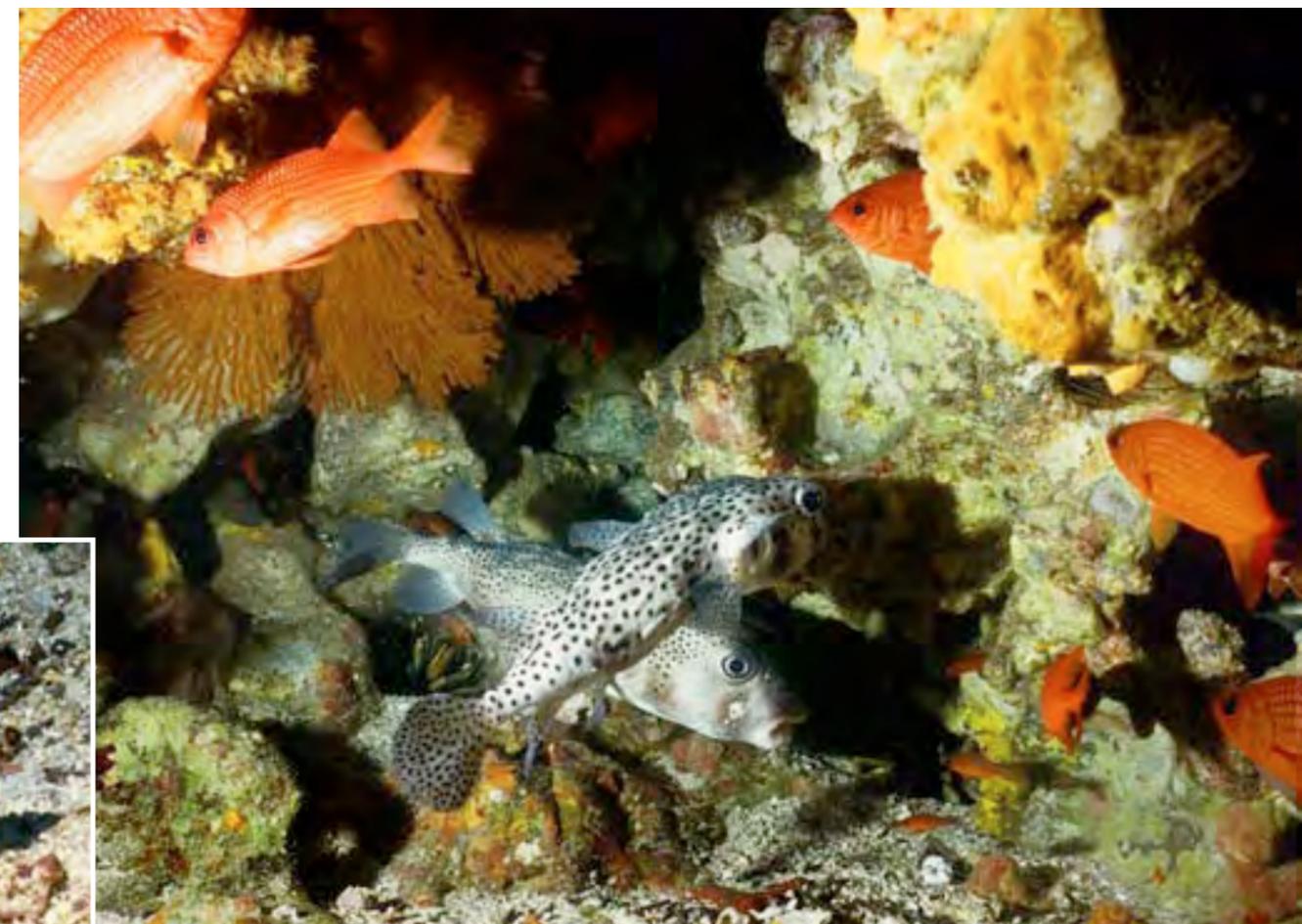
In July 2001, I attempted a dive at Moon Island's east point. The ocean was rather choppy, and the cape was wrapped in a cloud of bubbles. The current did not look too ominous, so I jumped into the water at a respectful distance.

The vertical wall was carved by a number of holes, which served as homes for sea urchins. The colorful site was dotted with blue and red sponges, black coral, soft corals, gorgonians and orange cup coral—the ideal biota for the blue-eyed damselfish,



grunts and Galapagos grunts (silvery with a yellow eye) roam the area. Sea turtles and sea lions are rather active, and the Galápagos blue porcupinefish is common. A school of steel pompnos (diamond-shaped fish with a swallow tail) often engulfs divers during decompression stops.

The two horns of Moon Island define a little bay, washed by surf. Underwater, the site evolves around a pinnacle, with a whirlpool of life—harlequin wrasse, spotted eagle rays, blue and gold snappers. I was thrilled to spot an orange Pacific seahorse



Galápagos blue porcupinefish (above); Slipper lobster with cleaner shrimp (top right); Red-lip batfish (left inset); School of grey grunts surround a Mexican hogfish male (far left)

manta rays come to feed in the current. Hornsharks rest on ridges or hide under overhangs.

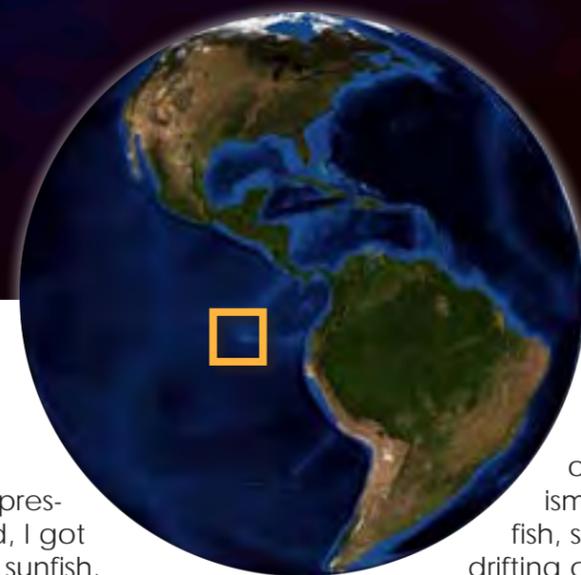
On the west side, the outline of the crater rim heads north at a depth of 28m, with a white sandy bottom on

the right hand side and a drop off on the left side. Marble rays are often at play. Here, an old stem of black coral is covered with leopard anemones. Mixed schools of metallic grey Peruvian





Galápagos



Cortez rainbow wrasse, large-banded blenny and a few species of gobies and octopus.

I was busy taking a photo of a long-nose hawkfish on a black coral when I suddenly sensed a presence behind me. Turning around, I got a real shock—a two-metre-wide sunfish, wide-eyed and bewildered, was staring at me as if I were from another planet. Stunned, I acted likewise!

This unusual fish looks like a giant triggerfish with dorsal and anal fins in the vertical axis moving sideways like a pendulum. It has a big head without a tail. The leather-like, silver skin has numerous dark blotches. Also known as the mola mola, the creature fixed a big, round, black eye on me. The mouth drew a perfect circle, mimicking pure astonishment.

This deepwater species belongs to the continental shelf, in the 200m depth

zone. It feeds on benthic organisms, jellyfish, salp and drifting ctenarians.

The mola mola comes up to the shallows (20m), when it needs to be cleaned by wrasses. It is even seen at the surface where seabirds also do the job. It prefers areas of upwellings and converging currents, as is also the case in Bali.

Two species of sunfish are found in the Galápagos, the other one being *Ranzania levis*. A new *Masturus* species was discovered in April 2008. [See www.expeditions.com/theater17.asp?media=561]

Three weeks later, I did a dive at Crescent Island—the third of the 4 Her-

Sunfish or mola mola (above); Pacific green sea turtle (top left); Location of Galápagos on world map

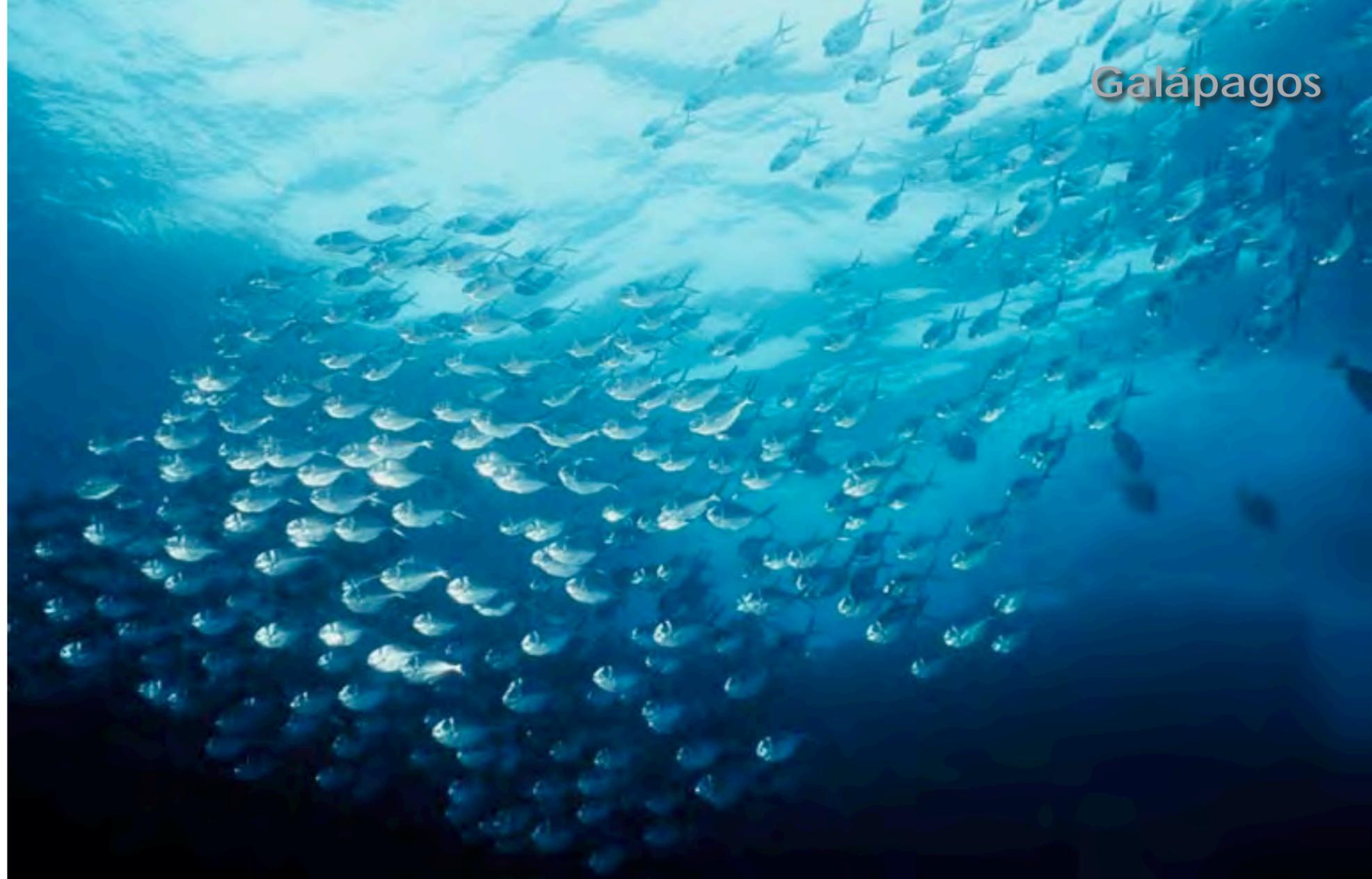
manos group. Once again, I encountered a sunfish at a depth of two metres. The biggest island has on its northern shore a long tunnel that runs into the volcanic tuff. The entrance to the cave

is 13m deep, and the tube finishes in a dead-end after 70 or 80 metres. This is a refuge for lobsters, stingrays, whitetip sharks and sea lions at play. A gentle slope is found outside the cave, with



Sponges on reef





scattered boulders. Mexican hogfish, grey grunts, harlequin wrasse, king angelfish and sea-horses are found there. Even mantas pass by occasionally.

La Viuda

Seen from the sky, Tortuga Island is a visual enchantment. The flooded crater is broken for most of its southern part, with two small islets pounded by the surf. I flew over the island one clear morning in February 2006 and allowed the pilot to take me into a rising spiral to give me “a better view”, as he put it. Tied by a rope around my waist, I was in the luggage hold taking pictures through the open hatch—not the best moment for a drop!

Northeast of Tortuga, La Viuda is barely seen at water level. The inconspicuous, rocky finger

mimics a black thumb covered in bird poop. My favorite dive site, it is a true aquarium bathed in the northeast current. It is definitely not a good choice for novices; the drop-off plummets down to 40 metres on the sandy floor of the crater.

A unique Galapagos species is found at depth—the *blanquillo*, or ocean whitefish (*Caulolatilus princeps*). Squads of golden rays



skim the bottom.

Following the inner slope of the crater, one discovers a series of small pinnacles—remains of the rim—alternating with some passes where the current is felt. Clouds of fish materialize into the blue—a school of barracudas and spotted eagle rays in formation. Sometimes bat eagle

rays join the ballet. They are olive green, dorsally, and white, ventrally, with a very long tail and a rounded head. On other days, schools of tuna, yellowtail scad and Spanish mackerel



COUNTER- CLOCKWISE FROM ABOVE: Stingray on sea floor; Large school of pompanos, or jacks; King angelfish on reef; Tortuga Island





CLOCKWISE FROM LEFT: Nudibranch, *Roboastra sp.*; Selema; Black manta ray casts a looming shadow; School of dusky chubs; Nudibranch, *Discodoris*; Nudibranch, *Carolyn doris*

carnivorous nudibranch, *Roboastra sp.*, will reveal itself with black, yellow and blue stripes. It is the predator of the smaller *Tambja mullineri* nudibranch, which is striated black and turquoise blue

for dive courses. Species there include the Galápagos porgy, soldierfish and squirrelfish, guinea-fowl puffer, soapfish, dusky chubs, scorpionfish and the charming Pacific snake eel, with its creamy color and rounded black spots,

foraging among the rocks.

Stimulated by the steady current flowing south, the east coast of Tortuga towards the point is more animated. The underwater scene is rugged with canyons, pinnacles, small drop-offs and boulders. Sea turtles, sea lions and stingrays are the norm here.

The particularity of the site is the presence of a great number of flat, oval-shaped nudibranch, which are whitish with orange spots and gills. This species of *Galápagos doris*

is probably endemic and is yet unidentified. It prefers cool waters, under the thermocline with temperatures of 12°C to 19°C at an optimal depth of 25m. The *Galápagos doris* nudibranch nests itself in cavities carved by sea urchins, on big boulders exposed to the current.

Another species of nudibranch divers

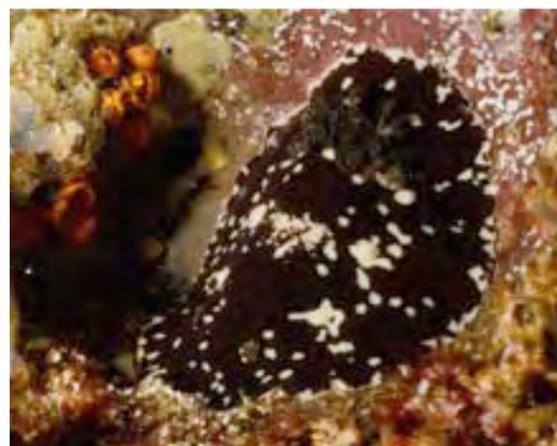
show up. Even Galápagos sharks and hammerheads can be seen. The dark shape of a black manta always comes as a surprise!

Closer to the rocks, yellowtail surgeonfish, king angelfish, barberfish, three-banded butterflyfish, humphead parrotfish, bacalao grouper and myriads of creolefish dot the scene. Various species of sea stars are found at La Viuda. Should you be lucky, the

and is endemic to the Galápagos Islands.

Tortuga

For an easy shallow dive with no current, head for the north coast of Tortuga where one will find gentle slopes, volcanic sandy patches in between ridges of tuff (light, porous rock of consolidated volcanic ash), small drop-offs and overhangs. The site is appropriate





CLOCKWISE FROM TOP LEFT: Flatworm; Orca flashing its white belly; Paulia sea star; Berthellina sea slug; Sea lion

encounter is *Glossodoros dalli*. A large triton—the Panamic horse conch—is also found on rocky substrates. It has red flesh dotted with blue. Some nice specimens of scallops hide under overhangs.

The southeast point ends abruptly with a sheer wall, plunging vertically to 50m. This is a wild spot where anything can turn up—Galápagos sharks, manta rays,

eagle rays and cownose rays, sunfish, dolphins and schooling hammerheads hunting prey.

Back in March 2005, at the heart of the 'Galápagenian' summer, I did a dive at the tip of El Triangulo, the islet south of Tortuga, which is exposed to the swell of the open ocean. On this occasion, I came upon an unusual endemic spe-

cies of nudibranch—the flat, oval *Carolyn doris*, which is brown with white blotches.

As we came out of the water, my companion pointed her finger towards the bay of the crater. "Over there! Dolphins!" she shouted. Somehow, neither the back nor the dorsal fin (which was very tall) coincided with the norm. "Holy (bleep)! These are orcas!" I was stupefied. I couldn't believe my eyes. Luck was smiling upon us. This rare sight put me in a

trance at once. Five killer whales frolicking in the bay is an opportunity not to be missed. "Wait for me!" I yelled. I signaled the boatman to stop the outboard motors and changed the macro lens on my camera for the wide angle lens.

Godfrey Merlen, a specialist on cetaceans and

longtime resident in Galápagos, did some research on these fascinating dolphins between 1992 and 1999. Statistics showed that at least 135 sightings had been made; most of these were made while the orcas were hunting at the surface. Common prey of the orca include sea lions, sharks, hammerheads, stingrays, mantas, sunfish, turtles, dolphins, whales and sperm whales—you name it. A top predator, it is known as the hyena of the seas. Man is not on the menu though,

but then again, it's yet to be seen.

Ready for the big jump, I gestured to the *pangero* (fisherman) to move on slowly towards the pod. One killer whale broke away from the group and came straight at the fibra. I swiftly slid into the water, holding my breath, and immersed myself right on the spot.





Octopus resting on reef (above); Yellowtail surgeonfish (right); Galápagos shark (left)



adrenaline!

The orca swung around again, this time displaying a flashy, white abdomen and eyeing me in a comical way. The fur of the orca is so silky that it reflects

the sunlight, creating an eerie blue aura around the animal. I shot various pictures in natural light, then broke the surface, exulting with total joy. Reassured, my friend joined me in the water, and we skin-dived with the orcas.

The dominant female passed under-

neath again, with a companion and a young calf, cruising just in front of us—an awesome, unforgettable moment! Life was simply here and now.

The Marine Reserve

Second in the world only to the Great Barrier Reef in Australia, the Galápagos Marine Reserve has a surface of 140,000sq km. First created in May 1986 following a presidential decree by Leon Febres Cordero, it was then labeled the Reserve of Marine Resources of the Galápagos and was half the size it is today.

The Master Plan of 1992 highlighted a number of conflicts of interest. As the years went by, repetitive abuses brought to light the illegal fishing of shark fins.

Pirate camps of fishermen were discovered around Isabela and Fernandina islands.

The Galápagos were declared a Biological Reserve in 1996, but this did not solve the problem. Instead, it just added more fuel to the fire. Seminars organized by the Galápagos National Park, or Parque Nacional Galápagos (PNG), together with the Charles Darwin

Research Station (CDRS) and Grupo Nucleo in 1997 brought the protagonists to the round table—the fishing sector, tourism, PNG, CDRS and the Ecuadorian Navy. As a result, a new master plan and a Special Law for Galápagos saw the light of day in 1998.

But UNESCO threatened to call the Galápagos a World Heritage Site in Danger (and now it is). Hence, came an





TOP TO BOTTOM:
School of golden rays;
Hammerhead shark;
Spotted eagle ray

Galápagos

Involved with politics of the Lista 5 (Demo-cracia Popular), they exerted pressure on the park to have new rights and work alternatives to compensate for the collapse of the *pepino* (sea cucumber) and shark finning industries. Eventually, dive cruises were paralyzed in 2007 (except

eruption dates back to October 2005. Or trek to the Muro de la lagrimas—the Wall of Tears—made of basaltic lava rocks, which is all that is left of the old penal colony. On the way, there are a number of places of interest including the lagoons of Puerto Villamil, Cerro Orchilla hill, the freshwater spring of El Estero, the lava tube and the enchanting beach of Tortuga Bay.

Visitors can also check out the Breeding Centre of Giant Tortoises of the Galápagos National Park or visit the islet of Tintoreras where one can see small whitetip sharks at rest. For snorkelers, there's the marine site of Los Tunneles and the

update of the new marine reserve, which was an extension of 40 nautical miles beyond the extreme points of the archipelago. This was an increase of 70,000sq km to what it was earlier.

Blame evil forces, but the rampant corruption and abuses kept going on. Fishermen went on strike, taking over the installations of the Galápagos National Park Service—or Servicio Parque Nacional Galápagos (SPNG)—in 2004 by sacking the park offices in Isabela Island and continued to demand that recreational diving activities should be handed over to them.



for a few boats), and the diving activity reverted in part to the fishermen with their *fibras*. A new system of *patentes*, or licenses, for dive boats was created in June 2009. All together, 16 licenses were conceded by the Instituto Nacional Galápagos (INGALA). Meanwhile, the number of visitors to the Galápagos National Park approached the 200,000 benchmark.

Other attractions

Go on an excursion to Sierra Negra Volcano and take a horseback ride to Volcan Chico for panoramic views of Isabela Island. The last

lagoon of Concha y Perla not far from Embarcadero, at the end of a boardwalk in the mangrove.

French born Pierre Constant's intimate connection with the Galápagos Islands has thrived over 30 years. With a university background in biology and geology, Constant is a naturalist guide, underwater photographer, lecturer, expedition leader and author of three books on the Galápagos. Having built a lodge on Isabela Island, he's now been a permanent resident of the Galápagos since 2002. For more information, visit: Scubadragongalapagos.com



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POINT & CLICK ON BOLD LINKS



Equipment *way to go*



Edited by Peter Symes &

Co-Pro

The CO-Pro is a simple and inexpensive product that can detect the lowest amount of carbon monoxide contamination due to poor filtration maintenance or failure and can mean the difference between life or death. A quick transfer of air from the tank value into the test balloon, and in seconds you have the results. Additionally, CO-Pro can be used multiple times over a period of months. Co-Pro.com



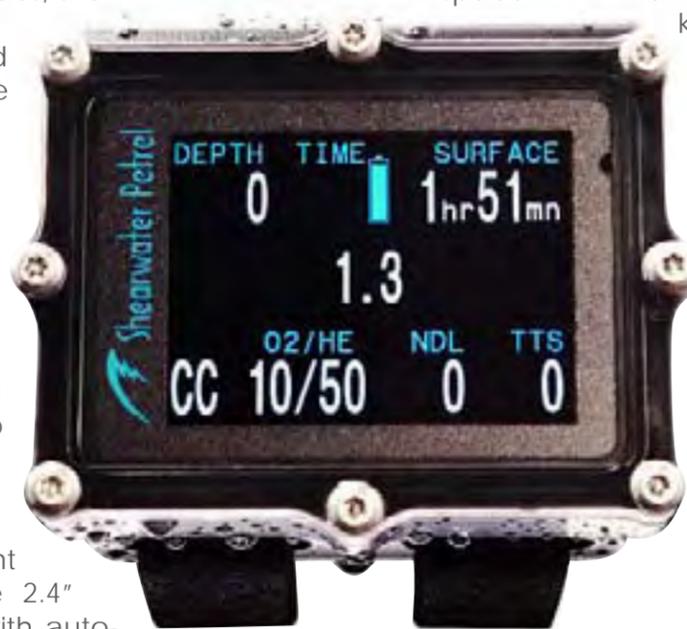
Nomad Fall 2012

The Nomad XT Fall 2012 model is built with streamlining in mind. A properly balanced sidemount rig should not require additional weight on the shoulders. Divers who wear heavy tanks or those just getting started with sidemount will often opt for this older solution to resolve trim issues. Seeing this makeshift solution in the field, Dive Rite redesigned their off-road sidemount rig with a new, wing design. Narrow at the neck and angled at the sides, the new Nomad XT wing is designed to give lift where its most needed—at the hips.

Diverite.com

Petrel

The Petrel is a technical dive computer for both open and closed circuit. Each mode allows for up to five gases, and conservatism is user-adjustable. There is a choice of decompression algorithms including Bühlmann ZHL-16C with Gradient Factors or an optional VPM-B. The 2.4" full-colour HD display is equipped with automatic screen brightness. The user interface is designed to be simple to use yet give easy access to advanced settings. Runs off a single AA battery. Shearwaterresearch.com



BMC for APD's CCRs

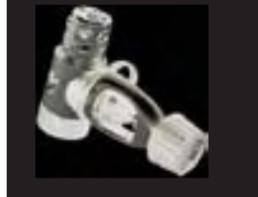
Ambient Pressure Diving has just launched their Back Mounted Counterlungs (BMC) for their popular Inspiration and Evolution range of Closed Circuit Rebreathers. The BMCs are available as an upgrade kit for existing APD rebreathers or as an option specified with any new unit. The benefits of the Back Mounted Counterlungs include a clutter-free chest area, stream-lined diver profile with reduced drag and more space available to clip on kit. The manual inflators that now come over the shoulders are easier to locate. The integral shoulder strap and harness design ensures the counterlung is fixed in the optimum position for best breathing performance. apdivingdirect.com



Fourth Element Argonaut

The Argonaut drysuit has been developed for the harshest diving conditions on the planet. Ergonomic design along with a telescopic torso allows maximum comfort and range of movement whether diving in conditions of extreme cold, using multiple thermal layers, or with lighter undersuits in warmer waters. Cordura Flex trilaminate material features an extremely hard-wearing outer Cordura™ fabric with a softer more flexible feel, which has already been specified for military use. This durable material is used throughout, making the Argonaut an extremely rugged suit. Fourthelement.com

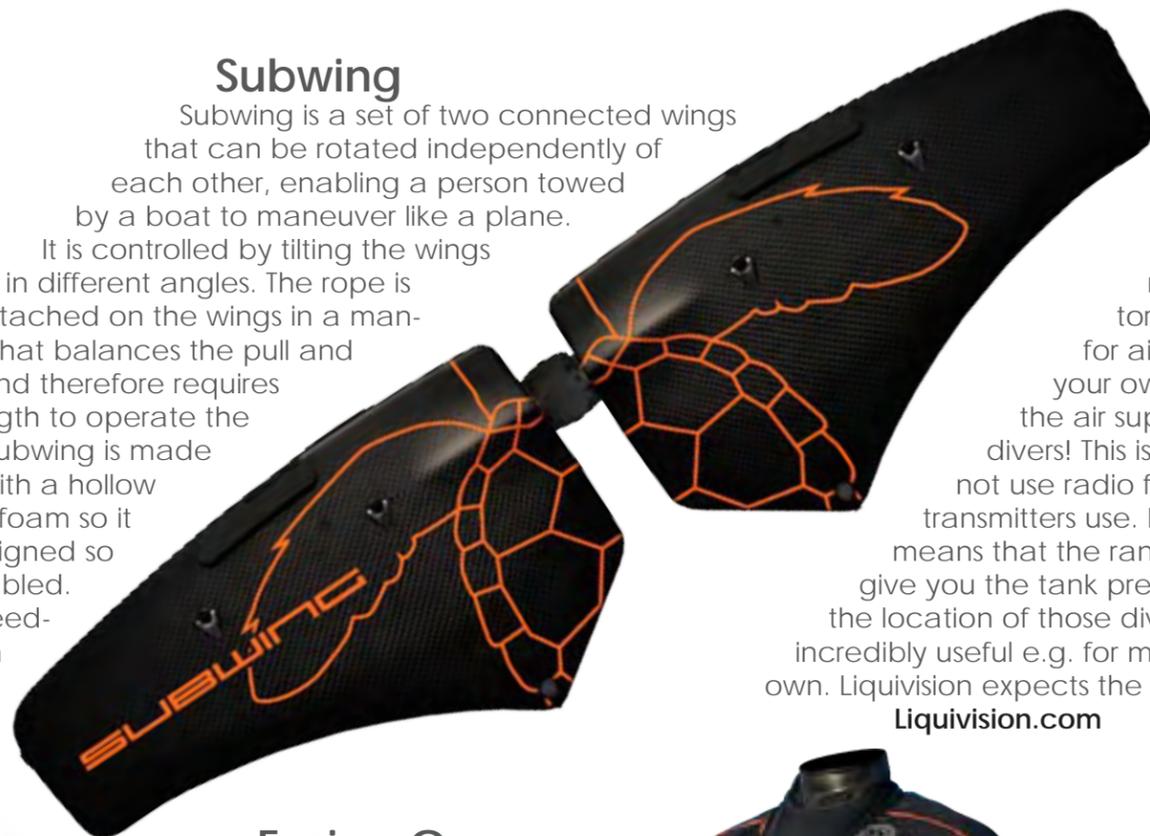




Subwing

Subwing is a set of two connected wings that can be rotated independently of each other, enabling a person towed by a boat to maneuver like a plane.

It is controlled by tilting the wings in different angles. The rope is attached on the wings in a manner that balances the pull and drag and therefore requires little strength to operate the wings. The Subwing is made from carbon with a hollow design filled with foam so it floats easily. It is designed so it can be easily disassembled. Only other equipment needed is a mask. Subwing.com



Liquivision Lynx

The Lynx is an air integrated dive computer. The computer allows up to three gases (air and nitrox 21-100%). It can be dived in recreation mode (air only), tech mode (up to three gases) or gauge mode. It has a dive planner, a dive simulator, a lifetime dive log and uses visual indicators for air time remaining. In addition to monitoring your own air supply, the computer can monitor the air supply and the direction of up to nine other divers! This is possible because the transmitter does not use radio frequency, which is what other wireless transmitters use. Instead, it uses ultrasonic technology. This means that the range is at least 100m. Also, it does not only give you the tank pressure of the other divers, it also triangulates the location of those divers and gives you a directional arrow. This is incredibly useful e.g. for monitoring your buddy's air supply on top of your own. Liquivision expects the Lynx to be available to the general public early 2013.

Liquivision.com



Fusion One

White's Fusion One skin is designed with 1mm neoprene for added abrasion resistance in high wear areas and heavy duty Lycra panels in high stretch areas. This optimal combination creates the perfect marriage of mobility and durability. The first layer "DryCORE" is a loose fit shell dry suit incorporating latex seals, dry zipper, air intake and exhaust valves to create the waterproof barrier. The ONE Skin attaches and removes easily from the DryCore via Velcro fasteners at the wrists, ankles and zipper to form a snug-fitting and streamlined second layer or "over suit".

Whitesdiving.com



Retro

The famous Aquadive watch brand, which was founded in 1962 is now being re-launched. This genuine NOS (New Old Stock) Aquadive has a Swiss hand made case equipped with a bidirectional rotating bezel and a classic aluminum insert. The modern update of the Aquadive dive watches are designed in the United States by a team of divers and engineers and handmade in Switzerland of German and Swiss materials. This watch has a depth rating of 660ft and is equipped with a new Aquadive dial with applied super-luminova markers. It is operated by a new Swiss made 25-jewel movement replacing the original movement in order to guarantee performance for years to come. Aquadive.com



Haztech

Haztech is a new lightweight, commercial grade dry suit from Viking for contaminated water diving. The new technology is based on lightweight and robust TPU (thermoplastic) materials, which offer lighter weight suits particularly suited for use in warmer water or warmer climate diving conditions where heat exhaustion can be a major problem. Ansell.com



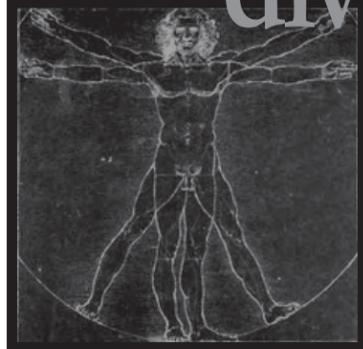
Flex

Oceanic's Flex BC is aptly named. Made from a stretchy fabric—a patented "BioFlex material", the jacket can stretch and conform to the body while remaining airtight. It has also permitted Oceanic to make a smaller creating less achieving high

Padded Soft Pad

air cell, bulk and drag underwater while volume of lift when required. The over compact backpack streamlines the BCD when you need to pack it for your next dive trip and keeps you comfortable when you are diving. Oceanicworldwide.com





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

Get a load of the triceps on this guy! It's the King Neptune statue by sculptor Paul DiPasquale, Neptune Park, Virginia Beach Boardwalk, U.S. State of Virginia

Neptune's Triceps

Text and photos courtesy of Gretchen M. Ashton, CFT, SFT, SFN, NBFE. Founder of ScubaFit®

Neptune, King of the Deep, is ripped! This Ancient Roman god of the sea has superhuman strength and endurance to invoke earthquakes, tidal waves, floods and storms. He is often depicted with massive arms brandishing a three-pronged spear called a trident. Neptune's ability to wield his weapon is made possible (in part) by the triceps brachii, the large muscle on the back of the upper arm. Like the trident, the triceps is comprised of three parts.

The long, lateral and medial heads of the triceps brachii perform extension of the elbow joint. The second role of the triceps is to act as a powerful antagonist, stabilizing and resisting the biceps brachii

and brachialis in flexing the elbow. Third, the triceps plays a minor role in moving the shoulder joint.

A prominent feature of the triceps is the horseshoe-shaped pattern of the muscle as it wraps around the pronounced common tendon. The muscle is well suited to intense training from almost every angle or position of the body. Changing the position of the shoulder joint and intensity slightly emphasizes different areas of the triceps, but the entire muscle utilizes all three heads during all movement. Rotation of the arm itself has little effect when training the triceps. The anconeus, a small muscle on the back of the lower arm located just below the elbow joint, assists the triceps. The triceps makes up two thirds of the upper arm, but because of its location, its size is often incorrectly attributed to the biceps.

All divers rely heavily on the triceps for overall upper body strength, all pressing movements with the upper body, and swimming. Specific examples of triceps involvement include donning and doffing gear, clearing a mask, reaching for valves, rescue activities and changing direction particularly on the surface.

Triceps and scuba diving

As divers age, this area of the arm may lose muscle tone and strength even with continued resistance training. Women, in particular,

covet a sleek toned upper arm. More importantly, women divers benefit greatly with increased upper body strength developed when training the triceps.

All divers rely heavily on the triceps for overall upper body

strength, all pressing movements with the upper body, and swimming. Specific examples of triceps involvement include donning and doffing gear, clearing a mask, reaching for valves, rescue activities and changing direction particularly on the surface.

The workout

There are more than 150 exercises for the triceps using free weights. Hundreds more variations of elbow extension may be performed with cables, machines and body





Triceps Dumbbell Extension extended position (below) and flexed position (bottom)



Triceps fail suddenly. Be on guard not to drop the weight on the face or head. With single arm exercises use the opposite arm for assistance and protection.

Triceps Dumbbell Extension

Lie on a flat bench or wall. Contract the abdominals, tuck the shoulder blades down and toward the center of the back and make sure the head is well supported. Extend one arm above the shoulder holding a dumbbell perpendicular to the arm as shown. Inhale and bend the elbow joint to approximately a 90 degree angle lowering the weight to alongside the head. The triceps resist, stabilize and help control the speed and direction of the weight during flexion. Exhale while engaging the triceps to extend the elbow joint

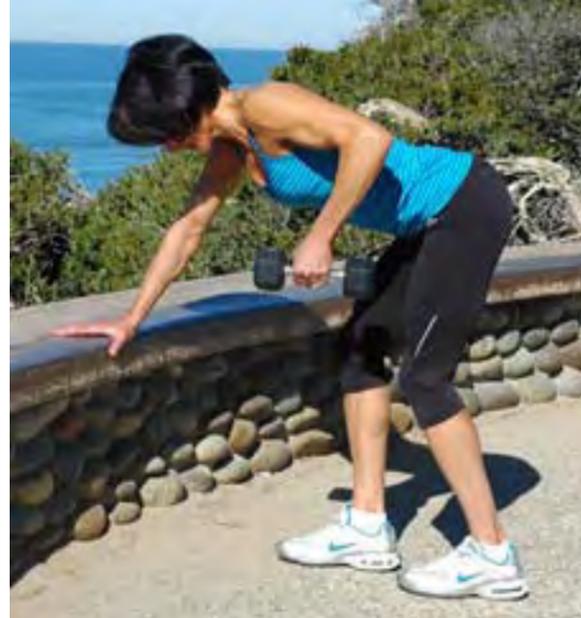
and lift the weight to the starting position. Repeat the exercise with the other arm.

Form and Precautions: When feet are on the bench, bend the knees to support the lower back. Otherwise, make sure feet are firmly planted on the floor with a natural arch in the lower back. Keep the wrist straight as part of the lever arm (forearm).

Variations: The weight may be lowered to the same side or varied diagonally across the body toward the opposite shoulder. Decide on one direction and maintain it through completion of all repetitions.

Triceps Dumbbell Kickback

Stand in a split stance, bent-over posi-



Triceps Dumbbell Kickback flexed position (left) extended position (below)



tion supported by one arm on a bench or wall as shown. A flat back is essential with the shoulder blades pulled down and toward the center of the back. Contract the abdominals and align the opposite arm alongside the body with the elbow bent and near the side of the waist. Inhale to begin. Exhale while engaging the triceps to extend the elbow joint and straighten the arm. Press back firmly and feel the triceps contracting. Inhale while bending the elbow to the starting position and repeat.

Form and Precautions: More support may be added for the lower back by kneeling on a bench with one knee. This exercise may also be performed sitting down and leaning forward with a pillow or rolled towel under the torso for added support.

Triceps Dip

Begin by sitting on a bench or wall. Place the arms and hands alongside the body as shown. Slide the body off the bench by walking the feet out a few inches. Make sure to keep the knees slightly bent. Inhale while lowering the body by flexing the elbow joints to approximately a right angle of the elbows. The triceps will resist, control and stabilize this movement. Keep the torso close to the bench and avoid flaring the elbows away from the center of the body. With the hands pressed firmly against the surface of the bench, exhale while engaging the

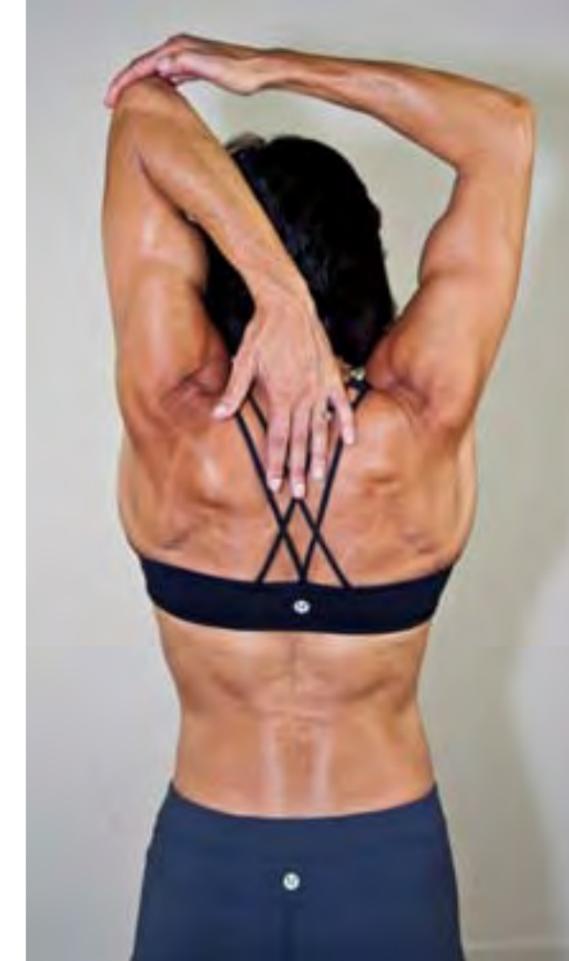
Triceps to extend the elbow joint and return to the straight arm position. This exercise works the pectoral muscles of the chest and the front of the shoulder along with the triceps.

Form and Precautions: Lowering the body far below a right angle of the elbow joint may result in excessive shoulder

work and possible strain and injury.

Variations: Beginners may place an aerobic step, block of wood, stack of books, or Bosu under the body as a safety stop. To add challenge to the exercise, the feet may be placed a variety of higher positions using a second platform or bench. Additional resistance may be added by resting weights on top of the thighs. ■

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

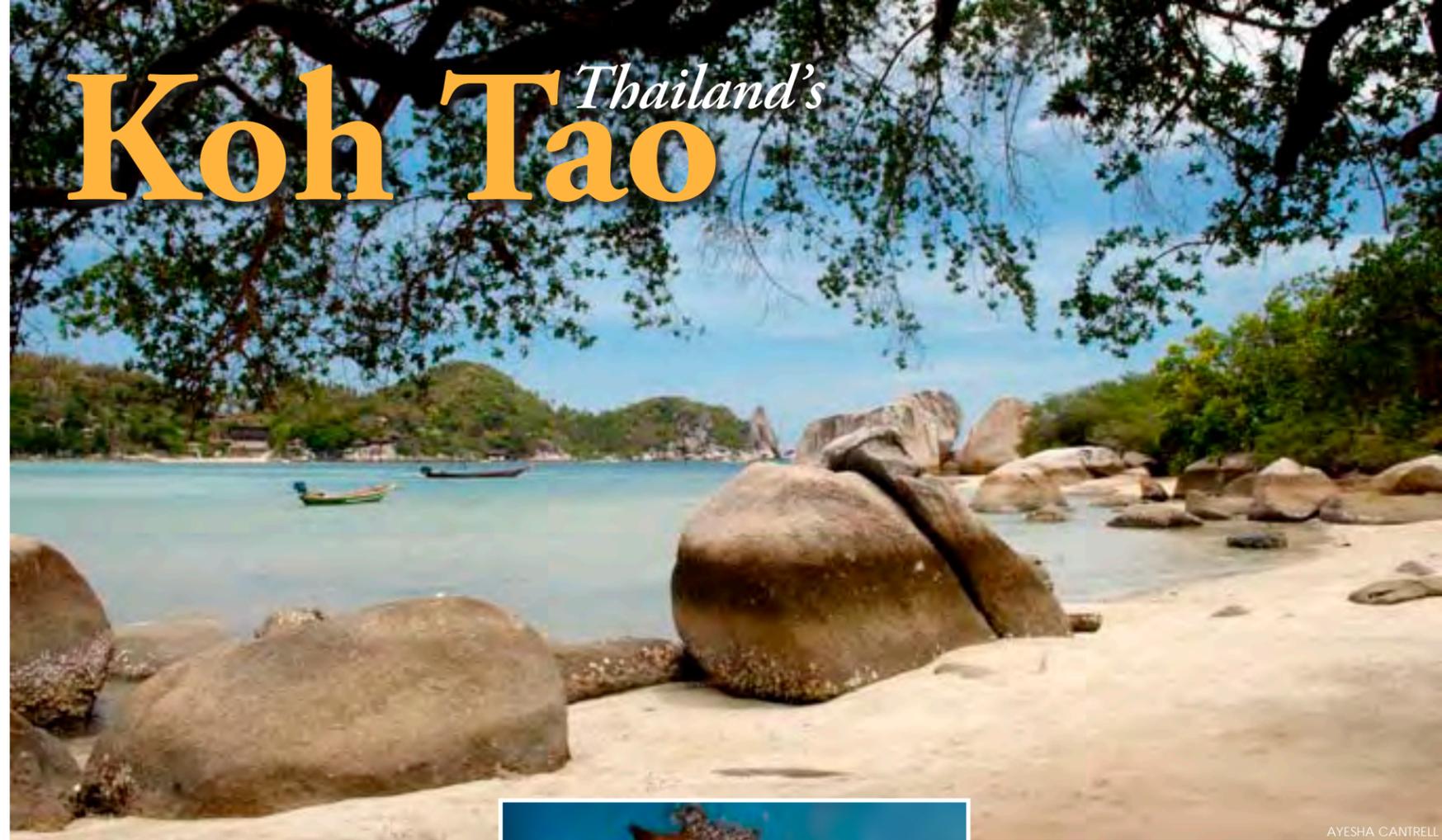
Triceps Dip extended position (left) and flexed position (above)



AYESHA CANTRELL

Barrel sponge covered with segmented worms underneath the mooring line at Chumphon Pinnacle

Koh Tao *Thailand's*



AYESHA CANTRELL

Text by Ayesha Cantrell. Photos by Ayesha Cantrell, Wilco Both and Nick Shallcross

If anyone was to mention diving in Thailand to you, then you would most likely think of one of the west coast destinations. Hardly a thought would be given to the small island of Koh Tao, which lies off the east coast in the Gulf of Thailand. I live and dive here, so I find this lack of attention a little unfair. Yet, it's hardly surprising, as it's largely overlooked by dive travel specialists, and for the most part, dismissed as nothing more than a diver training centre. This apparent lack of appreciation is even more surprising when one



WILCO BOTH

Common seahorse, *Hippocampus kuda*, in the sand off Pottery Pinnacles

considers that the two coasts of Thailand are seasonally almost opposite. When the Similans and Surins are closed and weather plays havoc with conditions at other west coast locations, the east coast is bathed in brilliant sunshine, reflecting off seas the color of that well known blue-bottled gin brand.

Looking out at the ocean at Chalock Ban Khao on the south of Koh Tao

So, which is best? This is an explosive debate for those who haunt the Internet forums. Living here, I'm probably not objective enough to answer it. What I will say is that they are simply different.

University of diving

So, let's get this on the table straight away. The island is home to around 40 dive centers and is a diving hot spot for those looking to learn anything dive related. It's probably one of the few places in the world where you can go to take training in any language with any of the major agencies to any level. It's all here, within walking distance, which makes it similar to a university town for divers only. Surely, this should not preclude Koh Tao from being a dive desti-





NICK SHALLCROSS



WILCO BOTH

CLOCKWISE FROM LEFT: Polka dot nudibranch *Jorunna funebris* found in most numbers at Shark Island; Bluespotted ribbontail ray at White Rock; Bubble coral at White Rock; *Pseudobiceros bedfordi* courting at Twins

nation, too?
I arrived here many years ago to join the scuba fraternity, and I love the diving today as much as I did then. I saw my first whale shark here gliding around

Southwest Pinnacle—a truly awesome experience. I've enjoyed many such encounters here since. The individuals that pass by are usually around four to five meters in length and hardly ever more than two at a time. Koh Tao is not the *seeing-spots-before-the-eyes-splash-fest* for which other dive locations are famed, but it is one of the few places in the world where you might see these leviathans soar past you underwater.

Between a rock and a hard place

Southwest and Chumphon Pinnacle are the deepest sites here and are home to the frenetic reef life activity that you would expect of any open ocean site. Huge malabar groupers rest

languidly at cleaning stations and seem as reluctant to vacate as any armchair aficionado. Schools of pick handle, chevron and yellow-tailed barracuda twist past, fusiliers whirl in a yellow pulsing mass, and jack fish and mackerel stalk the unwary. Batfish shimmer in the current and anemones and their pink inhabitants carpet the pinnacle. What's not to like?

The two sites differ in their topography. Chumphon Pinnacle reminds me of Table Mountain in Cape Town, South Africa, whereas Southwest Pinnacle is a more typical pointy mountain shape. Like the majority of underwater formations here, they consist of boulders of varying shapes and sizes. The island's coastline is made from the same rugged material, which juts, overhangs and leans, making for interesting formations. Underwater, it is more so, creating swim-throughs, majestic pinnacles and plenty of hiding spots for their inhabitants.

The coral reef has grown up and around the boulders, creating pinnacles full of life with coral beds spanning in between. Coral is mainly of the hard type, and

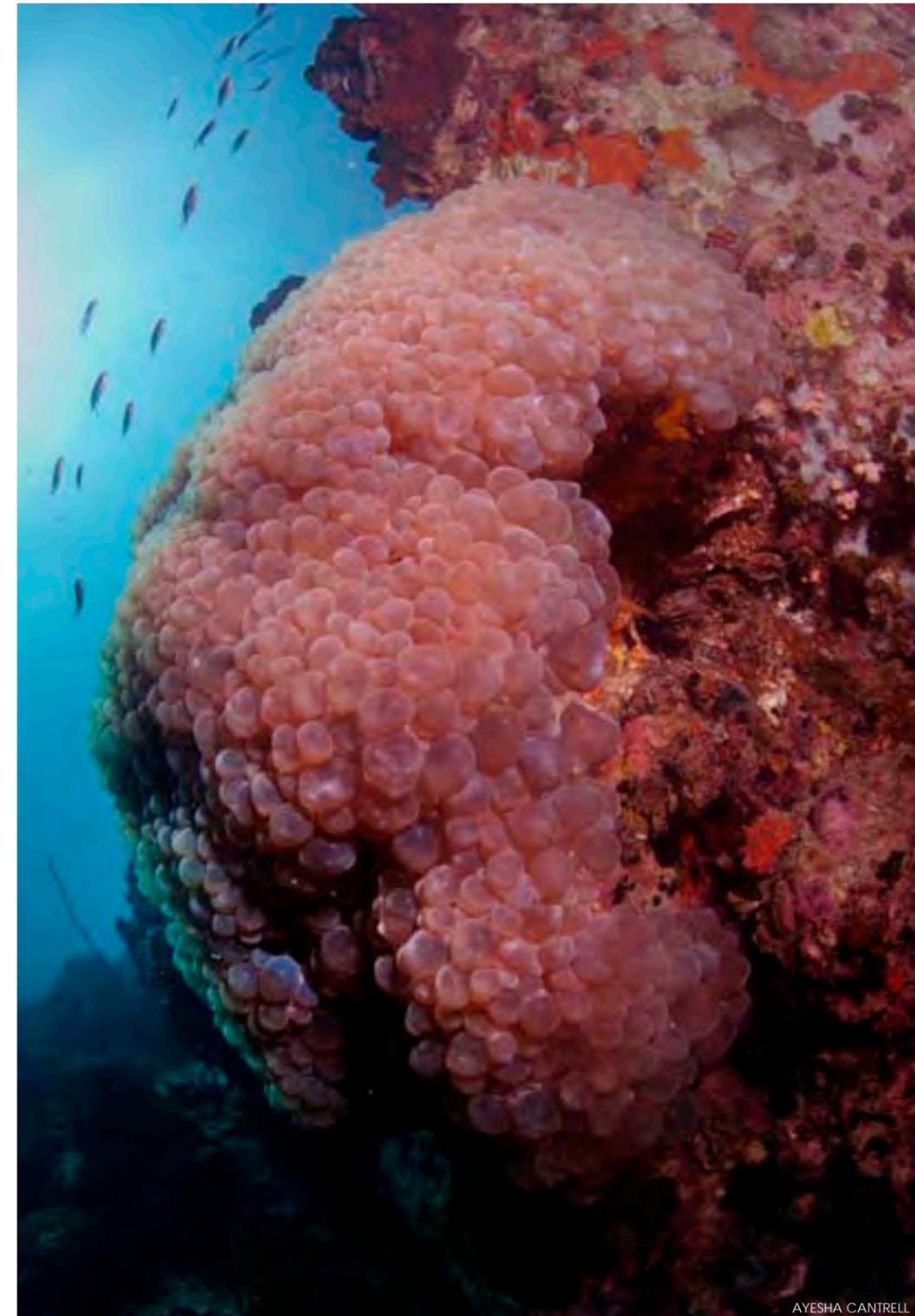
I think that this is one thing that makes Koh Tao different. There are a myriad of different varieties here and some amazing hard coral gardens. Fantastic specimens of staghorn, brain, table, lettuce, knobby, porities, mushroom and slipper coral can all be seen in some great formations making an interesting and varied backdrop.

No matter how breathtaking the coral texture and formations are, it is all the same colour. Is this another reason that Koh Tao could seem lackluster when compared with saturated images of colorful soft coral in other locations? However, splashes of color are added by barrel sponges, with their segmented worms feeding on that which the sponge filters out, and Christmas tree worms adorn coral everywhere in glorious blues, yellows, reds, pinks, greens and variegated, adding a rainbow to the reef. I never tire of watching them hide and slowly emerge. In addition, butterflyfish, parrotfish, angelfish and luminescent moon wrasse are conspicuous against the muted color of the hard coral reef.

What's in a name?

Koh Tao actually means 'turtle island'. It was named for its appearance; from a certain approach, it does indeed look like a turtle. It's simply coincidence

that both the shiny polished green turtle and its somewhat unkempt looking cousin, the hawk-bill, choose to hang out here. Similarly, Shark Island—a small island and dive site that lies to the



AYESHA CANTRELL



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CLOCKWISE: Divers passing overhead at Chumphon Pinnacle; Titan trigger fish, *Balistiodes viridescens*, in attack mode at Green Rock; Comensual shrimp living in an anemone at Junkyard Reef



AYESHA CANTRELL

Koh Tao

underwater world over for its defensive tactics. While titans can be seen or avoided at most sites here, Green Rock is the best place to see their slightly smaller and more passive yellow margin cousin. The sands around the rock are dotted with pits, but do take care, as there are titans around, too.

Green Rock itself is great fun for those who love a good swim-through. It's like a like a block of Swiss cheese, riddled with passages and crooked overhangs—a great place to spot wart slugs and banded sea crates as well.

After dark

White Rock is certainly worth several dive trips and definitely one at night. Its randomly heaped boulders and expansive coral gardens teem with life. Turtles frequent the site, and the eagle-eyed will have fun spotting scorpion fish and nudibranch.

At night, the dive site comes alive



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south—was named for its fin-like shape rather than its inhabitants. This is a great place to find polka-dot nudibranch and one of the only places you will see Weibels butterflyfish schooling.

Koh Tao legend has it that one of the first divers to explore the sites around the island was Italian, which is why we have sites called Red Rock, White Rock and Green Rock. Whether there's truth to this anecdote, I don't know, but it makes for a nice story.

Red Rock and White Rock sit just off the coast of Koh Nangyuan, which is actually a couple of small islands joined by a sandbar off the northwest coast of Koh Tao.

drop-off point for the gentle dive along the coast into Japanese Gardens. This coastline is home to the pink-tailed triggerfish -- a much shyer specimen than its much larger cousin, the infamous titan triggerfish.

The titan trigger is the largest in the triggerfish family and is famed the

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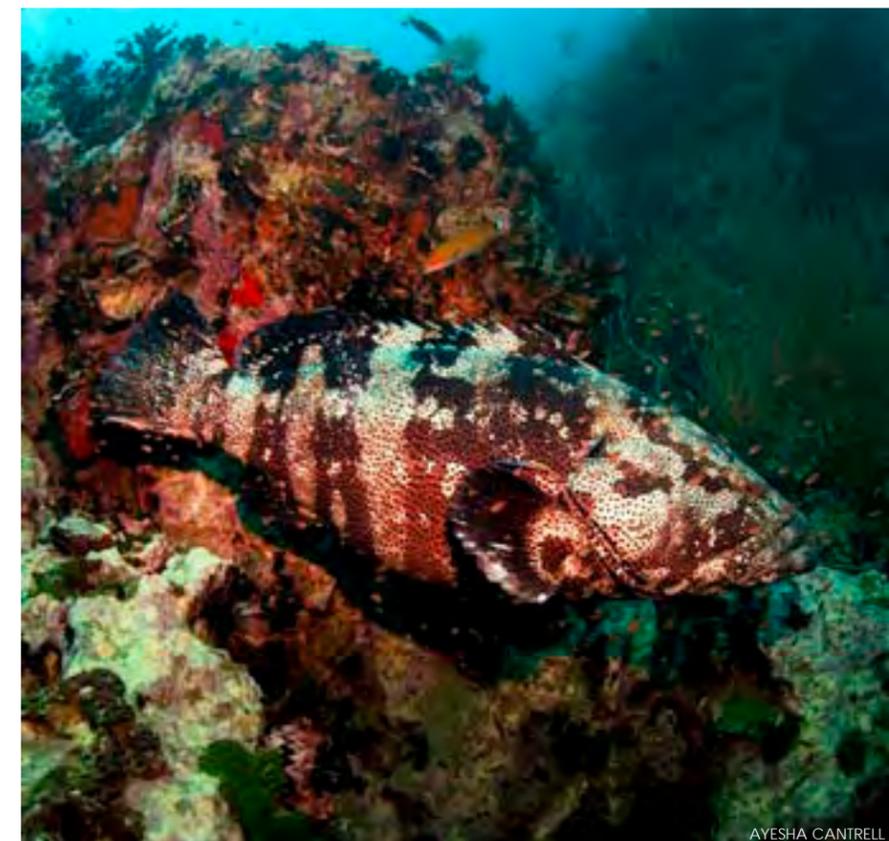
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CLOCKWISE FROM ABOVE: Huge barrel sponge at Shark Island; Amazing hard coral formations at Mango Bay; Orsaki Flatworm, *Maiazoon orsaki*, at Twins; Malabar grouper, *Epinephelus malabaricus*, being cleaned on the west side of Chumphon Pinnacle; Durban dancing shrimp at the pinnacles of Hin Ngam

Longfin bannerfish, *heniochus acuminatus*, can be seen all over Koh Tao

with chevron barracuda hunting by your torchlight, bluespotted ribbontail rays marauding in the sand and multicolored feather stars unfurling and strolling around the reef. For many divers, the opportunity to peer at a sleeping titan triggerfish is a must, and White Rock is where you'll find them tucked up for the night.

Twins is a fun site in the daytime and has been expanded with artificial reef structures designed to give new divers somewhere to practice their buoyancy. At night, it's a cool critter corner. While you are not so likely to see barracuda hunting, you and your buddy will probably be the only divers there. You are likely to see a turtle turn-

ing in for the night as well as a myriad of shrimp, black and white sole, numerous varieties of crabs and a range of camouflaged critters.

Fighting words

Diving has taken me all over the world, yet nowhere else have I encountered fish with the punch

that they pack in Koh Tao. This is not just limited to the triggers, which, to my mind, seem abnormally large versus the specimens I have seen elsewhere.

The farmer damselfish quite often give you nasty nips, as you approach their algae garden

and are as feisty and territorial as a dog with a bone. Watch them driven to distraction when a huge school of juvenile parrotfish scours the reef for food. The cleaner fish and moon wrasse seem to be unable to distinguish divers from





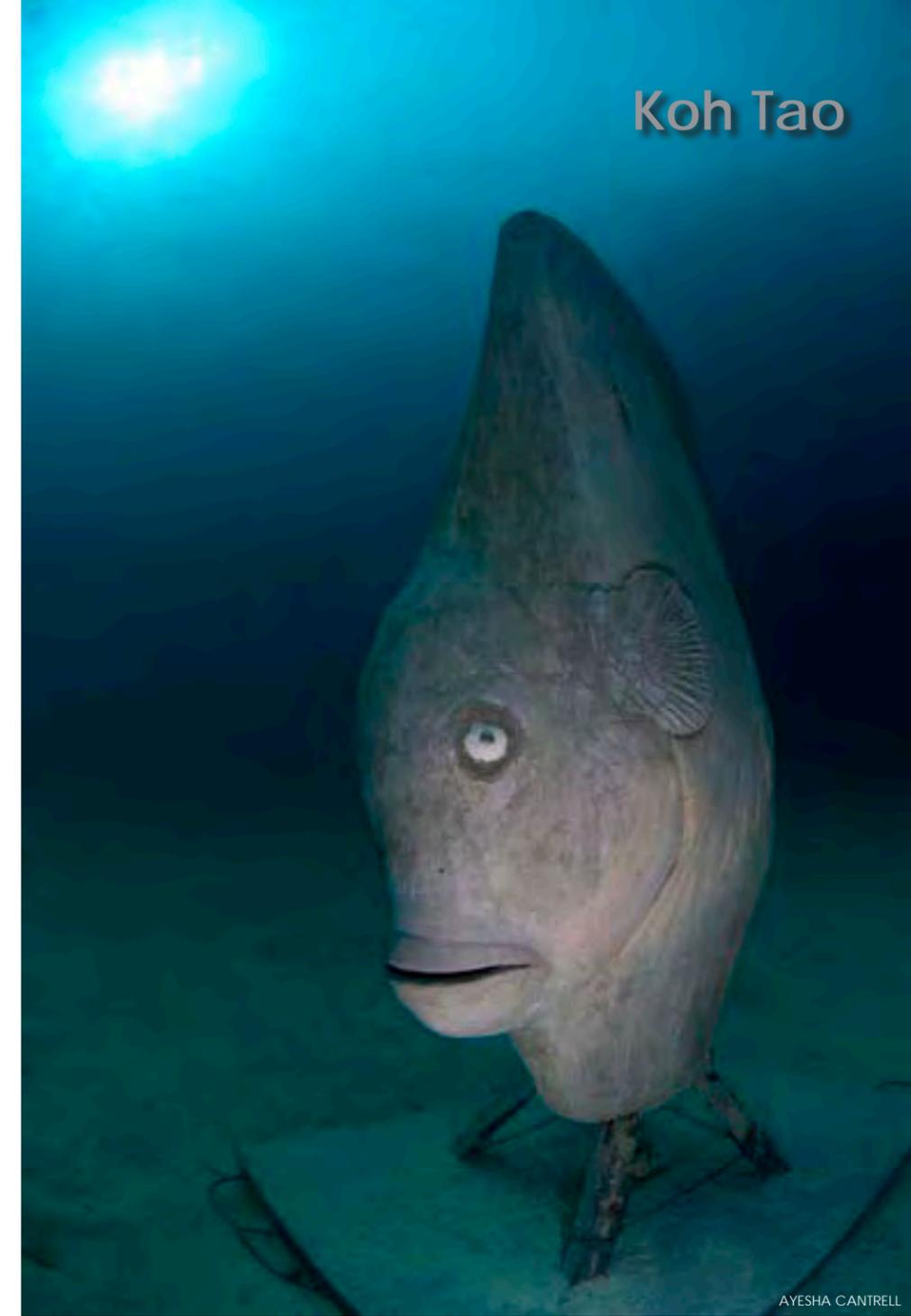
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CLOCKWISE FROM LEFT: Coral nursery structure in Aow Leuk Bay; Saddleback anemonefish and eggs on a discarded bottle off Pottery; Nudibranch *Chromodoris aureopurpurea* on sand close to Pottery Pinnacle; Batfish statue in a buoyancy training area near Koh Nangyuan; Hermit crab at Hin Ngam; Gym equipment, one of the structures at Junkyard Reef

fish; woe betides you if you jump in with any cuts

or scrapes. The saddleback anemonefish will quite literally rear up and headbutt you, and given half a chance, give you a decent nip, too.

While the anemones that cover the reefs are home to the charming pink anemonefish, you have to head out into the sand to find "Nemo". The best place to do this is to depart from Pottery Pinnacle, around the outskirts of Junkyard Reef or North Sairee. You need a guide who knows where he or she is going, but the specimens are fabulous -- you won't be disappointed. Not only will you be blessed with numerous examples, they often have eggs, as well. You can actually see the eyes in these tiny bubbles, and watching the adults nurture them is

mesmerizing.

Around and about, you are quite likely to be treated with some newsworthy nudibranch and flatworms. Pottering around in the sand is usually very rewarding and often turns up filefish, pufferfish, pipefish, mantis shrimp, crabs and even seahorses.

Wrecked

There are many wrecks littering the Gulf of Thailand, but the greater number are in the 50-70m depth range. Koh Tao is the jump-off point for a liveaboard to visit these wrecks, and if you are trained to this depth, then it's a remarkable trip. The WWII USS Lagarto lies in little over 70m of water. She's fully intact and sits upright in warm clear water. There are other wrecks of the same vintage, P.O.W carriers, munitions ships, drill platforms and many more, and the best bit is that they are virtually un-dived.

Don't worry though—Koh Tao has a couple of wrecks in recreational depths. The MV Trident, which is credited for finding many of the above wrecks, was laid to rest to begin a new life as a wreck herself. She was scuttled in September 2010 and is already encrusted with life. She lies in just over 35m of water just to the south of the island. Barracuda and grouper already haunt the vessel, and the small fry that use the wreck for protection are prolific. She can be a more challenging dive. Due to her location, she is prone to current, so make sure you choose a centre that dives her according to local tide tables.



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The most recent metal addition went down in June 2011. The HTMS Sattakut served her time as a landing craft for infantry. Launched in 1944, as part of the U.S. Navy, she saw action in the Pacific Theatre of War before being transferred to Thailand in 1947 for use by the Royal Thai

Navy. She was donated to Koh Tao with the purpose of creating a new dive site and artificial reef. Unfortunately, bad weather hit on the day she was to be sunk. The result was that, not only did she sink in the wrong place, but she was



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CLOCKWISE FROM LEFT: The bow of the *HTMS Sattakut*; Diver and green sea turtle at Hin Pee Wee; Hin Wong Bay on the east coast of Koh Tao; Deck gun (below) on the *HTMS Sattakut* thankfully undamaged while being encouraged to rest upright

also lying on her side in silt. This wasn't exactly the plan!

In late July, efforts were made to move her to her planned destination where she sat upright for less than 24 hours. Clearly, her belligerence was not to be tamed. Thanks to careful engineering, she now sits proudly upright. She is 48m long, has guns both fore and aft, and

lies at a depth of 30m. Fish life moved in quickly, and a large green turtle splits its time between the wreck and the neighboring dive site Hin Pee Wee.

She is perfect for penetration with large clear passage ways and roomy corridors. Most divers tour the wreck then head off from the bow and complete the shallower portion of their dive at Hin Pee Wee. Banded sea snakes

are a common sight here, along with the myriad of usual reefs suspects, and it's a more pleasant way to end your dive versus hanging in the blue.

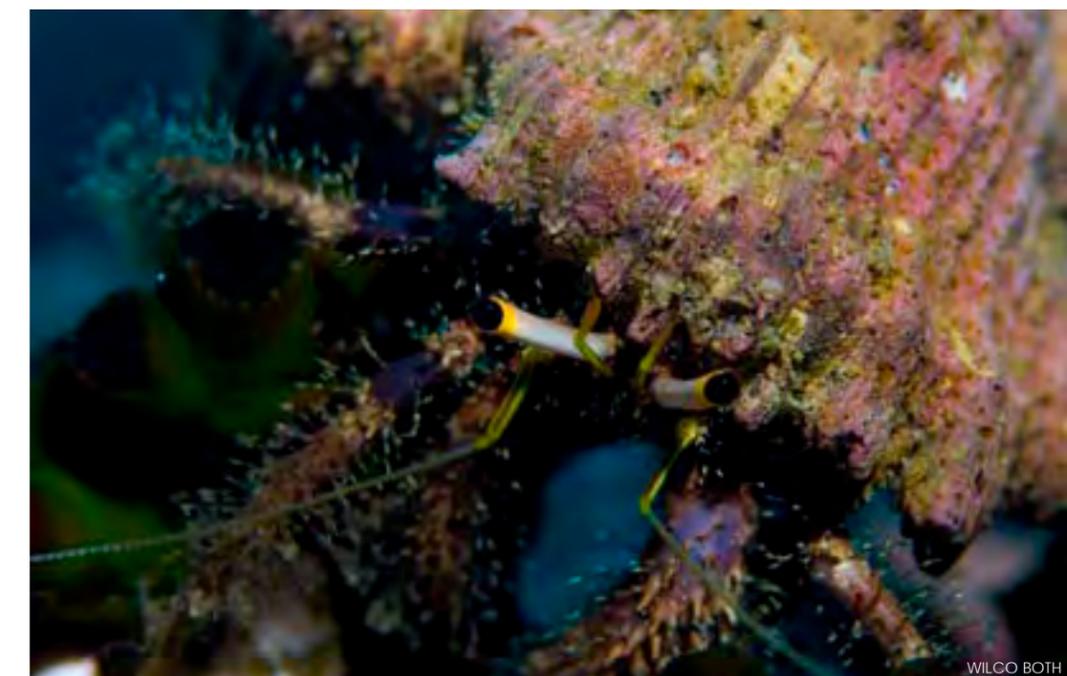
Topside activities

Dive sites are accessed by boat, and the

furthest site is little over 40 minutes away. This means you can make two dives and

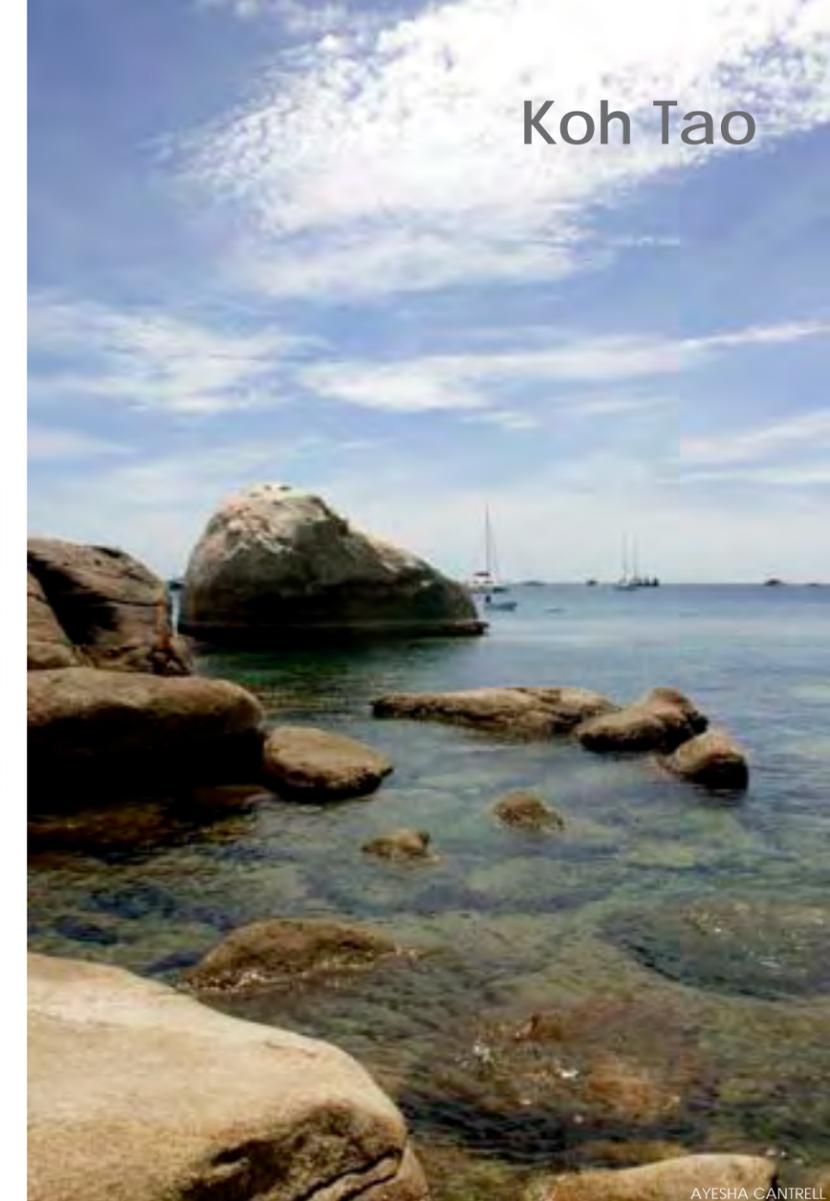


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Hermit crab trying to hide



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Barrel sponge surrounded fairly basslets *pseudanthias* at Chumphon Pinnacle

be on the beach by lunchtime—perfect for those who travel with families or non-divers. There's lots to entertain them, too, so they may hardly notice that you are gone.

Non-diving daredevils will enjoy the flying trapeze school, the island to island zip line, rock climbing and cliff jumping. Beachcombers will enjoy exploring the many bays on Koh Tao, taking a kayak out for a spin to explore the boulder-forged, rugged coastline and plunging in to snorkel and enjoy the ocean sites from the surface. Cooking and massage courses are available as well, spas are

a-plenty, and there's even ten-pin bowling and mini golf. Of course, land-loving travelling companions may just want to relax, soak up the sun and rip through those holiday novels. But there are also opportunities for families to learn about the local environment and how to protect the fragile ecosystems.

Environmental

The bleaching incident that damaged many reefs all over the region a few years ago did impact the reefs on Koh Tao, but not to the extent seen elsewhere. By and large, the reef stood up



SOURCE: MASTER DIVERS

Map of Koa Tao dive sites



Koh Tao

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This could be you at the flying trapeze school in Sairee

well and recovered, leaving the area in comparatively much better condition. A journalist recently asked me about the effect of divers on the environment and in a

concentrated area like Koh Tao, this was probably a valid question. My answer was that the impact was positive. There are many environmentalists on this small rock who tirelessly educate on the issues facing the ocean. Divers cannot fail to

come away with some new understanding of the challenges facing the ocean and what they can do to help.

Over the years, many different environmental projects have been undertaken, from the safeguarding, rearing and releasing of juvenile turtles, to sponsored swims for shark charities. You will find reef and wild life monitoring programs in place, as well as artificial nurseries and artificial reefs, too. These sites have been successful in offering new habitats, growing and transplanting of coral as well as relieving pressure on other sites. If you want to learn and know more about the environment, then the knowledge and experience is here. If not, make sure you visit one of these sites; they're a great place



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Giant hairy hermit crab at Twins





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to spot both the unusual and juvenile specimens.

Bubbles or fish?

With the number of dive centres on Koh Tao, it would be easy to imagine that every dive here is as crowded as the SS Thistlegorm wreck in the Red Sea. While this can happen, visiting outside of the peak months of January, February, July and August will ensure a more peaceful experience. The month of June would be my overall recommendation of when to come. The hottest time of the year March-May has passed and visitor numbers are low. Seas are calm, and the visibility is usually good. As with any dive holiday, choosing the right company to dive with can make or break your holiday, and in this instance, can have a bearing on the number of divers one sees. Look for centres with small boats that guarantee small groups and make an effort to avoid the crowds.

Simple fun

While Koh Tao doesn't enjoy the fame given to locations drenched in colour, it certainly has its merits. It's a great location if you want to take in some of the culture Thailand has to offer such as...

and also spend some time diving. If you trawl destinations looking for somewhere to go that divers and non-divers will enjoy, then Koh Tao should be on your shortlist.

The diving schedule is ideal, and there's plenty to occupy the non-divers as well. If you just like easy diving or want relaxed conditions to practice your



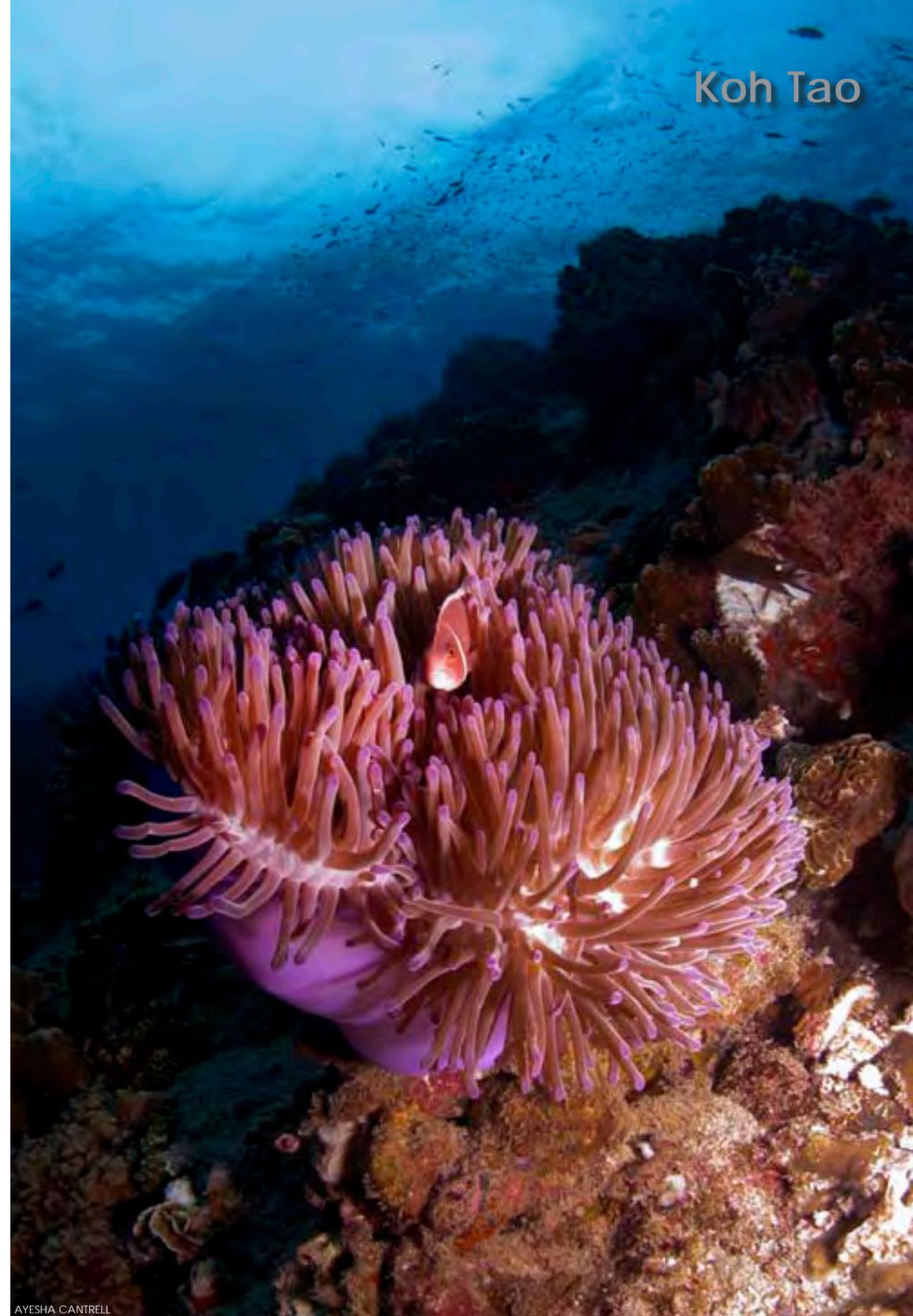
WILCO BOTH



Diver and photographer Ayesha Cantrell

photography, or if you want to learn anything at all, it's perfect. Junior divers and those new to diving will gain some valuable experience without too much challenge, yet still be awed. It's a wonderful location for children to learn to dive, and it won't break the bank either. So, if you fit into any of these groups, be a devil and put this overlooked isle on your shortlist. ■

Ayesha Cantrell is a PADI and SSI Instructor and part owner of Master Divers on Koh Tao, Thailand. She is a passionate photographer, loves writing and amongst other things managed the marketing and blog for her dive centre but given half a chance is underwater with her camera shooting fish.



AYESHA CANTRELL

Pink anemonefish (above) at White Rock; Black blotched porcupine fish (top left) at Pottery; Sea hare *Aplysia dactylomela* at Junkyard Reef (left)

fact file



Thailand



SOURCES: U.S. CIA WORLD FACT BOOK

History In the mid-14th century, a unified Thai kingdom was established. It was known as Siam until 1939. Out of all the Southeast Asian countries, Thailand is the only one that has never been taken over by a European nation. In 1932, a peaceful revolution led to the establishment of a constitutional monarchy. Thailand was allied with Japan during World War II. But in 1954, it became a U.S. treaty ally. Thailand sent troops to Korea and fought alongside Americans in Vietnam. In 2006, a military coup resulted in the overthrow of Prime Minister Thaksin Chinnawat. Since then, turmoil in the government between pro- and anti-Thaksin parties has wreaked havoc in the governing of the country, which was further tested by historic flooding in 2011. In addition, thousands of people were killed and wounded in separatist uprisings in the southern ethnic Malay-Muslim provinces in

2004. These challenges have hampered the plans of constitutional reform of the current government led by the Puea Thai party. Government: constitutional monarchy. Capital: Bangkok

Geography Thailand is located in Southeastern Asia. It borders the Andaman Sea and the Gulf of Thailand, southeast of Myanmar. Thailand is in control of the only land route from Asia to Malaysia and Singapore. Terrain consists of a central plain, the Khorat Plateau in the east and mountainous areas. Coastline: 3,219km. Lowest point: Gulf of Thailand at 0m. Highest point: Doi Inthanon at 2,576m.

Climate Thailand is tropical with a warm, rainy, cloudy southwest monsoon from mid-May to September and a dry, cool northeast monsoon from November to mid-March. The southern

isthmus is always hot and humid.

Water temperature is 28-30°C.

Natural hazards include droughts and subsidence of land in the Bangkok area due to

depletion of the water table.

Environment Thailand suffers from air pollution due to vehicle emissions, water pollution due to organic and factory wastes, deforestation and soil erosion, as well as illegal hunting, which is threatening wildlife populations. Thailand is party to the following agreements: Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Hazardous Wastes, Marine Life Conservation, Ozone Layer Protection, Tropical Timber 83, Tropical Timber 94, Wetlands

Economy Thailand has a well-developed infrastructure and an economy of free-enterprise, with pro-investment policies and strong export industries. It has enjoyed solid growth since 2000 after recovering from the Asian financial crisis of 1997-98. Thai exports, which consist primarily

RIGHT: Global map with location of Koh Tao Island

BELOW: Location of Koh Tao Island on Thailand map



of machinery and electronic components, agricultural commodities and jewelry, make up half the GDP. However, the country felt the effects of the global financial crisis of 2008-09, which severely cut Thailand's exports. Since then, the economy has contracted and expanded, until the historic flooding of Bangkok in 2011 crippled the industrial and manufacturing sector. However, recovery is expected with modest growth in 2012.

Population 67,091,089 (July 2012 est.) Ethnic groups: Thai 75%, Chinese 14%, other groups 11%. Religions: Buddhist (official) 94.6%, Muslim 4.6%, Christian 0.7%, other religions 0.1% (2000 census). Living with HIV/AIDS: 530,000 (2009 est.) Internet users: 17.483 million (2009)

Currency Thai Baht (THB). Credit cards are widely accepted in hotels and dive centres but incur a 3% charge. Exchange rates: 1EUR=40.20THB; 1USD=30.83THB; 1GBP=50.11THB; 1AUD=32.21THB; 1SGD=25.17THB

Language Thai, English (secondary language for upper class), ethnic and regional dialects

Getting There Depending on the departure point, consider flying into Bangkok, Singapore or Kuala Lumpur and then connect to Koh Samui, where one can catch a ferry to Koh Tao. If landing after midday, overnight in Koh Samui and catch a ferry the next day. For those on a budget, overland travel from Bangkok to Chumphon by rail or bus is cheaper. From Chumphon, catch a ferry to Koh Tao.

Visa Passports must be valid for at least six months upon entry. A 30-day visa exemption will be issued upon arrival for holders of Australian, U.S., European and New Zealand passports.

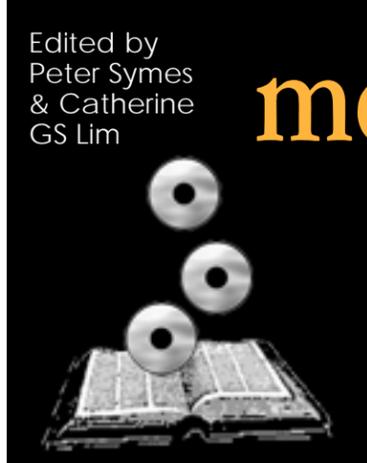
Health There is a high degree of risk for food or waterborne diseases such as bacterial diarrhea; vectorborne diseases such as dengue fever, Japanese encephalitis, and malaria; animal contact disease such as rabies; water contact disease such as leptospirosis. H5N1 avian influenza has occurred in this country but poses a small risk to tourists, those who have close contact with birds (2009)

Decompression Chambers The closest decompression chamber is on the neighboring island of Koh Samui: SSS NETWORK / Samui Hyperbaric Services of Thailand 34/8 Moo 4 Bophut, Koh Samui, Surat Thani, Thailand 84320 Phone: +66 (0)77 427 427 Emergency: +66 (0)81 081 9555 www.sssnetwork.com ■



Sand lizardfish at Japanese Gardens

WILCO BOTH



Beneath the Garden State

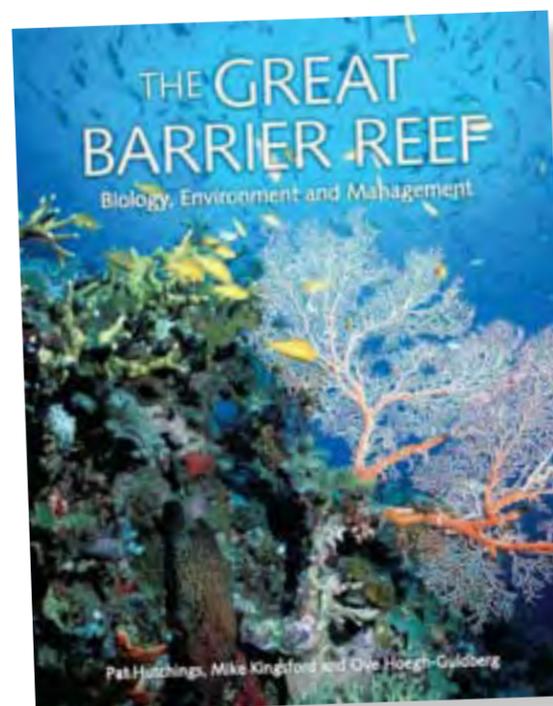
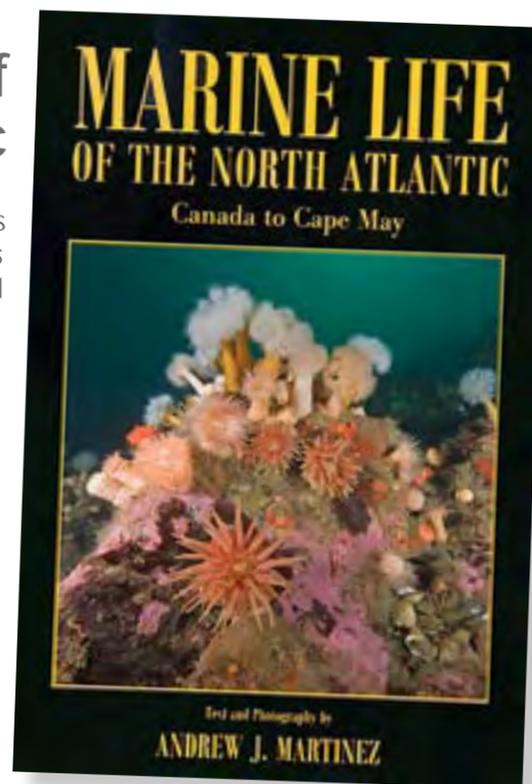
This hardcover 166-page book takes landbound explorers beneath the dark New Jersey waters, introducing them to the rich marine life that resides within. Witness life in the form of the 1.5" long naked sea butterfly, the ever-vigilant monkfish, or a sea star growing new arms. Of course, New Jersey's artificial reefs of cars, army tanks armoured personnel carriers, tugboats and ships are not forgotten. Photographer Herb Segar's affection for the creatures near his hometown shines through every photo. According to him, "The majority of people who live in New Jersey just have no clue what's beneath the water." Well, with this book, now they do.

Hardcover: 144 pages
Publisher: Schiffer Publishing, Ltd.
Publication date: 28 April 2012
ISBN-10: 076434109X
ISBN-13: 978-0764341090

Marine Life of the North Atlantic

This revised edition contains write-ups of 278 species of fish, invertebrates and marine plants found in the coastal northeast Atlantic, from Canada all the way to Cape May, New Jersey. Each write-up covers the species' habitat, range, natural history, etc. The 390 photos aid in the identification, and helps to make this title a must-have for anyone diving in the area.

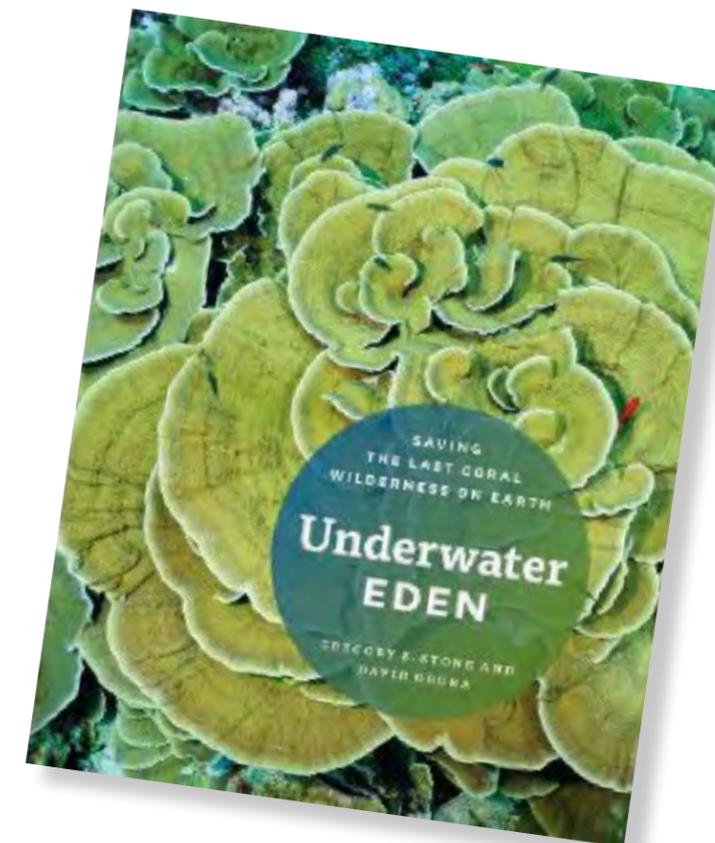
Paperback: 304 pages
Publisher: Aqua Quest Publications
Publication date: 16 February 2011
ISBN-10: 1881652351
ISBN-13: 978-1881652359



The Great Barrier Reef

The Great Barrier Reef is one of the world's greatest natural wonders. Maintaining it in its pristine condition has become more challenging through the years. This book examines the reef's geology and processes, as well as the organisms and ecosystems within it. The contemporary issues of climate change, coral bleaching and disease, and the challenges faced by coral reef fisheries are also discussed in this book. There is also a field guide that helps in the identification of common animals and plants of the reef.

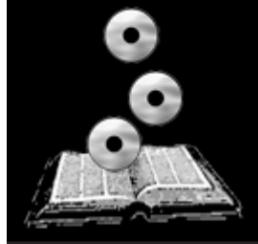
Paperback: 392 pages
Publisher: Springer; 2009 edition
Publication date: 30 November 2012
ISBN-10: 9048180341
ISBN-13: 978-9048180349



Underwater Eden

At an area covering 408,250 square kilometres, the Phoenix Islands Protected Area (PIPA) is the largest marine protected area in the Pacific Ocean. When conservation scientist George S Stone went diving in the waters of the Phoenix Islands, he said, "it was the first time I'd seen what the ocean may have looked like thousands of years ago." Indeed, the corals were healthy, the marine life was abundant... so much so that he and his dive companion David Obura were determined to keep it that way. This book tells the story of how they succeeded in this quest, finding common ground amongst conservationists, businesses and governments, to establish the PIPA, now the largest marine UNESCO World Heritage Site.

Hardcover: 184 pages
Publisher: University Of Chicago Press
Publication date: 21 November 2012
ISBN-10: 0226775607
ISBN-13: 978-0226775609

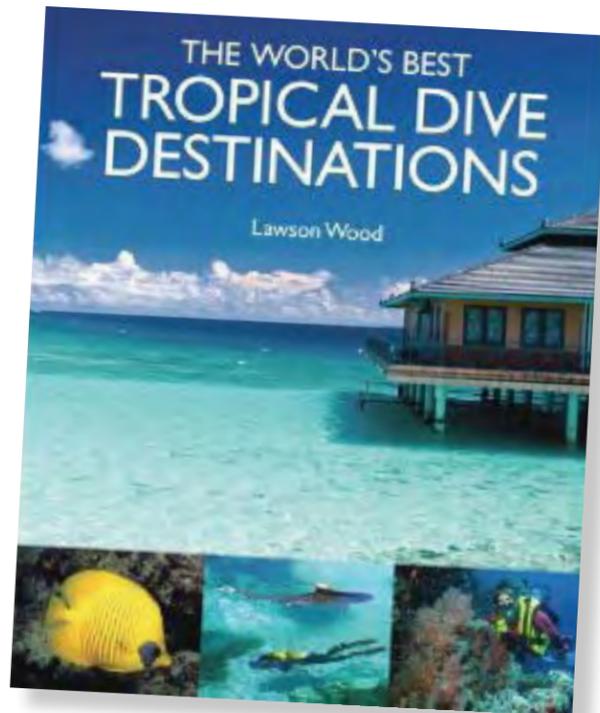


The World's Best Tropical Dives

If you find yourself looking longingly at the cover photo, it's probably time to start planning your next dive vacation.

This book covers more than 275 exotic destinations worldwide, from the Caribbean Sea, Bermuda, the Red Sea, the Indian Ocean, the Indo-Pacific and the Pacific Ocean. Whether you are on the lookout for large humpback whales, swimming alongside large schools of fish, cave dives, muck dives, wrecks, or even liveaboards, this book can point you in the right direction. The descriptions of the dive sites include a regional site map, travel advisory, as well as the type of dive to be experienced and what you can expect to see.

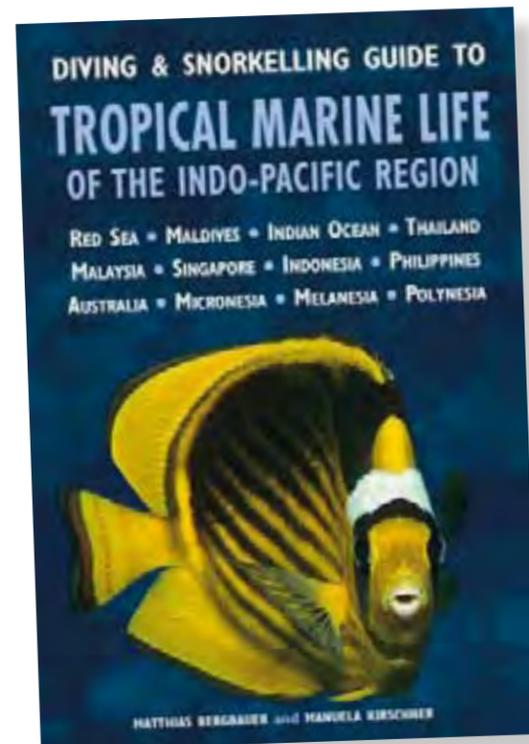
Hardcover: 208 pages
 Publisher: John Beaufoy Publishing Ltd
 Publication date: 4 October 2012
 ISBN-10: 1906780234
 ISBN-13: 978-1906780234



151 Dives

This 460-page book is packed with useful information for divers at all levels. Writer Betty Pratt-Johnson had personally dived at all the dive sites featured, which are found along the coasts of British Columbia and Washington State, ranging from gentle drifts and shallow reefs to plunging drop-offs and current-swept passages. Comprehensive information about the diving conditions is given, including the water salinity, temperatures, visibility, currents, riptides, boats and log booms, marine life and dive flag regulations, etc. For each dive site featured, essential information like its uniqueness, GPS locations, tide and current tables, hazards, facilities, dive shops and tourist information can also be found in the book.

Paperback: 460 pages
 Publisher: Adventure Publishing
 Publication date: 2007
 ISBN: 0-921009-40-2
www.sandhillbooks.com



Tropical Marine Life

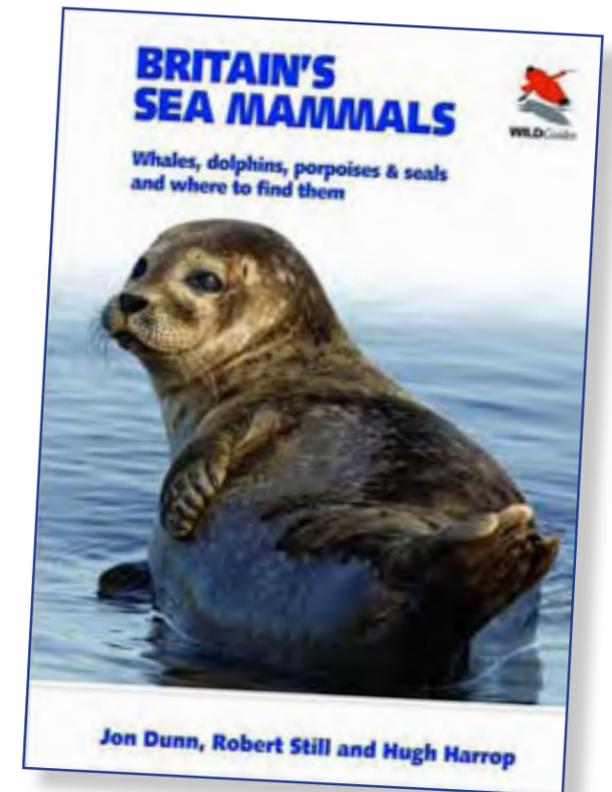
Diving in the Indo-Pacific region can be a tad overwhelming, with the vast range of fish, reptiles, amphibians and invertebrates swimming within. This handy book outlines more than 270 marine species that you may encounter during your dives, listing their characteristics, size and distribution, together with a colour mug shot of the creature. So the next time you are planning a dive in the Red Sea, Southeast Asia, the Great Barrier Reef, Micronesia or Polynesia, be sure to check out this handy guide.

Paperback: 224
 Publisher: John Beaufoy Publishing
 Publication date: 1 November 2012
 ISBN-13: 9781906780555

Britain's Sea Mammals

Arm yourself with this book, a pair of binoculars and a healthy sense of adventure, and you're all set to go on the hunt for Britain's sea mammals. Be it whales, dolphins, porpoises or seals, you'll find the essential details pertaining to the 34 species of sea mammals found in the United Kingdom. The details on animal behaviour, biology, habitat, characteristics and distribution, are tempered with more than 100 photos and about 40 beautiful illustrations. For those new at creature-spotting, there are even introductory chapters on how, when and where to look for these sea mammals.

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Ambon

Maluku's Magical Isle

Text and photos by Don Silcock





Blenny on a sea-whip



Pair of Coleman shrimps on a fire urchin. PREVIOUS PAGE: Octopus in mid-water at the Twilight Zone

Indonesia is a country that can constantly surprise and delight—usually when you are least expecting it! So it was, with my first experience of Ambon back in 2006, when I and a very sad and seasick party of Banda Island-bound divers found our way into the safety of its magnificent natural harbor. We had departed from Maumere in the south some five days earlier, and after two days diving around Alor and other sites along the Lesser Sunda Islands, we headed northeast for the mystical Bandas.

September is a time of changeable weather on the Banda Sea. We encountered heavy seas that made our Pinisi-style liveaboard take on all the characteristics of a cork, as we pounded our way forward into the wind.

Pinisi boats are designed and built for the monsoonal trade winds to carry them along with the wind, not head-on into it. After two days and nights of constant pitching and rolling, we were offered a choice—at least two more days of the same punishment or 18 hours of easier seas by heading due north to Ambon.

The instinct to survive is a powerful one. The decision to abandon the trip to Banda Naira was unanimous, and the next day, we reached the safety of Ambon's harbor.



Porcupine fish watches warily



CLOCKWISE FROM LEFT:
Anemone fish; Inside
Hurikila Cave and superb
sea fans at Pintu Kota on
Ambon's South Coast

Ambon

THE SPICE TRADE

Now known as the province of Maluku, the remote Moluccas with its lush tropical climate and rich volcanic soil was where the exotic spices of cloves, mace and nutmeg first originated.

Today, these and other spices are a common supermarket commodity. But in the 15th century, they were so valuable that they were the driving force behind the Age of Exploration—a 200-year period when the major powers of Europe dispatched their sailing ships to find and control the fabled Spice Islands of the Far East.

Small quantities of spices from the Moluccas had first trickled into Europe via the so-called “overland route” through India and the Arabian Peninsula during the Middle Ages. Initially used by wealthy families to improve the taste of poorly preserved meat, over time, the spices were perceived to offer a degree of protection against the deadly plagues that periodically ravaged Europe, which further inflated their already exorbitant price!

Possibly the first really global commodity, control of the source of the spice supply was the key to enormous profits. The mission given to the ships’ captains by their sponsors, was to find a sea route to the Spice Islands and break the Arab monopoly. In that process, Christopher Columbus discovered the New World of the Americas, Ferdinand Magellan’s expedition circumnavigated the world for the first time, and Vasco Da Gama rounded the Cape of Good Hope at the tip of Africa and established the sea route to the Indian sub-continent.

In terms of their influence on the world economy today, the Moluccas are a mere shadow of their former glory, but are a fascinating place to visit for anyone with a sense of history. ■

as the Indonesian Army moved in to seize control and restore order.

It took well over two years before tempers cooled and order was fully restored, and by 2004, a strong recovery was underway, aided by significant investments into the area by the Indonesian government.

Diving Ambon

Before the troubles, Ambon had an excellent reputation as a remote but first-rate dive location, and the Ambon Dive Center run by Carol Palmer and Sonny Tjandra, had built up a strong and loyal following.

Located about 30 minutes southeast of Ambon City, at a pleasant beach-side location near the village of Lathualat on the Letimar Peninsular, the dive center provided meals and accommodation as well as a base from which to explore the



The Moluccas

Back in 2006, Ambon had just about returned to normal after the “troubles” of 2000 when heavy rioting broke out between the Christian and Muslim populations of the island.

Indonesia has the largest population of Muslims in the world, with some 86 per cent of its total population of almost 250 million following Islam. It also hosts the largest Hindu population outside of India, resident on the island of Bali, and a significant number of Christians on Ambon and in the surrounding Maluku province.

The Christians are a legacy from the 16th century when the Dutch made Ambon their center of operations in the Molluccas, as the area was called then, while they dominated and ran the incredibly lucrative spice trade.

Prior to independence, the Dutch colonial rulers introduced a policy called Transmigration, whereby workers from the densely populated main island of

Java were “encouraged” to work on plantations in Sumatra and other locations. Post-independence, the Suharto regime revived the policy as “transmigrasi” whereby whole families were given financial inducements to relocate from Java to areas such as Ambon and West Papua.

In Ambon, the transmigrasi migrants grew into a significant block of Muslims, who established their own village kampongs alongside Christian ones. The two religions coexisted reasonably peacefully until Christmas 1999, which coincided with the end of the Muslim holy month of Ramadan, when a combination of circumstances came together and were ignited by, of all things, a traffic accident between a Christian bus driver and a Muslim youth.

The subsequent riots and civil unrest escalated into what became known as “the troubles”, and resulted in the area being effectively closed to all foreigners,



LEFT TO RIGHT: Flamboyant cuttlefish; Purple *Rhinopias* at Rhino City; Pair of ornate ghost pipefish

30+ dive sites that Carol and Sonny had identified.

Unfortunately, the riots brought all that to a sad end, and the dive center had to close down in early 2000. When the troubles subsided in 2002, and the military restrictions on the area relaxed, it became possible to dive the area again, but only on the various liveaboard dive boats that work the area on their way to Raja Ampat.

Then in July 2005, expat Englishman Andy Shorten and

his partners took over the lease on the Ambon Dive Centre and reopened the operation as Maluku Divers.

It was Andy whom we contacted after arriving safely in Ambon and had recovered our appetite for the water again. The top of his list of potential dive sites was the Twilight Zone.

The Twilight Zone

Christened by American dive explorers Burt Jones and Maureen Shimlock after a

chance exploration dive in 1994 while waiting to pick up incoming passengers for a trip on the liveaboard *MV Cehili*, the Twilight Zone is the area under and around the aviation jetty at the village of Laha near Ambon's airport.

The jetty was built to allow aviation fuel to be unloaded from tankers for the airport, but has become home to a fleet of fishing boats that work the rich waters around Ambon and southwards into the Banda

Sea.

The Twilight Zone really is a special place and probably the most appropriately named dive site I have ever had the pleasure of visiting—think Alfred Hitchcock meets the Lembeh Strait.

The black volcanic sand is covered in a dense mixture of organic and inorganic waste,

while above, the fishing boats moored alongside each other block out the sun, as their diesel generators create a steady but penetrating deep throbbing noise.

The inorganic debris is a mixture of car tires, filing cabinet drawers and other assorted flotsam and jetsam, which has been discarded over the years



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CLOCKWISE FROM FAR LEFT: Beautiful Seahorse; Above water at the Twilight Zone; Maluku Divers guest bungalows; The restaurant area at Maluku Divers



and created an underwater junkyard. The organic waste comes from fish carcasses, which are simply thrown over the side of the fishing boats after their crews have cleaned and filleted their catches for shipment to Bali.

The junkyard is now home to an amazing assortment of critters, fish and the most numerous moray eels I have personally ever seen in one location. The whole population is well fed from the fish carcasses.

We dived the Twilight Zone several times. I was so impressed that I arranged to spend four days with Maluku Divers

the following year when I went back to Ambon in transit to the Banda Islands. Operating as it did from the old Ambon Dive Center on the Letimar Peninsular meant regular crossings over the wide harbor to get to the Twilight Zone as well as other sites on the western side of the bay.

It has to be said that the dive center was really showing its age. Nonetheless, I very much enjoyed the diving and saw a really great selection of critters.

The new Maluku Divers

Let's fast forward to 2011 and a chance encounter with Andy Shorten on Facebook, who regaled me with stories about all the new sites they have found now that Maluku Divers had migrated across the harbor—just down the shore from the Twilight Zone!

I just had to go back. So, in December I did just that, spending ten days diving both the old and the new sites and greatly enjoying the new resort, with its very nice restaurant, large dedicated camera preparation room and well-



appointed rooms.

The resort is run by Dutch expatriate Marcel Hagendijk and his crew of experienced Ambonese, who are, to his great credit, a well-balanced mixture of Muslim and Christians all very well versed in the basic requirement to get on well and ensure that the guests get to see what they came for.

Critter dive sites

Twilight Zone. No discussion about diving Ambon can be complete without reference to this unique site and, in particular, the photographic opportunities here. The jetty can be thought of as the epicenter of about 100m of sloping sandy shoreline around a small sheltered bay, which offers protection for both the ships at anchor and the critters that inhabit the netherworld beneath the surface.

The thing that is really special about the Twilight Zone is that it is really two





Blue ribbon eel



sites—the mother of all muck sites most of the time, and then around midday, it transforms itself into a kind of unique and eerie wide-angle photography studio where you can practice all those techniques you’ve read about.

For a couple of hours around noon the bright Indonesian sun is overhead and sends beams of light down through the

gaps in between the moored fishing boats and around the jetty itself. This intense light seems to excite the large resident shoal of silversides, which normally hide away under the jetty. They stream around the pillars of the jetty and out underneath the fishing boats.

A similar thing seems to happen with the large colony of catfish, who also get a little agitated and start to do things out of character. This provides excellent wide-angle photo opportunities.

Then, there are the moray eels who come out of their daytime hideaways, seemingly disturbed by all the commotion and provide excellent foreground subjects for the creepy background. Add in all the other larger critters such as scorpionfish and stonefish, and one can understand why midday at the Twilight Zone is one of my favorite places—not just in Ambon, but in Indonesia. It’s that special!

At night, the sight transforms again as the fish and critters active during the daytime settle down for the night in their hiding holes, and the nocturnal predators emerge. Extra care needs to be taken at night, as there are so many potentially stinging and poisonous things to kneel on such as stonefish, a profusion of scorpionfish—including lots of the Ambon variety—dozens of urchins around the junkyard area, and of course, the morays, which may be out foraging.

Sea whip crab (left); Leaf scorpionfish (bottom right); Cuttlefish in warning display (center)

West side of Ambon Bay. Maluku Divers have now identified a total of 18 sites on the west side, huge bay that forms Ambon’s natural harbor, starting with Mimic Point in the north, near the newly identified “shipwreck”, and ending in the

south at Bata Badiri. Many of the sites are named after the specific critters that are found there—such as Mandarin City on the edge of the Twilight Zone, or one of my other favorites—Rhino City. Dive master Marcel Hagendijk

Ambon





LEFT TO RIGHT: A tiny blenny blends in; Saron shrimp at Amahusu; Moray eel peers from its lair; Diminutive orangutan crab

and his team dive all these sites regularly and know the current status of what is there depending on the time of year, as water temperature directly impacts what critters are around, and will adjust the diving program around the specific things you want to see.

The area around the village of Laha, where Maluku Divers is located, is a particularly "target-rich" environment for critter spotters and photographers.

Besides the Twilight Zone itself and Mandarin City, there is Laha itself, which hosts a variety of things to see, and Rhino City, which has been known to have up to six resident *Rhinopias* scorpionfish at certain times of the year. It was down to "just" three when I was there!

East side of Ambon Bay. There are less sites on the east side of the bay, with a total of

seven identified and dived regularly, with Amahusu and the nearby Dark Blue Jetty being the most prolific.

Amahusu, with its resident colony of very photogenic Saron shrimps, was my personal favorite. These shrimps, which are rarely seen, make excellent photo subjects with their Captain America stars and stripes liveries!

The diving at all of the sites on both the west and east sides requires much the same diving discipline, as they are all located on the fairly steep slopes of the bay. So, care is needed with buoyancy skills to make sure you can hover above your subject matter. Plus, there are often strong currents running in the bay, which need to be heeded.

The shipwreck

I love critter diving as much as anybody,

but after several days of macro photography, I found myself gazing longingly at the wide-angle lenses in my camera bag. The quickest way to satisfy that urge in Ambon is a dive on the mysterious "shipwreck" located on the western side of the bay close to the state oil company Pertamina's main jetty.

Marked by a large but rather rusty buoy attached to the stern, which is in just 12m of water, the wreck is 100m in length and lies facing down the slope of the



harbor with its foredeck at 32m and the bow in over 40m. Very little was known about the wreck, but as with many things in Indonesia, there were no shortage of



Coral crab; Ornate ghost pipefish (far left); Beautiful paddle-flap scorpionfish at Rhino City (center)

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explore. One large exit hosts some very luxuriant gorgonian fans and sea whips, which can be showcased against the blue water from above.

Both Pintu Kota and Hurikila Cave are must-do dives and the minimum sites you should consider along the south coast. But, there are a total of ten other sites identified sites that are possible to dive

on a day boat.

Afterthoughts

All in all, Ambon offers a terrific combination of probably the best critter diving anywhere in Indonesia, apart from the Lembeh Strait, together with an interesting shipwreck and some great coastal dive sites. Add in the excellent new Maluku Divers resort, plus the unique spice trade history, and it's easy to understand why it is so high on the "bucket list" of places to experience in the vast archipelago that is Indonesia. ■

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rumors and tales about it.

One such story was that the wreck is the remains of a Dutch cargo ship scuttled deliberately during WWII to prevent it from falling into Japanese hands, while another is that it was bombed and sunk by a single bomb dropped down its funnel by a (very good) mercenary pilot during civil strife in the 1950's.

Dive master Marcel Hagendijk is a wreck fanatic and conducted a series of penetration dives inside the shipwreck. He found a plaque in the engine room that identified the ship as the *Duke of Sparta*, built in 1940 at the William Gray shipyard in West Hatlepool in the north-east of England. Sold in 1951 to the Grimaldi brothers in Naples, the *Duke of Sparta* was renamed the *SS Aquilo*.

Marcel established that the ship was bombed in Ambon's harbor during Operation Haik—a clandestine Cold War CIA operation against Indonesian communist rebels in 1958.

The initial bombing did significant damage to



dust off the wide-angle lenses, is a trip along the south coast to Pintu Kota and Hukurila Cave.

Pintu Kota means Gate of the City, in Bahasa Indonesia, and is located on a small headland about an hour's boat ride along the south coast from the entrance to Ambon's harbor. It gets its name from the several large archways that honeycomb the headland. The archways create an impression of large doorways that lead into a huge inner cathedral-like chamber.

Underwater, there is a very large archway at 17m that mirrors the ones above water. This archway and the healthy surrounding reef and clear blue water, combined

with the overall ambience created by the streams of sunlight penetrating down through the above water chambers, create a wonderful environment in which to use your widest wide-angle lens.

Hurikila Cave is further east along the coast from Pintu Kota and is another small honeycombed headland, which hosts a particularly interesting twisting chimney that is best entered from the top. The large passageways provide several interesting photo-opportunities with large sponges and archways against which to frame your model.

At the bottom, there are three exits to

the *Aquilo*, but not enough to sink her. It was another month before she finally went down on May 27.

The shipwreck being located in the harbor meant that visibility was not that great and varied between 10-15m. But the wreck is still very much intact, and all its features are clearly identifiable. Soft and hard corals have grown abundantly on the wreck, making it a very nice alternative dive if you are a little crittered out.

The south coast

Another good antidote to an excess of critter diving, and an excellent excuse to



Inside Hurikila Cave on Ambon's South Coast



Stonefish



fact file



Indonesia



SOURCES: US CIA WORLD FACT BOOK, SCUBADOC.COM, E-MED.CO.UK

History In the early 17th century, the Dutch began to colonize Indonesia. During WWII, the islands were occupied by Japan. After Japan's surrender, Indonesia declared its independence, but four more years passed with intermittent negotiations, recurring hostilities, and U.N. mediation before the Netherlands let go of its colony. Home to the world's largest Muslim population, Indonesia is the world's largest archipelagic state. Its government faces several challenges including alleviating poverty, preventing terrorism, consolidating democracy after 40 years of authoritarianism, reforming the financial sector, eradicating corruption, halting human rights violations by the military and police, and controlling avian influenza. Indonesia reached a historic peace agreement with armed separatists in Aceh in 2005, which led to democratic elections in December 2006. In Papua, a low intensity separatist movement continues to confront Indonesia. Government: republic. Capital of Indonesia: Jakarta. Main city of Ambon: Ambon City.

Geography Indonesia is located in Southeastern Asia. It is an archipelago between the Indian Ocean and the Pacific Ocean, which consists of 17,508 islands, of which 6,000

are inhabited and the country is approximately three times the size of Texas. Indonesia straddles the equator and has a strategic location along major sea lanes from the Indian Ocean to the Pacific Ocean. The terrain is mostly coastal lowlands with interior mountains on the larger islands. The lowest point is the Indian Ocean at 0m, and the highest point is Puncak Jaya at 5,030m.

Climate Tropical, hot and humid. Temperatures range from a high of 31°C (88°F) to 25°C (78°F) low. Highlands are cooler and drier. Lowlands along the coast are pleasantly drier than the main tourist areas in the south. Monsoons: the dry season takes place April through November, and the wet season, December through March. Natural hazards include occasional floods, severe droughts, tsunamis, earthquakes, volcanoes and forest fires.

Economy Indonesia is a vast polyglot nation, which grew an estimated 6.1% and 6.4% in 2010 and 2011, respectively. The government made economic advances under the first administration of President Yudhoyono

RIGHT: Location of Ambon on global map
BELOW: Location of Ambon on map of Indonesia
BOTTOM RIGHT: "Deep Throat"



Indonesia's credit rating to investment grade in December 2011. Indonesia still struggles with poverty and unemployment, inadequate infrastructure, corruption, a complex regulatory environment, and unequal resource distribution among regions. The government in 2012

(2004-09), introducing significant reforms in the financial sector, including tax and customs reforms, the use of Treasury bills, and capital market development and supervision. During the global financial crisis, Indonesia outperformed its regional neighbors and joined China and India as the only G20 members posting growth in 2009. The government has promoted fiscally conservative policies, resulting in a debt-to-GDP ratio of less than 25%, a small current account surplus, a fiscal deficit below 2%, and historically low rates of inflation. Fitch and Moody's upgraded

faces the ongoing challenge of improving Indonesia's insufficient infrastructure to remove impediments to economic growth, labor unrest over wages, and reducing its fuel subsidy program in the face of rising oil prices.

Population 248,216,193 (July 2011 est.) Ethnic groups: Javanese 45%, Sundanese 14%, Madurese 7.5%, coastal Malays 7.5%, other ethnic groups 26%. Religions: Muslim 88%, Protestant 5%, Roman Catholic 3%, Hindu 2%, Buddhist 1%, other religions 1% (1998) Internet users: 16 million

Language Bahasa Indonesia is the official language and is a modified form of Malay. Other languages spoken: English, Dutch, local dialects (Javanese is the most common)

Health Be prepared and get your shots before you go to Indonesia. There is a high degree of risk for food or water-borne diseases including bacterial and protozoal diarrhea, hepatitis A and E, and typhoid fever. There is also a risk for vectorborne diseases in some locations. These diseases include dengue fever, malaria and chikungunya. Bird flu, or highly pathogenic H5N1 avian influenza, has been identified among birds in Indonesia. It poses a very low risk, but check with your doctor before you go.

Environmental Issues Deforestation, sewage, industrial water pollution, urban air pollution, forest fire smoke and haze

Visa Travelers from most Western countries do not need a visa and are automatically given a 30 day stay permit upon arrival. Passports must be valid for at least six months upon arrival in Indonesia. Indonesian immigration is very strict. No work is permitted while visiting on a tourist visa.

Indonesian Law Very hard on drug offenders; the death penalty is regularly applied on narcotics couriers.

Driver's License A valid international driving license is required. Rental car insurance is

highly recommended. Drive carefully. Traffic rules are not followed as well as in the West. Accidents are frequent.

Currency Indonesian Rupiah (IDR). Exchange rate: 1EUR=10,002 IDR; 1USD=9132IDR; 1GBP=14537IDR; 1AUD=9,500IDR; 1SGD=7,316IDR. Credit cards are accepted by most higher end resorts and businesses. Payment in U.S. dollars and traveller's checks is widely accepted.

Decompression Chambers

Ambon. Rumah Sakit Angkatan Laut (RSAL) Halong, Ambon Tel. 62-911-52152
Bali. Sanglah General Hospital, USUP Sanglah Denpasar, Jl. Diponegoro, Denpasar 80114 Bali Tel. 62-361-227911 www.sanglahbalihospital.com
Jakarta. Rumah Sakit Angkatan Laut (Navy Hospital) Mintoharjo in Jl. Bendungan Hilir No.17, Central Jakarta. Tel. 021-5703081

Web sites

Indonesia Tourism www.indonesia-tourism.com
Maluku Divers Divingmaluku.com



—ed. Our features editor, Robert Osborne, interviewed freediving champion Stig Åvall Severinsen for an insightful look into the man and the philosophy that underlies his success as well as forms the basis of his recent book, *Breatheology*—the Art of Conscious Breathing.

Text by Robert Osborne
Images courtesy of Stig Åvall Severinsen

Freediving is easy. All you have to do, according to freediver extraordinaire, Stig Severinsen, is “learn to hold your breath as long as you can”. Simple.

But it becomes a little more complicated when you set out to turn what most of us do when we’re fooling around at the bottom of the pool into an almost mystic disci-

pline, which has allowed Severinsen to break long-standing records and win world championships. So, how does Severinsen manage all that? Well, in the words of the Bard, “There’s the rub”. Severinsen accomplished this by transforming a sport into a personal philosophy.

Severinsen discovered he could use meditation to decrease his physical need for oxygen, a kind of mind over body approach. And once he’d perfected that, he began to see the potential for his methods beyond the world of freediving—it could inform an entire philosophical approach to life. “For me, breath holding work is ‘walking the talk’ of human potential. It’s more of a metaphor for what’s possible in life.”

And where did this obsession with what he calls “underwater meditation” begin? Where it begins for most of us, sinking to the bottom of his family’s backyard pool when he was barely able to walk—and holding his breath.

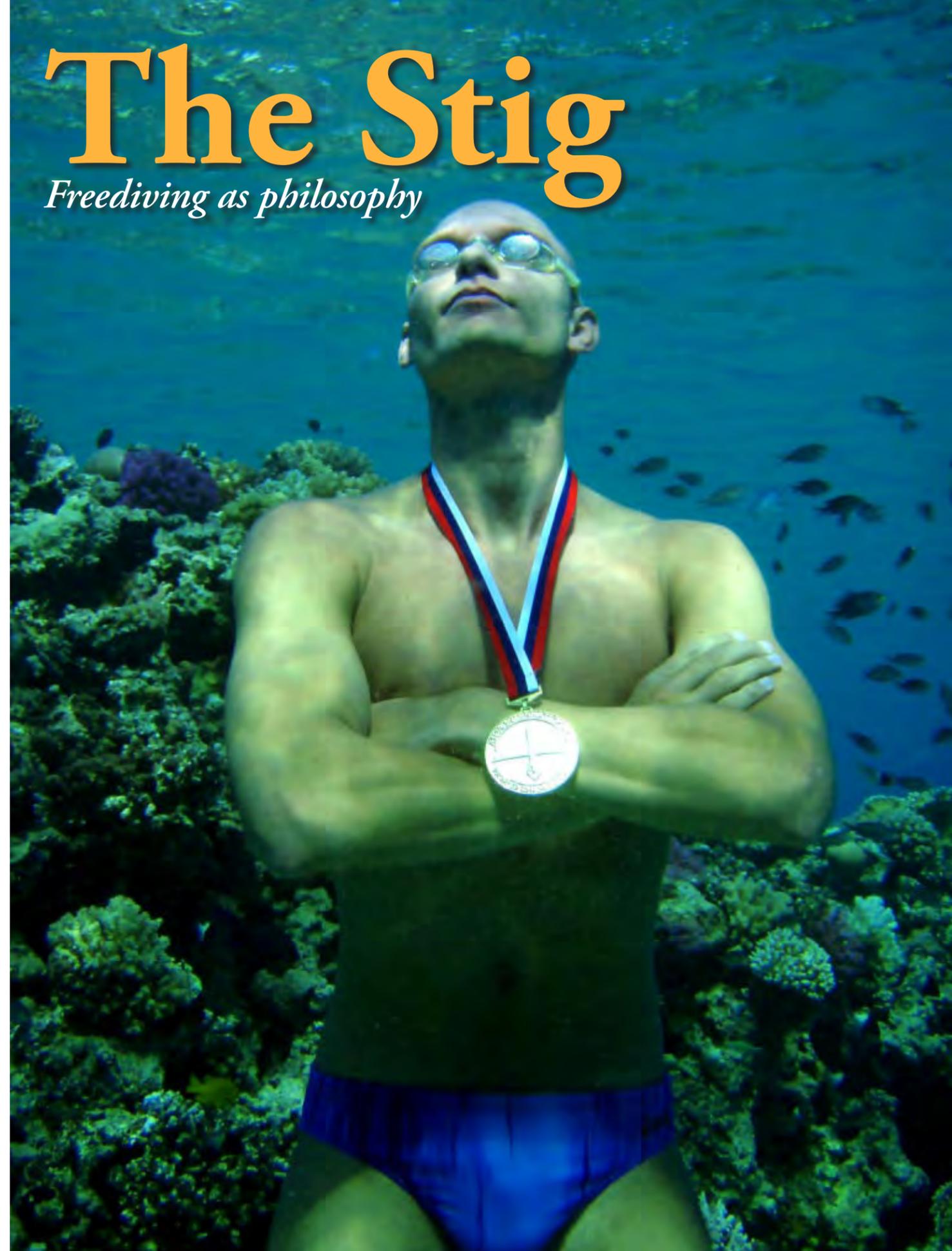
History

Severinsen was born in Aalborg, Denmark, in 1973. Family lore has it that his connection to the sea began literally in the womb—“I was conceived on a boat,” he laughed. Regardless of whether that anecdote is family fact or revisionist history, Severinsen said he has always had a love of the sea and has always felt quite at home underwater.

By the time he’d turned six, he was competing as a swimmer at school. From the age of nine he was a champion, winning Danish National Championships four years

The Stig

Freediving as philosophy





sounded a deep inner note in Severinsen's psyche. Breath-holding dives not only became a challenge to him physically—for the driven young man—it "became a way of getting away from myself". In order to become really accomplished at the sport, he would learn to "relate more to my heartbeat than my brain functions".

from this ancient practice onto the elegant challenge of freediving. The results were impressive.

Championships

Between 2000 and 2007, he won no fewer than four freediving world championships: a gold medal in Switzerland in 2005, gold in Egypt in 2006 and a double gold in Slovenia in 2007.

He also set several world records—among them, a freedive in 2007 to 186 meters without using a set of fins to propel himself. That same year, he set another record by swimming 225 meters distance on one breath.

More recently, he wrote himself into the 2010 Guinness Book of World Records by being the first person to swim 72 meters under the ice without the use of an exposure suit. In 2012, he broke another

er record by becoming the first human being to hold his breath for 22 minutes.

Anyway you measure it, Severinsen's combination of yogic breathing and freediving has been enormously successful.

Interestingly, despite being a freediving world champion, Severinsen said he still suffers the same anxieties as any kid holding his breath at the bottom of the pool. "Of course, I still feel that burning desire to head for the surface, but I've trained myself to let the diving response kick in." His belief that feeling fear is inescapable but controlling that fear is quite achievable has become a personal doctrine and a metaphor for life.

Paying it forward

In 2010, Severinsen began to look for another "mountain" to conquer. Given



ing all of his time with his head underwater. In the midst of all that activity, he somehow found the time to complete a master's degree in biology and then added a Ph.D. in medicine for good measure.

It goes without saying that most people would look at what Severinsen had accomplished by the age of 27 and think that it was already an impressive career. But it was only the begin-

Meditation

Initially unaware it was even happening, freediving for Severinsen became a form of meditation. He trained himself to slip into a state in which his brainwaves were operating on the alpha level instead of on the more active beta level. Essentially, Severinsen said he was learning to mimic the "mammalian dive reflex", which whales and sea lions use instinctively. By dropping himself into that alpha state, he lowered his entire body metabolism—thus using less energy and less air. More than anything, Severinsen credits the ability to achieve this state of mind to his phenomenal success as a freediver: "It's more important to go into this state for long or deep dives than to have huge capacity in your lungs."

And just how was Severinsen able to descend into this alpha state while floating in the ocean inhaling massive quantities of air while preparing for what many might describe as nothing less than a horrifically deep dive? Well, in the late 90's, Severinsen had started to study yoga. And yoga became his secret weapon. He transposed the breathing and meditation techniques he learned

ning of Severinsen's aquatic vocation. As it turns out, his early accomplishments would be a pale shadow of what would come next.

In the year 2000, Severinsen discovered the challenging world of competitive freediving. On top of the physical challenges of the sport and the adrenaline rush it offered, the challenge of controlling the most basic of impulses—breath—

in a row. By 1993, his powerful obsession with the water progressed to a different venue. Now at university, Severinsen began playing underwater rugby, ultimately becoming part of the Danish National Team. A few years later, while studying at the University of Barcelona, he joined the Spanish National Underwater Hockey Team.

But clearly Severinsen wasn't spend-





they could accomplish parallel feats in their own personal venues.

The book

Ultimately, Severinsen's approach to transcending mental limitations was put together in a book. Originally published in Denmark, *Breatheology—the Art of Conscious Breathing* explains his belief that any one of us can do what he's done: create a link between the mind and body through proper breathing and drive the self to achieve much more than we ever thought possible. The book was a best-seller and went on to be published in English, Chinese, Spanish and Russian; Arabic and Portuguese versions are in the works.

The philosophy also has a website: Breatheology.com. And Severinsen has recently created a brand new online platform called Breatheology Academy, which gives people

instant 24-hour access to training via video exercises.

Certainly, the whole idea seems to have caught fire. Severinsen is on the go virtually 12 months of the year, hopping around the globe, giving talks and running workshops on Breatheology. In a single week he'll fly between Spain and Hong Kong and the United States—all to promote his concept. His ultimate goal—to have the book translated into as many languages as possible and to have as many people as he can benefit from what he believes is a powerful life tool. Breatheology has taken over his life.

As for freediving, Severinsen simply no longer has the time to compete on the world championship circuit. What training time he does have he devotes to working on achieving still greater underwater breath-holding world records. It seems that having shown thousands of people how to transcend their limitations, he's run into one of his own—time. ■

Features editor Robert Osborne is an internationally published dive writer, television producer and reporter based in Toronto, Canada.

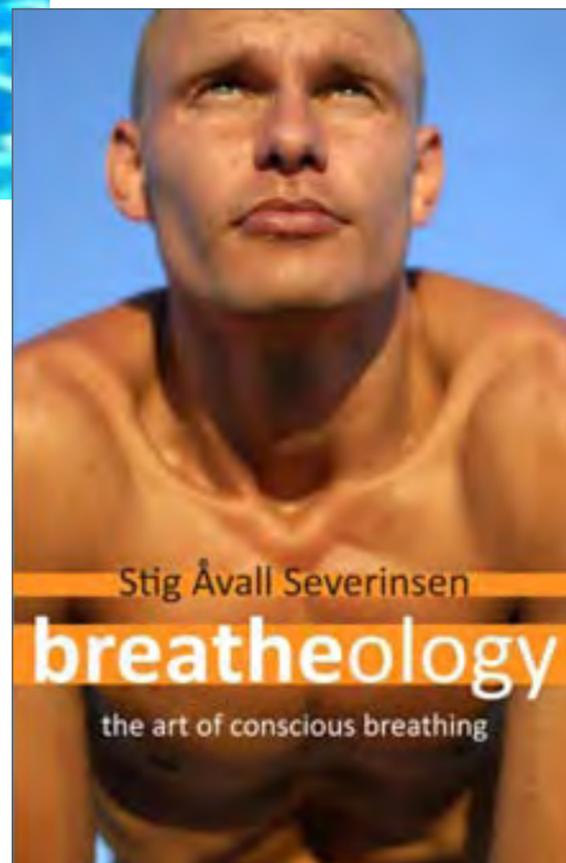
what he had learned about his own ability to use his mind to master his body and accomplish pretty much any goal he set out for himself, Severinsen saw no reason why others could not benefit from the same approach. So, he set out to share some of the knowledge he'd gained.

First, he began to work with elite athletes from around the world including the likes of cyclist Alberto Contador and Olympic gold medalist Martin Kirketerp—not to mention the Danish National Freediving Team and soccer star William Kvist. Severinsen said, when it comes to elite athletes, "Their physical and anatomical differences are not that different." So, what does make the difference between a champion and an also-ran? Severinsen suggested that one needs to

tap into some kind of extraordinary ability.

Amazingly, "For people who manage superhuman efforts, it's the way they've trained their minds." And with that, we are returned to exactly what Severinsen specializes in—using breathing and meditation to train your mind to go beyond where you believe it can go.

He started with athletes, but soon his client base expanded to include everyone from CEO's to people with physical disabilities. In each case, Severinsen applied the same wisdom. He worked to teach them how they could transcend their physical limitations with their minds. In the same way he had pushed his mind and body to achieve near superhuman efforts underwater, he showed them how





No Limits

—New medical technologies for apnea diving

Text and images courtesy of Andrey Bizyukin, Mikhail Artamonov, Igor Erenburg, and Damir Musin.

“What is the hypoxia? It is a deficit of oxygen in the lungs, blood and tissues. Each of us feels hypoxia from time to time, even if we do not realize it.”
What is the limit of human capability? How long can a person swim without breathing, and to which depths can a diver reach in one breath? This question has troubled generations of athletes, apnea divers and scientists as well.

The dream of the “Blue Abyss” is embodied in the depth records of some of the most famous divers—Jacques Mayol, Francisco Ferreira and Umberto Pelizzari—who have destroyed so many myths and even scientific theories about the limited capacity of humans as overland beings.

It was a hard road of study—to develop the infinite possibilities, which are sleeping somewhere deep inside of us. The representation of the features of the human body and the

ability of the body to adapt to unusual, new and extremely harsh conditions—excessive pressure, hypoxia and biophysical changes on all levels, from the cellular level to the whole organism were changed with each new achievement.

Now, we have more and more people coming to the discipline of freediving. New names of champions are appearing. The records for apnea diving depths have shifted from 137 meters to 154 meters and deeper, while the records for breath hold for the last five years have remained unchanged until just recently, when the record for breath hold reached 7 minutes 35 seconds in a static position and 8 minutes in

exact dynamics.

The time has come for new scientific and medical technologies in the training of “human dolphins”. In Russia, new research is being done in one of Moscow’s medical clinics, on human physiology in hypoxic conditions. Here, a method of “interval hypoxic training” has been used. It’s based on an alternation of hypoxic breathing gas with oxygen at reduced concentrations (from 14% to 9%) and normal air (21% oxygen).

One participant described the scene: “Tables with soft chairs, devices worn on fingers, and masks on faces with corrugated hoses. It seemed that sitting motionless in a chair and

breathing through the mask, even on a low oxygen mixture that was not very serious, was challenging. Divers would more likely prefer to do something more extreme—for example, lift some dumbbells or spin a bike—to at least blend in with the background of normal patients in the clinic.”

In particular, apnea divers, are used to more “extreme” training regimes. In this experiment, the oxygen concentration was reduced to eight percent, which corresponds to the partial pressure of oxygen at 7,000 meters above sea level. For participants, the lack of oxygen began to feel much larger.

In these very low oxygen conditions, a normal person starts to feel that really not enough air is going in. Breathing becomes deeper and more frequent. The pulse rate and intensity at which the heart has to work is increased a great deal. The person starts to suffocate. To survive this challenging situation, it is necessary to switch on the protective reaction of the body.

Stillness

The main and most important thing to accomplish is maximum relaxation, reduction of respiratory function and heartbeat. Concentration of consciousness can achieve a state of almost complete stillness, in which one



stops thinking and “time” stands still, tapping into one of our internal resources.

Breathing a hypoxic mixture does not feel like the state a diver experiences right before a dive, when he or she breaths in and out intensively (hyperventilation), and a feeling of euphoria comes—filling the body with what yogis call “breathing prana” or life force—and it feels like one could stay under water for ages.

While the participants breathed the hypoxic mixture, they felt

some slight intoxication, dizziness and weakness. One participant said, “I often fell asleep or dreamt ‘under the mask’ while sitting up.”

It seemed inevitable that the breakdown mechanism worked out by divers in the process of training for dives in the water would occur. This is when the mind begins to save “emotions”, and the awareness of what is happening here and now is perceived from a side view, an impartial view of just what is happening to you. In





terms of martial arts, specifically the philosophy of Karate, this condition is called *Mitsu no kokoro*—when the human mind is like the surface of a “sleeping lake” and is a desirable goal of adept martial artists, automatically achieved by breathing oxygen-depleted air.

At the clinic, doctors constantly monitored oxygenated hemoglobin in the blood as well as the heart rate of each participant. With several training sessions, the frequency of the heart rate fell to 30 beats per minute, which meant that the

bodies of the participants adapted and responded adequately to hypoxia.

Methodology

The research methodology of this experiment consisted of 10-30 sessions; each session consisted of 5-10 cycles, with durations of two to 15 minutes. If hypoxia is not too strong, it activates the body’s internal reserves, and slow adaptation occurs. “Answers” to the body’s stress had become a more appropriate and sustainable.

There is going to be improving pulmonary ventilation, a decrease in the frequency and an increase in the depth of breathing, improving lung diffusion capacity, enhancing the effectiveness of external respiration, and an increase in oxygen capacity, improving the antioxidant properties of the blood, increasing the heart rate and cardiac output, volume, while the increase in the number of red blood cells is reduced. Blood flow to organs and secondary systems and increases in primary systems (such as brain and heart) increases the activity of anaerobic enzymes.

Conclusions

The tangible result of the experiment was the increase of breath-holding time, without prior pulmonary ventilation, to 4-4.5



minutes, which was previously achieved only after prior intensive hyperventilation for 1-2 minutes.

During the workout in the pool, participants in the experiment at the clinic were able to overcome the time of 5 minutes 30 seconds in static apnea. It was pointed out that it was a very quick and easy entry; Participating divers were in good shape despite the long absence of training at sea. If they did the same hypoxia training from the first day, they could easily reach depths of 30-35 meters. Whereas, it usually took three to four days of intense training in order to reach these depths.

Today, hypoxic training is used widely in clinical medicine and sport. And the results of the successful experiment at the Moscow clinic once again allows us to recommend the method of interval hypoxic training as one of the most effective ways to improve the adaptability of the human body. ■



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New study reaching back thousands of years may disprove long standing theory about bowhead whales

Until recently, it was the wide-spread belief among the scientific community that bowhead whale populations existing on opposite sides of the Arctic were unable to intermingle and were therefore genetically unrelated. After all, how could two distinct groups of whales separated by miles and miles of impenetrable ice sheets be able to interact?

But scientists from the American Museum of Natural History, the Wildlife Conservation Society and other organizations have published the most comprehensive broad-range genetic analysis of the bowhead whale ever conducted and may have debunked that theory all together.

Using hundreds of DNA samples collected from whales over the past 20 years as well as ancient genetic samples (some over one thousand years old) showed that whale populations in both regions were related, and thus individual whales must be able to make the journey.

Just how does a team of researchers go about gathering DNA samples from whales that lived thousands of years ago? Good question.

Apparently, researchers tracked down archaeological sites and now-abandoned settlements of indigenous Arctic

hunters known as the Thule people (the likely ancestors of the Inuit) and collected genetic samples from centuries-old specimens—extracted from old vessels, toys and housing material made from bowhead baleen—still preserved due to the extreme cold of the icy climate.

The new study attempts to shed light on the impacts of sea ice on this threatened but now recovering species. “Our study represents the first genetic analysis of bowheads across their entire range,” said Elizabeth Alter, the study’s lead author and professor at City University of New York. “The study also illustrates the value of ancient DNA in answering questions about the impact of changing climate and human exploitation on genetic diversity in bowhead whales.”

Specifically, the study was aimed at examining DNA from all bowhead populations that are believed to exist for the purpose of gauging “gene flow” between those groups, i.e. whether or not these separate populations intermingle sexually and mate with individuals from other groups.

“The assumption that Arctic sea ice has separated bowhead whale populations over the past several thousand years is contradicted by the genetic analysis, which indicates that significant

migration between Atlantic and Pacific populations has recently taken place,” said Dr Howard Rosenbaum, Director of WCS’s Ocean Giants Program and senior author on the study. “The finding reveals much about the abilities of bowheads to find navigable routes through sea ice and helps illuminate hidden connections between populations.”

Achieving lengths of 65 feet and weighing up to 100 tons, the bowhead gets its name from its enormous arched head, which it can use to break through ice up to two feet thick in order to breathe. The whales may also be among the most long-lived mammal species on the planet. A few years ago, aboriginal whalers in Alaska landed a whale that had a harpoon point embedded in its blubber. When the metal tip was dated, it was discovered to have been manufactured in the 1890’s.

■

Killer Court Case – Round Three

The third round of the fight to free the orca ‘Morgan’ from captivity set to begin on 1 November 2012.

If you are unfamiliar with the ongoing fight over what to do with the juvenile killer whale, let me fill you in on the details.

On 23 June 2010, a young female orca was found alone and starving in shallow water of the Wadden Sea, off the Dutch coast. The exhausted cetacean was brought to a dolphinarium—a cetacean theme park—at Harderwijk, The Netherlands, and given the name ‘Morgan’. The company vowed they would care for her until she regained her strength to be released.

After a short time in recovery, the dolphinarium determined Morgan would be better off in captivity than in the wild and mentioned other marine mammal parks as possible destinations for Morgan. They soon made plans to send the young whale to an entertainment facility called Loro Parque in Tenerife—one of the Canary Islands off the north-west coast of Africa.

“The theme park is the best option for her because that is where she can live in a group and that is the best we can offer her,” said Niels van Elk, a vet who has been working at the dolphinarium for 13 years. “We as humans should not pretend that we can replace the chal-

lenges and the satisfaction that a group of killer whales can give. It is an artificial environment, it’s a different life but it’s a good life all the same.”

Not everyone agreed, and it was at this stage that a group of concerned Dutch animal welfare and conservation NGO’s founded the Orca Coalition.

According to law, rescued cetaceans should only be kept in captivity if it is not in the mammal’s best interest to be released. Orca coalition and several cetacean experts working with the group believe that the dolphinarium’s assessment of Morgan’s future was incorrect based on their own findings and started court proceedings.

Two important hearings followed. During the first, held on 3 August 2011, a judge ruled that the responsible parties had neglected obligations on the issue and should do additional research to investigate the possibilities to rehabilitate the orca and set her free. The scheduled transport of Morgan to Tenerife was temporarily blocked.

However, two weeks after the second hearing, which took place on 7 November 2011, the judge announced in her ruling that the dolphinarium was allowed to move Morgan to Loro Parque, and she was transported to the island later that month.

Now, the third round of court proceedings are about to come before the Dutch courts, and the judges must decide whether Morgan’s continued captivity is in her best interest or in the best interest of the Dolphinarium Harderwijk and Loro Parque. To do so, they will need to obtain an unbiased evaluation of Morgan’s health as well as weigh the evidence presented by the Dutch veterinarians who first cared for Morgan and the conflicting data given by the Orca Coalition.

At stake is not only the future life of the young killer whale but also a new legal precedent if Morgan is set free. ■ SOURCE: BBC NATURE, SEATTLE PI



WIKIMEDIA COMMONS





marine mammals

Young beluga imitates human speech tones

The internet is buzzing right now with headlines claiming: "SCIENTISTS FIND WHALE CAN SPEAK LIKE HUMANS!" and "EXPERTS SAY BELUGA LEARNED ENGLISH!" But before you run off and tell all your friends and neighbors about the amazing white whale that can talk, let's take a closer look at what researchers actually are saying.

In late October, a paper entitled, *Spontaneous human speech mimicry by a cetacean*, published in the journal *Current Biology*, researchers from the National Marine Mammal Foundation, the University of California San Diego and the U.S. Navy Marine Mammal Program describe a young beluga, named NO-C, who apparently had a short-lived ability for vocalizations that sounded, not like human speech itself—as so many internet stories are saying—but similar speech tones used by humans when speaking.

Confused? Yeah, so was I. But here is what happened according to the research paper:

A whale named NO-C

In 1977, as part of a program to study whether or not cetaceans and other marine mammals could perform underwater reconnaissance missions or perhaps disable mines, the U.S. Navy captured several beluga whales in Canada's Hudson Bay and brought them to California. The smallest of the pack was nicknamed "no-see-um" or "NO-C" for short.

Several years later, staff mem-



bers started noticing that unusual sounds were coming from around the vicinity of the dolphin and whale enclosure—almost, they said, as if two people were conversing in the distance just out of range of understanding. They realized that the "voices" they were hearing must be coming from NO-C when one day a diver came to the surface outside the white whale's enclosure and asked his colleagues, "Who told me to get out of the tank?" When pressed about what he heard, the diver said he thought he heard the word "Out" repeated several times.

Scientists began recording NO-C's speech-like sounds in air and underwater and soon saw that the rhythm and frequencies and tones of vocalizations were all similar to those of human speech, but several octaves lower than NO-C's usual clicks and whistles.

The lead author of the paper, Dr Sam Ridgway of the National Marine Mammal Foundation, is convinced the juvenile beluga was deliberately imitating the speech tone of humans. "Our observations suggest that the whale had to modify its vocal mechanics in order to make the speech-like sounds," he said. "Such obvious effort suggests motivation for contact."

The researchers encouraged NO-C to keep up the vocalizations by giving him rewards, allowing the team to examine him more closely.

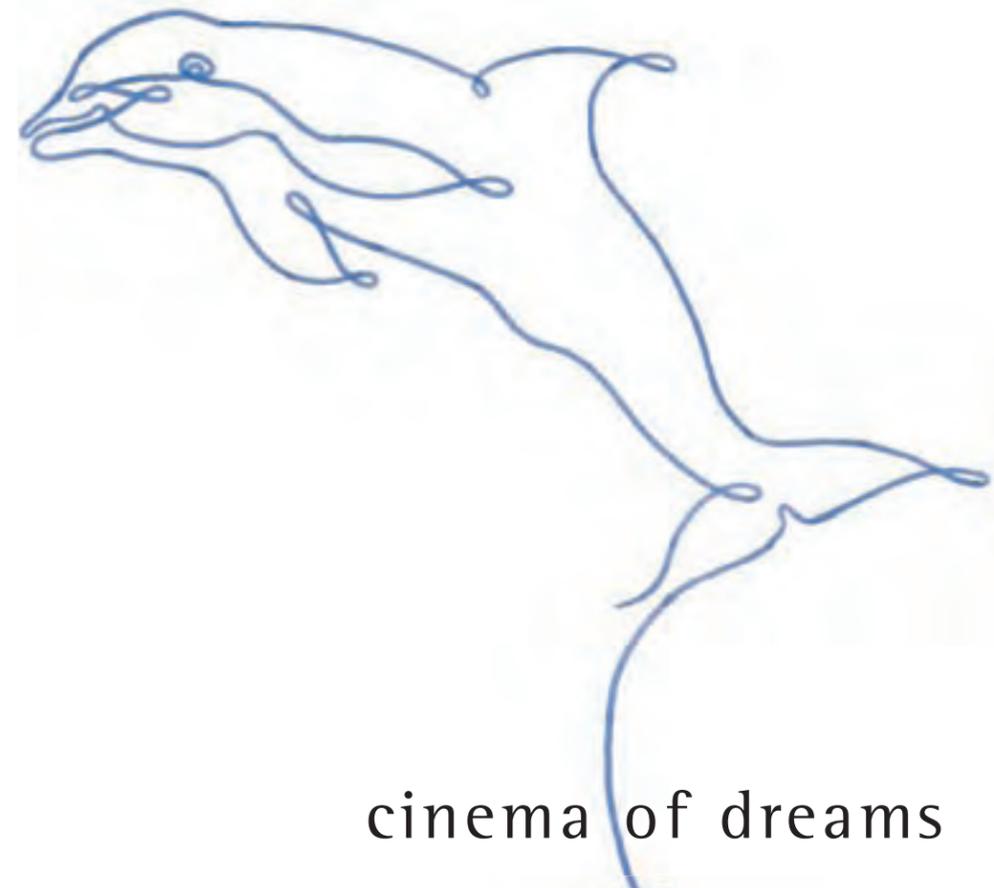
Speaking the beluga way

In general, whales make sounds via their nasal tract (not in the larynx as humans do) so the team decided to use catheters inserted into NO-C's nasal cavity. By doing so, they were able to determine that the beluga had to vary the pressure in his nasal tract while making several other muscular adjustments, as well as inflate a special sac in his blowhole—not the easiest of tricks.

One such recording of NO-C has been posted on several internet sites, and you can listen to it yourself. Just don't expect to hear a whale chatting about the weather, or even anything that remotely sounds like a person talking, as the screaming web headlines might have you believing.

But if you close your eyes and listen carefully, you should be able to hear how the tone and pitch of the sounds could be confused with distant chatter, almost as if a group of children were all talking at once. And as a diver, you will probably appreciate how those same sounds could be confused with someone speaking underwater. ■

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turtle tales



Edited by
Bonnie McKenna

Sea turtle nests increase

A record number of sea turtle nests have been recorded along the beaches of Volusia and Flagler County, Florida, USA, this summer. More than 1,480 nests have been counted and officials say more than 50,000 eggs have been hatched.

Hundreds of those hatchlings have been reported as disoriented before finding their way to the sea. Open lighting from homes and businesses seem to be the cause. This summer the counties had about 185 open lighting cases as it tries to enforce the ordinance requiring that lights be shielded from shin-



STEVE JURVETSON / CREATIVE COMMONS

ing onto the nesting beaches. Volusia County is working with property owners to resolve lighting problems.

Grants from the Sea Turtle Conservancy, which administers the BP grant program, funded by

the sale of crude oil recovered at the site of the Gulf of Mexico oil spill has paid for improvement in lighting retrofits at facilities along the beaches most frequently visited by nesting sea turtles. ■

Green turtle hatchlings crawl to sea

It was reported that 75 green sea turtles crawled to the sea

at Senggigi beach in Lombok, Indonesia.

As the hatchlings reached the sea, tourists kept their cameras on to capture the event.

The management of the Sheraton hotel in Senggigi said the green sea turtles were

hatched at the hotel's turtle conservation center.

The hotel buys eggs from locals and incubates them. The hatchlings stay at the center for three months before being sent to the sea.

"In 15 years, we have released more than nine million turtles to their habitat," said Sheraton sales director Jelantik Suharta. ■



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Rescued Leatherback sea turtle released off Cape Cod

A seven-foot long, 655-pound leatherback sea turtle found stranded near Cape Cod, Massachusetts, USA, was released back into the wild after being treated for dehydration, trauma and shock.

The turtle was found near death. Experts said it was underweight, lethargic and a large portion of its left front flipper was missing. New England Aquarium officials say it might have been entangled in a vertical line of a lobster pot or boat mooring.

Veterinarians treated the turtle with drugs to stabilize its blood values and oxygen levels. As the turtle regained strength, it was released, with a tracking device, a couple of miles off the coast.

"He dove deep right away and did not re-surface within sight of the boat," aquarium spokesman Tony LaCasse said. "That is normal behavior for healthy leatherbacks. A couple of early hits came in off his satellite tag indicating that he was moving." ■

Rare white sea turtles found in Florida

The unusual coloration of the two turtle hatchlings is known as leucistic, or lack of pigment. Mike Walsh with the University of Florida's College of Veterinary Medicine says such animals have some pigment in their skin or eyes

—unlike albinos. Leucistic animals are uncommon in the wild, and they can become easy targets for prey since they lack the natural coloring to help them blend into their surroundings. ■

Earthquake in San Salvador destroys 45,000 sea turtle eggs

The director for the El Salvador Zoological Foundation said the 7.4-magnitude undersea quake sent at least three waves approximately 30 feet high up the beach and destroyed thousands of nests and just-hatched sea turtles. The waves also washed up on 150 people collecting eggs in

order to protect them in special pens hundreds of feet up on the beach. The waves injured three people. Last year, the zoological foundation successfully hatched and released 70,000 turtles from four species of endangered sea turtles. ■



CHRISTOPHER BARTLETT

Lawsuit launched to save whales, sea turtles and sharks from California's gillnets

Conservation groups filed a notice of intent to sue the U.S. federal government under the Endangered Species Act for authorizing California's drift gillnet fishery.

Most gillnets have been banned in California, but the fishery targeting swordfish and thresher shark continues to operate. Nets stretch a mile or more and are set to 'soak' overnight and catch and drown marine animals indiscriminately. On average, more than 130 protected whales, dolphins, seals and sea lions as well as thousands of sharks and non-targeted fish are caught and discarded each year. Government observers documented the lethal take of two sperm whales in 2010 and estimates 16 sperm whales were injured or killed in the fishery that year.

"Deadly fishing nets are risk-

ing the future of large whales and sea turtles," said Catherine Kilduff of the Center of Biological Diversity. "Gillnets entangle everything in the sea, wasting sea life that is precious to the balance of our oceans. It is time to retire gillnets. They should belong to the past."

The notice of intent to sue the national Fisheries Service also seeks new analysis of the gillnet fishery's impact on sea turtles. This includes leatherback sea turtles in the Pacific, whose status has been upgraded

from threatened to endangered because their population has declined by 80 percent over the last decade. ■



CHRISTOPHER BARTLETT

California designated the Leatherback as the state reptile

In a strong affirmation of the U.S. state of California's commitment to the environment, the endangered Pacific leatherback sea turtle has been chosen as the state reptile.

Per the new state law, 15 October 2013 will be the beginning of California's annual Leatherback Conservation Day. Schools will be encouraged to teach students about this endangered sea turtle species that travels an incredible 6,000 mile journey from Indonesia to California to feed on jellyfish.

By designating the leatherback, California has established itself as a national leader in promoting

conservation of Pacific leatherbacks.

More than 16,000 square miles of California coastal waters were designated as critical habitat for leatherbacks earlier this year. The new law encourages state and federal agencies to build cooperative relationships with island nations where the Pacific leatherback turtles return to nest.

Pacific leatherbacks are on the brink of extinction and public awareness is the key to saving these ancient marine reptiles. ■



PROJETO TAMAR BRAZIL/MARINE PHOTOBANK

shark tales



Matthew Oliver with OTIS underwater device



Underwater robot to track tagged sharks

In a bid to better understand migration patterns of sand tiger sharks, researchers from the University of Delaware (UD) and Delaware State University (DSU) are utilizing an underwater robot to track the shark movements.

Resembling a yellow torpedo, the Oceanographic Telemetry Identification Sensor (OTIS) is a remote-controlled underwater device normally used for testing water conditions. Scientists have outfitted the device with acoustic receivers to recognize signals transmitted by previously tagged sharks, as they traverse their coastal habitat. "This is the first time that a glider has found tagged sharks and reported their location in real

time," said Matthew Oliver, assistant professor of oceanography in UD's College of Earth, Ocean, and Environment.

OTIS will be tracking sharks with a trio of different tags. The first is an acoustic transmitter that "pings" receivers while passing by a set of 70 devices situated around Delaware Bay. DSU maintains these receivers and has successfully tagged more than 500 sharks since 2006. Another feature is the pop-off satellite archival tag. The team is utilizing 34 of these tags, which store data on the sharks' journeys for up to a year before being automatically released for retrieval.

Newest is the larger VEMCO mobile transceiver (VMT), which receives and transmits information to specify its location and listen for the pings of other marine animals outfitted with acoustic tags. The VMT tag "will tell us not only where it is, but who it's with", said Oliver. "It's like a social network for sharks."

Oliver and students from both

universities spent the summer catching sand tiger sharks and surgically inserting the transmitters.

OTIS will play a big part, helping researchers find out which water conditions sharks prefer to swim in during their migrations as well as gathering information on water temperature, quality, clarity and oxygen levels. University teams plan to map these habitats, cross-referencing shark data with satellite and remotely sensed environmental conditions to create a comprehensive picture of shark habitats. The team hopes the data will provide scientists with a better understanding as to why these sharks head to certain places.

Sand tiger sharks are the largest commonly occurring shark in Delaware's bay and coastal regions. Generally slow-moving and placid, these apex predators play a crucial role in the region's ecological balance. In 1997, sand tigers were listed as a 'species of concern' by the National Marine Fisheries Service.

The next goal is to direct the glider to remain near the sharks, as OTIS can last up to four weeks without recharging. "We have at least another two weeks of battery," Oliver said. "We'll see how it develops." ■



FILE PHOTO: SCOTT BENNETT

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Bull shark has strongest bite

Relative to body size, bull sharks bite harder than their larger relatives.

Research has revealed that bull sharks bite with almost 6,000N, a force that is greater than what is required to kill and eat prey. In a study published in the journal *Zoology*, Maria Habegger from Tampa's University of South Florida, along with colleagues in the United States and Germany, examined bite forces produced by 13 shark species and their close relatives, ranging from 1m-long rat-fish to the great white shark.

"We expect strong bite force values in the larger sharks that occupy top positions in the food chain, for example, the great hammerhead, great white shark, tigers and bull sharks," said Habegger. "These species usually prey upon large prey items such as dolphins, turtles and other sharks, so high bite forces are expected due to the mechanical demands of this type of prey."

"The study shows that pound per pound, bull sharks have the largest bite force value among all studied sharks," said the biologist. "Bull sharks can bite harder than a great white shark and great hammerhead."

The study raises an intriguing question: Why do bull sharks

require such a powerful bite?

It may be advantageous for young bull sharks, allowing them to eat more diverse prey earlier in their lives. Smaller bull sharks bite harder than expected for their size, but larger individuals do not.

"From our knowledge there is no need of such massive values to break fish skin or even to puncture bone," Habegger added. It is believed that a strong bite is particularly useful for hunting in murky waters that bull sharks inhabit. "In a lower visibility environment catching prey may be more difficult than in open water. So, once you get a prey between your jaws, securing it is crucial to not lose your meal," she added. However, it is possible that the huge bite forces are simply an artifact of the large size these top predators attain. ■



FILE PHOTO: SCOTT BENNETT



Edited by
Michael Menduno

*Switching to rebreathers
after diving open circuit scuba*

But I want one...

ed.—Technical Diving Instructor Mark Powell looks at switching from traditional open circuit SCUBA to closed circuit rebreathers.

Many of the pieces of equipment used by technical divers look different to the equipment used by recreational divers. However, for most of the time, the basic principles are the same. However, the use of rebreathers in technical diving completely changes many of the basic principles that govern recreational diving. Some limits are removed almost completely but other complications are introduced.

Text by Mark Powell



A rebreather is simply a way to reuse the gas breathed out by the diver in conjunction with a method of removing the carbon dioxide produced by the diver. The main advantage of a rebreather is that it is much more efficient on gas usage. When breathing normal air at the surface we use up about 4% of the oxygen in the air for our metabolism and breathe out the rest of the oxygen as well as all the nitrogen. This means that 96% of the gas we breathe escapes with each breath. At depth this is made even worse by the fact that we are breathing gas under much higher pressure and so each breath contains a much higher volume of air. At 40m we are breathing 5 times the volume of air with each breath compared to the surface and at 90m we are breathing ten times the volume that we would be on the surface. With every breath this gas escapes from our second stage and bubbles to the surface. This is inefficient as the body still only needs the same amount of oxygen but we are



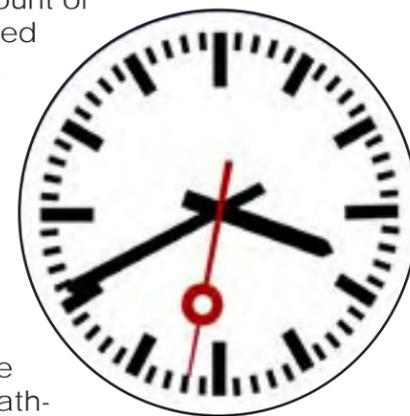
wasting ten times as much gas with each breath in order to obtain it. This is one of the reasons why for open circuit divers gas planning and breathing rate is so critical. The limiting factor for an open circuit dive to 90m is almost certainly going to be the amount of gas that needs to be carried for the dive. A rebreather avoids this problem by re-using the gas breathed out by the diver, as the majority of the gas isn't being wasted the diver doesn't need to carry as much gas in order to do the same dive. A rebreather works by catching this exhaled breath and instead of allowing it to escape it reuses it in the next breath. The small fraction of Oxygen that was used up by the body is replaced with more Oxygen. This means that rather than wasting the vast majority of each breath we reuse all

of the gas.

By reusing our gas this provides three key benefits to the technical diver.

1 - Gas Duration

Firstly we don't need to use anywhere near as much gas as an open circuit diver. The amount of Oxygen required by the body is roughly the same at any depth and so our Oxygen will last the same at 100m as it will at 20m. The balance of the gas in the breath-



ing loop, known as the diluent, is reused rather than wasted and so again we use the same amount at 100m as at 20m. This vastly decreases the amount of gas we will need to complete the dive and rather than twin 20L cylinders we can use two 3L cylinders.

On open circuit we breathe much more at depth due to the effect of pressure and so as we go deeper and deeper we have to take larger and larger cylinders. Despite taking these large cylinders they will still be used up very quickly and so the amount of available gas becomes the most critical part of our dive planning. On a rebreather our gas supply is used up at the same rate irrespective of depth and so the amount of gas we are carrying is no longer the limiting factor. This means that running out of gas on a rebreather is much less of a concern than for an open circuit diver. Instead the critical factors become the amount of decompression we are incurring, the duration of our carbon dioxide absorbent and our risk of oxygen toxicity.

2 - Gas Costs

One of the biggest factors that comes into the decision to switch to a rebreather is costs. This has two aspects, the costs of the rebreather, including buying and maintaining it, set against the cost

of open circuit diving.

One of the biggest disadvantages of open circuit trimix diving is the cost of the gas. A Twinset of trimix can cost anything from £30

for a relatively week mix for use in 40m to over £100 for a mix suitable for diving deeper than 100m. This makes each trimix dive an expensive proposition. On the other hand a rebreather uses much smaller cylinders because the gas is reused rather than wasted, as a result we use much less and the gas costs are much lower. We might only be spending £5-£10 for the same mixtures discussed above. As a result there is a significant gas saving when



A Twinset of trimix can cost anything from £30 for a relatively week mix for use in 40m to over £100 for a mix suitable for diving deeper than 100m.

Depending on the model a rebreather is likely to cost between four and eight thousand pounds.

Despite taking these large cylinders they will still be used up very quickly and so the amount of available gas becomes the most critical part of our dive planning

compared to open circuit diving. This can look very attractive when you are spending considerable amounts on each open circuit fill. However this must be set against the costs of the rebreather. Depending on the model a rebreather is likely to

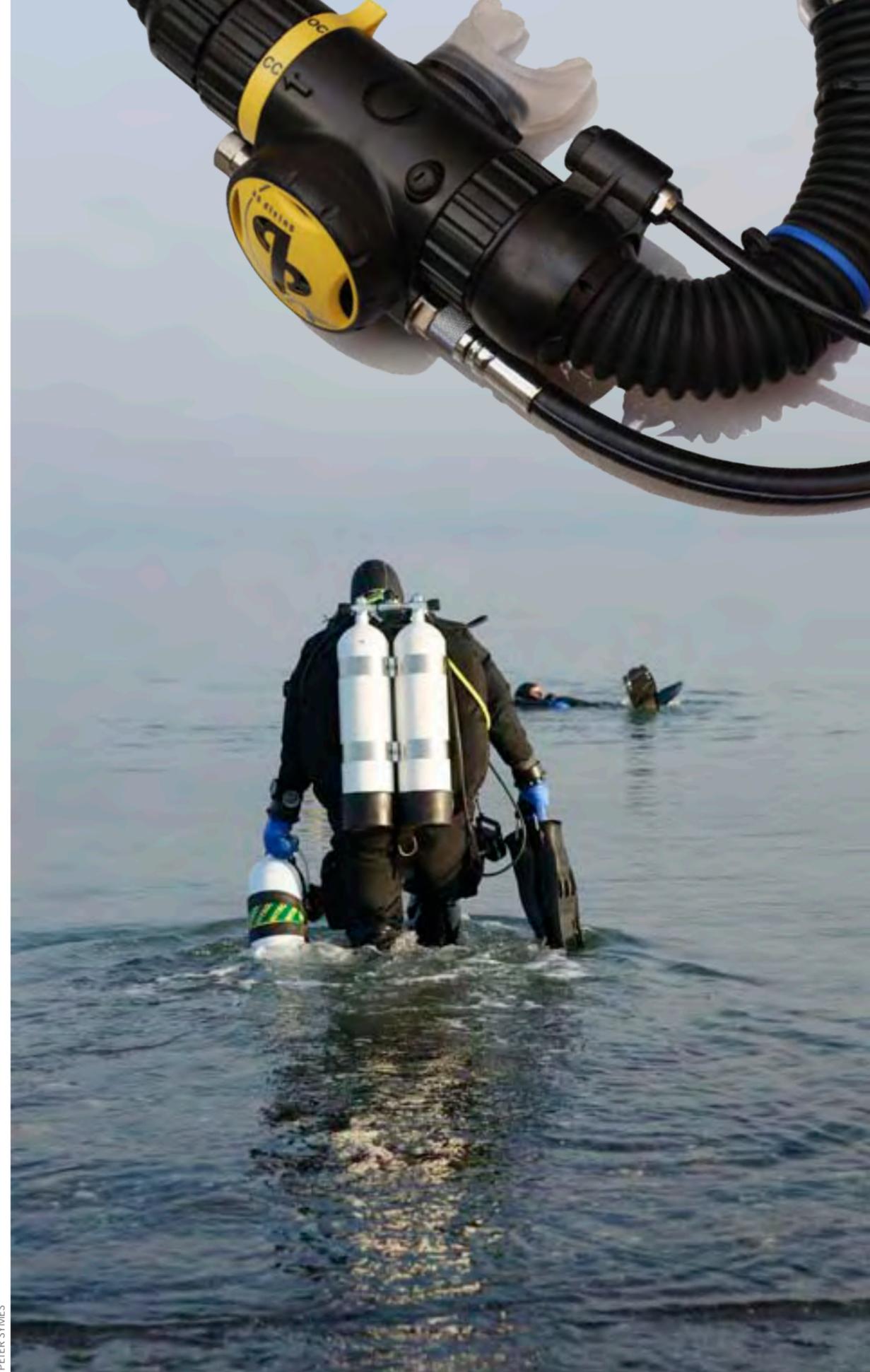
cost between four and eight thousand pounds. If you go for an older second hand model then you might get one for less than this. In addition to the initial cost of the rebreather you will need to factor in training on the rebreather which is likely to add on another thousand pounds. In addition there will undoubtedly be additional costs to add on

extra equipment to the basic rebreather. As a result it is not uncommon for the initial start up costs on a rebreather to be between 6 and 10 thousand pounds. Obviously you will need to do a lot

of trimix diving in order to save enough to justify this initial outlay.

The majority of divers do not do enough diving to clearly justify buying a rebreather based on savings in gas costs. Unless you are doing 20 or more trimix dives a year then it is not cost effective. If you also do a significant amount of recreational diving then each dive may actually cost you more on a rebreather.

On open circuit you may only need to pay for an air fill but on even the shallowest dive you will still need to use pure oxygen in one of the cylinders and use carbon dioxide absorbent in the rebreather. The



REBREATHER TERMS:

OC	Open Circuit (traditional SCUBA)
CCR	Closed Circuit Rebreather
SCR	Semi-closed Circuit Rebreather
eCCR	Electronically controlled Closed Circuit Rebreather
mCCR	Manually controlled Closed Circuit Rebreather
HUD	Heads Up Display (LED display of oxygen partial pressure)
BOV	Bail Out Valve (Open Circuit bail out used in an emergency)
Diluent	Gas used to make up the balance of the breathing loop, can be air or trimix
Scrubber	Module used to remove carbon dioxide from the breathing loop

PETER SYMES



annual replacement of the three oxygen sensors and handset batteries also needs to be taken into account. This means that a shallow recreational dive may only cost £5 for an open circuit diver but £10-£15 for a rebreather diver.

It is clear that unless you are doing significant numbers of deep trimix dives a year with little or no recreational diving then the gas savings from using a rebreather will not outweigh the initial start up costs. However there are still a number of other reasons why a rebreather is an attractive option.

3 - Gas Logistics

The third advantage that the improved gas usage provides is in simplifying gas logistics during longer dive trips. Open circuit divers may be using up twin 12L, 15L or even 18L cylinders on each Trimix dive. In addition they may be using up to 4 stage cylinders for decompression gas for

The fact that a rebreather uses smaller cylinders makes the logistics of filling much easier

each dive. This requires lots of additional helium and oxygen each day and filling these large back gas cylinders and decompression cylinders each day is expensive, time consuming and labourious.

The fact that a rebreather uses smaller cylinders makes the logistics of filling much easier. The volumes of gas needed are much smaller when filling a 3L cylinder rather than twins 12s and so it becomes feasible to take enough gas with you for even a weeks diving. This contrasts with the situation when using open circuit where significant volumes of helium and oxygen will be required as the majority will be breathed out and wasted. This can make a big difference if you don't have a local dive shop that can fill trimix. If you have to drive 50 miles there and back to drop off a twinset for a trimix fill and then do the same

The majority of divers do not do enough diving to clearly justify buying a rebreather based on savings in gas costs.



thing next day to pick it up then the logistics of this can be significant. Similarly if you are diving somewhere without easy access to a dive centre that can fill trimix the ability to take your own gas simplifies the planning and logistics.

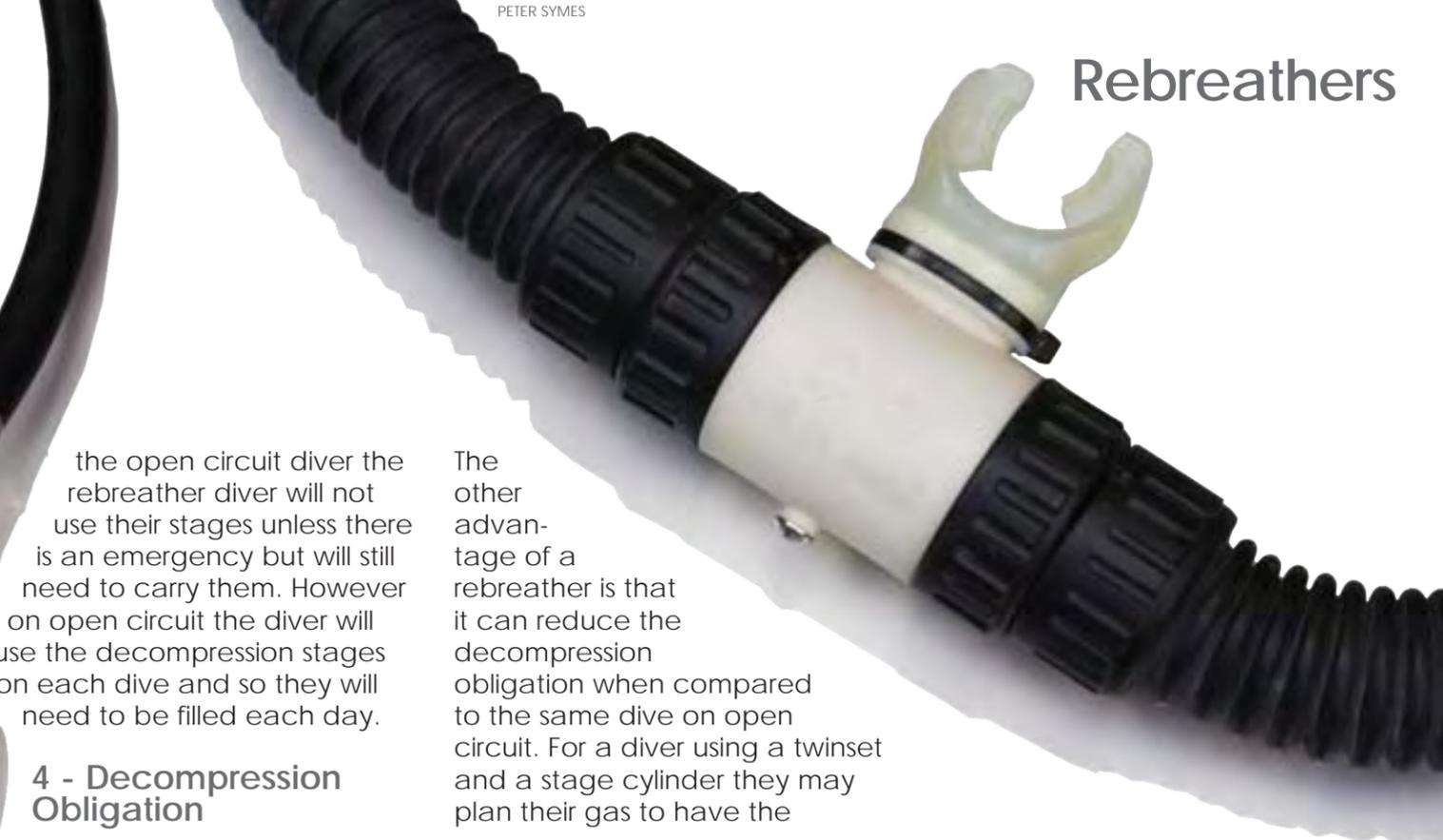
Of course this assumes that the rebreather will always work as intended. Just in case there are any problems with the rebreather we also need to carry open circuit gas to get us safely to the surface. In this case we would need a bailout cylinder that we could start using at the maximum depth and would then need sufficient bailout to get to the surface completing all our decompression. Unlike

The fact that a rebreather uses smaller cylinders makes the logistics of filling much easier.

the open circuit diver the rebreather diver will not use their stages unless there is an emergency but will still need to carry them. However on open circuit the diver will use the decompression stages on each dive and so they will need to be filled each day.

4 - Decompression Obligation

The other advantage of a rebreather is that it can reduce the decompression obligation when compared to the same dive on open circuit. For a diver using a twinset and a stage cylinder they may plan their gas to have the



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optimum mix on the bottom, i.e. the highest oxygen percentage in order to reduce the amount of inert gas absorbed by the body. They will also make a choice of the decompression gas carried in the stage cylinder with a view to ensuring that they get rid of the inert gas as fast as possible during the decompression. However, the choice of each of these gasses will always be a compromise. The bottom gas will be chosen to be as rich as possible but with some margin for error in case the dive is a little deeper than expected. If the diver ascends up from the planned maximum depth then the mix is no longer the optimum mix. Equally the decompression mix will only be the most effective mix at the depth at which the diver switches to it. Prior to the switch the diver could have switched to a leaner mix and at the later stops there will always be a

richer mix that would have provided faster offgassing. A rebreather avoids these problems by constantly adjusting the gas being breathed to ensure the minimum amount of inert gas is being breathed. The rebreather (or the diver in the case of a manually operated rebreather) adds oxygen to ensure that the minimum amount of inert gas is being breathed. At depth the diver can ensure that the

breathing loop of the rebreather contains the maximum amount of oxygen and hence the minimum amount of inert gas. This will reduce the rate of ongassing. As the diver ascends and completes his decompression stop the diver can ensure that the mixture again contains the maximum amount of Oxygen which will accelerate the offgassing and reduce the required decompression. In this way the rebreather is constantly providing the best gas for the depth the diver is at. To simulate this on open circuit a diver would have to switch to a new breathing gas every meter of the ascent in order to constantly have access to the best possible

A rebreather avoids these problems by constantly adjusting the gas being breathed to ensure the minimum amount of inert gas is being breathed.

decompression gas. For this reason a rebreather is sometimes unofficially called a best mix generator. We can see that rebreathers offer a number of significant advantages over open circuit diving. However a rebreather introduces a number of significant additional costs, risks and complications to any dive and should not be seen as a magic wand to solve all of the potential problems of deep technical diving. In the first place

Rebreathers

At depth the diver can ensure that the breathing loop of the rebreather contains the maximum amount of oxygen and hence the minimum amount of inert gas.

buying a rebreather is an expensive proposition. Prices vary from £3500 to over £8,000 for the unit alone. When combined with training and the inevitable extra bits

of kit it is a false economy to buy a rebreather in order to save money on gas fills. In addition to the cost there are a number of other risks introduced by using a rebreather.

Whenever we breathe out as well as exhaling the remaining oxygen and inert gas the body has also added carbon dioxide. If our breath is recycled without removing the carbon dioxide then the levels will build up and eventually the diver will succumb to carbon dioxide poisoning, this is one of the biggest risks of rebreather diving. In order to avoid this, the carbon dioxide must be removed by a chemical process. This takes place when the exhaled gas passes through a scrubber which is packed with a suitable chemical designed to remove the carbon dioxide. Correctly packing the scrubber is one of the most important steps in preparing a rebreather as incorrect packing can allow carbon dioxide to be 'channelled' through the scrubber and cause a build up in the breathing loop and lead to carbon dioxide poisoning. This can cause headaches, lack of concentration, unconsciousness and death. Unfortunately the

go quietly, amid the noise and haste...

[3 hours @ 20m - no deco]



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Image by Roy van Eerden of Prodivers, Kurudu, Maldives

... rebreathers offer a number of significant advantages over open circuit diving. However a rebreather introduces a number of significant additional costs, risks and complications to any dive and should not be seen as a magic wand...

diver suffering from this condition may be unaware of the condition or may be so incapacitated as to be unable to respond to the problem. Overusing the scrubber material is another potential cause of carbon dioxide poisoning and for this reason it is vital to monitor the amount of time that the material has been used and to replace it at the appropriate time. If there is any doubt in the diver's mind that they may be suffering from carbon dioxide poisoning then

they are taught to bailout to a known source of gas. For this reason rebreather divers carry open circuit bailout gas. In addition many rebreathers are supplied with a Bail Out Valve (BOV) which allows the diver to switch from the rebreather loop to an open circuit regulator at the flick of a switch. Of course once the diver has bailed out to open circuit they are limited by all the same gas consumption issues that

preparation of the unit or by managing the

problem on the unit rather than by bailing out to open circuit.

In addition to excess carbon dioxide the other big danger that faces rebreather divers is an incorrect partial pressure of oxygen. In an eCCR the rebreather itself maintains the partial pressure of oxygen within the breathing loop whilst on an mCCR it is the divers responsibility to maintain the partial pressure. Either way it is always the diver's responsibility to know their partial pressure at all times and this is one of the golden rules of rebreather diving. All rebreathers will have a display which shows the partial pressure of oxygen. This can be an electronic gauge which is often wrist or console mounted or can be a visual display using coloured LEDs. These Head Up Displays (HUDs) can provide instant warnings of incorrect partial pressure levels. During the dive a diver will usually aim to maintain a partial pressure of between 1.0 and 1.4 bar of

oxygen. This is known as a 'set point'. Allowing the partial pressure to rise to high can lead to oxygen toxicity

Correctly packing the scrubber is one of the most important steps in preparing a rebreather



PETER SYMES

Many rebreathers are supplied with a Bail Out Valve (BOV) which allows the diver to switch from the rebreather loop to an open circuit regulator at the flick of a switch.

added complication of the kit also increases the

problems whilst allowing it to fall too low can lead to Hypoxia and a blackout.

The equipment used in a rebreather is more complicated than open circuit and the procedures required are more detailed and intensive. Preparing a rebreather to dive will inevitably take more time than preparing open circuit equipment. The

chances of a problem occurring, either before the dive causing it to be aborted, or during the dive causing potentially more serious problems. These considerations are covered in extensive detail during any rebreather training course but one of the biggest dangers for rebreather divers is complacency. As they build their experience they start to take short

Rebreathers

cuts or start to neglect basic checks. It is typically divers who have around 50 hours of experience who tend to fall into this complacency trap.

But I want one

Even if you want save money and don't need a rebreather for logistic reasons there are still other reasons to switch. Diving is a hobby and so doesn't always have to be justified on cost reasons. The cheapest option is not to dive but most of us don't

REBREATHER CLOSED CIRCUIT DIVING (CCR)

CCR ADVANTAGES

- Reduced gas requirements
- Reduced decompression obligation
- Warm air
- Simplified gas logistics

CCR DISADVANTAGES

- Risk of CO₂ poisoning
- Risk of CNS toxicity
- High initial costs
- Additional complication
- Non-standard equipment procedures
- Need to relearn diving skills

OPEN CIRCUIT SCUBA DIVING (OC)

OC ADVANTAGES

- Simple equipment configuration
- Simple to set up
- Standard equipment allows for easier repairs
- Standardised procedures

OC DISADVANTAGES

- High gas costs
- Gas consumption limits deeper dives
- Complicated gas logistics

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consider this a possibility. In the same way that some people spend their money on motorbikes, horses, home cinemas, model helicopters or any other hobby there is no reason why someone shouldn't spend their money on a rebreather just because they want one. Other people may switch to a rebreather to challenge themselves to learn something new.

Should you switch?

As we have seen there are a

number of reasons why many divers want to switch to a rebreather. However the risks of rebreather diving mean that there are some people who are better suited to rebreather diving than others.

Rebreathers are significantly more complicated pieces of equipment than an open circuit scuba set. Whilst rebreathers do not require a huge amount of effort they do nonetheless require more care and maintenance than open circuit. For divers that

throw their kit into the back of the car or into the garage and then don't look at it until the next dive this can cause a problem. This type of person is not really suited to rebreather diving unless they can discipline themselves to ensure they maintain the rebreather. On the other hand there are many divers who enjoy cleaning and maintaining their equipment almost as much as the dive itself. They get pleasure from adjusting the kit until it is just right and it is viewed as part of the

hobby rather than an added chore they must do. This type of person is ideally suited to rebreather diving.

In addition to cleaning and maintenance rebreathers require discipline whilst diving them. There is a certain mindset that is required to ensure that the unit is assembled correctly each time and that all of the pre-dive checks are rigorously followed. Most rebreather accidents are caused by the divers not following the correct procedure. This

includes not diving the unit if there is any problem with it. Many divers become complacent and will dive with known problems with their rebreather. They are confident that they can overcome the problem and in the majority of cases they manage to deal with the known problem. However if there is any problem during the dive the impact of the initial problem can be significantly increased by subsequent problems. It requires a significant level of discipline to call a dive for what might appear to be a minor problem but becoming complacent about these failures is one of the most common causes of rebreather accidents. During the dive the diver must constantly monitor the unit to ensure it is operating correctly.

This is summed up by the golden rule of rebreather diving "Always know your partial pressure". It doesn't matter if the diver is at 10m or 100m

the level of monitoring is the same and so a 10m dive must be approached with the same

mindset as a 100m dive. As such there is no such thing as a casual rebreather dive. Not all divers have the mindset to adjust to rebreather diving but without this mindset they should not consider rebreather diving.

In order to be a safe rebreather diver there are a number of skills that need to be mastered over and above the basic open circuit skills. Some of these are related to the normal operation of the rebreather and some are related to emergency situations. Like any skill it takes practice to master these skills and practice to maintain them. When moving from open circuit to a rebreather there are skills, like buoyancy control which must be re-learned. This takes time and effort. For an experienced diver this means the

frustrating process of going back to basics and building up their experience. Unless you are prepared to put in the time to master the basic skills you will

always be diving on a base of weak rebreather skills, even if you were previously a very experienced open circuit

Most rebreather accidents are caused by the divers not following the correct procedure. This includes not diving the unit if there is any problem with it.



diver. These skills also need to be practiced regularly in order to ensure that they are maintained. This means that it is essential to dive a rebreather regularly in order to maintain the appropriate skill levels.

For these reasons not all technical divers have adopted rebreathers. It is clear that for some people a rebreather is a desirable and in some cases an essential way to progress their technical diving. For others the

advantages do not necessarily outweigh the disadvantages. For depths between 30m and 80m open circuit technical diving is still a very feasible option and there will always be open circuit technical divers in this range. Beyond 80m then rebreather technology becomes the more common tool and it is likely that for dives in excess of 80m rebreathers will continue to be viewed as the tool of choice. For this reason it is a very personal

decision and not one to be taken lightly. First you must decide whether there is a good reason to dive a rebreather and then whether you have the right mindset to be able to dive it safely. Like many things the correct decision will vary from one person to another. ■

For more information on any aspect of technical diving visit: www.dive-tech.co.uk



RICHARD LUNDGREN

It is likely that for dives in excess of 80m, rebreathers will continue to be viewed as the tool of choice



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Image courtesy of Jill Heinerth

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Is the bulky SLR or DSLR camera (shown) a thing of the past? Enter, the slim mirrorless camera

Text and photos by Don Silcock

There is no doubt that digital technology has revolutionized underwater photography, and what was once the exclusive preserve of a few dedicated divers, has now become so common, that you stand out if you *don't* have a dive camera. Until quite recently, the technology behind digital photography has been firmly divided into two basic genres of cameras—compact digital point-and-shoot (or *digicams*, as they are often referred to) and digital single lens reflexes (DSLR's).

In general terms, digicams tend to be considered simpler devices, which most people use just for snapshots, while DSLR's are generally thought of as much more complex and technically competent cameras.

Probably the most fundamental difference between the two types is that digicams are "all-in-one devices" that have built-in zoom lenses, which means you are basically restricted to the lens on the camera you opt for, while DSLR's can use a wide variety of different lenses.

Then, of course, there is the cost issue. Digicams start at less than a US\$100 and go up to around \$750, while DSLR's start



Using Mirrorless Cameras Underwater

from around \$700 and go up to \$8,000!

For underwater photography, most people start with a digicam, as there are cost-effective housings available for many digicams.

X-RAY MAG's editor, Larry Cohen, recently completed an excellent series of articles on the use of point-and-shoot digital cameras underwater, and Lawson Wood provided a comprehensive series

on DSLR's underwater before that. Check out X-RAY MAG's archives online to download these articles.

The objective of this, and subsequent articles, is to provide an insight into

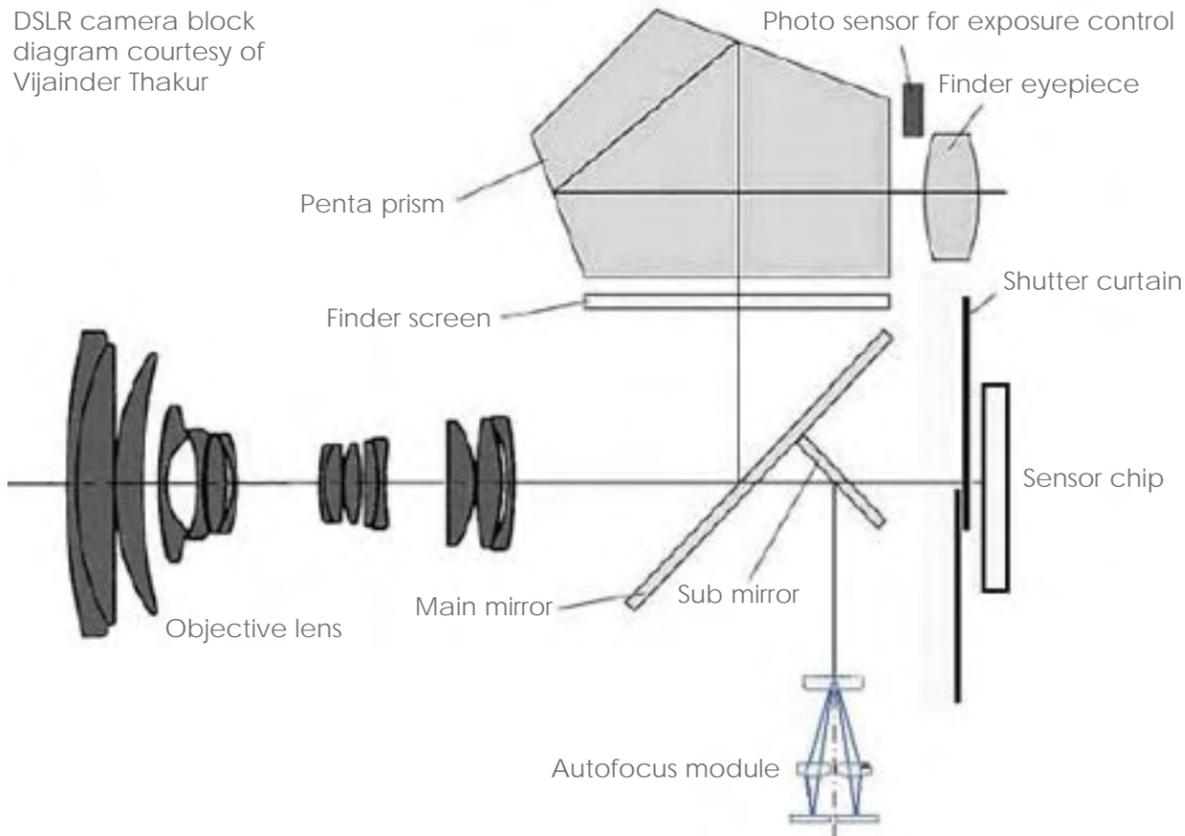
the new technology space that has appeared on the photographic scene in the last couple of years—mirrorless or EVIL (Electronic Viewfinder Interchangeable Lens) cameras.





photo & video

DSLR camera block diagram courtesy of Vijaiinder Thakur



Mirrorless

Why mirrorless?

Mirrorless cameras have created a new space in the photographic world, and manufacturers love nothing better, because it allows them to bypass the existing competition in the never-ending battle for overall sales volume.

In the DSLR camera space, the *Big Two*—Canon and Nikon—dominate, while all the rest of the manufacturers try to find a way to grow.

Sony is a good example of this, and a few years ago, it announced aggressive plans to break the stranglehold of the Big Two by releasing a number of very good DSLR's. But most photographers had too much invested with either Canon or Nikon lenses to change brands. So, the Sony DSLR's have yet to really take off.

Then Sony decided mirrorless cameras was the new space they were looking for and developed the highly regarded NEX range. Sony has subsequently enjoyed significant sales success and established a loyal following.

Mirrorless cameras offer the primary advantage of a DSLR—interchangeable lenses—but in a much smaller and cheaper package. They have been marketed well and have been positioned as a trendy alternative to DSLR's. They are a very logical next step for digicam owners and looking to upgrade also provide a great "second camera" option for DSLR

What's the buzz?

The new mirrorless cameras have created a lot of buzz in the diving community, because they seem to offer two very distinct advantages. First of all, they bridge the price gap between digicams and DSLR's in a very attractive manner, while offering a very cost-effective way to increase photographic capability underwater. Secondly, they are small and light and solve the travel problem all underwater photographers using DSLR's face when it comes to check-in time at the airport.

This means that mirrorless cameras are not only attractive to the digicam user looking to upgrade to a DSLR but baulking at the cost, they are also catching the attention of the existing DSLR users who are fed up with the bulk and weight of their equipment. The key question both these scenarios raise follows: Is the capability of mirrorless cameras underwater really good enough, or are they just expensive stop-gaps on the way to (or back to) a DSLR?

So, what's a mirrorless camera?

The basic concept

behind Single Lens Reflex (SLR) cameras is that a hinged mirror is used to cover the image storage medium while the subject is viewed and composed. This is done by the photographer looking through the viewfinder, mounted at the top of the camera body, into an optical prism that allows the image on the mirror below to be seen.

The image that is available on the mirror is a function of the lens attached to the camera body. A wide-angle lens allows a broad sweep of the immediate area in front of the camera to be seen, while a telephoto lens isolates specific subjects in the distance.

The combination of the prism, mirror and various lenses allows the photographer to compose the subject to their taste. When the shutter button is pressed, the

hinged mirror rapidly swings out of the way and allows the storage medium to record the image.

The fundamental difference between SLR's and DSLR's is that with SLR's, the storage medium is film, while with DSLR's, the medium is a digital sensor. The rest of the camera body is basically the same.

The flexibility and usability of SLR's is why they are so popular. The downside is that the need for a prism and mirror means that a basic model is much bigger than a digicam. Top-of-the-range SLR models can be really big and heavy.

The concept behind mirrorless, or EVIL, cameras is to remove the optical prism and mirror to greatly reduce the overall size of the camera body, while providing the ability to change lenses as well as the use of the LCD panel on the back of the camera to view and compose the subject matter. The storage medium is a digital sensor; there are no film-based mirrorless cameras.



Size comparison, compact and DSLR, courtesy of Canon



Olympus OM-D



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But which format? —I'm confused

Digital photography can be very confusing to the uninitiated because of all the technical jargon and acronym soup related to the size of the sensor—FX, APS-H, DX, APS-C, to name but a few—and now we have *Four Thirds* and *Micro Four Thirds*.

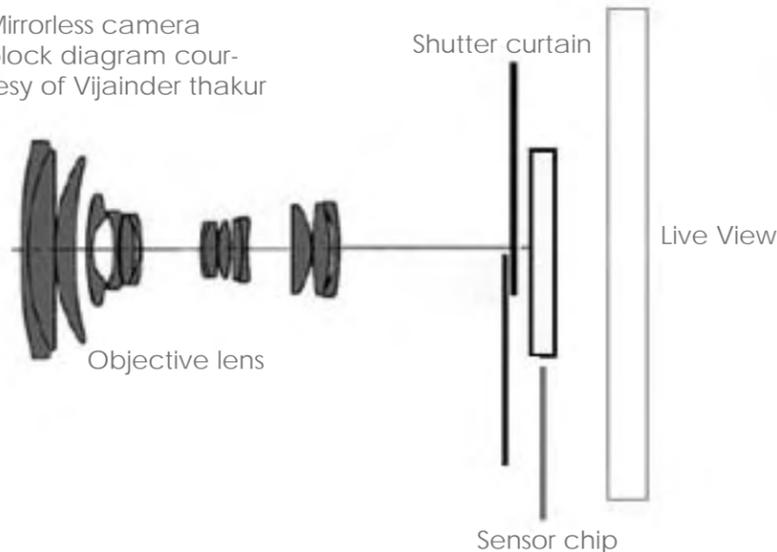
The reference point for all these sensor formats is the 36x24mm size of the piece of 35mm standard that used to record the image in the days of film—remember that stuff? FX sensors are the same size as those pieces of film, while the

others are smaller and therefore apply a *crop factor* such as 1.5 with the Nikon DX format.

The crop factor is applied to the focal length of a lens. So, for example, a Nikon 20mm FX lens on an FX camera is a 20mm lens, but the same lens used on a Nikon DX camera becomes a 30mm lens (20 x 1.5).

The premise for the Four Thirds system is that rather than design digital sensors around a size and format that relates to film, it is better to start from scratch and design for purely digital use. The original concept was developed by Olympus and Kodak (remember those Kodak moments?).

Mirrorless camera block diagram courtesy of Vijainder thakur



The Four Thirds sensors are approximately half the size of the FX sensors and use a ratio of 4:3 (width to height) rather than the 3:2 inherited from film, which means that they have a crop factor of around 2, so that a 20mm lens would be 40mm.

The small sensor is both the Four Thirds system's biggest advantage and, some would argue, its weakest point, too. The size means that the camera bodies and lenses can be much smaller than those of a DSLR. But its detractors point out that it lacks the imaging horsepower of the bigger sensors.

Olympus counters that argument by explaining that, physically, the sensor is only very slightly smaller than the DX/APS-C variants, and, because the Four Thirds system is designed from the ground up for digital imaging, the sensors can out-resolve (in optical terms) the larger sensors in the equivalent focal lengths.

The Micro Four Thirds format uses the same sensors as Four Thirds, but in a smaller and

much thinner camera body plus smaller lenses, so that the overall size is even further reduced—all of which start to make a compelling story for underwater photography.

Sony NEX

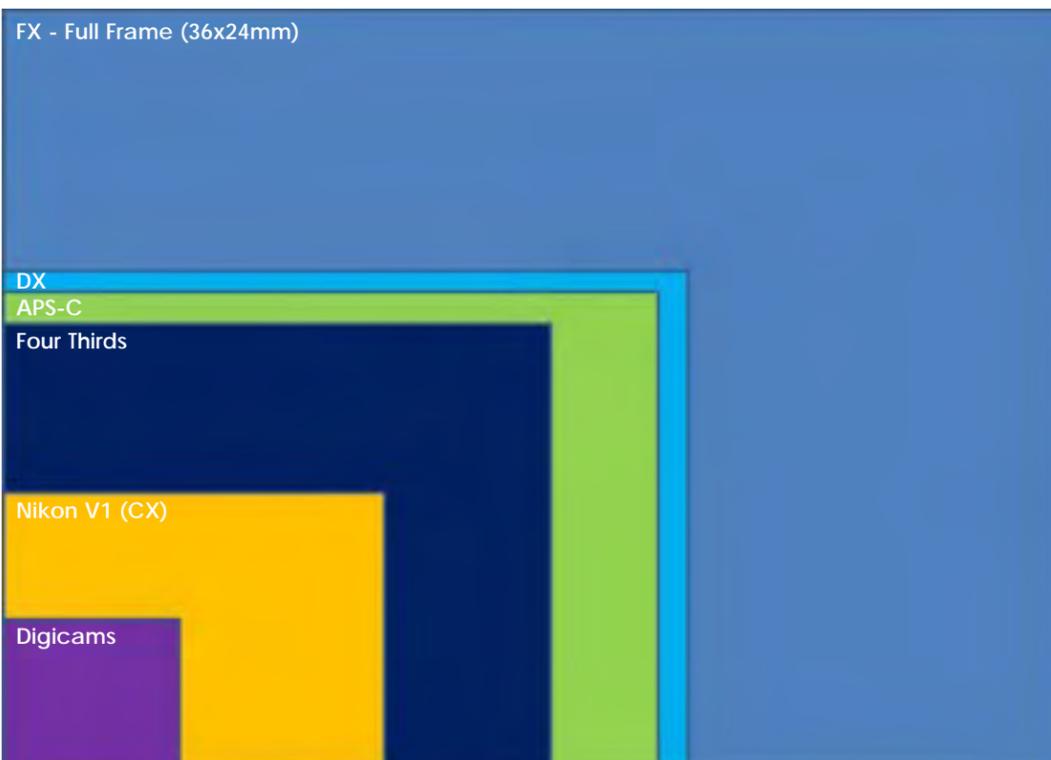
Sony opted to use a larger sensor for its NEX range of mirrorless cameras, which means the lenses required are much bigger than those used in the Four Thirds systems. The results from the APS-C sized sensors are impressive, as is the fact that the NEX bodies are much smaller than their DSLR equivalents using the same sensor.

CX Nikon 1

Just to add one more potential level of confusion, Nikon recently responded to the growing popularity of mirrorless cameras and released its own versions—the V1 and J1. The fact that Nikon entered the fray, and Canon is rumored to



Sony NEX 5



Digital sensor sizes



photo & video

be following suit, is indicative of just how much momentum the mirrorless space is gaining.

While the entry of Nikon is a positive sign, they did it with a different size of sensor—one that is smaller than the Four Thirds system—plus the lenses developed for the V1 and J1 can only be used on those cameras. Nikon's mirrorless cameras are even smaller than the Micro Four Thirds versions and have

received a lot of attention for their state-of-the-art efficiency.

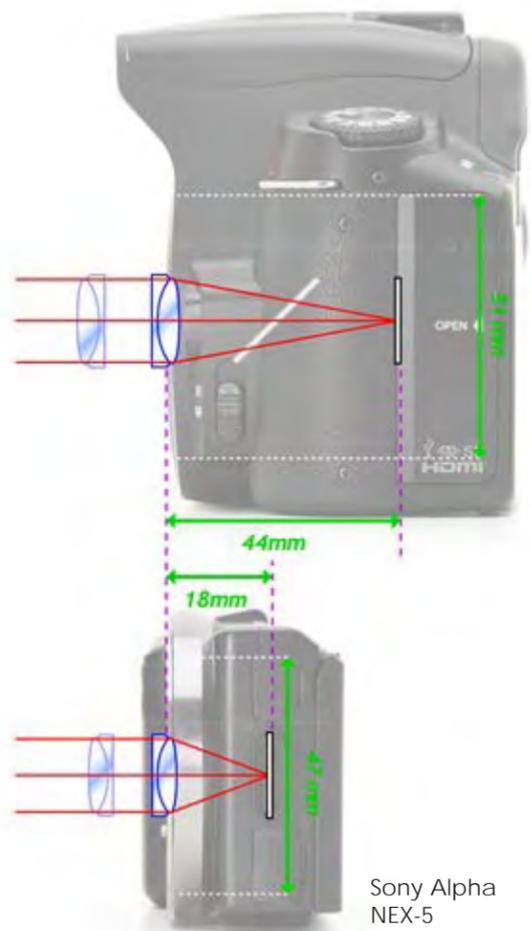
Lens choices

Because the whole area of mirrorless/EVIL camera technology is a completely new space, there are no legacy lenses available to use on the new cameras. Currently, this is probably the biggest single drawback.

Given time, this problem will go away completely, as the new systems have real momentum in the market. Nikon's entry with the V1 and J1, plus Canon's rumored entry into the space, show that they are here to stay.

Third part lens manufacturers such as Sigma are now releasing lenses for various models, which is also a very positive sign. But for now, none of the manufacturers have a complete set of lenses available, although Panasonic and Olympus, with their joint format Micro Four Thirds system, are close, followed by Sony.

For underwater photography, the biggest gap is with macro lens availability—but again, if the rumors are to be believed, the missing lenses are on their way.



Sony Alpha DSLR A330

Sony Alpha NEX-5

Size comparison: DSLR vs. mirrorless

Summary

Simply stated, mirrorless/EVIL cameras are an exciting new area of photographic technology that offer many of the most important features of DSLR's but in a smaller, lighter and cheaper way, which is particularly appealing for use underwater.

They are both a logical step up for many underwater photographers who started with a digicam and are ready for something better, and, at the same time, a logical step-down for DSLR users who are tiring of all the hassle of carrying their gear around or getting hit with excess baggage charges.

Both ways, this is a space to watch. The next article in this series will look at the housings and associated equipment needed to use mirrorless cameras underwater. ■

ADVANTAGES

- Smaller and lighter cameras and lenses than DSLR's
- Interchangeable lenses
- No mirror means one less piece of precision equipment inside the camera
- No mirror means no "mirror slap" noise and resultant camera vibration or movement
- The smaller sensor size gives deeper depth-of-field for the same equivalent field of view and aperture

DISADVANTAGES

- The sensor is smaller than the ones used in DSLR's and so (theoretically) the image quality will be less
- Autofocus is not as good as on a DSLR but is only really an issue with sports photography
- No high quality optical viewfinder
- Because there is no mirror over the digital sensor, changing lenses can introduce dirt and dust more easily than with a DSLR—although many mirrorless cameras have dust-removal systems
- The smaller sensor with its deeper depth-of-field means it is more difficult to achieve out-of-focus backgrounds



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photo & video

Nikon D600 DSLR — Full-frame becomes affordable

Nikon's much-rumoured entry level full-frame FX DSLR, the D600, has been formerly announced and is available at a suggested retail price (SRP) of US\$2,099. Pitched firmly at DX upgraders, the new D600 is a lightweight and compact camera, which has a 24.3 megapixel full-frame CMOS sensor with a native ISO range of 100 to 6400 combined with Nikon's EXPEED 3 processor.

It is also likely to appeal to D4 and D800 owners looking for a second camera body. The D600 features Nikon's Scene Recognition System for AF, combined with a 39 point MultiCAM 4800FX AF module and has 100% coverage through the viewfinder. Video functions include 1080p video at 24p, 25 or 30, 720p at 60, 50 and 30 and the video image can be displayed on the LCD screen while simultaneously shown on another monitor through the HDMI, with or without shooting data. In addition, uncompressed video can be recorded through the camera's HDMI connection.



Canon EOS 6D full-frame DSLR

In a move that appeared timed to neutralize Nikon's announcement of its entry level full-frame DSLR, the D600, Canon has released its contender for that space in the market—the EOS 6D. Nikon announced the D600 as the "smallest and lightest full frame DSLR" but the EOS 6D weighs in at 770g, compared to the D600's 850g. As they say, size matters. The Canon EOS 6D appears to be a full-frame version of the EOS 60D, in much the same way as the D600 seems to be a full-frame version of the very popular D7000. The EOS 6D features a 20.2MP full-frame CMOS sensor with DIGIC 5+ image processor, an ISO range of 100-25600 standard, which is expandable down to 50 and up to 102,40 and 4.5 fps continuous shooting. The Auto Focus system has 11 points, but only the central one is cross-type (i.e. sensitive to both vertical and horizontal detail). However, according to Canon, it will operate at extremely low light levels—right down to -3 EV—a stop dimmer than the 5D Mark III. The EOS 6D is retailing at US\$2,099—the same price as the the Nikon D600.



Canon announces the G15

Canon has announced the latest iteration of its highly regarded G Series of digital compact cameras. Many in the photo industry wondered if the Canon G1 X, which had a "G" type body but with a much larger sensor meant the end of the previous series, but the release of the new G15 indicates Canon intends to maintain it. The new Canon G15 features a new 28-140mm equivalent zoom lens that is one stop and a third faster, at F1.8-2.8 rather than F2.8-4.5 than the previous version. It is also 15% slimmer than the previous version, but that comes at the expense of the articulated LCD screen, which was a very nice feature of the earlier version. The G15 uses a Canon-made 12.1MP 1/1.7"-type CMOS sensor, the same as that found in the co-announced S110 (and similar to the one used on the S100), which offers an ISO range from 80 to 12,800 in concert with the DIGIC 5 processor. The G15 will retail at US\$500.

Sony A99 full-frame DSLR

After a four-year hiatus, Sony has announced its new full-frame camera—the A99. Sony has a long and thoroughly deserved reputation for innovative technology, and its new flagship full-frame DSLR continues that tradition. The A99 utilizes an SLT system, which means that it has an electric viewfinder and a fixed, semi-translucent mirror that is always reflecting light to the autofocus sensor. This means the A99 has full-time phase detection autofocus. While Sony's previous flagship DSLR—the A900—didn't have live view or video recording ability, the A99 is a live view camera. The full-time phase-detection autofocus is ideal for the A99's 1080p60 movie recording, as it's faster and more fluid than contrast autofocus. Overall, the A99 has some impressive specifications, and it will be interesting to see if any of the underwater housing manufacturers decide to produce something for it.



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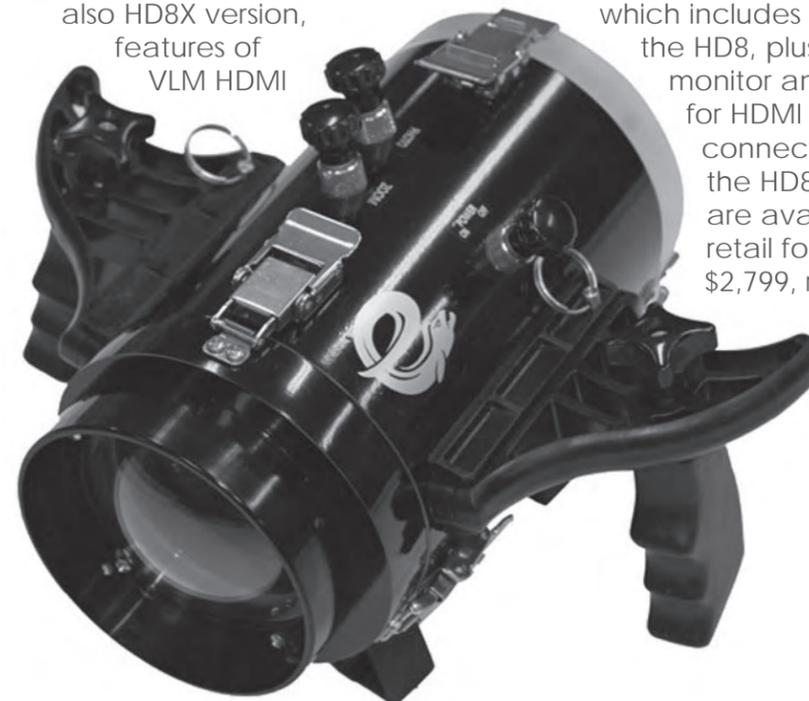
Nauticam NA-LX7 Housing for the Panasonic LX7

Nauticam continues to release new housings at an incredible pace. This time, it's their housing for the highly regarded Panasonic DMC LX-7. Nauticam has designed the NA-LX7 as a very compact housing while still offering full access to all camera controls. The NA-LX7 features a hand grip that has been sculpted into the housing to provide easy access to those controls, which include the camera's aperture ring and built-in neutral density filter. The NA-LX7 housing also features removable fiber optic ports for strobe triggering and both M10 threaded and cold shoe attachment points on the housing body. The new housing will be available in late October at a retail price of US\$950.



Equinox HD5 and HD8 Video Housings

Equinox has released two new video housings, the HD5 and the HD8. The HD5 is designed to accept both Canon and Sony camcorders and, according to Equinox, is smaller and lighter than any other housing they have produced and will perform at greater depths than most other housings in its class. The HD5 features 4-5 manual control functions (more can be added at request), a new 330-foot depth rating, 2.5 inch rear mounted LCD screen, and a 58mm wide-angle lens with macro (if camera allows for it). The HD5 is now shipping and will retail for US\$1,349. The HD8 is designed for the popular JVC HMQ10 4000K camcorder and is depth rated to 250 feet and offers access to all manual controls. There is also HD8X version, which includes the same features of the HD8, plus a Sony 5in monitor and bulkhead for HDMI Mini connection. Both the HD8 and HD8X are available and retail for \$1,799 and \$2,799, respectively.



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Nauticam NA-650D Housing for the Canon EOS T4i/60D

Nauticam also released their new NA-650D housing for the Canon EOS T4i/60D SLR. The NA-650D features a new switch that avoids needing to push AV button and turn the aperture at the same time—easy enough to do on land, but less so underwater. Nauticam's solution is an Av button control, which is assigned to a switch. By flipping it, the button is held down, making it easy to change settings. The NA-650D will retail at US\$2,400.

Gates C300/C500 Housings

Gates has announced the release of their new underwater housings for the Canon EOS C300 and C500 digital cinema cameras. The new housings feature support for a variety of Canon and PL mount lenses, Gates' "Seal Check", a full lineup of port systems, and mechanical controls. Additionally, Convergent Designs' Gemini RAW recorder can be included for true RAW recording. The housings are now shipping and more information can be found on Gates' website.

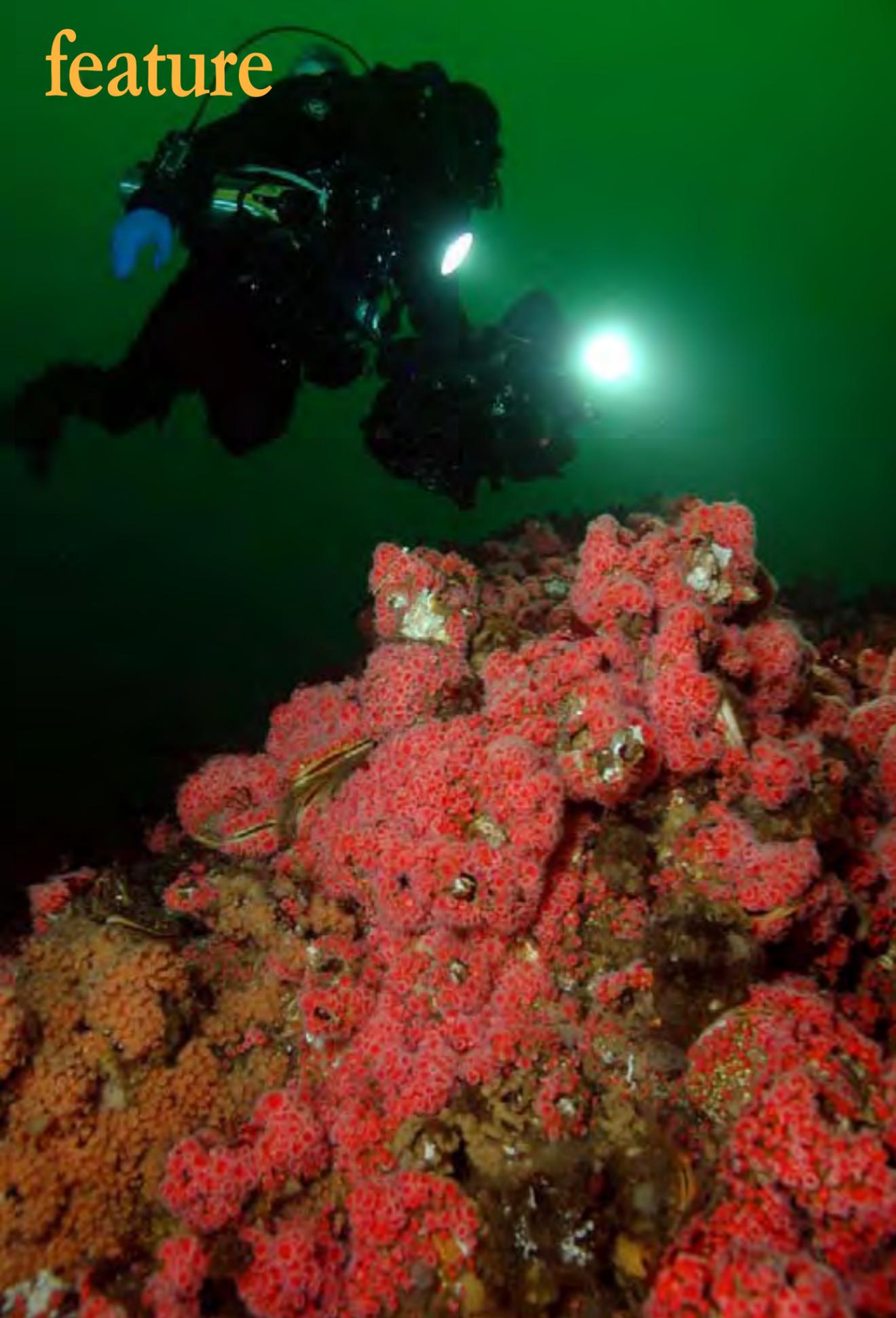


British Columbia

Text and photos by Barb Roy

Critter Connection





CLOCKWISE FROM LEFT: Diver shooting video of luscious, coral-covered reef, Nootka Sound; BC ferry passes Snake Island, Nanaimo; Diver with yellow fins kayaking in Barkley Sound

British Columbia (BC), Canada is known for having some of the most colourful temperate water diving in the world. This holds true for excellent critter sightings as well, found throughout the varied coastal regions. Underwater photographers often enjoy the challenge of photographing the illusive giant Pacific octopus or getting all wrapped up with a friendly two-meter-long wolf eel! For the visiting extended-range technical divers, the natural shipwrecks and deep walls are usually covered in a swathe of intriguing marine critters.

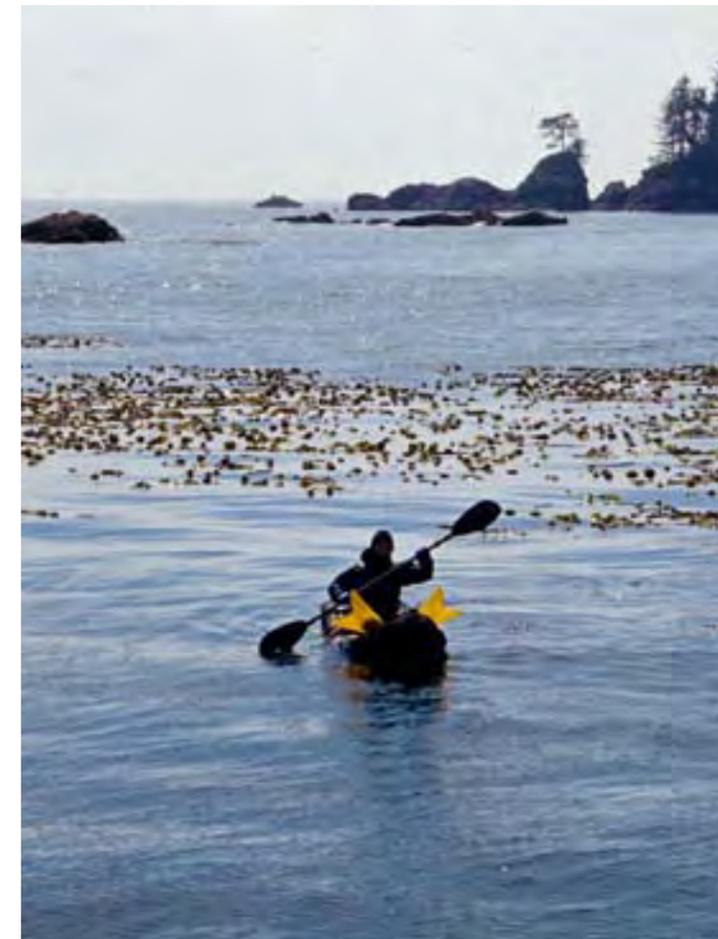
To get a better understanding of what BC has to offer, let's take a closer look at each region. Keep in mind however; most of the underwater life you will encounter can also be found at multiple locations.

Howe Sound

Bordering Mainland Vancouver and the Coastal Mountain Range, Howe Sound is a deep fiord fed by cool upwelling nutrient-rich water. Like most locations along the coast, seasons are mild, the wildlife plentiful and diving can be done year round. For those needing to wet their appetite for outdoor adventure, Howe Sound is a great place to start.

Shore diving can be done at Whytecliff Park and Porteau Cove where divers might find wolf eels, octopus, huge cabezon and lingcod. Orange and white swimming anemones, small crabs, hydroids and frosted nudibranchs are also plentiful. Porteau Cove has several small boats in the park, scuttled to enhance the terrain.

For half and full day boat charters, dive boats meet groups at Sewell's Marina in Horseshoe Bay. Howe Sound is full of pinnacles, islands and islets,



some marked with mooring buoys to designate the dive sites. Below the emerald water, divers might find orange sea pens, small sculpins and brittle stars at the Bird Islet site. Cowan

Large yellow-eye rockfish, Nanaimo



Because of the depth and relatively mild currents, Agamemnon Channel is a favourite among technical divers. Personally, I find the increased size of the gorgonians impressive and always try to bring along a Trimix system when visiting this area, just for the gorgonians!

Skookumchuck Rapids is another breathtaking dive with a multi-coloured collection of white, orange, green and pink anemones. Clusters of orange and purple ochre sea stars plaster themselves on large boulders scattered about the terrain in the shallows. In deeper water, the entire ocean floor is covered in red, green, yellow and orange anemones and sponges. Although diving is done at slack (when the water stops to change direction) current in the Skook (as locals call it) can reach up to an impressive 30km per hour!

The wreck of the *HMCS Chaudiere*, scuttled in 1992 by the Artificial Reef

Point is good for zoanthid anemones, hairy-spined crabs and beautiful red crimson anemones. Under any of the mooring buoys you can usually see rockfish, wolf-eels and the occasional Puget Sound king crab. The 366-foot (111-meter) retired Canadian Navy ship *HMCS Annapolis* is the latest addition to BC's collection of artificial reefs, scuttled in October of 2012.

high as a diver. Watch for small orange sharp-nose crabs and rockfish hiding within the cloud sponge openings. At this site, I have photographed many different small crabs, orange peel nudibranchs, juvenile yellow-eye rockfish, sea cucumbers, cup corals, abalone and so much more.

Lower Sunshine Coast (Sechelt/Egmont)

Getting to the Sunshine Coast requires a ferry ride across Howe Sound from Departure Bay to Langdale. (See www.bcferrys.com). After a short drive to Sechelt and then to Egmont, divers wanting a weekend getaway can meet a dive operator here for an excellent selection of advanced dives.

Beneath the Power Lines, in Agamemnon Channel, is a deep wall full of life starting upon descent. Immense clusters of yellow and white cloud sponges are dispersed all along the wall, as it gently cascades to depths beyond 200ft (61m). Around 90ft (27m), huge red gorgonian sea fans majestically stand as



Diver (above) at Dodd Narrows, Nanaimo; Diver inspects one of the many artificial reefs of BC (right)





is located at the old mill in Powell River, along a breakwater of ghost ships. The shallow wreckage of the Malahat's remnants is scattered about the bottom but chocked full of large and small fish. Entry is done from shore on a sandy beach next to the breakwater. The wreck can be found by skirting around the large boulders and heading straight out from shore, moving towards the mill in about 30-80ft (9-24m) of water.

For a unique boat dive, all divers usually enjoy the site of the MV

inhabiting the side of the vessel hull. The forward gun barrels, pointing straight down, now host a small growth of yellow cloud sponge about midway down.

Upper Sunshine Coast

(Powel River/Lund)

After another ferry ride from Earl's Cove to Saltery Bay across Jervis Inlet, you will find the friendly community of Powell River. Near Saltery Bay is Mermaid Cove where a three-meter-high bronze mermaid welcomes all underwater. Campsites, wash-room facilities and changing rooms are available in the park.

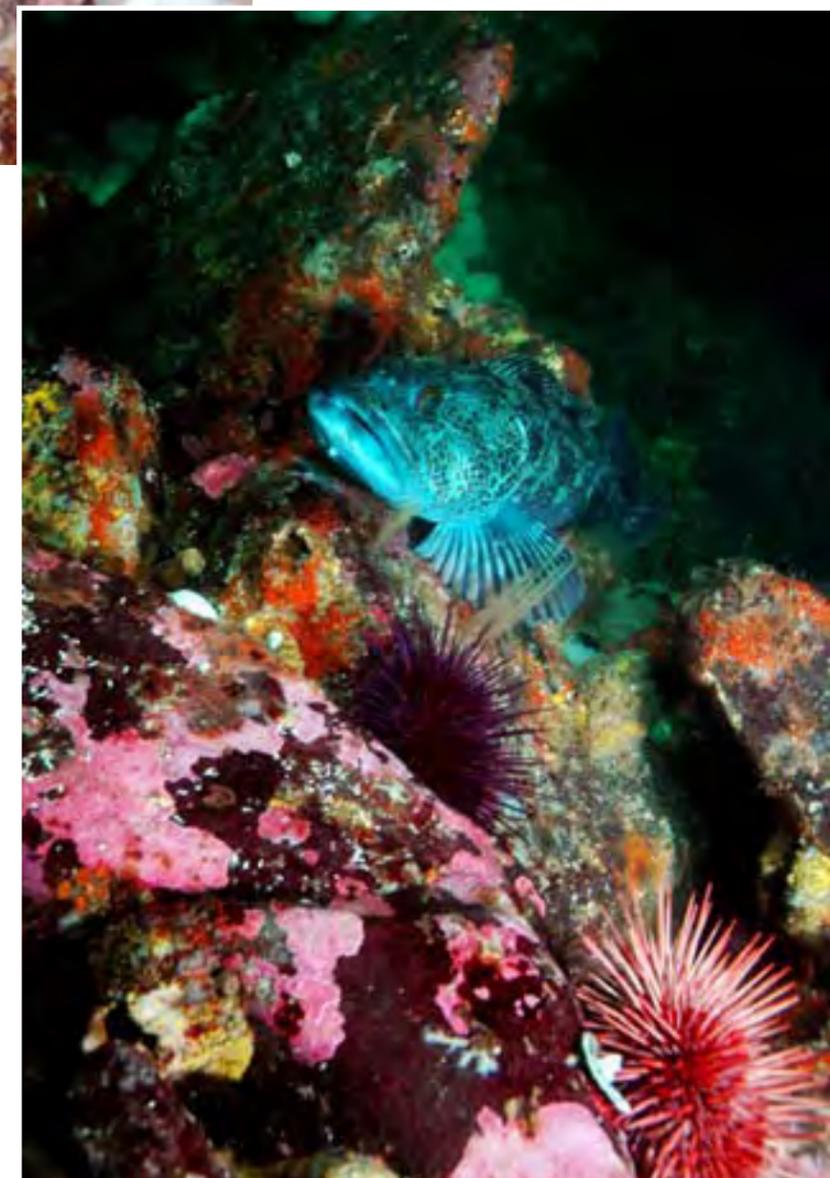
This easy shore-entry dive is suitable for all skill levels, complete with a wheelchair ramp and a place to unload gear. High tide usually brings in clear water for viewing the mermaid, created by Simon Morris before being placed at 60ft (20m). Be sure to check out the statue's base for a resident octopus. Not far from the mermaid is the wooden hull of a small boat, where small gobies and lingcod like to hang out. Next to the wreck is the start of a wall with very large boot sponges. Again, watch for rockfish peering out the sponge openings.

Just up the road is a place called Octopus Hole, another easy shore dive, where small octopus hide in rocky dens. The terrain is favourable to crabs, which are always on the cephalopod's menu. Orange and brown burrowing sea cucumbers, swimming nudibranchs and tiny sculpins call this place home.

Another interesting shore dive



Tiger rockfish, Union Bay



Lingcod (above); Diver (far left) at Saskatchewan, Nanaimo

Society of British Columbia (ARSBC), lies on its port side in 60-145ft (20-44m) of water in Sechart Inlet. Visibility is best between September and April,

sometimes yielding up to 100ft (30m)! The wreck wears a cloak of glass tunicates on the railing and deck structures with white and orange plumose anemones





Giant Pacific octopus, Rock of Life, Port Hardy (above)

anemones can be found here. This is one of those dives where technical divers can explore the deep wreck, and the naturalists can check out the island's multitude of critters in the shallows.

Northern Coastal British Columbia (Beyond Port Hardy)

Liveaboard dive vessels are your best bet for exploring BC's vast coastal waterways, departing from Port Hardy or Prince Rupert. Wreck diving is one of the main activities for divers in this area, but the sites are almost always covered with so much life, it's

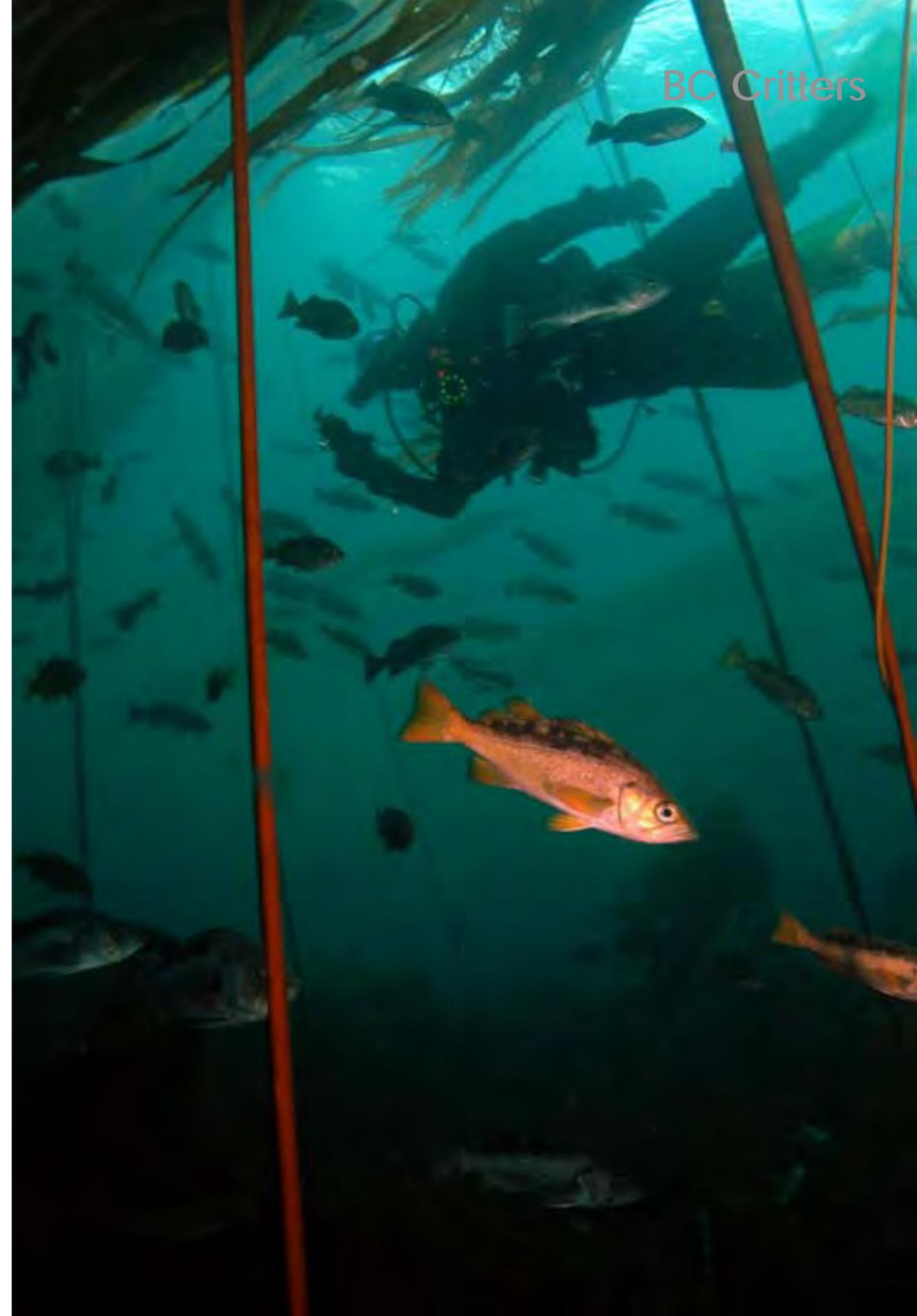
hard to tell they actually sailed on the ocean above.

The charm of seclusion is another reason why divers venture this far north. Waking up in a tranquil calm cove with a humpback whale surfacing nearby

mingled with the sounds of eagles fishing for their breakfast of salmon is well worth the experience.

A favourite wreck is the *Transpac*, sitting vertically against a wall with its bow in 90ft (27m) and the stern at 285ft (87m). Even though visibility can be 60-100ft (18-30m) here, lights and extended-range gear are advisable. Upon ascent, however, there is a nice wall to the right, which offers a multitude of invertebrate life. On one of my favorite dives here, we were lucky enough to spot a very young, pink Alaskan king crab.

On the wrecks of the *Ohio*, *James Drummond* and the *Drumrock*, I photographed giant clusters of yellow and white cloud sponge, tall white plumose anemones, bright orange yelloweye rockfish, lingcod in shades of blue and grey and numerous anemones of all sizes.



Diver (above) at Seven Tree, Port Hardy; Diver and affectionate wolf eel, Port Hardy (left)



Gulfstream, sinking in 1947 at Dinner Rock. This advanced wreck dive is in 125-155ft (38-47m) of water. Although the island's wall is steep, a host of abalone, lingcod, rockfish, cup corals and huge white and orange plumose





Northern Vancouver Island

Most dive operators pick up their groups in Port Hardy or Port McNeil for multi-day and week-long excursions. One of the most popular sites in the area is Browning Wall, stretching from the surface down to over 250ft. This almost vertical wall is crowded with pink and white soft corals, long tan finger sponges, nudibranchs, moss-head and decorated warbonnets, along with beautiful red Irish lords.

Watch for small to medium size octopus out hunting on the wall. With so much life at this site, it's hard to focus on just one thing, but try to look down the wall and behind you for the hovering rockfish. Quite often the abundance is astounding.

A thick forest of kelp wraps around many of the islands where huge black rockfish float suspended beneath the canopy. I am always in awe looking up to the surface from depth. In the shallows around the reefs, look for thousands of small, colorful brooding anemones residing on the strands of kelp where they attach to the rocks. Many will have tiny buds on them to promote the next generation.

For those with a good photo eye, look close on soft coral branches for tiny yellow sea spiders. Large numbers will sometimes cover the entire branch. The reason for this unusual symbiosis is still unknown to biologists, but some believe the spiders are feeding on the polyps.

Other excellent boat dives

include Barry Islet for small pink and white gorgonian sea fans, many with miniature basket stars clinging to them.



The Swell liveaboard boat in northern BC

BC Critters

The wreck of the *Themis* is over 100 years old providing home to box crabs, sponges and wolf eels, around Crocker Rock, Seven Tree, Dillon Rock, Nakwakto Rapids and Hunt Rock are all worth the journey to find wolf eels, octopus, and red-lipped gooseneck barnacles (at Nakwakto).

Central Vancouver Island

(Campbell River/Hornby Island) Heading south from Port Hardy is the town of Campbell River. The body of water between the town and Quadra Island is called Discovery Passage, containing several first-rate boat and shore dives. The wreck of the *Columbia* and the May Island ferry always seem to have perch, rockfish, lingcod, and painted greenlings on them. Giant purple tubeworms grow to an impressive size at the Copper Cliff dive site. Tubeworms can also be found on the *Columbia*. Whiskey Point has a seemingly endless



Rainbow shrimp, Port Hardy (above); View from the Swell, Port Hardy (top left)

carpet of strawberry anemones, sponges, large crabs, and generally, a resident wolf eel. Marine life seems to be plentiful at all of the

current-dependant sites, yielding additional kelp greenlings, nudibranchs, brittle stars, juvenile crabs and trumpet sponge. On one of



Harbor lions (left) are found all over BC; Location of British Columbia on world map (right) and satellite map of BC; Basket star on soft coral (inset lower left)



rock scallops and barnacles. Rose stars, octopuses, extra large painted anemones, sea cucumbers and orange sea pens also flourish.

Nootka Sound is accessible from Campbell River by heading west to Gold River then down a logging road to the township of Tahsis. When not diving, kayaking, fishing and hiking are all popular.

Barkley Sound is home to excellent reefs, pinnacles, wrecks, current-swept sites and the Broken Group Islands. On the outer edge of the Sound, debris from the *Vanlene* shipwreck is scattered in both shallow and deep water, hosting a selection of nudibranchs, bryozoans, crabs, rockfish, anemones, abalone and more.

There are several other sites where a sixgill shark might be sighted between July and September, so keep your eyes open. When photographing these large, slow-moving sharks, be patient and plan to go deep if needed. Some of my best shots have been around 90ft (27m)

on cloudy days. There was once a time when sixgill sharks were sighted regularly at Hornby Island, in Nootka Sound and in Barkley Sound. Now, they are only randomly seen.

Barkley Sound is north of Nanaimo and south of Ucluelet, with access from Port Alberni. Another way in is down a gravel logging road to Bamfield.

Nanaimo Area

There are two ferry terminals in Nanaimo from mainland Vancouver, making this an easy place to spend a day or weekend. Snake Island is a short boat ride from Departure Bay where divers can find grunt sculpins, wolf eels, harbor seals and a waterfall of white anemones on the northern side of the island.

On the other side of Snake Island, two more ships were scuttled by the ARSBC—the *HMCS Saskatchewan* and the *HMCS Cape Breton*. Resembling a fish nursery, hundreds of small fish hatch here every spring. The *Saskatchewan's* upper structure is covered with white anemones giving it a textured appearance when looking up from the deck at 60ft (18m). It's not uncommon to see immense lingcod resting on the deck or look inside a hatch and see a yellow cloud sponge beginning to grow. Be sure to ask the dive charter operator where to find the huge resident rockfish fish, because it's bright orange

beginning to collapse, so divers should always remain on the outer parts of the ship. This is a great rockfish location with older, large residents and beautiful thick cloud sponge masses. Quillback, cop-

exhilarating!

At one of the many other boat diving sites around Hornby, you might encounter octopuses, wolf eels, tiger rockfish or see anemones, sea pens or herring eggs covering everything in the spring. One of my favorite dives near Union Bay yielded more than a dozen wolf eels, each accompanied by large orange and black tiger rockfish. Very cool indeed.

West Coast of Vancouver Island

(Nootka Sound/Barkley Sound) When exploring Nootka Sound, don't forget your camera or video because the colours are not only vivid, they are spectacular. Mozingo Point is within minutes of Tahsis where red gorgonian sea fans, yellow cloud sponges and Puget Sound king crabs can all be found on one dive.

At another site not far away, red strawberry anemones and yellow zoanthids carpet the ocean floor, even covering giant

per and black rockfish can also be found here. Most of the wreck is covered with white plumose anemones of all sizes giving it an eerie appearance.

A fun seasonal dive is done with sea lions around Hornby Island between November and April. Divers sit on the bottom in about 20ft (6m) next to a small island and wait for dozens of friendly, curious sea lions to come over and play. Be sure to keep your hands close to your body, because their play can be quite

my dives at the Columbia, I photographed two huge octopuses on the bottom, next to the ship.

The *Capilano* wreck and Mitlenatch Island are two more critter-rich dive locations accessed from Campbell River, Powell River or Courtenay. Immense sea lions and fat harbor seals like to lounge on the beaches at Mitlenach.

The 120-foot (36-meter) SS *Capilano* sits upright in 145ft (44m) of water. The hull and prop may look intact, but the structure is



Sixgill shark



BC Critters

CLOCKWISE FROM FAR LEFT: Anemones at Dodd Narrows; Lingcod at Campbell River; Red-lipped gooseneck barnacles; Mosshead warbonnet; Frosted nudibranch, *Dirona albolineata*

Afterthoughts

No matter where you begin your dive holiday, BC will provide a fun relaxing experi-

ence for the whole family. During peak summer months book your ferry travel (www.bcferries.com) and activities early. Dive charter and store contacts can be found at www.diveindustrybc.com. Gear is available for hire in most communities. Keep in mind, most of the dive operators do not allow spearfishing or taking anything from the ocean habitat except for photos. ■

nes, encrusting sponges and kelp cling to the hull.

Victoria Area

Located at the southern end of Vancouver Island, Victoria's strong nutrient-rich currents support an assortment of large and small marine residents. Race Rocks is a breathtaking boat dive located about three nautical miles from Pedder Bay in the Strait of Juan de Fuca. Here, tons of life reside, much like in the north. Pink and white clusters of soft coral, finger sponge and colorful nudibranchs share an underwater rocky terrain with lavender coralline algae and overlapping leaves of ground-covering kelp.

Victoria is also known for its wonderful bottle and shore dives, including Ogden Point breakwater where octopus and wolf eels are often seen. Several reef balls have been placed along the concrete wall, attracting even more critters.

Sidney and Saanich Inlet

Near Sidney the *HMCS Mackenzie*, the

GB Church and Arbutus Island are all close easy boat dives. However, at times the *Mackenzie* can have current on it, so be prepared. Huge clusters of cloud sponges are located in the calm waters of Saanich Inlet along with Puget Sound king crabs, plumose anemones, nudibranchs and scallops. Saanich Inlet also has several shore diving sites and great kayaking opportunities.

Graham's Wall is a great current-dependant site in Haro Strait near Domville Island, stretching down to 90ft (27m). Close-up and macro photography is awesome here, with plenty of nudibranchs, blood stars, white tunicates, orange social tunicates, cup corals, decorator crabs, scallops and lacy bryozoan.

wreck of the 190-foot (58-meter) long duel paddle-wheel steamer *Del Norte*, sinking in 1868. Not much of the wreck remains except the ship's two paddle-wheel bases with protruding spokes and a couple of boiler stacks. Chunks of coal are everywhere.

Another easy dive is the 737 jet air-frame body near the town of Chemainus. The plane sits on a stand in 90ft (27m) of water with the main body at 70ft (21m). Currently over 100 marine life species have been identified at the site by author and biologist, Andy Lamb. Andy and his wife run Cedar Beach Lodge on Thetis Island, catering to divers.

Porlier Pass, located between Valdes and Galiano Islands are home to wolf eels, basket stars, huge lingcod, cabezon and rockfish. There are several wall diving sites and the wreck of the *Point Grey*. Sinking at Virago Rock, the *Point Grey* is a 32-meter-long steel tugboat sitting upside down in 10-15m of water. Fish love to hide in the structure and will peer out at passing divers. Colonies of anemo-



appearance will be worth the trip!

For an exciting adrenalin dive, Nanaimo has two drift dives—Dodd Narrows and Gabriola Pass. If currents permit, divers will be treated to a magic carpet ride over a terrain of anemones, sea stars and giant barnacles. Both sites remind me of public aquarium habitats, complete with swaying kelp fronds.

Chemainus and Porlier Pass

Porlier Pass, Trincomali Channel and Stuart Channel offer divers something different at each location. One of my favorites was a dive on the historical

