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Ornate ahost pipefish, Anilao, Philippines, Photo by Steve Jones



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Troy Cheek, October 201



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Back to the beginning

In this issue the main spotlight is set on Italy, courtesy of Marco Daturi who runs the Italian dive portal ScubaPortal and the e-magazine ScubaZone.

Diving is a lifestyle, but living doesn't stop at the water's edge, and I know of few other places than around the Mediterranean where divers understand how to also enjoy the other pleasures in life, in particular food and good times with friends and family.

But that is not why we have been moving focus a bit closer to home of late. Recreational diving came of age in the 1970s and 1980s before booming in the 1990s. During this period dive travellers went further and further abroad, pushing the frontiers outwards like slow expanding rings on water.

In Europe the focus of diving first moved from the Mediterranean Sea to the Red Sea thanks to the ascent of cheap package deals, which actually made the Red Sea the cheaper option for many. Years later it moved onwards to Thailand and the Maldives for those who could spend a little extra. Today there are few spots left on the planet that are economically out of reach for a diver from the European or North American

middle class who are willing to save up some money. Fiji and the likes are no longer reserved for the very affluent.

But with the moving of our focus and desires further and further afield, as well as continually raising the bar, it often seems to me that we are losing our footing and forgetting, or rather, overlooking what may have been right in front of us all the time. In Europe diving in the Med became scorned, if not outright frowned upon, by dive travellers who often seemed ignorant of the options so much closer to home.

Kurt Amsler, one of our longest standing contributors and arguably the most renowned European photo pro, related to me just recently that, thanks to ongoing conservation efforts, there are now so many fish in various places in the Med that he considers it better than the Red Sea (i.e. see the Cote d'Azur travel feature he contributed in the previous issue). And I have to agree.

Some years ago I had the pleasure of having a few dives off the French port of Marseilles, and I was really impressed with all the marine life and brilliant colours under the waves. In fact, I am itching to go back.

So where am I going with all this? It is not necessary to jump on a plane and fly around the world to find great experiences or have new adventures. In many cases it may not be necessary to jump on a plane at all. It is a pleasant fact that in both the Americas and Europe good diving spots can be reached by car—even where traversing half a continent is required, it can be done in a few days—if not just in a matter of a few hours.

On a somewhat related note, let us not forget either the pleasures our local dive site may provide us with, however lackluster they may often seem—in particular on a dull winter day—in comparison to the colourful reefs on the other side of the planet. But in a quarter of a century of diving, I have never had a dive where I did not see something new or ever regretted overcoming the inertia of staying put on the comfy couch and watching movies instead. I always feel in a better mood after a dive, however trivial the location and circumstances. Since my first dip in the 1980s, diving has consistently been enriching and invigorating, and I still can't wait for my next

Diving Rocks! Happy New Year!

— The X-RAY MAG Team



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from the deep



Giant clams keep corals reefs healthy

Giant clams are reef builders and shapers, food factories, reservoirs of algae, water filters, nurseries for fish, and serve as refuge for juveniles escaping predators. Their shell ridges provide privacy for adults laying eggs.

Peter Todd, a marine ecologist at the National University of Singapore, and his colleagues have examined the clams' roles, and hope the findings will reinforce the case for conserving the molluscs. Giant clams are under great pressure from threats such as overfishing and global warming.

The team found that the 13 species of giant clams are food facThey host food-making algae scavengers such as small snails, al defences exhibited by giant clams is also indicative of their importance as a food source.

tories for coral reef inhabitants. known as zooxanthellae, serve as food for predatory crabs, lobsters, and even their spawn and faeces attract opportunistic feeders and crabs and lobsters. The wide array of morphological and behaviour-

Giant clams and their predators are likely to have been in an evolutionary arms race for millions of years. To resist attack, tridacnines have evolved large body sizes, reduced byssal orifices, and strong heavy shells. Reef builders

Their shells also help build reefs. Finally, dense populations of giant clams produce large quantities of

that are eventually incorporated into the reef framework. Some species produce 80 tonnes of carbonate shell material per hectare each year, which is available as housing for soft corals, sponges, sea squirts and large algae. But these benefits are likely to continue only if giant clam populations are healthy, making their conservation paramount, the team concludes



Forests of rare staghorn coral discovered off South Florida

A scientist from Nova Southeastern University's Oceanographic Center found the coral while doing a survey for the environmental agency, which wanted a better map of shallow reef system.

The department of environmental protection wanted a better map of the coral's locations to improve the management of beach-widening, coastal development and other activities that could harm corals, as well as improve responses to incidents such as oil spills and illegal boat anchorina.

Along the Fort Lauderdale coast, a patch was found about 325 yards off Northeast 18th Street. another about 430 yards off Vista Park and one about 325 yards off the north end of the Bahia Mar Fort Lauderdale Beach Hotel. where A1A splits. Another patch stands about 540 yards off the center of John U. Lloyd Beach State Park. It is illegal to touch the

The northern limit for the species is roughly around Boca Raton, but in the past, it was densest in the Florida Keys. The species has been disappearing there, however, battered by a variety of problems. including coral bleaching and white-band disease. ■

calcium carbonate shell material



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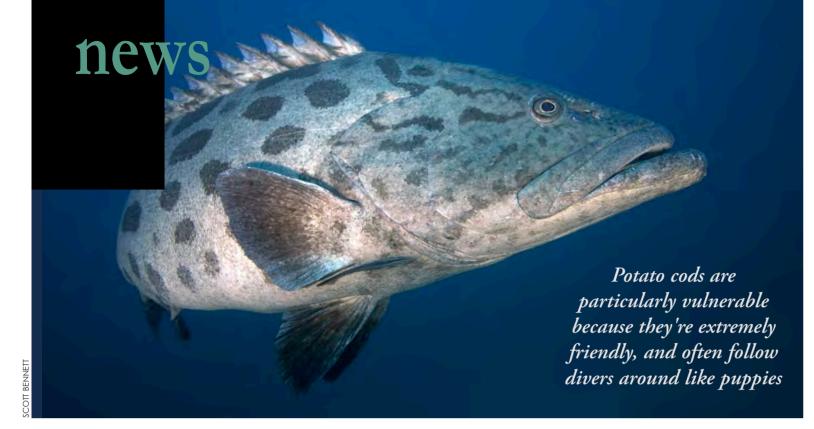
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Great Barrier Reef potato cod at risk from own friendliness

Habituated to people, fish are especially vulnerable to illegal fishing.

Potato cod in Queensland are at risk, and it's their placid and curious nature that appears to be playing a major part. The Great Barrier Reef Marine Park Authority (GBRMPA) is investigating reports that illegal fishing and fish 'framing' are responsible for declining potato cod numbers at the Cod Hole, a popular dive site off Lizard Island.

The area is a protected Green Zone, but GBRMPA tourism and stewardship director Karen Vohland said at least two potato cods have been spotted with fishing line stuck in their gills. "Potato cods are particularly vulnerable because they're extremely friendly, and often follow divers around like puppies," she said. "However, these creatures, which can live for decades, don't mature until late in life, meaning the loss of a potato

cod can impact on the size of the local population," she added.

Framina

Association of Marine Park Tourism Operators has observed visitors fish 'framing', which involves dangling fish heads or carcasses into the water to attract the cods to the surface.

"They'll drop them over the side of the boat and almost have a wrestle with the potato cod, and bring them right up behind the boat," said Col McKenzie, chief executive with the group. "It could be accidental, it could be that people are deliberately targeting these fish... what we do know is we used to have more than ten, and now we've only got have three or four," he added.

Potato cod grow up to 2.5m long and can weigh up to 100kg. They are habitat fish, remaining in the same location their whole lives. After 40 years of being visited by tour operators, they have become very habituated to people."On a 40- to 60-minute dive in that location, these things will just swim round like a doa behind you... when you're looking in a hole or a cave, they'll swim up beside you wanting a look," he McKenzie said. "Their friendliness is killing them."

Vohland has urged tour operators and private visitors to report any signs of illegal or irresponsible activity, but McKenzie urged GBRMPA to put manned patrols at Cod Hole. "That would fulfill two roles—showing a presence in an important area, and educate those people who don't know whether they're doing the right thing," he said. ■

Gabon creates Africa's biggest underwater reserve

Central African nation declares almost a quarter of its territorial sea off-limits to commercial fishing. creating a first-of-its-kind network of marine protected areas in the region.

The new Gabon marine protected area network complements an existing terrestrial protected area system anchored by 13 national parks created in 2002.

When Gabon's President Ali Bongo Ondimba declared that the African nation was protecting almost one-quarter of its Atlantic Ocean territorial waters, home to dozens of species of threatened whales, dolphins, sharks and turtles, the worldwide reaction was positive and instantaneous.

"Gabon's President has assured the conservation of the globallyimportant breeding populations," said Hugo Rainey of the Wildlife Conservation Society. "Not even in my wildest dreams

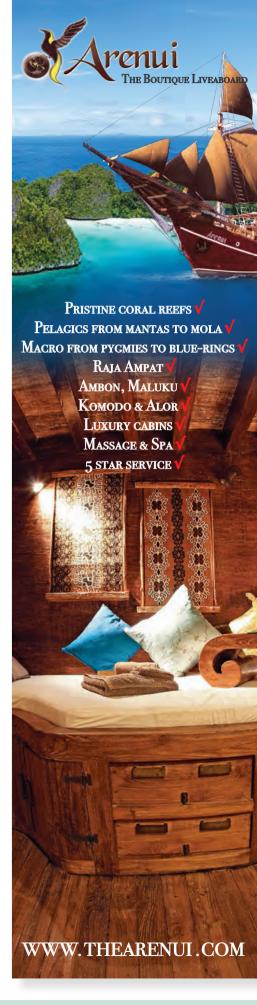
could I have imagined that waters held such an abundance of marine life," said explorer Enric Sala of the National Geographic Society.

"On behalf of the U.S. Fish and Wildlife Service, I commend President Ali Bongo Ondimba. This action underscores Gabon's leadership on this vital issue," Dan Asha, director of the United States agency, said in a statement.

The announcement comes less than two months after the Obama Administration established the largest marine reserve in the world by expanding an existing monument around U.S.controlled islands and atolls in the central Pacific. ■



The protected area will cover 18,000 square miles of ocean, home to great hammerhead sharks, manta rays, whale sharks, and tiger sharks



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FEATURES TRAVEL





The expedition ship, Pacific Provider, off the coast of Stromboli (left); Nomad sub explores the Formingas Reef Wall (far left); Divers work near the amphora field (below)

This is a "black and blue" story of *Panarea III*, a 2,200-year-old shipwreck discovered in the Mediterranean just north of Sicily.

The Aeolian Archipelago is a group of seven volcanic islands north of Sicily, Italy. The islands are listed as UNESCO World Heritage sites both for their unique natural environment on land and underwater, and for their oral tradition.

The archipelago is named after Aeolus, the mythological Greek god of the wind, and perhaps for good reason. The wind, together with strong currents, unpredictable weather conditions, make the islands one of the most dangerous places for seafarers to navigate. Nonetheless, archaeological

evidence dating back seven millenia shows that the archipelago was the center of short and long distance commercial networks.

Mycenaean and Egyptian pottery show the islands were a prehistoric crossroads for people from all over the Mediterranean. Carthaginian, Greek, Roman, Arab and Norman archaeological artefacts show that the islands were crucial stepping-stones for naval battles and used as reference points for navigation through the Messina Strait.

This millenary history of conquest and sea supremacy is reinforced by the discovery of dozens of shipwrecks, especially around the islands of Filicudi, Lipari and Panarea. The island of Panarea in particular, which is surrounded by dangerous reefs, surface rocks and deep underwater cliffs, made a perfect spot for deep-water shipwrecks.

An active volcanic archipelago north of Sicily, lava, obsidian and volcanic ash formed the Aeolian Islands more than 500,000 years ago. The Aeolian Sea, a legendary ocean popular in myths and legends, has an intense shade of blue and a spectacular deepness, taking our team of divers from Global Underwater Explorers (GUE) to depths of 130m in the Mediterranean.

The dream

Explore, dream, discover are the first words that come to mind when recollecting the great adventure our team experienced this summer in the sea of Sicily. It's a dream come true, a dream that

began more than 18 years ago when I accidentally came across in my first amphora. This chance find indelibly marked my life by lighting a fire that even today, years later, pushes me to go in search of ancient civilizations.

Since that day, when I was still called a boy, my journey as an explorer has evolved. I studied, I listened and I learned that the discovery is only a small part of

the research, an inevitable consequence of long, hard work that often takes one away from the sea, into the midst of books and university classrooms.

Today I do not leave anything



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Divers clean pillar near amphorae (left); Diver and sub examine amphorae (below)

crucial moment in the history of the Roman Empire and the Mediterranean

In addition, Panarea III reveals the tragedy behind the wreckage, the loss of human lives. This is not an ordinary story of a master and its crew, the unexpected event of a storm and its subsequent shipwreck. The ship's history is a voyage into the most sacred beliefs of a community.

The seabed around Panarea was extensively investigated in 2010 by the Soprintendenza del Mare (the Regional Department for Underwater Heritage) directed by Sebastiano Tusa and Martin Gibbs, chief archaeologist of the Aurora Trust foundation. The preliminary geo-acoustic survey detected more than 20 sensitive targets between 50m

to chance, and this does not limit my emotion and my desire to discover but rather intensifies it, because it is only then, when you know you have a chance, that you really enjoy and understand the deep meaning of an emotion.

Now when I see a wreck of a Roman or Greek ship from more than 2,000 years ago, I can enjoy every single detail of that time capsule, which contains within itself a bit of human history.

Diving into the future

What happened this summer represents the future of underwater archeology, and I say this without presumption, because what we achieved was the result not only of training, but of years invested by participants, in time and resources, to accomplish this feat. We created a team of explorers that for the first time saw action at the same time as researchers and government institutions, by using innovative technologies.

The team conducted the study of two ships, Greek and Roman, with the aid of Triton submersibles. Scientists were able to dive with no time limits and study live wrecks—a unique experience that allowed us to collect an amazing array of data and findings.

And this was just the beginning. A collaboration between Global Underwater Explorers (GUE) and the Sicilian government is underway to develop an ambitious research project of exploration and study of deep wrecks and water management in the Aeolian Archipelago. The project sets the stage for the beginning of a new era of underwater archaeology.

The ship

Panarea III is not only the material evidence of economic damage due to

the loss of very expensive commercial cargo, the shipwreck also reveals new and unexpected commercial networks, which shed light on the social, political and military dynamics at a

and 150m. The Panarea III was one of them.

Untouched for 4,200 years The shipwreck is positioned on a sandy

WHY INSPIRATION? 9 KEY REASONS UNIQUE DUAL O, CONTROL **REC-TO-TEC VERSATILITY** BENCHMARK DESIGN **FULLY UPGRADEABLE GLOBAL RECOGNITION INTUITIVE CONTROLS MULTIPLE PATENTS** EASY TO PREP **EASY TO DIVE OVER 45 YEARS OF** DIVE MANUFACTURING, **INNOVATION & DESIGN LEARN MORE**

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Diver documents artifacts at Panarea III shipwreck site

platform at 130m, near an isolated area of volcanic rock. The archaeological site, untouched for more than 4,200 years, appears out of the blue as an oval-shaped assemblage of hundreds of amphorae and other ceramic containers. In addition, the lead part of the wood and lead anchor has been identified on top of the volcanic rock. The remains of the wooden structure of the shipwreck haven't been found so far; they are most likely resting under the amphorae layer.

The cargo was composed of several archaeological artifacts. There are wine amphorae from Campania and Pompeii; Punic amphorae from Cartage or from Sicily, whose contents are still unknown; and there are plates, cups and stone mills.

One of the most interesting finds of the *Panarea III* shipwreck was a sacrificial altar. The uncertainties and perils at sea, especially in this area of the Mediterranean Sea

and the Messina Strait, required the protection of the gods. The altar was used to perform religious ceremonies to protect the voyage, and practices often required sacrifice of small animals such us birds.

The spectacular discovery of a rare and expensive object like the sacrificial altar sheds light on the most intimate religious aspect of early navigations. The altar, decorated by sea waves and a mysterious inscription in Greek letters on the base, is currently under investigation by Soprintendenza del Mare and the University of Sydney.

The preliminary investigation suggests that the ship was sailing from southern Italy towards Sicily (or vice versa) approximately during the late 3rd century BC or the beginning of the 2nd century BC. This is an important period in the history of the Mediterranean Sea and the Roman Empire. It is the time of the Second Punic War (218-201 BC) and the battles be-

tween the Romans and the Punics for sea supremacy.

The ship could have belonged to an allied town of Campania (Neapolis, Capua, Velia or other Greek-speaking town) supplying the Roman war fleet with food, or maybe it was a supply vessel to the fleet of the Roman general Claudio Marcello who conquered Syracuse in 212 BC, where Archimedes was killed. However, the ship could also have been a merchant ship owned by a wealthy merchant, trading wine or oil from a Greek-speaking town in the area of Naples.

The reason that the ship sank was likely due to the dangerous reefs and surface rocks near the island of Panarea. The unpredictable weather conditions and the difficulty of finding protected bays made even the easiest journey through these islands challenging to navigate.

The Panarea III shipwreck is one of the most important discover-



ies of this decade, not only as an experimental site for the improvement of deep-sea technologies and techniques for scientific archaeological investigation, but also as an important piece of information, which sheds light on a

crucial moment in the history of the Roman Empire, and the people of the time. No matter if they where sailors, masters or generals, friends or enemies, through sailing, praying, fighting, they all shared a common sea: the Mediterranean.

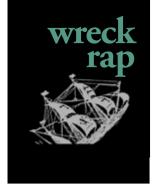
Francesco Spaggiari is a professional technical diver and instructor for GUE (Global Underwater Explorers) and Alba Mazza is an Italian archaeologist with the University of Sydney in Australia.



Diver at amphorae field of *Panarea III* shipwreck



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Wreck Beer Recreated

In the summer of 2010, divers salvaged beer and champagne bottles from the 1840s found in an old shipwreck in the Åland archipelago. Based on extensive scientific analysis, Stallhagen has succeeded in recreating the historical recipe and produced a fresh version of the 170-year-old beer.



The brew was reproduced thanks to elaborate research by Finnish and Belgian scientists who teamed up after the wreckage was discovered off Finland's Åland Islands in 2010.

Divers exploring 40 feet down found only five bottles of beer next to 145 champagne bottles—confirmed as the world's oldest drinkable bubbly—in the long-lost wreck. The government of the autonomous Åland Islands is the owner of the findings and had the beers analyzed at VTT Technical Research Center in Finland.

The research results showed that the old bottles contained two different types of beers.

The Finnish
Stallhagen brewery has produced
120,000 bottles of
what it has aptly
named Stallhagen
1843, which CEO
Wennstroem
described as "refined
and subtle".

ound in a shipwreck - recreated by Stallhan

University of Delaware locates WWII plane wrecks in the Pacific

Project Recover is a collaborative effort to enlist 21st century science and technology in a quest to find the final underwater resting places of Americans missing in action since World War II.

In 2010 a research team at the University of Delaware was tasked with studying how typhoons destroyed coral reefs and how climate change is affecting the area around Palau. Two years into their research, they ran into volunteers with BentProp, a nonprofit group dedicated to finding and returning remains of U.S. World War II servicemen listed as missing in action. The group, led by Patrick Scanlon, has been combing historic records in search of missing aircraft information for the last 20 years.

As the scientists and the BentProp volunteers talked, they figured out that the marriage of their high-tech research tools, along with the historic, archival records and interviews with people who witnessed the events at the time, might be a good match and thus increase the chance of finding the remains of U.S. aircraft and their crews.

In 2012 they formalised the cooperation and launched "Project Recover." In March 2014 the first two plane wrecks were found that still contained the remains of the crew. Project Recover does not see the raising of wrecks or their contents from the seabed as the group's

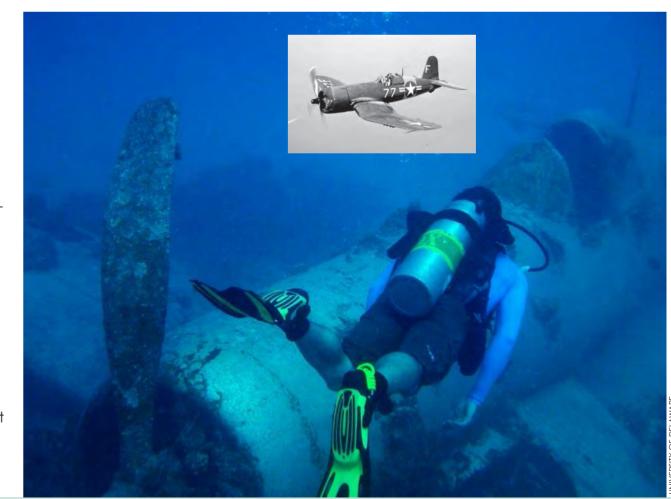
tasks, but when a wreck is located, they send all possible data to the U.S. Navy, which then must decide what to do.

It is estimated that about 78,000 U.S. servicemen disappeared without a trace during WWII.

The remains of a Vought F4U Corsair was located by the University of Delaware team in March 2014

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The B-29 Superfortress was a fourengine propeller-driven heavy bomber designed by Boeing and one of the largest aircraft to have seen service during World War II. It was a very advanced bomber for its time, with features such as a pressurized cabin, an electronic fire-control system, and a quartet of remote-controlled machinegun turrets operated by the firecontrol system in addition to its defensive tail gun installation.

Due to the B-29's highly advanced design for its time,

unlike many other World War II-era bombers, the Superfortress remained in service long after the war ended. The wreck in Lake Mead crashed on 21 July 1948, while engaged in high-altitude atmospheric research. The crew of five survived the crash.

In June 2003, archaeologists from the Park Service's Submerged Resources Center mapped and documented the wreck for management and educational purposes. The area has been closed to diving in order to

protect the historical resource.

Now the Park Service is looking for companies to lead scuba dives on the B-29 Bomber. The two-year commercial use authorizations (CUA) will include the authorized services of scuba dive guiding on the B-29 site, limited to 100 client dives during each 12-month period of the permit, and unlimited scuba instruction and scuba charter for other locations at Lake Mead National Recreation Area. ■

WWII British bomber found in Norwegian fjord

The almost intact wreckage of a RAF bomber shot down over northern Norway during a raid on the German battleship *Tirpitz* during World War II has finally been found 72 years after it went missing. The Halifax bomber was struck by heavy flak and made a successful crash landing 600ft down a water inlet in northern Norway.

The sunken bomber will be protected as a war grave because of the likelihood of the remains of the two airman still being on board.

Professor Martin Ludvigsen, of the marine technology department at the Norwegian University of Science and Technology, said: "It was a construction company which found the plane initially.

They didn't realise it was there or what it was. We went to the site and used a remote controlled underwater vehicle which dived to 180 metres." ■







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Airlines lack the motivation to reduce fares. Thanks to mergers in the industry, many flights are now full, demonstrating a demand that can fetch a high price.

> John Heimlich, IATA's chief economist

Will falling oil prices drive down airfares?

Oil prices continue to plummet, leading to all sorts of economic boosts for consumers. But the drop in oil prices has yet to benefit air passengers, who may or may not see lower airfares in the coming year.

Travellers will be pleased that plummeting oil prices may have a positive impact on airline ticket prices. The International Air Transport Association (IATA) has announced an improved outlook for industry profitability in its Economic Performance of the Air Transport Industry report. On a per passenger basis, airlines will make a net profit of US\$7.08 in 2015, more than double the \$3.38 earninas achieved in 2013. As lower industry costs and efficiencies are passed through, consumers are set to benefit substantially.

After adjustment for inflation, average return airfares are expected

to fall by some 5.1 percent on 2014 levels (excluding taxes and surcharges). "While we see airlines making \$25 billion in 2015, it is important to remember that this is still just a 3.2 percent net profit margin," said IATA director general Tony Tyler. "The industry story is largely positive, but there are a number of risks in today's

global envipolitical flicts, and regional among a 3.2 percent net profit margin does not leave much room for a deterioration in the external environment before profits are hit," he added.

Meanwhile, other airlines have stated they will consolidate. Airlines for America, a trade organization representing major U.S. carriers, said that falling fuel costs meant that airlines could reinvest in the business, and that lower fuel costs didn't mean as much as some consumer bodies have made them out to. "While fuel prices have abated from their historic highs, fuel is just one cost, and it's important to note that for the first nine months for the nine publicly traded U.S. passenger carriers, operating expenses rose 3.1 percent in 2014," the statement reads.

So far there's been no relief for passengers, IATA says, mainly because carriers are still using fuel that they bought months ago at higher prices. But once the airlines use up all the fuel they bought earlier at higher prices, average fares for air passengers probably will be 5.1 percent lower in 2015 than this year. ■



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New Zealand shark cage operators granted permits amid controversy

The decision by the Department of Conservation brought cheer to the operators but was met with dismay by those against shark cage diving, including the paua industry and some residents of Stewart Island.

In February 2014 the Department of Conservation announced that permits would be required from 1 December to dive with sharks in coastal waters, coinciding with the start of the diving season at Stewart Island.

Allegations of modified shark behaviour through feeding and diver-shaped dummies have been brought forward by paua divers who are concerned they face an elevated risk of shark attack as a result of cage diving operations.

These claims are unfounded and based on only rumour and hearsay, says Peter Scott, of Shark Dive NZ. "There is no scientific research conducted which indicates that these sharks have been conditioned by cage diving tourism worldwide. The risk has always been there and always will be. We spend such little time at the Island it would be impossible to condition an apex predator."

Philippines: New rules and dive regulations coming up in 2015

The Philippine Commission on Sports Scuba Diving (PCSSD), an agency attached to the Department of Tourism (DOT), will be implementing new rules and regulations (to be officially announced by January 2015 in the *Official Gazette*) for divers in 2015.

All divers will be required to have dive computers when diving in the Philippines as well as having with them a Surface Marker Buoy or Balloon. Proper use of both equipment, of course, is part of the diver's minimum training. This does not necessarily include discovery or intro students. The new IRR contains several more developments all geared towards improving safety standards in

the Philippines, and of course synthesized and coordinated with standards from recognized scuba diving agencies.

This, among other minimum standards like dive planning topside consistent with international standards including the trends of the future, were the results of five nationwide consultations in key dive destinations and threeday focus group discussions with dive industry reps (recreational, tec, cave, wreck, resorts, agencies, etc) and chaired by the PCSSD.



Lanzarote to get underwater sculpture park by Jason deCaires Taylor

Internationally acclaimed sculptor Jason deCaires Taylor who has often been featured in X-RAY MAG has signed a contract with the government of Lanzarote to arrange for his spectacular work to be placed on the sea bed off Las Coloradas Beach near Playa Blanca, Lanzarotte. The site has been chosen because the "amazing seascapes" will provide a "gateway to the Atlantic and encourage people to love the planet more through an understanding of marine life."

Called the Museo Atlantico, the Lanzarote project will be a permanent installation and will echo similar projects by deCaires Taylor in Mexico and Grenada. However, at

a cost of €700,000, there has been some disapproval of the planned project by locals, who argue that the money could be spent on more pressing matters such as healthcare.

The projected date for the opening of Lanzarote's Museo Atlantico is the end of 2016, and two percent of revenues taken by the museum will go towards local ecological research.

The Museo Atlantico Lanzarote will take two years to complete. The tourism office hopes it will stimulate the growing segment of dive tourists visiting the island and help Lanzarote to differentiate from other tourist market competitors.







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Sunset view of village on the Italian coast (above); Spiny seahorse (center inset)

Italy is truly a beautiful country to explore. It is a place where one can not only savor the regional specialties and cuisine in between dives, but also experience the country's cultural diversity, lifestyle and heritage.

Many years have passed since I was a child, but I still have fond memories of when I went to the beach with my parents to look for crabs and shrimps among the rocks of Liguria. It was decades ago, and a lot has changed, unfortunately, not all for the better. The sea is now nearly depleted of the bountiful marine life it once held. Even so, it still carries a great charm, perhaps more so now and with more poignancy than it did for me before, with the realization that the crabs and shrimps might have been better off left alone on the beach.

Over the years I have had the good

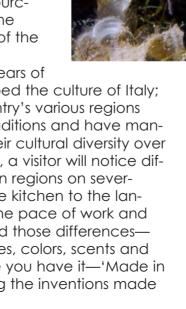
fortune to be able to dive and experience the sea more closely. From Tavolara to Ventimiglia, from Levanto to Castellammare, from Noli to Gialio, from Portofino to Sicily—every dive gave me something special. Every time I plan a trip, I remember and relive it all with joy. Indeed, I have travelled to many tropical seas in other parts of the world all warmer and, in some respects, more colourful than the Mediterranean. Yet, diving in Italy continues to be interesting, and every dive is still a discovery, a search, an adventure.

The landscape and nature found in Italy offers diversity like few others. Only a handful of miles separate the very blue seas along the coast from the snow-capped mountains of the Alps. In between we have the green plains, the parks, the rivers, the lakes and a number of large and small cities.

The boot-shaped peninsula that makes up Italy is over 1,000km long and has a coastline of 7,600km. Along

the coast, the various sea regions that border the Mediterranean Sea include the Ligurian, Tyrrhenian, Ionian and Adriatic seas. They strongly influence the climate of Italy and are valuable resources, determining the temperate zone of the Mediterranean.

Thousands of years of history have shaped the culture of Italy; each of the country's various regions have different traditions and have managed to keep their cultural diversity over the ages. Indeed, a visitor will notice differences between regions on several fronts—from the kitchen to the language, even in the pace of work and life. Mix and blend those differences the variety of styles, colors, scents and flavors, and there you have it—'Made in Italy'. And among the inventions made







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making it almost impossible to describe a typical dive in Italy, because it can be completely different depending on where in the country it takes place. So how does one describe diving in Italy? Any generalization would be out of place. The seas lapping the Italian coast offer diving for every taste. In addition, for fans of freshwater diving, there are inland lakes,

in Italy, there are also those created for the underwater realm. In fact, it is in Italy where several of the major dive manufacturers were established and are still innovating.

H**S**BW 55 €

The diversity and variety mentioned above are also reflected in the sea,



Italy

COUNTER-**CLOCKWISE** FROM LEFT: Duomo di Milano, the Cathedral of Milan: Typical Italian street market: A Ferrari, the Italian luxury sports car; Fresh baked focaccia, Italian flat bread

streams and rivers, with a perfect fit for any diver.

Suffice it to say that, in Italy, every diver has the option

of choosing to pursue the kind of divina for which he or she has a passion or a curiosity—whether it be marine life, marine archaeology, wrecks, walls, or caves. If you want to explore the underwater world in and around Italy, I recommend you refer to the database that we Italian divers have compiled, covering 500 dive sites distributed between the Peninsula and the surrounding islands. (See ScubaPortal.it)

If a friend from a another country—

say, somewhere far to the north—called and asked me for information on where to go diving in Italy, I would first investigate my friend's interests and make some recommendations based on his or her preferences, in order to provide some alternatives from which my friend could choose. I would then explain an important fact about div-

ing in Italy: that the Italians

love the good life, and between dives, we love to eat well in each other's company.

way, the diving would have more 'flavor'. Then, I would throw onto the table some little cards marked with the It would then be my duty to show my friend from the north, in addition to possibilities, brief descriptions of dive sites on the main



Typical fishing boats found in picturesque harbor towns along the Italian coast

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Diver at ruins of old mill (left) in Lake Capodacqua near town of Aquila, Abruzzo in central Italy; Combtooth blenny (below); Mediterranean red seastar on reef (right); Grouper (lower right); Swimming octopus (lower left inset)



all tastes.
From
Cinque
Terre and
Portofino
in the east
to Riviera
dei Fiori in

the west, Liguria is a region that attracts tourists both for its natural beauty and for its man-made features. I recommend Portofino National Marine Park, not far from Genoa. In this natural protected marine reserve, which was established in 1999, one can find corals, barracuda, dusky grouper, common dentex or sea bream and other fishes that are more plentiful now than they were several years ago. At both ends of the Liguria region, there are



coasts of Italy, including Lampedusa, Ustica, Ponza, Elba, Ventotene, Aeolian Islands, Pantelleria, Volcano and Favignana. These small island paradises offer a myriad of great dive sites, some nearly tropical in flavor. The islands farthest south are real jewels, far away from

mass tourism, but they require quite a bit of transit to reach.

Take Lampedusa, for example. It's a picture postcard of beaches and exceptional diving in clear waters with a variety of fish that can compete with many tropical destinations. Ustica, known as

the "Black Pearl of the Mediterranean" because of its lava rocks, is truely an open-air aquarium. The island of Elba in the region of Tuscany is closely connected to the mainland and well-known for its diving, with many dive centers ready to welcome guests who make it there by their own means.

Ligurian Sea

The Ligurian Sea probably offers the most variety for all levels of divers and for

peninsula and the surrounding islands, as well as a few grains of insight gathered from my own and my Italian colleagues' best diving experiences.

The islands

Aside from the two big beautiful islands of Sardinia and Sicily, there are many smaller islands scattered around the

Divers at a dive site in the Ligurian Sea



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Italy







Historic wrecks include ships, tankers and aircraft, such as a helicopter (right)

Divers on descent line (above); Brilliant yellow and pink sea fans (top right)

two very interesting areas for diving: the area of Latte–Ventimiglia with the area of shoals at Balzi Rossi, and on the other side, the area of Levanto and the Cinque Terre National Park, with numerous wrecks.

Liguria offers a wide choice of dive sites for wreck divers, including ships, aircraft and other historic vessels including the famous tanker, *Haven*, which sank in 1991 at the mouth of the port of Genoa. At 80m maximum depth, it's a destination of interest for advanced divers with some experience.

Tuscany

From Liguria divers can head down to Tuscany, a region whose name is derived from the ancient name *dall'etnonimo* used by the Greeks to define the land inhabited by the Etruscans. "Etruria" later turned into "Tuscia" and finally became "Tuscany".

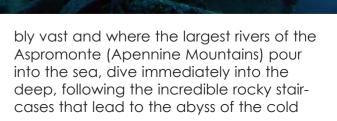
Aside from the island of Elba, which is well-known as a popular dive destination, other islands in the area deserve a mention including Argentario, Capraia, Giglio and Giannutri islands. These islands offer excellent diving between rocks and shoals. Not far from Elba is Pianosa Island, which has been open for diving, albeit on a quota system, since 2013. It is part of the Tuscan Archipelago National Park and is famous for the high security prison, which was closed in 2011.

Ionian Sea

When I think of the warm and wild seas of the south,

my immediately association is with underwater photographer Francesco Turano's poetic description of this region:

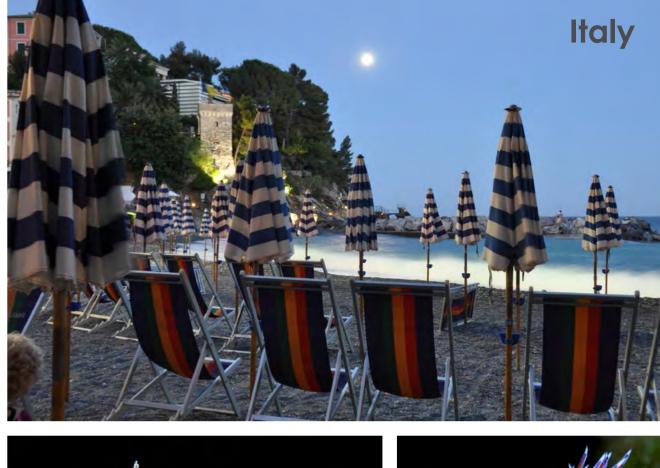
"In Calabria, where it is still wild and desolate, where the beaches are incredi-





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Characterized by deep trenches and extended abyssal plains, the Ionian Sea is one of the most geologically active areas of our

"The portion of the Ionian Sea that borders southern Calabria is extremely intriguing from an

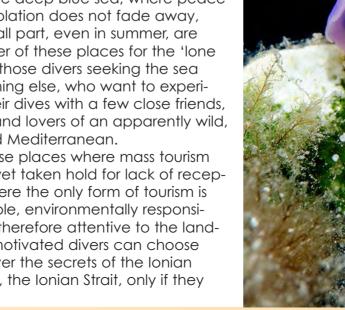
underwater point of view, as the submerged earth presents a landscape that does nothing to stop one from thinking of cathedrals of rock not far from shore.

"The charm and unbridled aggression of the deep blue sea, where peace and desolation does not fade away, in no small part, even in summer, are the power of these places for the 'lone wolves', those divers seeking the sea and nothing else, who want to experience their dives with a few close friends, experts and lovers of an apparently wild, untamed Mediterranean.

"In these places where mass tourism has not yet taken hold for lack of receptivity, where the only form of tourism is sustainable, environmentally responsible and therefore attentive to the landscape, motivated divers can choose to discover the secrets of the Ionian Calabria, the Ionian Strait, only if they



Beautiful Italian beach at dusk (top right); A variety of nudibranchs (above and left) can be found in waters off the Italian coast





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waters of the Ionian and Tyrrhenian seas,

and you will find perhaps a less colourful

sea, but a sea no less full of surprises for

the diver who loves the Mediterranean.

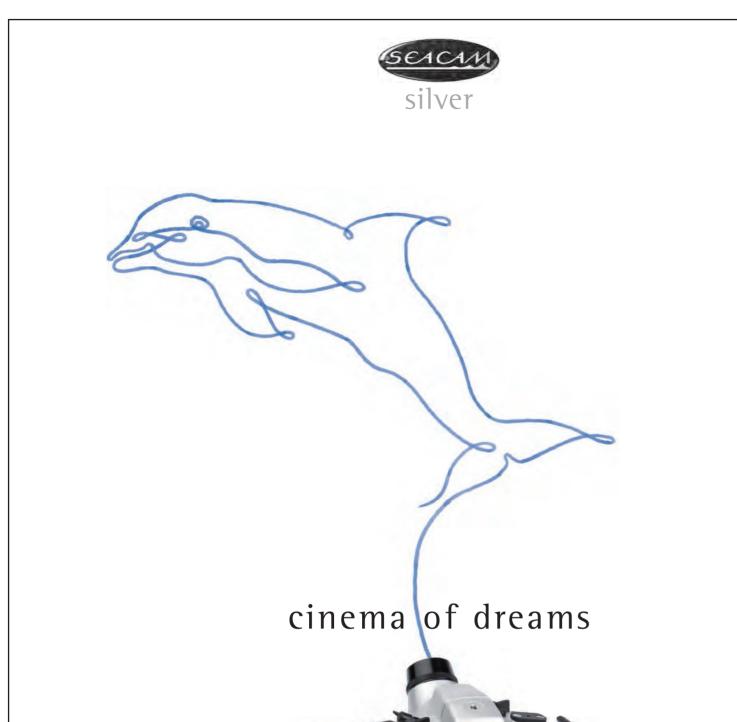
"The Ionian Sea occupies the cen-

tral part of the southern Mediterranean:

depth of 5,093m in the Hellenic Trench.

this is where it reaches its maximum

TRAVEL





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Going down the east

coast of Sardinia are very

interesting areas around

Molara where a series of

Cagliari to Cape Teulada

where deep dives require

have good experience and many dives under their belt."

Sardinia

Sardinia is a little story in itself with a landscape that has nothing to envy in more tropical seas. The clear, turquoise waters and white, sandy beaches create a unique landscape that continues below the surface of the sea. The natural beauty of Sardinia goes well with a vision of a holiday that is also suitable for families who do not want to limit their stay to exclusively underwater activities. For divers, the depths around Sardinia offer diving for all tastes including walls, shoals, caves and wrecks.

Sardinia is also surrounded by smaller islands, among them, Caprera Island, in the Maddalena Archipelago is recommended. The water is so transparent that its depths can be seen from above.

Brilliant yellow cup coral, Levanto, Liguria; Cardinalfish holding eggs in mouth (left); Cuttlefish (below)

more experienced wreck divers in depths down to and beyond 100m.

A very interesting destination at the northern tip of the island is Santa Teresa di Gallura, where one can view the unique and evocative scenery of Sardinia.



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Lake Garda (above), Italy's largest lake, near Verona, and Lake Orta (below), a sub-Alpine lake, near Novara, northern Italy

Sicily

The most interesting diving in this region is found around the islands surrounding Sicily. The islands of Lampedusa, Ustica and Pantelleria, not to mention the Aeolian Volcano are definitely at the top of the list of dive locations in Italy. A friend of mine—Roberta—the owner of a dive center in Lampedusa, describes this island perfectly:

"Lampedusa is known for having one of the most beautiful beaches in the world and is just waiting to be discovered, also for its great diving. Like a dream scenario, set in an enchanted atmosphere, incredible marine life and clear waters in shades of blue attract visitors from all over the world almost all year round. There are not many other places in the world where you can find such a wealth and variety of fish, admire beautiful colors of walls covered in sea fans and spong-

es, where you can explore underwater caves, groupers, snappers, lobsters, amberjack, giant stingrays, dolphins and, with a little luck, sometimes gray sharks."

You may be lucky to meet the grays, but the rest of the menu is auaranteed.

The Adriatic coast is probably the least interesting for diving. The shallow, mostly sandy bottom makes for monotonous and uninteresting diving along almost the whole stretch of the eastern coast of Italy. Of course there are some

Adriatic Sea

among these some deserve to be mentioned, at least the Tremiti Islands and the coastal town of Numana. The Tremiti Archipelago, a natural offshoot of Gargano, is a detour route and a great location for fish fauna.

Numana and the Conero Riviera in the Marche region offer several



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exceptions and







CLOCKWISE FROM LEFT: Pearly razorfish; Common octopus; Spiny seahorse; Greater weever; Streaked gurnard

dives, which are mostly on shoals, for divers of all levels. Although the visibility is often not the best around Numana, le Tenue and the wreck of the *Paguro*, it is still worthwhile for underwater photographers.

In the lower Adriatic, the southern point of the region of Puglia plunges into the Ionian Sea. Puglia has around 800km of coastline from Gargano to Salento. A group of islands off the coast comprise the archipelago of the Tremiti Island Natural Marine Reserve established in 1989 where divers can explore 50 dive sites.

Cold waters

The lakes are visited by thousands of fans of freshwater diving and a frequent destination for foreign tourists. Underwater the lakes are all very similar with visibility more or less limited depending on the time of year and a winter temperature close to zero and summer above 20°C. The lakes are probably one

of the last areas people think of for diving but are of interest to people who are accustomed to or interesting in diving in colder temperatures. With that in mind at least three lakes deserve mention, the Garda, Maggiore and Como, which are spectacular, although perhaps actually more so out of the water than below. Some other goodies deserve to be considered, at least as a unique experience. Among these are Lake Capadacqua in Abruzzo with its submerged mills and Lake Tovel in Trentino. But both have restrictions for diving.

Marine life

The marine life of Italy is a perfect testimony to the typical biodiversity found in the Mediterranean, with several hundred species that live on and give color to the reefs. Depending on the area and the type of diving, you will find different species—trivial but true.

In recent decades the sea has

been depleted a lot, and only recently have we witnessed a reaction, with measures to protect this resource through the establishment of parks and more stringent regulations. It is thanks to these interventions that protected areas are the most interesting to dive, at least in regards to the amount of fish one can see. However, it is also true that many areas outside of these protected areas are also now able to naturally support fish fauna.

The Portofino National
Marine Reserve is an
exceptional example of the operation of this type of regulation in
this area, and the diving is definitely richer in comparison to similar areas only a few kilometers
away, but outside of the park. After



many years, coral species, groupers, barracuda, amberjack, snapper, octopus, lobsters and many other fish have returned in abundance. Outside of the protected areas, meeting a grouper is very dif-

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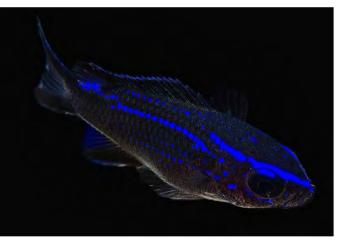
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Mediterranean damselfish juvenile (left); Red scorpionfish (above); Spiny seahorse and *Pleurobranchus testudi-narius* nudibranch (center insets); *Bolzaneto* wreck, Levanto, Liguria (above); Deck gun on wreck (top right)

ficult and most unlikely. But you can visit beautiful wrecks where, with a little luck you can also find sunfish, common lobster, conger eel and forkbeards.

To discover the hidden treasures of the seas around Italy, it takes patience, curiosity and passion. If one dives carelessly and with haste, it will be pure luck that one has any encounter with a unique creature or catch a glimpse of intriguing fish behavior. If you dedicate yourself to meticulous research, perhaps with the help of local dive guides, you will enjoy diving and discovering things within just a few meters of your descent point.

A classic example of this are the sandy

bottoms of the coast, which at first glance seem boring and lifeless, but stay calm and attentive and the underwater environment reveals a rich diversity of small creatures, ideal for macro photographers. Aside from the spiny seahorses, which are increasingly rare and precious, we also have stargazers, weevers, gurnards and angler monkfish. Smaller creatures are found almost everywhere; just look around a bit in the rocks and you will find colonies of hydroids grazed upon by colourful flabellina, dorid and other species of nudibranchs.

Underwater photography

I may not be the most qualified person to talk about the technical aspects of underwater photography. But I do have some practical experience, so I can share some useful information with you about what to shoot in Italy's underwater realm that may perhaps lead to some satisfaction in your underwater photography.

Underwater photography in Italy, as in the Mediterranean in general, requires

a lot more concentration and knowledge of the underwater world than is required in areas such as the Red Sea, the Maldives or Southeast Asia. Of great interest here is nature photography, which requires a good knowledge of marine biology and in particular of the behaviour and habits of fish. A nature photographer in the Mediterranean, as indeed elsewhere, must have a great feel for the sea and its players to find the rarities and exploit its beauty. The first

dive into unknown waters is always the most difficult for photographers, and if time is limited, it is recommended they rely on expert guides or, better yet, on other underwater photographers.

In Italy there are no large fish like sharks or manta rays, or at least, none found during 'normal' dives. Even encounters with the sunfish (Mola mola) or other medium size creatures are pretty rare, so it is good to focus on



Submerged truck

small fish or even macro photography for many dives. For fans of macro photography, subjects are almost never

lacking. Even in sandy bottoms you can spend hours taking photographs in only a few meters of water.

For wide-angle the situation is different, yet almost everywhere you can still find corners more or less interesting to photograph, among the shoals, walls, or in sub-

The state of

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merged caves. The many wrecks offer perfect scenarios for fans of wide-angle photography, but the visibility is highly dependent on currents of the sea and does not always match the needs of the

Grouper (above); Flabellina sp nudibranchs (top right); Angler monkfish (right); Threefin blenny or Tripterygion melanurus (left)

photographer.

The art of underwater photography in Italy is tough and very challenging but it can be rewarding, you just have to arm yourself with patience, do a lot of diving and make the right choices in terms of dive guides for places that you do not know.

General information
Diving equipment. A neoprene
wetsuit is fine in the warm months
while for the winter months it is
good to use a semi-dry or drysuit

as well as a hood and gloves. For your safety, I recommended you carry a good dive knife or shears, as there can be nets and lines stuck in rocks and wrecks. Using a flashlight during the day can make it

more interesting to explore nooks and crevices.

Regulations, laws and certifications.

There is an absence of specific legislation in diving at the national level. This "legal vacuum", with the increase of the people getting into diving—both professionally (as instructors, dive guides, dive operators) and purely for leisure—has become increasingly apparent and there have recently been a number of proposed laws to regulate the field. Local ordinances governing diving vary, so it is always good to find out about the rules at your destination.

Dive centers. Dive centers are located throughout the country and are easily searchable on the web. But don't judge



a book by its cover; keep in mind that in some cases dive activities are coordinated by 'recreational clubs', which often have beautiful and well-organized websites that can rival those of professional dive centers. You are advised to always consult only with professional centers that make dive activities their work.

It's also good to verify some important aspects such as the languages spoken

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by staff; diving equipment available if required; the availability of oxygen, water and boat first aid kits for emergencies; the availability of parking if necessary; as well as the number of vessels used. The latter are normally comfortable, fast rafts, with all the necessary safety equipment, that quickly reach the most interesting dive sites.

Dive prices. The price of a dive has, on average, settled around 30-35 Euros each and includes about 60 minutes with a dive guide and boat transport, tank and weights and use of the local dive center. The most exclusive prices can get up to 45-50 Euros per dive. The equipment rental is not included but available on request from the majority of dive centers. In some centers it is possible to do full-day dive trips and,

sea conditions permitting, even mini-dive cruises.

Climate. In the temperate climate of Italy, it is typical for people to enjoy the four seasons that are more clearly differentiated in the north, where the hot season is concentrated between the months of June and August. The air temperature in winter here oscillates between 0°C and 10°C, and in summer, between 25°C and 35°C, with 10 degrees difference between northern and southern Italy.

The water temperature varies greatly in different dive locations, and it is advisable to use a wetsuit during the summer season and a drysuit during the winter, especially in the north-central part of the country. In northern Italy, the surface water reaches a temperature

of over 26°C during the warm months but the thermocline is felt already at 10 meters depth where the water temperature drops down to below 14°C. In the hottest places, the water is warm enough so that a wetsuit may be sufficient. In winter the temperature drops dramatically, and it is recommended that one use a semi-dry or drysuit. The latter in particular will make for less traumatic journeys by boat.

Language. Despite Italy being one of the world's leading tourist destinations, English and other languages are not widely spoken. Although the language skills of Italians are among the lowest in Europe, the art of understanding and of being understood is very developed. Not all dive centers have adequate personnel to handle foreign tourism, so you are

Typical boats in harbor (left); At 1178m, Lake Tovel is a beautiful mountain lake to dive, located in Trentino, northern Italy (below)

advised to check ahead of time on the availability of staff with foreign language skills.

Hyperbaric chambers. The Italian national health system provides several hundred hospitals, many of which have a hyperbaric chamber. Check ahead of time with the dive center about the closest facility.

Accommodation. There are a wide variety of hotels in Italy, and everyone can easily find a suitable choice that is within their budget. When you choose a hotel, always consider the availability of parking, which

is often limited and expensive. Check also on the distance to the dive center. An excellent alternative to hotels are bed and breakfasts and apartments, which are in some cases included with the dive package. It is recommended that you ask the dive center for advice on lodging.

Italian divers

Italian divers have never been counted since there is no register or a database for them, only for dive professionals such as instructors. Sample surveys have repeatedly been carried out, thanks to which, it has been discovered that fans of diving in Italy are sev-

eral hundred thousand strong, a number which is growing every year. In fact, many Italians live close to a dive center, take dive courses and plunge into this new world—beginning an adventure that changes their lives for the better, of course!

Italy

The underwater community in Italy now has about 300,000 divers with different levels of preparation and passion. At sea divers are usually seen in mixed groups transporting from the shore on boats and rafts, wearing dark suits, tanks and masks, to return after a few hours with smiles on their faces. Those who approach these groups cannot help but





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Google map of dive centers in Italy (left); Divers at Lake Orta (far left)

Italy

certification. The majority further their training to become guides and instructors. Immediately after their initiation to the underwater realm, many choose to continue their education, encouraged by possibilities to expand their knowledge base in various branches of diving such as specializations in deep diving, night diving, wreck diving, etc.

Marco Daturi, who emerged from the warm waters of a nursery in 1972—a restriction prescribed by an inclement, authoritarian doctor was always very close to the sea and the underwater

world, which he continues to explore with a passion whenever he can. Having survived the attack of a Liqurian porter crab, the false attentions of Indonesian nudibranchs, an underwater wedding, and insistent invitations to get into technical diving, Daturi continues to enjoy the passion that is diving, which culminated in 2003 with the creation of ScubaPortal.it. A certified divemaster, Daturi also holds a doctorate in economics. and two masters in marketing and sports management.

For more information, visit www.scubaportal.it or email: info@scubaportal.it.

notice that these folks will go on for hours talking about those 60 minutes spent underwater. Overhearing these tales often triggers curiosity: Who are these masked people dressed in neoprene? What do they do in life? And more importantly, "Why am I not with them?"

In a recent market research study conducted on ScubaPortal.it, we traced the identity of the diver.

The average age is 25 to 45 years. Diving in Italy is an activity for all ages; one can start young, at 14 years, but one can also begin in old age. In fact, A woman of 80 years has been certified. Even if this is an isolated incident, there are certainly more certifications being issued to elderly participants.

Italian divers are 30 percent female and 70 percent male. There is one woman for every two men—a low average, but fortunately growing. If it were true that women were less attracted to this hobby, then we wouldn't find that when women do participate, they're even more crazy about it than men are.

Around 45 percent of divers in Italy are college graduates. The level of education has increased in general in recent years and even more so in diving, where nearly 10

percent also have a master's degree. Not that it takes an advanced degree to go into the water, but it is indicative of a hobby that attracts mostly people with a high level of education.

Distinguishing characteris-



tics: Italian divers are sporty, open, dynamic and full of interest. Divers here do not just explore the depths, many divers are also keen skiers and play sports, read a lot and have many interests.

In terms of diving experi-

ence, most Italian divers have less than 200 dives, but, of course, there are those who, plunging in several times a day, can make up to 100 working dives in a month!

In general, those who start diving do not stop at the first



Divers preparing for a dive (above) and enjoying a delicious afterdive dinner (center)

The

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Text by Peter Symes Photos by Peter Symes and courtesy of Grotta Giuti Resort

I felt thrust back a century or two, perhaps into the setting of the Count of Monte Christo. Lounging in the majestic sitting room, in the stately old mansion that now houses Grotta Giusti Spa but was once the seat and residence of a family from the Italian gentry, I cannot help but ponder the history these walls must have seen. Outside I can see the Tuscan countryside, with its rolling hills and slender stone pines. We are nowhere near the ocean. Yet I am just about to go diving—inside the mountain. In fact, I am about to go to Hell.

The spa gets its mineral waters from some hot volcanic springs that come out of the mountain right under the complex. From the ground floor, we go down a ramp that leads into a cavern draped in stalagmites and stalactites. After we pass through a curtain, it is already significantly warmer and quite humid.

I am being told that starting from the entrance through to the deepest part of the Grotta, three different zones are crossed, each one increasing in heat, which some humorous tradition has been named Paradise, Purgatory and Hell. These zones are like saunas with different temperatures, and other guests draped in robes heading in or out, as we are being briefed for the upcoming dive, give us the usual puzzled stares.

But yes, we are going for a dive in the pools and crevices beneath the chambers where the guests sit and sweat in natural steam baths. The thermal mineral waters flow at a temperature of around 34°C (93°F). The

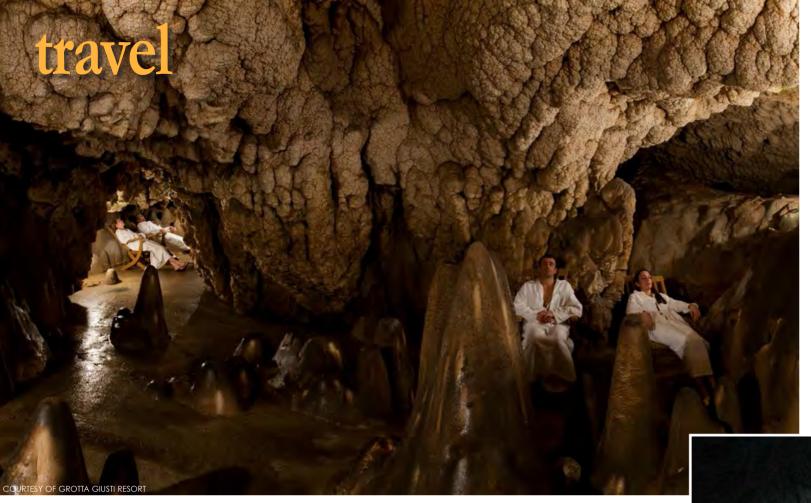


THIS PAGE: Exterior and interior views of spa

Diver underwater in the thermal cave, Grotta Giusti, located in Tuscany, Italy

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TRAVEL



The age-old cave is divided into three sections: Heaven, Purgatory – with its Lake of Limbo, and an average temperature – and Hell, where humidity reaches 98%. Each area has a different temperature, and allows you to enjoy the benefits of the thermal vapours to the full, providing a fifty- minute path to well-being.

For nearly an hour and a half I walk and crawl along dramatic formations, sliding through crevices as if I could levitate. It was easier and far more

resulting vapours create a steam bath, which is said to be effective against respiratory, circulatory, gynaecological, osteomuscular, nerve and skin complaints. Other techniques are also used, such as mud baths, inhalation, vaporisation and aerosol therapy.

T-shirt & no fins

Several factors make this an unusual dive. First of all the water is too warm to wear any kind of suit so we are all just wearing t-shirts. Secondly, we won't be wearing any fins as we essentially will have to walk and climb underwater.

I am still not quite sure how cool I feel

about the upcoming adventure, as I do have a bit of an issue with cramped spaces in overhead compartments as a result of once almost getting stuck in a wreck. But as it turns out it is not really an overhead environment, as there will be air above us at almost any given moment, and soon I surrender myself to what is turning into a surreal and certainly unique experience.



pleasant that I thought it would be. In fact, my biggest concern was not bumping my dome port into some protruding rock when going through some of the narrower passages.



Massage

We decided to give in to total indulgence and went for a massage afterwards. The therapists were very professional starting off with a short talk about my main issues, sore points and old injuries. As if any of all that talk was necessary, she found them all right soon enough—ouch, eek, aah! It was complete bliss afterwards. The long dive in warm water having already thoroughly warmed up my muscles and joints seemed to make the massage even more efficient

THIS PAGE: Underwater views in cave



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Spa entrace to the cave in the mountain

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Opulent entrance (above) to Grotta Giusti luxury resort and spa, where lavish floral arrangements adorn every space; In the hotel's restaurant, guests can enjoy a delicious menu of exquisite Tuscan dishes and original recipes by Chef Giuseppe Argentino, accompanied by an impressive selection of wine and aperitifs

The thermal outdoor pool where guests can enjoy relaxing underwater hydromassage, a waterfall and fresh fruit drinks, lunch and snacks from the poolside Bioaquam Café

as she could dig right straight in where it mattered.

After the session I wobbled—my gait hardly qualifying as walking—out of the massage room and went for a shower. Getting dressed I noticed that I had worked up quite an appetite, and having a quality restaurant just upstairs, I knew where I was heading next.

Dinner

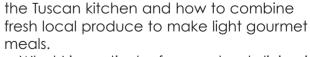
The classy surroundings makes you want to dress up nicely and promenade down for dinner in style, although, as it turned out, it also acceptable to dine in your robes. As strange as it may sound it did not seem out of place, perhaps because even the robes were classy, and after all, it was a spa.

Italian cuisine shouldn't need any further introduction, and here we are, in the middle of Tuscany where they produce some of the best wine in the world. Needless to say, I was in for another treat and I had burned off the calories to make room.

As in any upscale restaurant, the menu was short and dominated by local specialties as it should be, and I found myself spoilt for choice. Under such circumstances, I usually ask the waiter for his recommendations, because even

though I am quite fond of Italian food and am familiar with many dishes, there always seem to be some new dishes to explore—often something that is just in season for a limited time.

We are clearly in good hands. Chef Giuseppe Argentino knows the secrets of



What I in particular favour about dining in the countries around the Mediterranean is that time seems to cease to exist once you are seated in a good restaurant. Dishes are never rushed but come in timely intervals, allowing one to more fully enjoy each one, and enabling the diner to have proper con-







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versations with significant others or friends, enjoying the evening in a relaxed manner without checking a time piece ever so often.

Health and well-being

The Spa also has a fitness centre, offering Pilates and Qi-gong, and outside there is a golf course and an exercise track in the nearby landscape so you can both please your inner health nut and enjoy being a foodie. Grotta Giusti is surrounded by 45 hectares of parkland, a natural environment of incomparable beauty characterised by age-old trees, fertile hills and fragrant flowers.

One can reach the spa building directly from the hotel, and thus access the extensive facilities providing traditional treatments such as mud baths, respiratory therapies and massages, and a

modern health farm featuring an oriental area, a well-equipped aym, numerous recreation areas and a centre for aesthetic medicine.

The complex is completed by the cave and the outdoor thermal pool with a surface area of 750 m² - complemented by underwater massages – and a spectacular waterfall. The water supplying it, containing minerals such as bicarbonates, sulphates, calcium and magnesium, maintains a temperature of 35°C.

It is possible to receive traditional treatments such as mud baths. ozonised baths in thermal water, thermal showers and respiratory therapies carried out under the constant supervision of specialist medical staff. These services are carefully targeted towards physical and psychological well-being

and the improvement of one's physical appearance.

Escape

It is a great escape for some days either as a conclusion of a busi-

ness trip or en route to or from some of the many great dive sites along the Italian coast. A combination with diving the nearby island of Elba springs to mind, or as a pleasant stop-over on the way further south. The resort offers one- to three-night or weekend packages of diving and spa services, appealing to both divers and non-divers alike, as there is the option for a 'floating'



THIS PAGE: Intererior and exterior views of the resort, flora and fauna on the nature walks

experience in the cave for the non-divers of the family. There are many other activities to enjoy on the resort's nature walks, tennis courts, swimming pools and several nearby golf greens.

The resort makes a great base from which this historic county of Tuscany can be leisurely explored. Sitting inside the triangle between Bologna, Florence and Pisa, there are plenty of great excursions to



historic places within a relatively short distance, not to mention a range of good dive spots. While the place may come across as being a bit on the posh side, you also get what you

pay for, and I find all the indulgences that come along with a little spluraing will make for a most pleasurable and memorable stay. I am quite inclined to pay another visit next time I am in Italy. ■

For more information, or to book a stay, visit: www.grottagiustispa. com

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The Underwater Project goes global with X-RAY MAG

Our new concept, the world's first perpetual underwater shootout competition, started half way through 2014 as an evolution of the popular Underwater Festival established eight years ago. Now the Underwater Project is announcing a partnership with X-RAY MAG.

And with the international scope of *X-RAY MAG* in mind, we decided to expand the horizons of the Underwater Project to a

global one. From the 1st of January 2015, you can shoot globally to become part of the growing Underwater Project, says Tim Hochgrebe, organiser of the Underwater Project

The Underwater Project is much more than a competition. As the name suggest we have taken the best of the **Underwater Festival** and have evolved it into a continuous event. A project that continues to share the beauty and the issues of the underwater world and shows the world what we have to lose.

The Underwater Project will create

and support unique local events across the globe throughout the year. Any dive centre, resort, liveaboard or dive club can become an Underwater Project Fringe Event host.

New features

☐ A great new fully featured Underwater Project Snapshot Map with entries from past years included (2013 and 2014 now)☐ Every member has their own stunning portfolio site with personal snapshot map and personal gallery. If you have been participating in the Underwater Festival in previous years, your past entries are part of your portfolio.

We aim to again offer up to \$100,000 in prizes!

per month. Premium memberships are available.

Submitted entries will be screened by the Underwater Project team. Entries that pass this first



Collect and display awards and achievements (coming soon).

Your Underwater Festival login and password will work on the project website.

No more entry fees —just a simple annual membership

There is no charge for individual image or video uploads, instead a simple annual membership fee of U\$50 to join the Underwater Project. Standard membership entitles to 5 photo or 2 video uploads

round of judgin will appear on the official Underwater Project Snapshot Map and in your portfolio.

Screened images will Get
be judged annually
by the established
Underwater Project
judging panel
including Mathieu Meur, Gary
Bell, Stephen Wong, Takako Uno,
Kevin Deacon and David Warth,
and we aim to again offer up to
\$100,000 in prizes.

Two step judging
—Participation is what matters
All year round you can upload

your images and clip links to the Underwater Project website.

Photos and videos have to be uploaded in the month AFTER the month they were taken—you no no longer need to change the camera date to participate.

Please help us to create all the amazing features we have planned for the Underwater Project and JOIN NOW!

Spread the word

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Project with our fantastic new banners and logos and link them back to the Underwater Project site

we are looking for social media marketing volunteers to help spread this project across the planet. If you know your way around social media and have some time to give, please aet in touch.

See you underwater!

— Tim Hochgrebe, Peter Symes and the Underwater Project Team

The Underwater Project formerly known as the Underwater Festival™

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The Philippine destination of Anilao has been described as the "center of the center of marine biodiversity" yet until now has largely remained unknown to European and American divers. This charming location has even more to offer than staggering critter life.

The water beneath me literally boils in a plethora of purple as anthias dance in the mild current. Beneath them the reef known simply as Beatrice

is encrusted so densely in brightly coloured crinoids that hardly a single centimeter remains unoccupied. The scene is simply stunning, yet I am in a destination known for its critter life rather than stunning seascapes. It would seem that Anilao is indeed a destination with multiple charms, with reefs awash with colour and sandy shorelines that crawl with the weird and the wonderful.

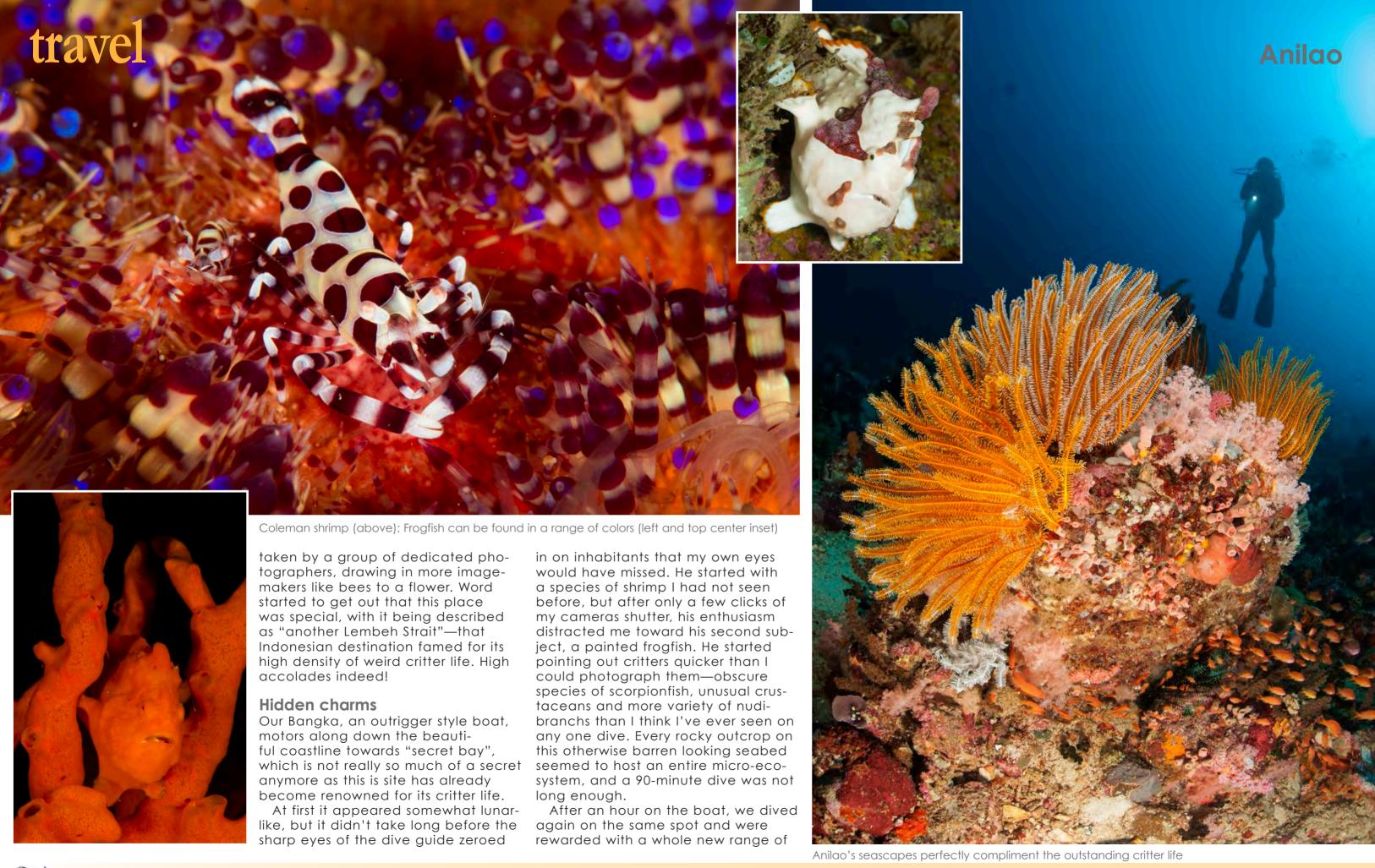
Peculiarly, Anilao has managed to remain largely off the tourist map outside of the Philippines until very recently. Social media has played a large part in generating interest in this area, with images of rare marine life



Hypselodoris emma nudibranch

Jacks, schooling above Twin Rocks

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THIS PAGE (CLOCKWISE FROM ABOVE): Some of the resident octopus population include wunderpus, blue-ringed octopus, coconut octopus and day octopus

species. It's difficult to imagine a more productive dive site, yet, as our boat sped back towards Aiyanar Beach and Dive Resort, I know there were more than 50 in the region waiting to be explored.

Together alone

This destination is commonly referred to as Anilao, however, the dive resorts actually spread for miles up the coastline from the small Anilao village in a way that doesn't make the place feel at all overcrowded. In fact, other than excursions, most holidaymakers tend to stay within their resorts.

This is a quiet place where relaxation is the name of the game—there is no evening social scene, other than what's going on within the resorts. If you are looking for a vibrant evening life, best look elsewhere, for this destination is one

where you can either switch off and relax or get totally immersed in the diving—or, of course, do a bit of both.

Anilao village has a shallow seabed in front of the beach covered in seagrass. This is the sort of dive site I would avoid in most destinations, but when in critter rich territory, this sort of site can be surprisingly good.

Sure enough it was not long before we soon found mimic, coconut and wunderpus octopus. Tiny and vulnerable looking filefish hovered cautiously amongst the sea grass whilst species of shrimp scuttled between burrows, using discarded human cans to hide behind, cans which were themselves occupied by sheltering fish.

Every hole, whether man-made or natural, became a shelter as dusk approached—being caught out in the open at night may not have a happy ending as the predators such as snake



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Life competes for space on every square inch of this reef



Striated (hairy) frogfish (above); Berry's Bobtail squid (inset); Thorny seahorse (right)

eel and the grotesque bobbit worms start to emerge from their daytime refuges.

Origins

I was surprised by what I was seeing. I'd heard Anilao was special but hadn't expected this—the quality of muck diving here was simply off the scale.

But how did this place remain a secret for so long? It is within easy reach of the capital, just a three-hour drive, depending of course on traffic (and Manila is particularly famous for its traffic!) and with international flights landing throughout each day, it must be amongst the easiest of the long-haul destinations to reach.

Dive Operator Marco Santos of Aiya-

nar Beach and Dive Resort commented, "For most Manila divers, Anilao would be their first underwater experience. We learned here, our first and most of our underwater experiences and our love for the ocean was brought about by Anilao, but it is the influx of foreign divers, marine biologists and the knowledge they have brought with them that has led to this place—that we thought we already knew—now starting to show us so much more."

It was that growing realization amongst the scientific community that Anilao was special, that led to marine biologists such as Dr Terry Gosliner beginning their surveys of the area, documenting the huge biodiversity.

The species count of nudibranchs



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"Every dive here is like somebody has reshuffled a pack of cards, as we keep finding new species even at sites we've dived many times before," said Gosliner. Over half of these are new species that have not been recorded anywhere else. He describes this area as the "Apex of the Coral Triangle" and he and many of his colleagues consider it the most remarkable place they have ever seen.





A boat ride to the outlying islands of Sombrero and Caban, brings us to some of the most spectacular seascapes in the area. Since they are swept by strong currents, diving on the submerged reefs here has to be timed carefully.

Clear blue water washes over reefs that





the planet.

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and their relatives alone now

stands at a staggering 863 in

Anilao and the nearby Verde

passage, and that number is

still rising! This is the highest on

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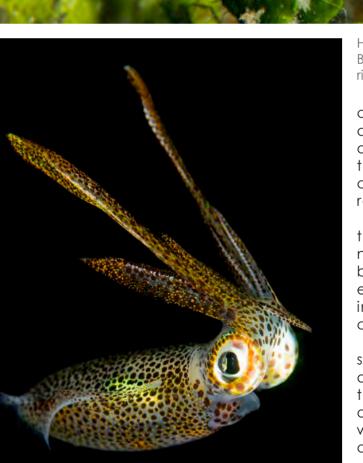
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Halimeda ghost pipefish; Banded Tozeuma shrimp (top right); Emperor shrimp (right)

are ablaze with orange and purple anthias against a backdrop of the brightly coloured corals, creating an epic rainbow-like scene.

I found that the contrast with the muck dives near the shore couldn't be more pronounced, emphasising the appealing diversity in the diving conditions here.

World class critter diving and stunning seascapes can be found amongst a huge variety of dive sites that are suitable for beginners to advanced divers and photographers will simply be in heaven in this A-List destination.

Guardians of the reefs

Overfishing has proved to be a huge problem in the Philippines, yet in

Anilao, it was recognised over 20 years ago that the reefs needed to be protected.

The first significant moves to conserving the area came in 1991 with the setting up of three Marine Protected Areas (MPAs) in the stretch of water that separates the mainland from the island of Maricaban. Known as Cathedral Rock, Arthurs Rock and Twin Rocks, these three MPA's are-



Ornate ghost pipefish

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Bigfin reef squid

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Anilao





Batfish on the Dari Laut wreck (left); Healthy soft coral growth adorns Anilao reefs (far left)







Flamboyant cuttlefish (above); Devil scorpionfish ((right)

maintained by committees of local villagers, who have really taken governance of the reefs to their hearts and keep the areas under constant watch, ensuring no fishing or anchoring in the protected areas.

Dive tourism helps in other ways as well, as many fishing boats instead now carry divers. Twin Rocks is a great example of a well-preserved reef, covered in large corals and sponges interlaced with schooling snapper and a resident school of trevally that stretches seemingly to the surface.

Indeed, finding the balance between long-term sustainability and short-term gain will continue to be a challenge for the Philippines. However, the rest of the world has also failed on a far grander scale to yet get to grips with this dilemma.

It is a great credit to the villagers in this Philippine province that they have proved that with proper stewardship, enough food can be harvested, but the communities as a whole can still reap the benefits that dive tourism can bring. Anilao

is truly a destination that offers the best of both worlds in so many ways.

The author gives special thanks to all the staff at Aiyanar Beach



and Dive Resort (aiyanar.com) and Terrence Gosliner, Ph.D, Senior Curator, Department of Invertebrate Zoology, California Academy of Sciences. More of Steve Jone's work can be seen at www.millionfish.com



Snake blenny; Black-finned snake eel (top)

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This reef explodes with colorful crinoids



TOP LEFT TO RIGHT: Hawksbill sea turtle; Skeleton shrimp; Ambon scorpionfish

TRAVEL INFORMATION

Fly to Manila. Aiyanar Resort is a 2.5 hour car journey from the airport, and the resort can arrange transportation any time of day or night.

Visa Requirements: Not required for stays of up to 30 days (29 nights)

Currencies: U.S. Dollar and Euro are widely accepted. Recommend changing some cash to Philippine Peso at the airport ATM.

Land Tours and Excursions: There are excursions to nearby hot springs, waterfalls and volcanos available.

DIVING INFORMATION

Experience Level: Anilao is ideal for both

beginners and more experienced divers

Best Time to Dive: All year, with November to June being regarded as the best months.

Air Temperature: Normally 25-34°C. During rainy season, 23-28°C.

Water Temperature: Most of the year, 28-30°C. During January and February, it can drop to 25-28°C. Note: I was there in April and definitely needed a 5mm suit and hood—a 3mm would have been inadequate.

Rainy Season: July to October

Security: As all around the world, be careful with your valuables and remain street smart. □

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SOURCES: U.S. CIA WORLD FACTBOOK U.S. DEPT OF STATE, SCUBADIVEPHILIPPINES.COM

History During the 16th century, the Philippine Islands became a Spanish colony; In 1898, they were ceded to the United States following the Spanish-American War. The Philippines became a self-governing commonwealth in 1935 under elected President Manuel Quezon who had to prepare the country for independence after a ten-year transition. The islands fell under Japanese occupation in 1942 during WWII. U.S. and Filipino forces fought together to regain control from 1944-45. Philippino independence was declared on 4 July 1946. A widespread rebellion of the people forced President Ferdinand Marcos into exile after 21 years of rule in 1986 when Corazon Aguino was installed as president. During her presidency, there were several coup attempts, which affected political stability and economic development. In 1992, Fidel Ramos was elected president who enjoyed a presidency marked by greater stability and progress on economic reforms. The United States closed its last military bases on the islands in 1992. President Joseph Estrada, elected in 1998, was impeached on corruption charges and was succeeded by his vice-president, Gloria Macapagal-Arroyo who was elected to a six-year term in May 2004. The country was one of the few relatively unaffected

by the 2008 global financial crisis. Beniano Aquino III was elected president in May 2010. Armed insurgencies and separatists in the south continue to be threats. Government: Republic. Capital:

Geography The country is comprised of an archipelago located in Southeastern Asia. east of Vietnam between the Philippine Sea and the South China Sea. Its terrain is mostly mountainous with narrow to vast coastal lowlands; Coastline: 36,289 km; Elevation; lowest point: Philippine Sea Om; highest point: Mount Apo 2,954m.

Economy The nation's economy faired better than most after the alobal economic and financial downturns because of several factors: less exposure to affected international securities, decreased dependence on exports, recovery of domestic consumption, large payments from several million overseas Filipino workers, and a fast growing business outsourcing industry. As a result, the Philippines has gained several upgrades in its sovereign debt credit rating, making financing its deficits with domestic and international markets easier. While current administration have increased social spending and infrastructure programs, long termchallenges

still remain in battling poverty, unemployment or underemployment. governance reform and improving the judicial system, infrastructure, regulatory predictability, and attracting greater local and foreign investment by increasing ease in doing business in the country.

Climate Tropical marine. The northeast monsoon occurs November to April, the southwest monsoon occurs May to October.

Environmental issues Challenges include soil erosion. uncontrolled deforestation, water and air pollution in major urban areas as well as coral reef dearadation and increasing pollution of coastal mangrove

Currency Philippine peso (PHP). Exchange rates: 1USD=44.97PHP; 1EUR=56.71PHP; 1GBP=72.92PHP; 1AUD=39.27PHP; 1SGD=35.26PHP



RIGHT: Global map

Population

107,668,231 (July 2014 est.) Ethnic groups: Tagalog 28.1%, Cebuano 13.1%, llocano 9%, Bisaya/Binisaya 7.6%, Hiligaynon llonggo 7.5%, Bikol 6%, Waray 3.4% (2000 census) Religions: Catholic 82.9%, Muslim 5%, Evangelical 2.8%, Iglesia ni Kristo 2.3%, other Christian 4.5% (2000 census) Internet users: 8.278 million (2009)

Language Filipino and English

Security Please consult your state department for the latest information. In the past year, there have been reports on activities against foreigners by terrorist or insurgent groups based in the area of Mindanao Island, the Sulu Archipelago and the southern Sulu Sea.

Health Please consult vour health department for the latest information. There is a high degree of risk for food or waterborne diseases such as bacterial diarrhea, hepatitis A, and typhoid fever; vectorborne diseases such as dengue fever and malaria; and water contact disease such as leptospirosis (2013)

Decompression Chamber

Batangas Hyperbaric and Wound Healing Center St. Patrick's Hospital Medical Center

Lopez Jaena St. Batangas City 4200 Tel. +63-43-723-8388

Links

Philippines Department of Tourism www.wowphilippines.com.ph



Pink-eared mantis shrimp



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TRAVEL

swamps.



Text and photos by Steve Jones

It's fair to say that Dr Terrence Gosliner has developed a healthy obsession with Anilao over the years. He is the Senior **Curator of Invertebrate Zoology** at the California Academy of

Sciences, overseeing the scientific research programs and guiding the Academy's efforts to discover new knowledge and help promote the preservation of life's diversity. He is also a

world-leading expert on nudibranchs so some would say it was therefore an inevitability that Anilao was going to keep him and his team busy for many years!

SJ: You've been visiting the waters near Anilao for many years but what led to you first coming to this area?

TG: Back in 1992 I was doing a lot of work in Papua New Guinea around Madang—that was actually the first area in coral triangle that I had worked in and

I thought the marine biodiversity was extraordinary. But then one of my friends suggested that I visit Anilao, saying it was on another level again. I went and I was immediately hooked. There were just a handful of resorts back then, it was a lot more rustic. We established ourselves with one of them and used that as our base



X-RAY MAG: 64: 2015 **PROFILES**



for operations in the region. I've been back around 30 times since!

SJ: What were the circumstances that led you to realize the richness and importance of the marine environment in this region?

TG: Even during the first dive it was evident this place was special. Evidence of the diversity was just there, right in front of us. Half of the animals we were seeing were new species and I was finding so many I was up till 2:00 in the morning just documenting our findings. The pace of discovery became so fast that it was impossible to keep up. Anilao just blew me away!

SJ: What factors contribute to this area having such rich marine biodiversity?

TG: There are several factors that combine to create the uniqueness in this region. First of all, the area has been very aeologically stable for tens of millions of years compared to other regions that have experienced far more geological upheaval. The deep water upwelling brings nutrient rich waters into the area and this is all helped by very strong currents. I call this area the Apex of the Coral Triangle.

SJ: What's your view on the success of the MPA's in the area and why is it so important that this area is protected? Given its position in the coral triangle what could be the potential impact to other regions if this area is not

properly protected?

TG: As recently as 2007 auestions were asked about whether the MPA's were makina a difference as there was pressure to relax the no-take controls. However there is clear

evidence that there is a fish factory effect in Anilao and the MPA's are the only areas where there is dense fish life. The fish seeding going on here is vital for surrounding regions, and there would be a cascadina impact to biomass diversity and density if these controls were not upheld. Even if you move a few hundred metres away from the MPA, the biomass decreases. The conclusion is that the MPAs have to be preserved. The MPA's and associated conservation initiatives have also been very effective in reducing highly destructive fishing practices such as dynamite fishing—I used to hear the bombs go off a lot when I first started visiting. We continue to make recommendations for increasing the MPA's as it's clear they are having a highly positive effect.

SJ: You've been documenting nudibranchs in this area for a long time—how many species have been found here and did you discover new species?

TG: The official tally of nudibranchs and their





Island Passage and Anilao area is 884 species and this may have increased by the time you go to press! This is actually the highest on the planet and I am sure more will continue to be discovered. In fact in April this year we visited for two weeks and added another 50 species to the tally. On average my team and I

relatives in the Verde

find one new species of nudibranch per dive. Even more incredibly, more than 50 percent of the 884 species are previously undocumented—they are newly discovered species. On every dive it is like a pack of cards has been reshuffled as the species we are seeing changes so frequently. Interestingly we compared Anilao with that other biodiversity

hotspot, Raja Ampat and we found that Anilao had twice the rate of species accumulation of nudibranchs.

SJ: Any other interesting finds you'd like to tell us about?

TG: You bet there are! On the last expedition Some of the most interesting finds were a brand new species of heart urchin which took our own global urchin expert several days to classify—its closest relative is only found in fossil records and it's a real Gosliner

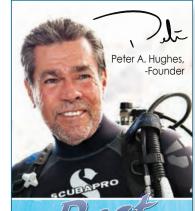
missing link—a totally new species! We feel that Anilao's prominence as the center of the center of marine biodiversity is also seen in urchin species. There is a growing feeling that Anilgo is the most remarkable we have ever

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

TG: Very positive—the local community takes seriously the effective management of marine resources. More moorings are being added and the local residents listen. Dive fees being channeled back into conservation and enforcement, and the meetings are run democratically. I continue to be impressed with the local communities attitude and understanding of the marine resources importance to the economy and the need to protect it.

Dr Gosliner's field studies have uncovered more than 1,000 new species around the world. He also has extensive experience in building collaboration to support sustainable management and conservation of the rich reefs of the Philippines and is a champion of educational outreach. He has published more than 150 scientific papers and five books thus far in his career. ■

























Edited by Peter Symes X-RAY MAG STAFF, NOR ARE THE ITEMS WARRANTEED. INFORMATION PROVIDED IS CONDENSED FROM MANUFACTURERS' DESCRIPTIONS. TEXTS ARE USUALLY EDITED FOR LENGTH, CLARITY AND STYLE. LINKS ARE ACTIVE AT THE TIME OF PUBLICATION

POINT & CLICK ON BOLD LINKS



Equipment



Tribord Easybreath

The Easybreath full-face snorkelling mask is designed to make breathing underwater as easily and naturally as you would on land using both your nose and mouth. It also does away with the usual mouthpiece. Valves make sure that air passes through the mask in only one direction. To ensure that water does not enter via the snorkel, the Easybreath mask is equipped with a mechanism that plugs the top

> of the snorkel when immersed in water. Furthermore, the top of the snorkel is highly visible in order to avoid any

collisions on the surface. Thanks to its large size, this innovative mask also offers users an unobstructed 180 degree field of vision, and is prevented from fogging up by a double air-flow system. Tribord.com

Beuchat VRT90

The VRT 90 from Marseilles, Francebased Beuchat is designed for diving in temperate or cold water. The membranecompensated first stage comes fitted with Beachat's anti-freeze system and interchangeable seat. It provides two highpressure and four low pressure ports and comes with either yoke or DIN fitting. The second stage has venturi control and the front is fitted with a big soft Soft-touch cover for larger purge zone. Beuchat-diving.com

Dive Rite has set out to

DiveRite

LX20

create a handheld primary light that suits any diver—be they entry level, an experienced recreational diver, a cave or a technical diver. The resulting LX20 is a very lightweight (1.25 lbs / 0.56 kg) compact (6 inch / 15cm long and 2 inch / 5cm diameter) torch. The design makes it an ideal size to dive either handheld or secured to a Goodman Handle. However the LX20 really comes into its own when you turn it on. It delivers 20,000 LUX, easily outshining most corded primary lights on the market today. **Diverite.com**



The latest regulator innovation from Scubapro is the patent-pending Extended

Thermal Insulating System (XTIS), which fully insulates the inner mechanical components for extra protection. With it, the coldwater protection rating for MK25 EVO surges another 30 percent, states Scubapro. The Black Tech coating is not only for aesthetics, it is also extremely scratch and corrosion resistant. Applied on both the first and second stages, this premium finishing gives a real technical plus to a high performing regulator. The MK25 first stage provides an ultra stable intermediate pressure resultina in an extremely punctual and constantly high delivery of air. This means instant air flow at any cylinder pressure and water temperature for a real carefree dive. The first stage comes with two high pressure and five low pressure ports on a swivel turret. Tank connections: INT (yoke) 230 bar or DIN 300 bar. Scubapro.com



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AQWARY



The console automatically detects and connects to other units nearby. The Smart Console is also a dive computer that replaces the regular console. It enables a diver to connect with up to 70 other divers nearby. With a receiver onboard a boat, a dive supervisor can monitor divers in the water. The console uses standard AA size batteries that can be replaced by the user. Rechargeable batteries on a full charge will provide up to ten hours of dive time. Dive data and logs are transferred via Wi-Fi. Agwary Smart Console also comes with an app store that lets you choose from a variety of useful and fun dive applications. For example you can expand your smart console with a 3D compass, Map Viewer and a Buddywatch. Aqwary.com

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Siberian huskies are hardy dogs well suited for the arctic environment. PREVIOUS PAGE: Diver at triangular cut ice hole in White Sea

White Sea

We gathered in the frigid pre-dawn hours, our gear and luggage piled in front of the snowmobiles and our noses freezing in the -22°F (-30°C) temperatures. It was time to be saying good bye to our Russian hosts after a week of diving the frozen White Sea but we were tempted to linger just a little bit longer. It was during these last few moments, as we stood under a curtain of stars on a deep, dark winter's night in Russia that we reflected back on the events of the past week.

We had come to this remote spot a week earlier filled with both excitement and anxiety over the prospects of exploring the icy waters of the White Sea. Nestled alongside the Kola Peninsula, and straddling the Arctic Circle, the White Sea, technically part of the Barents Sea, is the only inland sea to completely freeze in the winter. Our base of operations for this ice-diving expedition

was the Arctic Circle Dive Lodge, located near the seaside village of Nilma and just north of the Arctic Circle. To get here, we chose to fly to Finland, arriving in the alpine town of Kuusamo. After spending one day dog-sledding in a National Forest in Finland's fabled Lapland, it was time to complete our journey with an over land transit into Russia.

An 8-hour white knuckle ride across the border and through the Russian wilderness brought us to the lodge, ready to dive.

Ice diving

Diving the White Sea in winter requires preparation, equipment, fortitude and, most important, adequate training in ice diving techniques. With surface tempera-

The authors entering the water



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White Sea

The dive team on the way to the dive site across the frozen surface of the White Sea (left); The dog sled team journeys deep into the magical forests in the Lapland region (far left); Snowmobiles are used to go from base camp to the dive sites (lower left); Divers must be prepared for extreme conditions (below)

the icy plunge into the magical world beneath the frozen sea.

Anemone Rock. Our first dives in the White Sea took us to a site known as Anemone Rock. Here, in 45 FSW (14m), a huge boulder lies on the bottom, perhaps 20ft (6m) in height. This rocky outcrop rises up from the slope of Bolshoy Krestovy (Big Cross) Island. Some say it is as big as a three-story building and shaped like a dragon's

tures routinely dipping as low as -22°F (-30°C), and with snowfall an almost constant factor, divers must be prepared for extreme conditions. The entire White Sea is frozen with almost three feet of ice and the ice is covered with six inches or more of snow. Once below the ice, divers will find water temperatures hovering near 28°F (-2°C).

Although visibility is generally good, the water can be extremely dark. Many of these dives can almost be considered night dives due to the lack of ambient light penetrating the ice ceiling. Fully functioning cold water gear and good training are essential.

The diving protocol employed here provides everything necessary to protect divers from the elements. Divers and gear are first transported from the lodge to the dive sites via snowmobile. The dive

sites vary and can be as close as a ten-minute run or as far as a 45-minute trek across the ice covered sea.

Once on site, specially constructed small wooden huts are used as shelters for donning on doffing equipment. Each hut is equipped with a wood burning heating system so divers can gain much needed warmth before, between and after dives. Indeed, the temperatures inside the huts are almost too hot and divers will often be seen propping the doors open to let in some cool air!

The huts are on skis and can be moved from location to location. They are generally placed within a few feet of the dive site, usually a triangular cut made into the ice and referred to locally as a "Maina". Once suited up, divers shuffle to the entrance and begin



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White Sea

CLOCKWISE FROM FAR LEFT: Arctic sculpin; Starfish can be found beneath the ice; Tunicates filter the cold Arctic water; Frilly anemone can be found under the ice

tooth. The seabed is very silty, so care must be taken so as not to stir up the bottom.

Anemone Rock is so named because of the profusion of life that literally covers this massive structure. Frilled anemones, colorful tunicates, beguiling nudibranchs and a wide variety of other small invertebrate life abound on this oasis of life in an otherwise nondescript sloping bottom.

Wedged inside cracks in the rock are wolf fish, expertly positioned to avoid the range of our cameras! Looking more closely alongside the rock, we did find small bottom dwelling fish such as the Arctic sculpin. Measuring close to four inches (10cm) in length, these wary denizens seemed unfazed by our attempts to photograph them—perhaps they were too cold to move!





Islands. Subsequent dives took us to dive sites alongside some of the islands in the White Sea. Small Cross Island is a small rocky outcropping with a tumbling, rocky slope, which we eagerly explored,

photographing the kelp (laminaria) covered rocks and the dramatic ice ceiling above. Diving beneath the ice affords the diver an out-ofthis-world experience as the surface ice takes on a green-

ish tint from the surrounding water.

Towards the end of our week's expedition, the tem-(-7°C), to a bone-chilling -22°F



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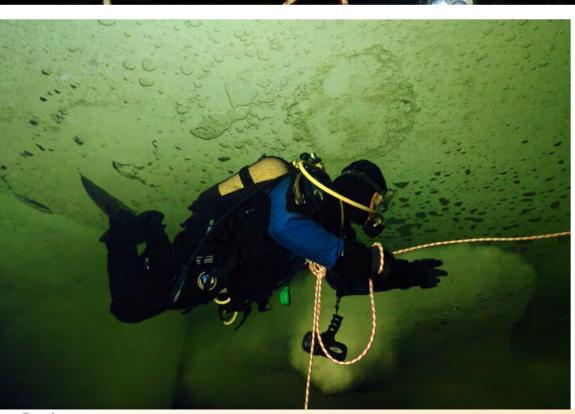
FEATURES

peratures plummeted from a rather comfortable 20°F





CLOCKWISE FROM FAR LEFT: Divers explore ice formations of Biofilter Bay; Divers enter and exit through the hole in the ice surface; Divers are secured to the surface using a system of ropes; Divers find clear, dark water beneath the ice



(-30°C). Suddenly, our dives became more arduous as we struggled to stay warm and keep our equipment functioning. Residual water would freeze instantly in the air and our equipment became encased in ice in a matter of minutes. The entrance to the dive site would become a slushy mix of ice and snow, and any water exposed through the hole would also start to quickly freeze solid. As we descended through a two-foot (.6m), tunnel of slush and ice, it took all of our selfcontrol not to breathe off the regulators until fully submerged lest we risk causing a free flow. And once under the ice we preferred not to think too hard about whether the surface tenders were keeping the hole cleared of solid ice.

Biolfilter Bay. At Biofilter Bay, a location named for its abundance of shellfish and filter feeders covering its rocky bottom, we



descended into a cathedral of ice. Biofilter Bay is nothing extraordinary in summer, but it completely changes in winter. The most interesting thing about ice diving here is the ice itself. Because of the strong tidal currents,

the high and low water levels differ by up to 6ft (2m), and the tidal cycle lasts about 12 hours. As the ice rises and falls within the water column, it freezes to the rock faces and other ice formations. It then breaks

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off and tumbles around bumping into each other, then freezes again to these surfaces. This constant tumbling and moving about allows the ice to carve amazing underwater ice sculptures.

As we drifted along the sloping shoreline just under the ice ceiling, we were able to witness and explore these chaotic jumbles of

fragmented ice crushed together in magnificently sublime formations. Huge slabs of ice along with bulbous ice boulders floated in the frozen sea, and as we swam in and around these icy monuments to nature's true beauty and power, we became reflective of how special this place really is.

With only our line to lead us back to the opening and to the spine tingling cold of the world above, we were truly encapsulated in the silence of the frozen ice spectacle below. We floated among these grand ice displays, becoming one with its frozen beauty before reluctantly returning to the entry hole and the surface.

Aurora

Beneath the White Sea, in the mysterious and seldom visited Russian Arctic, we had experienced moments of true physical hardship along with experiences of

The spectacular northern lights, or aurora borealis (left); Authors Michael Salvarezza and Christopher P. Weaver with sled dogs (below)

fabulous and magnificent beauty. And now, as we stood in the bitter cold waiting for our transport

back to Finland, we swapped

riences. Suddenly, as if on cue, a shout rang out in the night:

We all excitedly scrambled

back to the edge of the frozen sea, our feet standing in newly

frozen snow, and we looked up to the sky. There, a shimmering,

undulating miracle of nature was being displayed across the night sky—the aurora borealis (northern

The script could not have been written more perfectly. It was as

if we were being bid farewell

by the Arctic itself. With brilliant

greens and yellows, the Aurora danced for us as we departed—a dance of indescribable beauty

that has beguiled people for mil-

And one that will continue for mil-

lennia in the northern latitudes.

lennia to come. ■

"Aurora!"

liahts).

stories and reflected on our expe-

WHITE SEA INFORMATION

DIVE TIME: Usually 20-45 minutes, diver dependant

White Sea

BREATHING GAS: Air. nitrox is not available

DEPTH: Rope dependant; usually not more than about 65ft (20m)

WATER VISIBILITY: 50-150ft (15-

ICE THICKNESS: Up to 5ft (1.5m)

WATER TEMPERATURE: 30-28°F (-1°C to -2°C)

AIR TEMPERATURE: 43°F to -22°F (+6°C to -30°C)

SALINITY: 27.5-28 parts per thousand, lower than the mean salinity of the Arctic Ocean

SURFACE INTERVALS: Heated huts are available for divers to don/duff gear, and to relax between dives

TRANSPORT: Snowmobiles are used to transport divers and equipment to and from the dive sites

ASSISTANCE: Diver tenders help divers exit the dive hole, ladders are not used

Michael Salvarezza and Christopher P. Weaver are underwater photographers based in New York. For more information on expeditions to the White Sea, visit: ecophotoexplorers.com/whitesea.asp

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Text and photos by Walt Stearns

Goliath grouper, or Epinephelus itajara, are the subject of strong opinions and divided emotions. Divers love to see these mammoth fish; underwater hunters denounce them as competitors, or covet them as outsized trophies; fishermen are just itching for a policy change that allows harvest; and regulatory bodies seem constantly poised to rescind longterm protection in favor of short-term exploitation. Opinions abound, and the rhetoric can get heated when interest groups clash. But when cooler heads prevail, the facts emerge and paint a picture of a species that has come back from the brink in the U.S. state of Florida but is still very much in need of our protection.



As the summer reaches its zenith, so begins a spectacle that divers and underwater photographers will not find anywhere else on

the planet except here in Florida. The event I speak of is the opportunity to dive with 40 to 90 plus giant groupers massed together for the purpose of propagation.

Spawning season here in Florida for the Atlantic goliath groupers is nearly two months long, beginning around mid-August through to the end of September, or the first of October.

Why they are called goliaths is quite obvious. Measuring up to 7ft (2.13m) in length, with a large robust body the width of a bar-

rel weighing over 450 lbs (204kg), goliaths are the largest of all bony reef fish found in tropical reef environments.

Atlantic goliath groupers are

capable of growing to extremely large sizes. Having grown up here in Florida, I have heard more than my share of monster goliath grouper tales, with the



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behemoths weighing in excess of 1,000 lbs (454ka). Yet, I have never met one this big. Nor have I seen one as large as the 680pound (308kg) IGFA (International Gamefish Association) all tackle

record grouper that was caught by sportfisherman off Fernandina Beach, Florida, back in 1961.

However, when you come face-to-face with one even half the size of that IGFA fish underwa-

> ter for the first time, it will be an encounter you will never forget. Throw in the magnification factor created by water's effect on a diver's facemask, the perspective to just how big that fish is, can be amplified enough to

make a 6ft (2m) long brute with a girth equal in diameter to an oil drum appear as big as a compact car.

Where and when

The most favorable location for encountering these giants happens between two natural and four artificial reef sites along Florida's Palm Beach County Coast. From mid August to the end of September/early October, these six key sites play host to the only goliath grouper spawning aggregations known to take place off Florida's east coast. Interesting, in that all of these take place less than five miles from shore. Where as the rest (approximately seven in all) take place in the southern Gulf of Mexico, 25 to

Diver with goliath grouper, known to grow up to 7ft (2.13m) and over 450 lbs (204kg)

40 miles offshore of Florida's west coast.

For underwater photographers on Florida's east coast, the timing and length of these huge spawn-



ing aggregations, combine with often highly favorable conditions like underwater clarity in the 60 to 90ft (18-27m) range, tropical water temperatures and calm

> seas, make it easy for them to capture images that defy words.

> In comparison to most other grouper species, this romance period these fish follow is more like a marathon than a 50-meter dash. While these concentrated annual gatherings don't really get going till mid-August, the journey for

Groupers

some actually begins as early as mid-July. More recent studies have found, following tagged fish, some of the distances traveled to reach one specific spawning aggregation site have been recorded greater than 300 miles (483km).

Spawning

Having followed these fish since the first spawning aggregation reappeared after a three-decade-long hiatus on a local site off Jupiter called the Hole-in-the-Wall back in 2001, I can pretty well describe the process by which it typically takes place.

Around the timing of the first full moon of August, the bulk of the spawning fish have completed their journey, swelling the ranks on a single aggregation site from a dozen big behemoths to a herd



Spawning aggregate of goliath groupers off the coast of the U.S. state of Florida

Record IGFA goliath catch, 680 lb (308kg), in Florida, 1961

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Spawning aggregation of goliath groupers off coast of Florida (left); Underwater photographers will enjoy encounters with the giant fish from mid-August to early October, when vis is 60-90ft (18-27m) (below)

Florida's east coast most southern spawning site, water temps were less affected by the upwelling's.

The 2014 season was a different matter. While the upwelling's were less apparent, the presence of the Gulf Stream was also less apparent, leaving most of the summer months with little to no current. Perhaps, these fish knew something we didn't.

Witnessing this spectacle could cause some to believe the fish are no longer threatened, and have successfully made a comeback. To call it such may be as premature as calling a herd of American buffalo in game reserves a full recovery for the species.

Long road back

Twenty-five years ago, encounters with just one of these reef giants off Florida's east coast was a considerable rarity. Around the rest of the state, the situa-

Crystal Blue Anilao, Batangas, Philippines info@divecbr.com
DIVECBR.COM

topping 40 to 60 fish.

Typically the first to see these numbers first are wrecks in Northern Palm Beach, off Jupiter called the Zion Train/ Esso Bonaire wreck trek and neighboring MG-111 and Hole-in-the-Wall. In a short span of a week or two, a similar number, comprised 50 to 60 fish have descended on a second set of wrecks, Mizpah and Danny, a few miles south off West Palm Beach. By early September, another wreck further south off Boynton Beach named the Castor completes the scene with the arrival of another 50 to 60 individuals.

In the last two consecutive seasons, we have seen surprising twist where the Castor wreck received the lion's share around the later part of September. Both times, as the spawning season was near the end, number of fish present swelled to around 100 fish in 2013, with the 2014 season peaking out

with nearly 150, the majority of which were fish that had pulled up or moved down the coast from both the Jupiter and West Palm Beach sites.

The first shift in preferred locations may have been influenced by a string of cold-water upwelling's that plaqued the first half of the 2013 season. Considering goliaths are not fans of cold water, the upwelling's (an event that takes place time to time along the Palm Beach Coast) may have pushed a number of fish off the Jupiter/West Palm Beach sites farther south than normal. It just so happens that in addition to Boynton Beach being





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from being pushed to complete collapse. The most heavily impacted are the dominant predators of the tropical reefs—namely the groupers, with goliath arouper taking the heaviest toll.

While our own management measures may have stopped the progression of the U.S. population of goliath grouper toward extinction, relentless fishing pressure elsewhere in their range alerted the International Union for the Conservation of Nature (IUCN) to list goliath grouper as "critically endangered."

The same year the fish was placed under its new protected status, the job of monitoring the recovery of this species was put into the hands of scientists at both the National Marine Fisheries Service (NMFS) and Florida State University (FSU). FSU's Research Ecologist, Dr Chris Koenig, and his colleagues, began a detailed study of the fish's natural history.

Understanding an enigma

Unraveling the story behind what makes these fish tick has led to remarkable discoveries. Like most reef dwelling species, including groupers, goliaths are broadcast spawners where a female releases a quantity of unfertilized eggs into the

tion was not all that much different.

Once highly abundant, particularly on distant wrecks far off shore in the southern Gulf of Mexico, the fish began to be beaten back by aggressive fishing practices during the mid 1980s. In a short few years, the fishery was so badly in decline, the federal government under the Magnuson-Stevens Fisheries Act, began work to close the fishery on goliath grouper completely.

By the time these protective measures were fully enacted in 1990, there were so few large goliaths left it would be some eight years (1998) before the first documented spawning aggregation would reappear in the southern Gulf of Mexico.

And another three years (August 2001) before the first spawning aggregation comprised of 27 fish off Jupiter, Florida, would be seen again for the first time on the east coast in nearly three decades.

But appearances can be deceiving, as a major portion of the entire regional population taking part in this ritual behavior is represented between this one zone off Florida's east coast and a key number of sites in the southern Gulf of Mexico.

Add to that the reality that at one time, the Atlantic goliath grouper were once highly abundant in not only Florida, but also along the entire Central and South American Continental Shelf as far south

as the southern edge of Brazil. Their historical range even spanned the entire Bahamas and Caribbean to as far away as Western Africa in the Gulf of Guinea.

Our planet's ever expanding human population and today's highly efficient means to harvest fish from the oceans has made it more difficult than ever to keep fish stocks the world over

Once abundant along the coasts, historically, goliaths groupers in the western hemisphere used to range from the Bahamas and the Caribbean, to the coasts of Central America, and as far south as Brazil; Goliath grouper with school of silversides on wreck (top left)



SFUPS INTERNATIONAL GOLIATH GROUPER **UNDERWATER PHOTO COMPETITION 2015**

In an effort to raise awareness of the plight of the endangered Atlantic goliath groupers in Florida, an organization of local underwater photographers in Fort Lauderdale called SFUPS—the South Florida Underwater Photography Society—is holding the first international photo competition featuring goliath groupers.

Be part of something extraordinary!

Goliath grouper, the largest bony fish, can grow to a size as big as a fridge. Florida is one of the few places on Earth where divers can witness spawning aggregations and swim with these gentle giants.

CONTEST DATES: August through October 2015 in Palm Beach County

PRIZES: Contest categories and prizes will be announced this spring 2015. (Past SFUPS contest prizes have included liveaboard dive packages, underwater photo equipment and courses, dive charters and scuba equipment, with a combined worth in the thousands of dollars—just to get an idea of contest sponsorship.)

SPONSORS: The contest is sponsored by Reef Photo & Video, the Florida State Department of Environmental Protection, Palm Beach County Diving Association, and Ocean Arts Media.

FOR MORE INFORMATION: Join the SFUPS mailing list to receive information on contest categories and prizes, travel iterary, and local discount assistance by going to:

goliath.sfups.org

water at the same time sperm is released by one or more males; the result is fertilization.

This behavior is typically nocturnal. Which is why during daylight hours on any given spawning aggregation site, divers commonly see the fish formed up in either one comprehensive group idly hanging close to one another, or arranged in three to five moderately



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Goliath groupers like to take refuge in certain wrecks of the Florida wreck trail

spaced subgroups milling about between their neighbors.

Nassau groupers (Epinephelus striatus), for example spawn collectively together in a massive unit under a full moon. Unlike their closest kin, the actual matina ritual for goliaths does not take place by the light a full moon.

Based on the data collected by Koenia and his research team from FSU, the highest amount of evidence points to spawning taking place during the new moon cycle rather then the full moon. How much of a role the moon phase plays is not exactly clear-

Through years of on-site data collection using specialized nets to capture fertilized egg on spawning sites to using hydrophones to listen in on various day and nighttime activates, Koenig

and his research team from FSU have narrowed the event down to commencing shorty after sun-

Also something of interest, which Koenig has found: instead of happening one night, the event period encompasses a succession of nights beginning four to five nights before the new moon, with another three to four nights after it.

Adding to this grand enigma is what precisely takes place when actual spawning is in motion. Rather than spawning as a collective group like Nassau groupers, they might—as claimed by a handful of diver eyewitness accounts—instead break from the main group in pairs or perhaps very small groups of three to four males and one female at a time.

Together, with the likelihood of working in the dark without any illumination of the moon has thus far made any documentation out of reach, much to the frustration of many underwater photographers and fish biologists who would love to have captured it on camera.

What is certain is that the fish always remain on or near aggreaation sites in force through the last new moon cycle of September. After that, the fish slowly begin their journey back home.

Humble beginnings

After the eggs are released during spawning, those that are fertilized will drift for a short period of time before they hatch, emerging first as free swimming pelagic larvae supported by a yolk-sac until



✝SURFACE INTERVAL AND FILM FESTIVAL (NEW)

ADEX 2015 is dedicated to the lovable dolphin. Dolphins have few natural enemies. However, some dolphin species face an uncertain future, such as the Ganges and Yangtze river dolphins, which are critically endangered. We're rooting for this friendly, freewheelin' cetacean and celebrating one of Earth's most intelligent animals!

Featuring members of the Women Divers Hall of Fame and the phenomenon of the Mermaid!

> **FEMALES ENTER FREE!** (10am to 12noon everyday)

IN CELEBRATION OF FEMALE DIVERS (NEW)





April 10-12

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*Speaker lineup subject to chang

underwater 3some

www.uw3some.com/ADEX



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Goliath groupers under ledge in Hobe Sound (left) and at Hole-in-the-Wall site (below). off Jupiter, Florida

Groupers

of growing to extremely large size. As I said earlier, having grown up here in Florida, I have heard more then my share of monster goliath grouper tales with the behemoths weighing in excess of 1,000 lbs (454kg). While the 680lb (308kg) fish from Fernandina Beach, Florida, still remains the most incontrovertible. have also found photos of a reported, but unconfirmed 10ft (3m), 790 lbs (360kg) behemoth that was supposedly landed in Brazil.

While stories of this fish and others of equal and larger persist, Koenig and his team of researchers have yet to come across a single fish past the 500 lb (227kg)mark since the study began in 1990. "It's not that I don't think there were fish of that size," Koenig points, "it's that

for a fish to get that size, it requires an extreme amount of time to do it, which I feel they no longer

It's amazing to think this giant started out at a size smaller than a head of a pin.

Home bodies

Surprisingly, for a big fish, goliaths favor shallow water. While we think of them on structures like wrecks, caves and large undercut ledges on a reef, they also have a propensity for taking up residence beneath large piers and bridges inside intercostal waterways along Florida's coast.

The most consistent places both divers and fishermen will find goliath groupers are on wrecks and

they grow large enough to feed themselves.

By this time the tiny fry are still smaller than a grain of rice, but now large enough to be seen by other—although small—predators. From here, their existence is at its most perilous, until currents from incoming tides deliver them inside coastal river mouth or inshore brackish water estuaries.

This explains why the likelihood of encountering an adolescent, much less a juvenile goliath on a reef is highly unlikely. That is because their life cycle is far different than most reef-dwelling fish.

Estuarine habitats play a pivotal role in the juvenile development of these fish. as manaroves' tanaled roots provide the necessary shelter from predators until five to six years of age. By this time they have reached a sub-adult size, around 4ft (1.2m) in length and better equipped to begin their new life in deeper water.

How big do they get? A goliath's growth rate begins

to slow after the first eight years.

From there, it may take as long as another seven to 15 years before they actually exceed 400 lbs (181kg).

Goliaths can live a surprisingly long time. The, the oldest specimen on record was 37 years old, which opens speculation that they could live well beyond 50 years of age. Through all that time, they will continue to grow, although quite slowly, until they are too old to effectively fend for themselves. This of course begs the question: how big does a goliath get?

Atlantic goliath is capable



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THIS PAGE: Florida Sate University researchers measure and tag goliath grouper



large artificial reefs. One of these steel structures can harbor anywhere from one to more than a dozen of these aiant groupers.

To understand why they prefer these man-made structures over most natural reef habitats, ask yourself which would you prefer to live in: a mansion or a tent?

While these big fish find artificial structures more suitable, they also favor reefs with high profiles affording deep undercut ledges. If neither is readily available for homesteading, in some cases, goliaths will excavate the sand from around the base of a limestone formation. By doing so, they expose and enlarge the space beneath a ledge that was buried in the sand.

One such example is a small reef off Hobe Sound just north of Jupiter, which I have known about and visited many times over the years. The reef is home to 15-16 resident goliaths, along with a wide assortment of fish, including gag grouper, snook, snapper, jacks, grunts and spade-

The most interesting feature of the reef is a series of ledges high enough for a diver to pass under, with one overhana wide enough for a car. Originally, the highest part of the reef was 4ft (1.2m) high. None of the features I spoke of existed until the first two goliaths moved in seven years ago. Over time, as more adult fish moved in, more and more of

Researcher shows fishing line removed from stomach of goliath grouper

ly pay a short visit to a neighboring loca-

Groupers

the bottom was excavated, leaving giant depression around the reef.

Since its beginning in the early 1990s, part of FSU's Goliath Grouper Recovery Study involved placing tags in both juvenile and adult fish. To more effectively track their movements, a large number of adult fish were also fitted with small transmitters surgically implanted in the body cavity. Each time one of these

fish would come within 100 meters of a specific listening receiver mounted on the sea floor, that fish's transmitter indentification would be loaged in.

What the study has revealed, once the fish have established a home base on a suitable site (be it a wreck, reef, pier or bridge), is that eight out of ten mature fish rarely roam more than a kilometer from it. Those who do move about, usualtion where food is likely more abundant.

Getting to the spawn on time

The one exception to this stay-at-home behavior is romance. When mating season rolls around, goliaths will pack up and swim considerable distances to join a spawning aggregation.

Part of the FSU's Goliath Grouper Recovery Study includes surgically implanting small transmitters in adult fish. The process also includes the placement of specialized underwater receivers designed to log every transmittered fish that passes within a 100m of it.

Between FSU, NMFS, FWC and other universities and research entities, there are now several hundred such receivers in place up and down the Florida coast. Through the array, biologists that are part of the cooperative network are able to tap into information on not only their fish, but also everyone else's, which are carrying similar tags.

Within the past three years, the migra-



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LEFT TO RIGHT: Groups of goliath groupers in wrecks off Florida coast; Goliath grouper in mangroves of Florida;
Spawning aggregation of goliaths

Groupers

saltwater fish in the world. With most, these trace amounts are seldom high enough for concern. But, with others—such as swordfish, tuna, King mackerel and tilefish to name a When enough of it is absorbed into our bodies, really bad things happen.

Mercury poisoning

Classic mercury poisoning includes tingling in the extremities, sensory impairment (vision, hearing, speech). As more neuronal cells are destroyed, the damage is irreversible, taking the form of more pronounced neurological disorders

like diminishing muscle coordination, or control, to kidney damage, even coma and death. Mercury poisoning risks are five to ten times greater for children under six and those in the womb, where underlying perils include reduced immune system response and brain damage.

As mentioned earlier, goliaths are a slow growth species, taking seven or more years to reach sexual maturity. Their slow growth rate and surprisingly long life spans of 30 plus years make this species especially prone to exposure to highly toxic organic compounds, namely methylmercury.

Working in conjunction with Koenig's research, research biologists Douglas H. Adams and Christian Sonne were carrying out their own study of mercury levels in the fish.

As part of their research, 56 Florida goliath groupers where sampled, with muscle, liver, kidney, gonad and gill tissue samples extracted from live fish and brain tissue biopsies harvested from dead fish.

In 2013, they presented their paper on mercury and histopathology regarding goliath groupers. What Adams and Sonne found, which includes a complete histology (microscopic anatomy of cells and tissues) of key organs to determine the depth of the contamination was pretty frightening.

tory behavior portion of FSU's study carried out by Ph.D. candidate, Robert Ellis, has revealed two of the August/ September regulars to the Zion Train aggregation site off Jupiter, Florida, came from an area just north of Cape Canaveral, which lies some 200km to the north. One of the fish made this journey in ten days.

The most compelling evidence of just how far some of these fish will travel to spawn comes from a very large adult fish, which, for two years in a row, made a 560km trip from its home near Cumberland Island in southern Georgia to the waters off Jupiter. Once there, they spend the next two months (August and September) selecting spawning sites that best suit them in one area off Palm Beach County.

In addition to placing acoustic tags in fish to study their movements, a large part of Koenig's research involved collecting data on what the approximated ages were among the population, what the they ate and how often, to what nat-

ural, as well as continued manmade threats they faced.

To answer this involved capturing a large number of both adult and sub-adult size fish on Florida's east and west coast. Whenever a fish is brought aboard, Koenig's team would

quickly go to work extracting fin ray samples for age determination and DNA cataloging, checking stomach contents, attaching visual tags to even implanting acoustic tags in the fish to track its movements before releasing it back into the wild. With each year, an extensive amount of new data is collected revealing even more information about this fish that challenges almost everything we previously knew about it.

Here's where things get interesting, as well as a little disturbing.

Slow growth equals high mercury

Trace amounts of mercury are found in just about every species of fresh and

few—the fish have the concentration levels for which we hear warnings issued by U.S. agencies like the Food and Drug Administration (FDA) and Environmental Protection Agency (EPA). They strongly advise women of child-bearing age, nursing mothers, and young children to completely avoid eating these fish.

The FDA's "action level" (for which the FDA may prohibit sale of fish) is 1.0 ppm. In comparison, the Natural Resources Defense Council (NRDC) considers .5 ppm as the "very high" threshold for human consumption.

Methylmercury is particularly nasty stuff, as absorption of this toxin through ingestion is accumulative in muscle and fatty tissues of both animals and humans.



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Spawning aggregation of goliath groupers, with school of silversides

Groupers

grouper, in any form, should never be considered safe for human consumption.

Conclusion

While this recent discovery of mercury levels adds a new wrinkle in the argument against reopening the fish for commercial or recreational harvest, it does not underscore the fact that goliath populations are still in trouble.

Using the Palm Beach County coast as a benchmark, it's taken more than 25 years to bring these fish back to where they are today. Furthermore, while the southwestern regions of Florida's Gulf coast and a section of Florida's east coast have shown

the greatest signs of the goliath grouper's comeback, the rest of the state has not seen an equivalent rebound. On Florida's southeast coast, from Fort Lauderdale and Miami, through to the Florida Keys and Key West, the number of adult size fish is still very sparse.

Looking back at the goliath's historical range—which includes the Bahamas and the Caribbean as well as the Central American coasts down to Brazil—fishing pressure has pushed stocks to complete collapse in over 90 percent of that range—Hence the reason for the IUCN's decision to "Red List" them as a critically endangered species.

As to what the future holds

for the reef's biggest fish, only enough concerned citizens will be able to answer that question, as the FWC (Florida Wildlife Conservation Commission) will be once again placing this fish up for review in September 2015 to determine whether they should remain under protection in U.S. waters or reopened to fishing.

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The greatest amount concentrated mercury found in those fish was in the liver, with mean mercury range from 2.87 µg/g to some containing as much as 22.68 µg/g in the tissue. Following the liver, brain tissue samples revealed concentration levels between 0.37 µg/g and 0.89 µg/g, with muscle tissue falling with a mean level of 0.63 µg/g.

Mean mercury concentrations observed in those goliaths were not only within the range known to cause direct health effects in fish after long-term exposure, the presence mercury induced

lesions, and histological changes were also observed in the liver, kidney, and gills belonging to several of the fish sampled.

Granted, the human body is capable of removing a fraction of the mercury that might be ingested from one serving of fish, but the process takes an exorbitant amount of time as the "half-life" of mercury in your system is about 60 days. What that means is this: your body absorbs two "units" of mercury from a fish you ate; after 60 days—provided no additional mercury is ingested—half of what was taken in (e.g. one "unit")

would still remain.

One way to visualize the accumulative process of mercury contamination is think of each trace amount of mercury as a drop of water falling into an empty bucket. Now think of that same empty bucket continually receiving one drop after another. With enough time, the accumulative process will eventually fill the bucket entirely.

Now think of that same bucket as a sexually mature goliath grouper (sexual maturity is seven to eight years of age). One could easily argue that adult goliath





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Text by Walt Stearns

The older the fish, the higher production of eggs. In the world of broadcast-spawning fish, it's all a numbers game in who will survive and who will not. To better the odds of survival of the species, adult female fish must produce a large quantity of fertilizable eggs, likewise with sperm from males. The purpose for this is larval mortality (from egg to fry) is extremely high, as they are cast into highly variable ocean currents and preyed upon by a wide variety of fish and invertebrates.

In terms of a fish's fecundity (the ability produce a large volume of fertilizable eggs), the older the fish, the more prolific it will be at producing viable eggs for fertilization. Unlike people and other mammals, reproductive output increases with age and size in fish. For a goliath, the height of fecundity is achieved around 13 to 15 years of age.

Gender bender

Most grouper species are protogynous hermaphrodites, meaning that individuals first mature as females, changing sex to become males later in life. Thus, the vast majority of large individuals in protogynous species are male.

Goliaths are a bit more complicated, as they don't exactly follow that rule. FSU researchers have found some males at small sizes—as small as the size of sexually maturity—and some at the largest sizes, but females are abundant among older age groups, a pattern unlikely to occur in typical protogynous species.

The bigger surprise is that they have found specimens that had both fully functional male and female capabilities in the same individuals. This new finding has led Koenig to surmise that these individuals are bisexual hermaphrodites, capable of functioning as a male at one time and a female at another.

Starting out

It was not until four years after the closure that a discernible number of juveniles started to reappear in regions like the Ten Thousand Islands in southwestern Florida. From the data collected by Koenig and his colleagues during the first phase of the distribution, a regional density and habitat study revealed the vast majority of juvenile fish sampled between 1994 and 1997 just started to exceed 400mm (15-16 inches) in length. While most were in the one to three-year age group, only a few fell in the four to six-year bracket.

But life here can also be quite harsh as coastal mangrove and sea grass habitats are constantly subjected to environmental shifts in water salinity and temperature.

During heavier than normal rainy seasons and when severe cold snaps in winter are fast and sudden, juvenile mortality can become excessively high. In addition to natural shifts in nature, the constant growth rate of human habitation in Florida has also had a harmful effect on

of sea walls, docks and piers. If that isn't enough, there is also the issue of runoff carrying pollutants like pesticides and

herbicides from urban areas every time it rains.
One of the worst natural environmental shifts on record to affect juvenile goliaths since the study began in 1990 took place the first week of January 2010 when a massive cold front pushed inshore

water temperatures (re-

corded by the Everglades

National Park) to as low as 5°C (41°F).

The sudden plunge in water temperature had such a detrimental affect on marine life in the shallow mangrove and sea grass beds, that it triggered a widescale fish kill up and down the Florida coast, essentially wiping out six full years of juvenile goliath development in one night.

What does a goliath grouper eat?

While their mouth is quite large and well-adapted for sucking in prey whole, their teeth are quite small for their size. Don't let their relatively slow swimming mannerism fool you. Goliaths are capable of powerful short bursts for overtaking slow-moving prey. But it is also this same physical appearance that has led many fishermen to assume these big fish are continuous, indiscriminate, eating machines, further fueling an inaccurate reputation that the goliaths are out of control on wrecks and reefs.

Goliath groupers, like many other large predators (sharks, barracuda, groupers, snappers, etc.) in the ocean are opportunistic feeders; meaning, if they encounter another fish—including another species of grouper in a distressed state (struggling on the end of a line or spear)—they will literally seize the moment. Of course when fishermen encounter such blatant thievery, snatching their catch on the end of their lines, you can somewhat understand their point of view

Contrary to what some believe, grouper and snapper are not a normal part of the goliath's diet. Koenig, along with his research team, have examined the stomach contents of over 500 adult size fish; half (230) of the captured fish stomachs were empty while the prey species predominately found in the remaining adult fish were crabs.

While a large goliath might not pass

up a large meal when the opportunity is right, they are not constant eaters. This is because a goliath's metabolism is not hyper-tuned, like tuna, mackerel, jacks, and dolphin fish, which have a hyper growth rate but also have to go far and fast for their meals. Instead, the goliath's daily metabolic requirement is low, allowing even the smallest meal to go a long way, leaving the impression among divers that big fish are lazy.

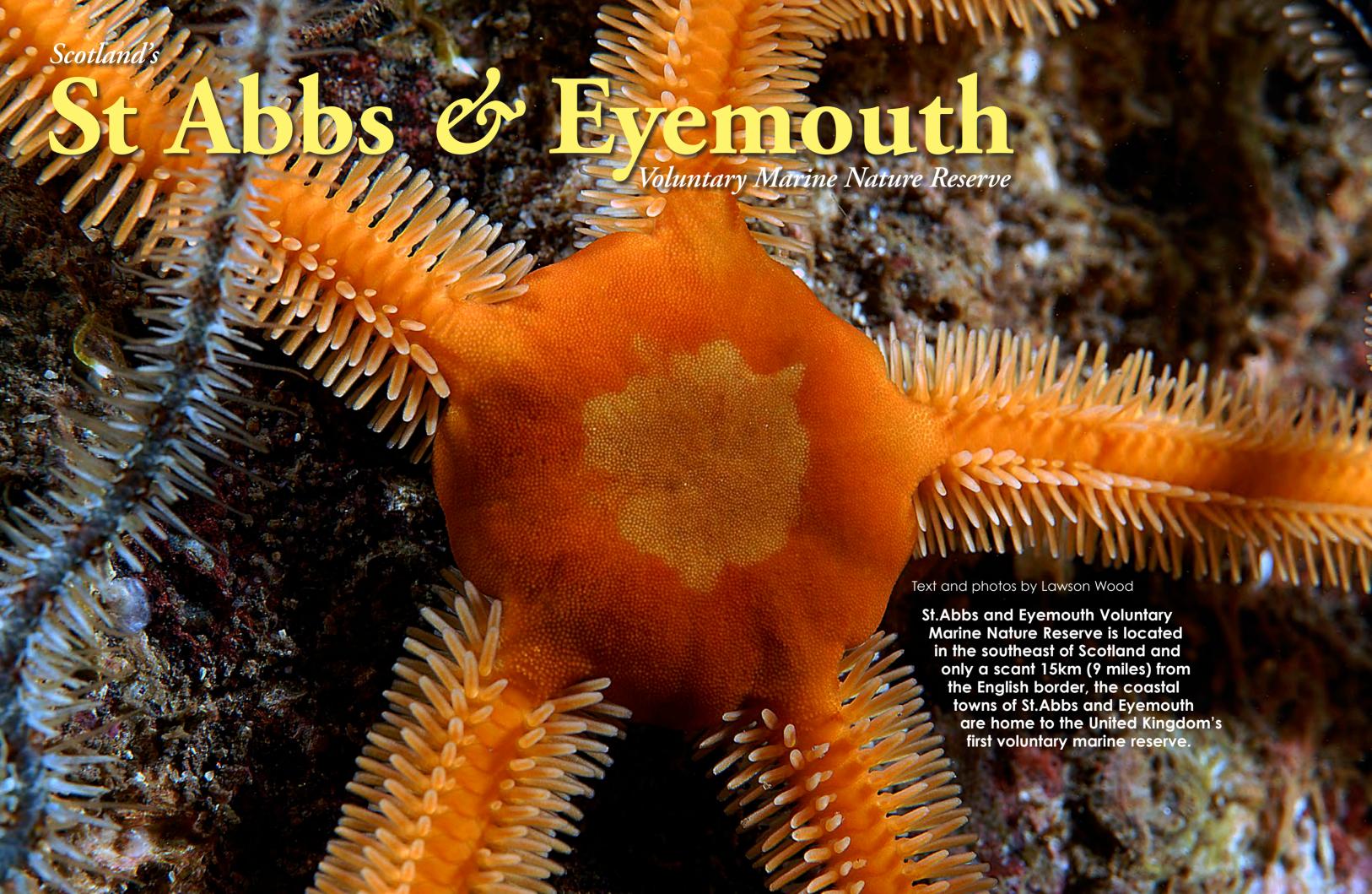
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St. Abbs Head, Scotland (above); Dead man's fingers (left)

— Marine conservation has always been important around St. Abbs and Eyemouth when a voluntary ban on the removal of shellfish was first imposed by divers back in the early 1970s with many diving clubs supporting this move. The first real change came in 1978 when Lawson Wood declared a small area to the north of Eyemouth the first voluntary marine

> reserve in Scotland. Barefoots, as it was then known, is still a major part of the St. Abbs and Eyemouth Voluntary Marine Nature Reserve, which was founded in 1984 and officially opened by Professor David Bellamy in 1986. Located just 15km (9 miles) north of the English border, the reserve now extends to St. Abbs Head and includes 7km (4.5 miles) of coastline and out to the 50 metre (165ft) depth contour. Lawson Wood was awarded the prestigious conservation award by the Marine Conservation Society in 1982 for his efforts. The author gives us a glimpse into the underwater world, flora and fauna, which

Since 1986, the marine reserve has been able to employ a warden who has liaised with divers, school groups, conservation organisations and local council authorities. Publicity materials have been published, the rock pool rambles are particularly well attended, and a new code of conduct has been produced for the benefit of all visitors to the area.

The Marine Reserve has 17 member partners on the committee including local from the Hurkar Rocks at Eyemouth council authorities, diving clubs, fishermen and conservation groups. Whilst this feature details the shore diving and near shore boat dives, many divers from all over the world are now visiting this region of the south east of Scotland for some absolutely amazing Technical diving on many (virtually undived) shipwrecks from both World Wars including two U-boats. In depths ranging around 45-60m (150divers will find in the nature reserve. 200ft) these are some of the best military

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shipwrecks in British waters.

The rugged shoreline is home to some of the greatest diversity of marine life to be found around the entire British coast. Tidal currents from both the warm Gulf Stream and the much colder Arctic Tidal Stream both terminate along this stretch of coastline along the east coast of Scotland

and have created an area of clear, clean water quite unrivalled in U.K. waters, where cold water species are found living alongside

There is an almost total lack of 'diver pollution' except at one or two of the most popular sites, and then again, only during peak holiday time. This is due to the

equipment sales and hire, boat hire, launching facilities, compresmore exotic warm water species.

sors, wrecks, good photography, etc. The dives within the confines of the marine reserve range from those easy, gently sloping shore dives to challenging drift dives in difficult tidal conditions.

The sea bed is generally covered with large boulders falling

away to aravel and sand at about the 20m zone (66ft). The exposed cliff faces are renowned for the great diversity of marine life and are festooned with 'dead men's' finaers' soft corals, brilliantly coloured anemones, hydroids, tunicates, fish and crustaceans. It is on these cliffs that Ballan wrasse eat out of your hand, and where wolf fish try to eat the rest of your hand!

The predominant feature is the kelp forest, which fringes much of the coast, grazed by sea urchins and home to spider crabs, nudibranchs and two-spot blennies. Further offshore are brittle-star

dahlia and plumose anemones, the rare arctic Bolocera anemone, burrowing anemones and huge angler fish.

beds with giant

Octopus and squid are common on night dives and the rare Yarrel's blenny

isn't rare here amongst the gulleys, canyons and caves that cut through the headlands.

Curiously, species such as the Devonshire cup coral (Caryophillia smithii). Painted top shell (Calliostoma zizyphinum) and the long-clawed squat lobster (Munida rugosa) are more commonly found on the western coast of the British Isles, along with the burrowing anemone (Cerianthus *lloydii*) and Yarrel's Blenny (Chirolophis ascannii) they make for very interesting finds in the North Sea. Many divers are also having superb in-water experiences with Grey seals which can be found

north of St. Abbs Head and south of Eyemouth on the offshore reefs of Burnmouth. The St. Abbs

TO RIGHT: Wolf fish with crustacean; Juvenile herring in kelp; Close-up detail of dahlia anemone; Fragile brittlestar

> and Eyemouth Voluntary Marine Nature Reserve is now part of the North Northumberland and Berwickshire Coast Special Area of Conservation and is part of the largest marine conservation zones

in Europe.

Evemouth shore dives The shore diving at Eyemouth is concentrated around the headland adjacent to Eyemouth Holiday Park. There are a handful of exceptional dives off the caravan park and although some of the access is a bit difficult at low tide. the diving is exceptional with cliff walls covered in soft corals and anemones.

Little Leeds Bay is reached by following the footpath from the caravan park and keeping to the right along the edge of the cliff. This is an ideal sheltered bay for trainees and the snorkelling is excellent with a profusion of life amongst the kelp covered boulders.





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LEFT TO RIGHT: Sun starfish at St. Abbs Head; Lion's mane jellyfish; Plumrose anemone; Scorpionfish on sun starfish

Divers Hole is the large cleft towards the end of Hairy Ness Point. The depth ranges from 7m (24ft) to 18 metres (60ft) and is best reached by swimming through the break in the headland. The cliff wall rises vertically on both sides and the amount of marine life to be found here is astonishing. At the end of the cliff on the right hand side, the wall curves around and you travel up a steeply inclined sand slope into a shallow cave.

Weasel Loch is by far the most popular of these shore dives with an average depth of only 7m (24ft) reached by a set of sturdy wooden steps leading down to the waters edge. Weasel Loch is a vertical cleft cut into the rugged Berwickshire coastline has walls lined with kelp and the sandy floor is home to all manner of molluscs and crustaceans. Octopus are seen on most dives. In the spring, lump suckers are quite common and during the full moon squid come close to shore to lay their large gelatinous eggs amongst the kelp fronds. This location is also excellent for snorkelling and for introducing you to the pleasures of night diving.





The **President** was travelling from Hamburg to Methil in Fife when she ran aground during thick fog on the 29th of April 1928 on a rocky reef known as Whup Ness located south of Agate Point to the south of Eyemouth. Originally launched in 1907 and weighing 1946 tons, she stood little chance as she ploughed into the channel between the rocks and ended up wedged with her stern facing the shore. The main boilers sit upright in a sandy gully in 12m (40ft) and wreckage is scattered over a very wide range, some of the larger plates are in 20m (66ft) and there is wreckage to be found in only 1m (3ft).

Agate Point (Cauldrons) is found at the tip of the headland to the north of the President wreck. The Cauldrons are the inshore part of a narrow gully which runs directly into the grassy headland. Due to the geology, some of the rock has been carved out by the sea and created huge

The Hurkar Rocks are opposite Eyem-

outh Bay and act as a natural breakwater, with an average depth of 15m (50ft), there are actually four large rocky outcrops which form part of a massive reef which runs underwater all the way to St. Abbs. The current is vari-

able to strong, possible surge on outside. Hurkar Rock is the largest and the sides steeply sloped and fringed in kelp. If you follow Hurkar rock around to the north and west, you will come to a narrow ver-

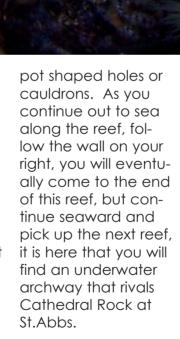


located to the right from the entrance of Weasel Loch

where a mini-wall is covered in soft corals and numerous species of anemone. The kelp forest reaches to only 8m (25ft) in this area and the far wall is deeply undercut with some very large holes where conger eels and wolf fish can be found.

Evemouth boat dive sites

The three caves which bisect the Hawkness headland to the south of Eyemouth are Horse Cave, Dove Cave and Scout Cave and may be susceptible to strong surge in the caves. Both Scout Cave and Dove Cave look as if they may connect underwater or underground at least, but they have been explored by many people over the years and do not. The walls are covered in marine life, particularly small seasquirts, hydroids, anemones and algae. The seabed is made up of well worn rounded stones and gradually makes way to a boulder bed which coincides with the underside of the main part of the cliff.





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tical walled canyon which twists its way through to the sheltered bay on the other side. Wolf fish (Anarhichas lupus) are always found here, generally in mating pares, the female being brown in colour as opposed to the grey coloured male.

Buss Craig and the wreck of the Mauretana are located to the west of the group. The Mauretana was a wood and steel steam driven fishing vessel which ran aground in thick fog in the 1920's. High and dry for some time, before a storm suddenly arose and wrecked

the ship before she could be salvaged. All that remains of the ship are the huge boiler which lies at right angles to the rock and various rusting plates, cogs and wheels which have all 'welded' together with the rocky substrate. The rocks and gullies in this area are just covered in soft corals,

sponges and anemones and are superb for photography.

Fold Buss is one of the higher peaks which forms the large 'dvke' which stretches from Evemouth to St. Abbs. With an average depth between 6 - 30m (20 - 100ft), this can be a difficult offshore site near the main shipping lane for boats entering Evemouth harbour from the north. There is always a current in this area and divers should have good boat cover and diver recovery flaas as the sea swell can be quite high and it may be difficult to see the boat under the worst conditions. The reef, although low lying has many mini-walls, under-hanas and crevices. The reef once more surfaces near St. Abbs and breaks the surface at low tide.

This section is called the Ebb Carrs and has two wrecks, the Viailant and the Alfred Earlandson. Diving all along this area is indeed spectacular, but care should be taken due to boat traffic and the possibility of being swept into a stronger current than originally anticipated.

St. Abbs boat dive sites The Ebb Carrs are not only an excellent reef dive, they are also home to two wrecks, the Vigilant and Alfred Earlandsen. A strong current passes through the rocks and can create quite a disturbance on the surface, the rocks should only be dived during slack water. These rocky pinnacles rise sharply out of a gravel seabed and form numerous interesting swimthroughs, gulleys and canyons teaming with marine life and all topped with a fringe of kelp. The Alfred Earlandsen was a coastal steamer from Denmark, 62m long (20ft), weighing 954 tonnes and carrying pit props as cargo. During a thick coastal fog, combined with rough seas, she completely wrecked on 17 October 1907. 'Hard hat' divers from St. Abbs were able to salvage the engine from the ship, but the rest was left to the elements and are now well scattered throughout the rocky pinnacles at a depth of between 12 - 15m (40 - 50ft). The Viailant is also testimony to the hazards of the Ebb Carrs; just one week old, the newly built MFV hit the rocks during a storm; the submerged rocks blanketed in thick fog and sank within 30 seconds in August 1977.

Wuddy Rocks is the first reef of rocks which juts out from the headland as you leave St. Abbs harbour towards the lighthouse. Three of the largest sections are dissected by a narrow winding gully and huge archway. Drop down to the seabed and you will find the opening to the shaft 'belled' out, follow the smooth bedrock into shallower water. swim over the lip and you will find yourself descending down a very narrow shaft, the sides of which are covered in dead mens' fingers. This route drops very quickly into the gloom and torches are necessary.

Nearby is **Black Carr**, which has been a firm favourite with divers for many years, as the depth drops off quite quickly over hard



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CLOCKWISE FROM LEFT: Anglerfish; Tub gurnard; Velvet swimming crab eating juvenile fish; Snake pipefish

flounders and swimming crabs are common. The sides of the walls are mostly covered in kelp and a few soft corals, sponges and anemones, the bottom metre of the wall is scoured clean by the constant moving of the sand in the channel during prevailing storms. Further out into the current the shelf drops away in 'fingers' similar to a spur and groove reef. Known as the Anemone Gullies, on the tops and sides of the ridges, huge plumose anemones can be found in three colour varieties as well as thousands of brittle starfish. In the val-





small and red in colour as well as a type of bryozoan called Clathrina, which is white. Even the scorpionfish come in shades or red and white.

The Glanmire was a 72m (242ft) freighter which struck the Black Carr Rocks on 25 July 1912 and eventually sank in 30m (100ft) about 500m (1/3 mile) east of St. Abbs lighthouse, the bows facing the shore. Now com-

pletely broken up, the 1,141 ton *Glanmire* is spread over a huge distance underwater and the highest part of the flat gravel and sand seabed is only 7m (24ft) high.

Skelly Hole is the last sheltered bay surrounded by huge rocky stacs before turning the corner to Pettico Wick Bay. The main channel into the sheltered inner bay is similar to Weasel Loch at Eyemouth with a wide sandy base where

leys between, massive dahlia anemones can be found as well as angler fish, dogfish and the angel shark.

The Nyon is located 6km (4 miles) north of St. Abbs Head and was a 4950 ton Swiss Motor Vessel. The Nyon was enroute from Leith to Dakar when she struck Meg Watson's rock near Fast Castle on 17 November 1958. Now utterly destroyed by the

inevitable winter storms which frequent the coast, parts of the wreckage can be seen at low tide jutting up amongst the tangle of boulders on the shore.

Fast Castle is 8 km (5 miles) north of St. Abbs Head and is probably as far as dive boats

have had a fortune in Spanish gold hidden in a cave beneath her cliffs. At the entrance of the cave an underwater shaft was discovered 6m down (20ft) and appeared to be the source of an underwater fresh water spring, but again yielded no sign of any treasure, just a fine silt and kelp debris which quickly reduced the visibility and prevented further exploration. This is still very much virgin territory.



Devonshire cup corals



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ground and wolf fish are commonly

Tyes Tunnel is a cut through the head-

land just to the north of St. Abbs light-

house. The entrance to the tunnel is

directly opposite a huge rocky stack

called Cleaver Rock, which is under-

neath the lighthouse some 30m above

(100ft). The walls of the tunnel are com-

pletely covered in Dendrodoa sea squirts,

found on most dives.

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CLOCKWISE FROM LEFT: Fragile brittlestar; Grey seal; Common lobster; Leopard-spotted goby

long (200ft), now completely broken up, mostly in shallow water, her ribs and plates are covered in a lush growth of kelp. The boilers stand upright well away from the main part of the wreckage and are surrounded by a sandy seabed. The wreckage continues out into 20m of depth (66ft) where much of it is piled against a rocky ridge.

Cathedral Rock. By far the most popular shore dive within the marine reserve is Cathedral Rock. This huge underwater archway has a





Pettico Wick is the sheltered bay facing north west the other side of St. Abbs Head. Reached by car, there is a steep walk down to the water. The 'Wick as it is affectionately known still has an ancient slip way which is robust and makes an ideal stage before you set off diving. Looking north east you will see the projection of a low rock called Wick Gaut. The wall of Wick Gaut has a strata which rises at 45 degrees forming narrow ledges which have squat lobsters, sea urchins and gobies, the vertical parts of

the wall are covered in dead mens'

fingers. The whole of Pettico Wick will suit any taste of diver, an excellent location for snorkelling and training.

The Odense sometimes referred to as the Peanut Boat due to the loss of its cargo of peanuts when she hit the reef and sank on 15 May 1917 is under the cliff in adjoining Broadhaven Bay west of Pettico Wick slipway. This coastal steamer weighed 1756 tonnes and was over 60m

smaller arch over it known locally as the Keyhole. The walls and the roof of the arch are festooned in a dwarf species of the plumose anemone as well as sponges, soft corals, mussels and hydroids. Ballan wrasse are very tame here and make for some great photographic subjects.

Broad Craig is the first big rock facing you at the east of St. Abbs harbour. Just to the right of the entry point is a deep pool

surrounded by rocks on all sides. This is generally known as the training pool due to its sheltered location. The floor of the training pool is alive with hundreds of hermit crabs, continually rummaging in the kelp debris which often collects after a storm. The occasional ray can be found here, but most divers just swim onwards from here and out to Cathedral Rock.

Big Green Carr (Amphitheatre) is the largest rock to the north east of the entry point from St. Abbs harbour wall. Keep the wall to your right and this will bring you into the amphitheatre, which has high vertical sides cut by narrow horizontal ledges which are home to the Strident squat lobster (Galathea strigosa) and rare Devonshire cup corals.

Maw Carr or Seagull Rock opposite the left side of St. Abbs car park, this side of harbour and is actually two rocks split, but joined in two. On the seaward side of this split, a cavern has been carved out by the sea and here you can find tunicates and dead mens' fingers.

For a comprehensive list of accommodation in the area that you are visiting, contact: Eyemouth Tourist Information Centre, Auld Kirk, Market Place, Eyemouth, Berwickshire. TD14. (Easter - October) Tel: 018907 50678

Wind and water conditions

The prevailing weather pattern is from the north east which may cause northerly swells, fortunately they rarely last any length of time. Water visibility alters drastically along the Scottish east coast and is generated by the prevailing wind only.



Two spot goby



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During heavy, prolonged rainfall in the Borders, a large amount of muddy water is swept into the sea and may linger for a few days.

Visibility and temperature

The average underwater visibility is around six metres (20ft) but 15m (50ft) is the norm when offshore winds (from the west) are experienced. The mean sea temperatures are 7.5°C (46°F) in Feb, 9°C (48°F) in May, 18°C (65°F) in August and 10.5°C (51°F) in November.

Best time to dive

Very rough seas are generally short lived, particularly from March to October when the prevailing wind shifts to a westerly direction which settles the sediment and brings flat calm seas close to shore, even during the strongest of winds. When this is the case, shore diving only is recommended as small diving boats such as inflatables or 'ribs' may well be blown off station when with divers. From August through to October the winds tend to be from the west, resulting in superb visibility and fantastic shore div-



ing all along the east coast of the United Kingdom.

Currents

For boat divers, tidal variations and current can be punishing to say the least particularly off St. Abbs Head, the Ebb Carrs and Hurkar Rocks. These currents only rarely affect shore diving. All of the skippers of the dive boats are very experienced in these waters and will suit dives to the diver experience, combined with the knowledge required to give you the most scenic dive in the best conditions.

Launching slipways

There are two slipways in Eyemouth at the inside of the harbour and opposite a handy car park,

CLOCKWISE FROM LEFT: Plaice: Juvenile haddock on jellyfish; Bloch's topknot; St. Abbs Harbour in Scotland; Common lobster; Yarrell's blenny

the other slipway is near the harbour entrance and runs onto the beach and is able to be used at any state of tide. St. Abbs has a slipway into the harbour, permission must be sought and payment is GB£10 and car parking for the day is also £10.00 payable to the St.Abbs Harbour Trust.

How to get there

By road, travel up the east coast along the A1 trunk road until you

> reach Scotland, then turn right or second right (if you miss the first turning) along the A1107 to Eyemouth, just 1.5km (1mile) from the A1. Coldinaham and St. Abbs are just five minutes' drive beyond Eyemouth.

Tidal variation Tide times are taken from Leith. To calculate the tidal variation at Eyemouth: **GMT**

High Water Leith minus 20 minutes Low Water Leith minus 10 minutes

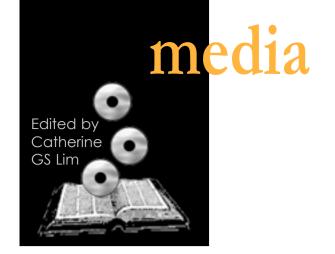
High Water Leith add 40 minutes Low Water Leith add 50 minutes ■

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



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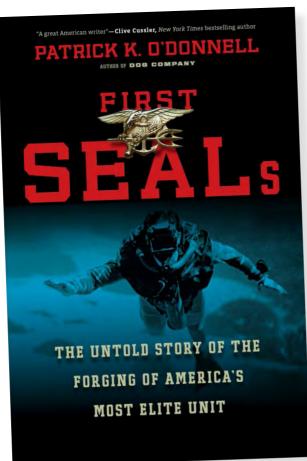
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Little Book of Scuba Diving

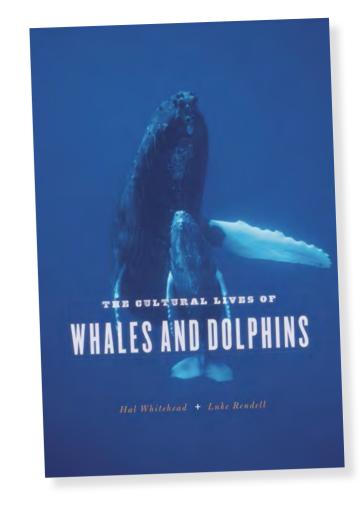
"Tips & habits of a good diver"

Kelvin J. Knight



First SEALs

Mention 'Navy SEALs' and images of courageous men undertaking nighttime clandestine missions, armed with the latest in weaponry and gadgets, come to mind. However, in 1942, when the unit was first created, it comprised a dentist, movie star, surfers, an archaeologist, among others. This pioneer group had sought to combine the capabilities of the Navy's Sea, Air, and Land (SEAL) teams. Despite being armed with only knives and wearing only swim trunks and flippers, the unit they formed developed into an elite band of swimmer-commandos during World War Two-infiltrating Nazi-occupied territory, leading rescue operations, conducting reconnaissance, etc. They also pioneered the tactics, technology and philosophy that would inspire today's Navy SEALs. After the war, their achievements were classified and largely forgotten...until now. Pick up this book and be awed by the bravery and ingenuity of this elite group of men. Patrickkodonnell.com



Little Book of Scuba Diving

Flip through this Kindle (figuratively speaking...), and you'll come across countless gems of scuba diving advice and tips. Whether you're a total beginner, seasoned diver or even a non-diver, the author's lighthearted writing style makes the read fun and enjoyable. All the 250 tips given are designed to help you dive safer and more efficiently. As a sampling

(and in the spirit of the holiday season), Tip

#4 suggests to "avoid looking like an underwater Christmas tree. Keep your gear streamlined and clipped off. Absolutely, no danglies!" In addition, there are also tips from other dive professionals like Alex Mustard, Bil Phillips, Leigh Cunningham, and Andy Phillips. Throughout the book, the author maintains that scuba diving is a privilege and advocates respect for the underwater environment and the creatures that live within. As such, a percentage of the proceeds would be donated to various marine environmental organisations. Amazon.com

Dive Truk Lagoon

During World War Two, Truk Lagoon was regarded as the most formidable of the Japanese strongholds in the Central Pacific. Then, on 17 February 1944, American forces launched a full-scale attack, which destroyed hundreds of Japanese aircraft, merchant ships and warships. The attack literally paved the way for American forces to advance systematically northwards towards Japan. Many of the downed vessels remain submerged beneath the clear waters of the lagoon, making it one of the world's areatest wreck diving sites. This book describes the events that led

up to the attack, as well as its execution. It

also focusses on 38 of the shipwrecks there, with detailed drawings and stunning photographs. Those interested in maritime history and divers would find this book to be a worthwhile read. **Whittlespublishing.com**



Whales and Dolphins

Does culture exist amongst whales and dolphins? Based on the findings described in this book, the answer is undeniably yes —from the songs of the humpback whales communicated across the vast oceans to how the dolphins in Australia's Shark Bay learnt to use sea sponges on their beaks as protection when foraging for food. How does such knowledge get communicated within and across—the communities, and from generation to generation? Drawing from scientific literature and their own research, the writers show that cetacean culture and its transmission are shaped by a series of adaptations, innate sociality and the creatures' unique environment. Throughout the book, they seek to define cetacean culture, why it exists, and what it means for the future of whales and dolphins—and ultimately, what it means for our own future. University of Chicago Books

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Text by Simon Pridmore Photos by Marco Daturi

It was a beautiful Caribbean day, water conditions were excellent but Anna was feelina confused. Water had started to seep into her mask and, although she knew how to clear it, somehow she was unable to get the water out. She started to ascend.

Concerned, the divergaster followed her up, signaling to Pauline, the other diver in his charge, that she should wait and he would come back.

On the surface, Anna removed her regulator, adjusted her mask, gathered her thoughts and decided she had been foolish. So, although she still did not feel well, when the divemaster swam over, she gave him the thumbs down signal, indicating that she wanted to continue with the dive. However, when they descended again, Pauline was nowhere to be found. By this time Anna was sick and disorientated and the divernaster, too, was having problems.

"I was dizzy," he said. "I don't remember much, but I know my eyes closed at some point, and right before we reached the surface, I had a pain in my chest. I felt terrible."

So they went back up and raised the alert. A search was carried out for

Scuba Confidential Pauline but she was never found. An investigation began several days later, but by then the equipment the divers had used had disappeared and a medical examination of Anna and the divemaster revealed nothing abnormal. Although they could not be sure, given FEATURES TRAVEL

the circumstances investigators strongly suspected that the culprit was one of diving's "black" gases, carbon monoxide.

What is carbon monoxide?

Carbon monoxide is a completely invisible, tasteless and odourless gas that is

formed when fuels such as gas, oil, coal and wood do not burn fully. It is very poisonous, has an immediately harmful effect on your respiratory system and is potentially fatal if it gets into your scuba cylinder, even in very small quantities.

Why is this?

The reasons for the toxicity of carbon monoxide are poorly understood. It is well-known that it bonds with the haemoglobin in our bloodstream much better than oxygen, so the presence of carbon monoxide can lead to a reduction in the



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carriage of oxygen to body tissues. However, at mild to moderate levels this can be compensated for by an increase in blood flow so that, although the blood contains less oxygen, oxygen delivery is maintained. It seems that carbon monoxide also has other effects on cells within tissues (particularly the brain) and that these produce the toxic symptoms.

How can it get into a scuba cylinder?

Carbon monoxide can get into a cylinder while it is being filled if there is an engine exhaust close to the compressor's air intake. The source might be the exhaust from the compressor engine itself if it is broken or poorly located or, on a liveaboard, it could be fumes from the boat engine. On land, the carbon monoxide could simply come from a car with its engine running parked close to the dive shop's compressor room.

How will you know?

Without deploying a little technology, you won't know! Analysers are now available that can be used to detect the presence of carbon monoxide in a scuba cylinder. For around US\$300 you can buy an analyser that you can screw on to your cylinder before a dive and test your air or nitrox to check that it is not tainted by carbon monoxide. The electro chemical sensor is user-replaceable but, unlike an oxygen sensor, does not need periodic calibration.

Similar devices are available, which dive centres and filling stations can use, that will warn them if carbon monoxide is present in their systems. Logic suggests that if you dive with operations that use these detectors, you can feel confident that you don't have to deploy your own.

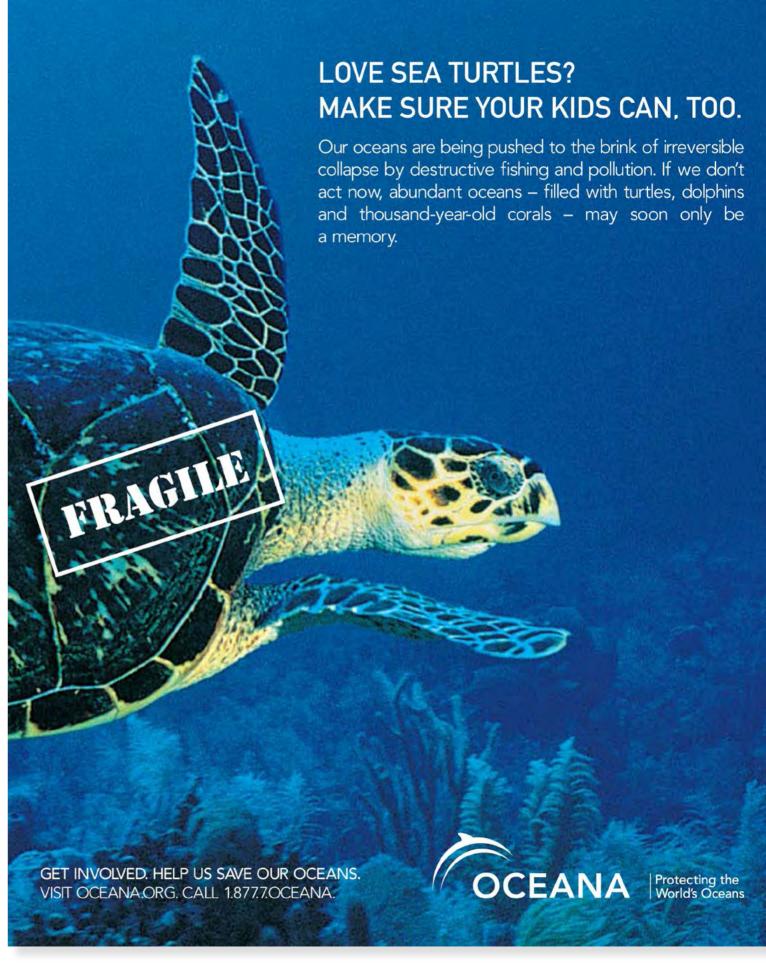
Otherwise, the first indication you get that you have carbon monoxide in your breathing gas will be

that you start to feel unwell during a dive. The symptoms are headaches, irritability, dizziness, confusion and shortness of breath. The confusion is a complicating factor because it means that your judgement will be impaired and you may not immediately take the correct action, which is to gather your dive team and all ascend together.

Two golden rules to follow:

- 1. If you feel unwell during a dive, abort.
- 2. One up ALL up: no questions, no exceptions. ■

Simon Pridmore has been part of the scuba diving scene in Asia, Europe and the USA (well, Guam) for the past 20 years or so. His latest book, also called Scuba Confidential, is available in paperback and e-Book on Amazon.





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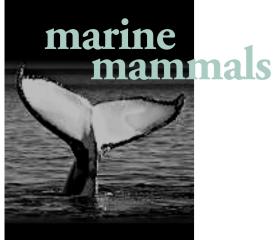
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It didn't take long for the seals to figure out the pattern.

Smart seals home in on fish tags for easy meal

Grey seals have figured out how to use sounds from acoustic fish tags to home in on prey.

The negative effects of anthropogenic noise on marine mammals can be pronounced, such as lethal whale strandings coinciding with exposure to military sonar. Acoustic deterrent devices (ADDs) aim to elicit avoidance responses in aquatic predators, such as seals, and are currently being used to reduce depredation in fisheries. However, seals that have previously

found fish at a location close to an ADD quickly habituate to these sounds.

Dinner bell

In other cases seals quickly learned that sounds emanating from research tags put on fish are the equivalent of a dinner bell. For years, scientists have used "pinging" tags that emit sound to study the population size, migratory movements, and longevity of many fish species. But they also have noticed that in some studies, the noise-making fish did not fare as well as fish tracked with silent tags.

Observational
evidence suggests that ADDs
may attract
predators and
in such cases
may even
cause higher
incidences of
predation due

to contextually learned associations between sound and prey.

If seals quickly learn to associate pinging tags with food, so do other marine mammal species, including dolphins, fish-eating whales, and orcas. Though the tagging of marine mammals is much rarer, those animals with pinging tags are probably similarly at risk of being eaten by predators up the food chain, Amanda Stansbury, the study's lead author, stated.



Humpbacks sing their prey out of hiding

Chances are you would have heard the songs of the humpback whales, either on a CD, online or —if you're lucky—in person. (Can

divers hear whale sounds when diving underwater?) The variety of sounds produced by these magnificent mammals are astounding.



Several species of sand lances are commonly known as "sand eels" or "sandeels", though they are not related to true eels

Now, a study has revealed that humpbacks produce 'tick-tock' sounds when hunting together at night near the ocean floor.

Assistant Professor Susan E. Parks of Syracuse University revealed this in the December issue of *Scientific Reports*: "Humpback whales are known to cooperate with others to corral prey near the surface. Recent studies suggest they may cooperate [with each other], when feeding on bottom prey as well."

The paper was co-authored by researchers at Moss Landing Marine Laboratories, Oregon State University, Gerry E. Studds Stellwagen Bank National Marine Sanctuary and the Whale Center of New England.

Nightly nibbles

In the study, scientists tagged humpback whales in the Gerry E. Studds Stellwagen Bank National Marine Sanctuary off the Massachusetts coast with special recording devices. They wanted to find out how specific sounds correlated with successful feeding behaviour near the seafloor. Their research revealed that the humpbacks produced tick-tock sounds when foraging for food near the seafloor at night, when it's pitch-black.

These sounds flushed out the sand lance, enabling the hump-backs to feed on them. Sand lance are eel-like fish that resist (Wikipedia used the word 'avoid'—which word is more accurate?) tidal currents by burrowing into the sand, leaving their heads sticking out.

Dinner bell

The tick-tock sounds might be heard by other whales, thus also serving as a sort of dinner bell. "Hints of behaviour suggest that

other whales who overhear the sounds are attracted to them and may eavesdrop on other whales hunting for food," said Parks.

Group behaviour

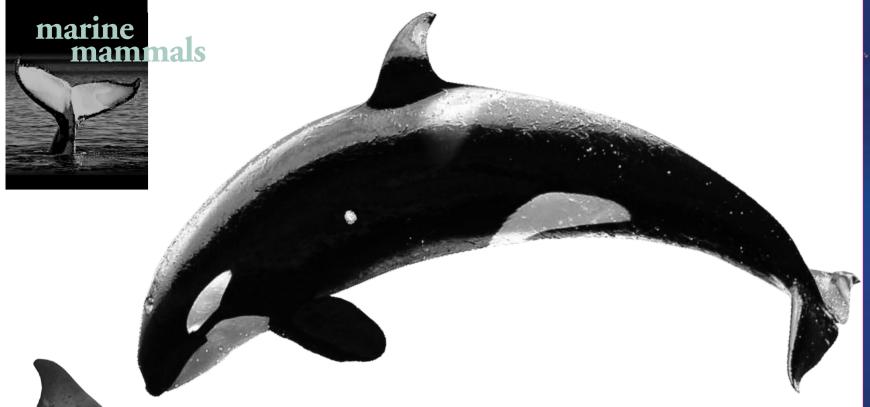
Interestingly, the tick-tock sounds were heard only when the hump-backs hunted in a group. When they hunted alone, no sound was heard. (If no sound was heard when they hunted alone, how can Parks say the humpbacks hunted using tick-tock sounds? How did they flush out the sand lance without any sound?) The reason for this silence when hunting alone is currently unknown.

Parks is part of a collaborative consortium that has spent a decade monitoring the feeding behaviour of the humpbacks in the sanctuary.



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Can orcas learn to speak dolphin?

Apparently, yes—provided there is sufficient contact between the two species. Researchers discovered that captive orcas (aka killer whales) that lived alongside bottlenose dolphins for several years adapted their vocalisation so that it is more similar to that of the dolphins.

> three lived amonast bottlenose dolphins.

Under normal circumstances, orcas communicated using a series of clicks, whistles and pulsed calls (repeated bursts of sound punctuated with silence). The pitch, duration and pulse of the vocalisation vary from pod to pod, so that each would have their own 'dialect'.

For the three orcas that lived amongst bottlenose dolphins, their vocalisation patterns aradually evolved so that there were more clicks and whistles, and fewer pulsed calls—characteristics resembling that of dolphins.

According to Bowles, "Killer whales seem to be really motivated to

match the features of their social partners."

Further evidence of the orca's linauistic ability came in the form of a unique chirp-sequence that one of the three orcas picked up. The keepers had taught this sequence to the dolphins before the orca was introduced to them. So the only way this orca could have learned it was from her dolphin companions.

These findings were published in the October issue of The Journal of the Acoustical Society of America. According to Bowles, "It's important to understand how they acquire their vocalisation patterns, and lifelong, to what degree they can change it, because there are a number of different cetacean populations on the decline right now." ■



world's first perpetual underwater

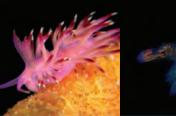
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An evolution from seven years as the Underwater Festival, the UP continues to share the beauty and the issues of the underwater world of Australasia and shows the world what we have to lose.

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- purposes and/or become available for sale with 50% of profits coming back









underwaterproject.org





"There's been

time that killer

an idea for a long

whales learn their

lect, but it isn't enough to say they all

have different dialects so therefore

they learn," said senior researcher

Ann Bowles, explaining the need for

experimental proof of how well the

text that would promote learning.

Research Institute in Carlsbad.

with other orcas, while the other

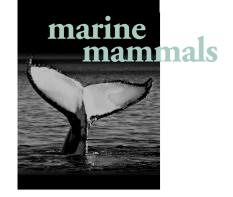
Hence, the researchers studied recordings of the vocalisation pat-

cetaceans learn and the sort of con-

terns of ten orcas at Hubbs-SeaWorld

California. Seven of them had lived

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This animal, we think, may be highly evolved with an ability to navigate using magnetic sense in order to find ice holes some distance apart and get back to them safely

Randall Davis
 Department of Marine Biology, Texas A&M University



Seals may use Earth's magnetic field to navigate

How are seals able find their way back to their dive holes with such amazing precision? Researchers believe they are using the Earth's magnetic field as a natural GPS.

If the hypothesis turns out to be true, it would represent the first evidence of such a trait in a marine mammal.

Randall Davis of the
Department of Marine Biology
at Texas A&M University, Terrie
Williams, a professor of ecology
and evolutionary biology at the
University of California–Santa
Cruz, and another colleague,

Lee Fuiman, associate director of the University of Texas'
Marine Science Institute in Port
Aransas, have been studying the behavior of Weddell seals for decades. The idea that Weddells can unerringly follow magnetic lines dates back to the late 1990s when the team first started working together in Antarctica. Fuiman said he was struck by

data from the very beginning that showed the seals returning to dive holes with amazing precision.

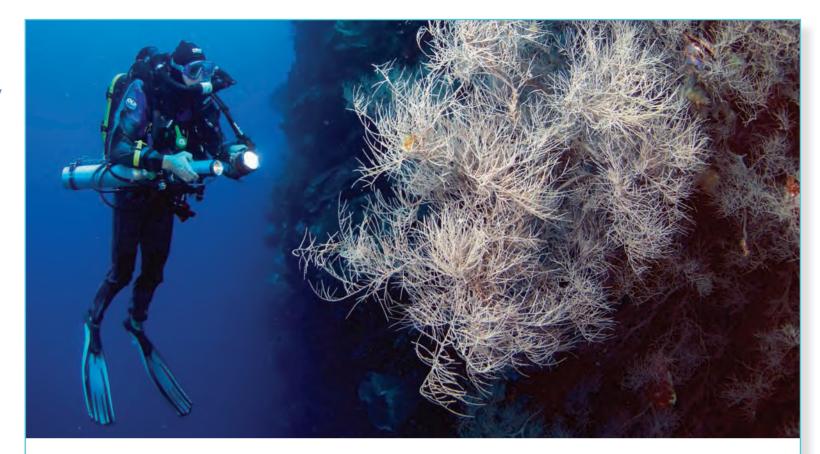
The question of how seals navigate is more than academic. It's about life and death for the animals, which like all mammals, require oxygen to breathe, despite their mostly aquatic environment. Time spent looking for a new place to surface after each dive would not only

be inefficient given the energy required to swim and hunt, but failure to locate a hole in the ice means the animal would drown.

Davis said it's possible Weddells may be using other strategies for relocating holes in the sea ice with apparent ease. One possible explanation involves the idea of piloting—using under-ice visual features, such as cracks in the ice, to navigate.

However, without light penetrating the ice during winter darkness, the team can eliminate another factor.

"Magnetic sense isn't the only sense that seals use for orientation," Davis said. "What we're trying to do is separate pilotage from navigation."



A CCR experience without equal

At Wakatobi, rebreather divers are not just accommodated, they are welcomed by a staff that understands the special requirements of the equipment, and in some cases, are CCR divers themselves. A supply of oxygen, diluent, and bail-out tanks are available on site, along with ample stocks of sorb with oxygen fills to 206 bar, with helium available by advanced request.

Rebreather groups may be provided with dedicated boats to accommodate their extended profiles. Equally attractive as the support system is Wakatobi's marine environment itself, which offers profiles that are ideally suited to rebreather diving, along with a wide range of marine subjects that become even more accessible to those who dive silently.

Bring your rebreather and experience Wakatobi today. Learn more at www.wakatobi.com or email office@wakatobi.com.

"Overall, it would be hard to imagine a more perfect environment. You don't have to dive a rebreather to experience all the wonderful attractions of Wakatobi, but having these systems can add yet another layer to your enjoyment of this magnificent ecosystem."

Craig Willemsen, owner, Silent World Diving



www.wakatobi.com

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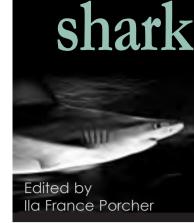
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Samuel H. 'doc'
Gruber in the lab
in 1963, microtome
slicing shark eye
for retina histology
(right); The young
Gruber spent his
weekends diving
and spear fishing on
the schooner Blue
Goose in 1957, when
there were still big
fish (below)



Doc Gruber

— Pioneer of Shark Science, Part I

Samuel H. 'doc' Gruber began studying sharks in 1961, perhaps before any other scientist had done full-time research on a living shark. During his long career, he founded the Bimini Biological Shark Lab, the Shark Specialist Group of the International Union for the Conservation of Nature, (IUCN), a United Nations organization based in Switzerland, and the American Elasmobranch Society. He has published over 200 scientific papers, and his work is still ongoing today. His ground breaking discoveries have given us an extraordinary glimpse beneath the veil of mystery surrounding these unusual marine animals that are so different from all other vertebrates. His decision to study sharks was as unplanned

Text by Ila France Porcher Photos courtesy of Dr Samuel Gruber Additional shark photos by Peter Symes

As a young man growing up in Florida, he loved to dive, and often went off for weekends of scuba diving and spear fishing on a 30m schooner called the *Blue Goose*. The ship had belonged to Hermann Göring, commander-in-chief of the German Luftwaffe (Air Force) under the Nazis, and it had found its way to Miami when it was liberated at the end of World War II. A weekend of diving fun on the *Blue Goose* cost only seven dollars, and at that time, there were still big fish!

On one of these outings in 1958, Gruber had speared a grouper hiding in a submarine cave, and was emerging with it into open water when he saw a hammerhead shark approaching. It was the largest shark he had ever seen, and as it glided towards him, it seemed to be the size of a submarine!

Sure that he was about to die, he plunged back into the cave with his fish, and found himself in the same position that the grouper had just been in, as he looked out. Watching in awe as the

momentous shark passed him, he was seized with the desire to know what sort of an animal it was.

When he returned to the university, he asked his professor what was known



about sharks, and found that no one knew much at all. So he decided then and there to become a marine biologist and study them.

Research begins

With the idea of becoming a medical doctor, Gruber was attending Emory University at the time, and was majoring in pre-medical studies. He had been especially intrigued by the study of comparative anatomy in which he had dissected a shark, a giant salamander, and a cat.

That summer he was taking courses at the University of Miami, and had asked if he could assist the comparative anatomy laboratory dissecting the animals. Now, inspired by his riveting meeting with the hammerhead shark, he transferred to the University of Miami, earned his undergraduate degree in zoology and chemistry, and applied to graduate school to study sharks.

In 1960, the University of Miami's Marine School had hired Dr Warren Wisby as professor and researcher in marine animal behaviour, with an emphasis on sharks. As a student of the famous professor Arthur Davis Hasler, Wisby was best known for having discovered the actual mechanism of homing in salmon. By marking hatchling salmon, and going back to their streams when they returned to spawn, Wisby had found that they came back to the exact stream in which they had hatched.

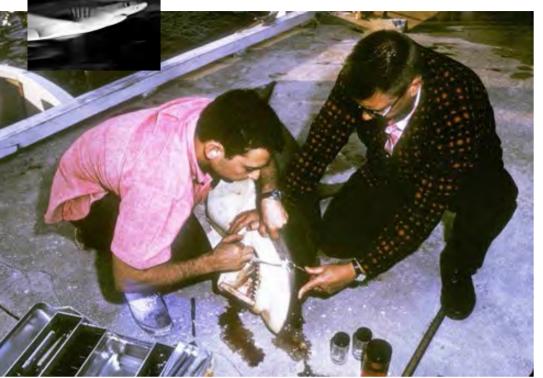
So Gruber's timing was perfect. He was given a research assistantship, and didn't have to pay for tuition. In fact he was paid the huge sum of 103 dollars

as it was final.

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Gruber (left) and Wisby (right) collecting eyes from specimen during shark tournament, 1963





a month as a graduate student there!

Wisby told him that the Navy had given them a grant to study shark senses. When aircraft went down at sea, it happened at times that sharks attacked the flyers in the water. In those days flyers wore two types of suits—high visibility suits called International Orange, and the standard khaki flying suits. According to a Navy report, the flyers wearing International Orange suits were attacked to a man, while the ones wearing khaki suits were left alone. As a result, the Navy had started calling those orange suits yum yum yellow.

Wisby directed Gruber to look at the literature and report back on the possibility that sharks have colour vision. So he examined all the old reports. They were mostly in German, and they concluded that sharks could not see colours because they lacked the coneshaped photoreceptors in the

eye's retina that permit colour vision in humans and other animals.

Duplexity Theory

The Duplexity Theory of vision was introduced in the 1860s by a German scientist named Max Schultze, and states that rods and cones in the retinas of an animal that possesses both, have two functions. Rods are used in night vision when there is little light, while the cones take over during the day, providing the ability to see colours, fine details, and to discern rapidly flashing lights.

Some animals, such as squirrels and iguanas, that are active in daytime, have no rods in their eyes, and nocturnal animals or those adapted to the darkness of caves or the deep sea, have no cones. Therefore, the lack of cones found by early researchers in the retinas of sharks, suggested that they were unable to distinguish colours.

But Wisby questioned the old conclusions. He asked Gruber to go out and actually collect sharks' eyes, and see what he could find. So Gruber went to shark tournaments and collected the eyes of every species of large shark caught off the of the eastern seaboard of the United States. He put a catheter into their hearts while they were still beating—the animals were brain-dead—and perfused gluteraldehyde, a preservative chemical, through their arteries, to fix their eyes for future study under the electron microscope.

On one occasion, he was notified that a young great white shark was caught and was being held for him. This was the chance of a lifetime for the young graduate student, as white sharks were very rare. He ran out in a boat to where the fisherman was waiting with a barely living 54 lb specimen, successfully perfused the shark, and collected the eyes.

Can sharks see colour?

Year after year, Gruber worked in a histology lab comparing the retinas photographs of the many species of sharks to see whether they had both rods and cones.
And, amazingly, every species he studied had them. Some species seemed to have better retinas than others, but they all had rods and cones. The great white shark had five rods to one cone, which was an especially high ratio.

It seemed that the earlier scientists had studied the cold-water, bottom-loving sharks of the northern seas off Europe, and those species had very few cone cells because they were

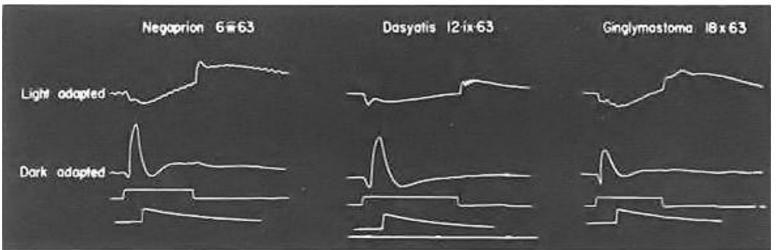
adapted to dark conditions. Those inaccurate early findings had resulted in many false ideas about sharks taking root. The idea that they had an excellent sense of smell had spread because they came quickly to a scent, and so the concept of a shark as a swimming nose, with poor eyesight, was born a century ago.

The forebrain of a shark, called the telencephalon, is considered one of the most important parts of the brain, like our cerebral hemispheres. And in the shark, the telencephalon was thought to be the centre that analysed scents, because that was how it looked to the early researchers. They did not know how the forebrain worked, and they had never looked at how sharks really behaved, or tried to do neural examinations, yet their primitive ideas about sharks had persisted.

Wisby was pleased with Gruber's discovery, but pointed out that just because the sharks had cone cells, didn't mean that they could see colours. "What do the rods and cones mean for sharks?" Wisby asked, and directed Gruber to experiment to learn whether sharks see colours, and investigate their other visual capabilities.

As the eyes of a human or animal adapt to darkness, rods take over the function of vision, providing high sensitivity to light, but no colour. The switching over between the cones and rods is something that can be mea-

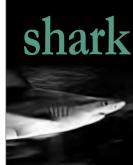




A comparison of the light and dark-adapted ERG's from the three species of elasmobranchs



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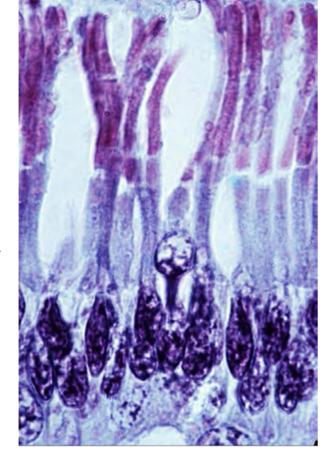


sured, and it was this line of research that Gruber began to pursue in 1962 for his master, and later his doctorate degrees.

He used the lemon shark as a model. and chose three methods to test the Duplexity Theory of vision in sharks. To assess the rod and cone activity in the retina, he put contact lens electrodes on anaesthetized lemon sharks, and recorded the electrical responses of the retina when illuminated. He used electrophysiology to record electroretinograms, which are similar to the electrocardiogram of doctors, in order to examine the electrical activity of the associated neurons.

His second method involved a behavioural study, following the Pavlovian method of testing called classical or respondent conditioning, and the third was the Skinnerian method, which is called operant conditionina.

Gruber's results were unambiguous. The an hour, achieving a million-fold increase



three methods gave the same results there was no doubt that sharks could see colour. The rods functioned as expected in the dark, and the cones were most active in the light-adapted state. He found that as sharks adjusted to darkness, the sensitivity of their eyes became greater and greater, and reached the maximum dark-adaptation after about

in sensitivity!

They adapted better than humans because unlike us, they possess the tapetum lucidum.

This is the mirror-like membrane at the back of the eye which produces eye-shine in some animals. Light entering the eye passes through the retina, and is reflected, as if by a mirror, back from this membrane, potentially

Sharks can see color! Pictured here are rods and cones in an eye (left); Sharks possess the tapetum lucidum, the mirror-like membrane at the back of the eve which produces eye-shine in some animals (right)

doubling the eye's sensitivity.

Learning rate

Another interesting findina that emeraed from Gruber's research durina his doctoral studies was the speed at which

sharks learn. He was working on Pavlovian training conditioning, doing an experiment in which a shark would see a flash of light, and then receive a mild electric shock. After a certain number of trials, when the shark saw the light, it would have learned to anticipate the shock, and have a reaction. This is called a con-

ditioned response.

The reaction that Gruber planned to use for the experiment was the pause in the shark's heart-rate resulting from the fear of the coming shock. Fear causes the heart to skip a beat, then accelerate, so at the moment that the shark realized that it was about to receive another shock. its heart paused, and this reaction could be measured. The number of trials it took for the animal to learn the association between the light and the shock, gave a measure of its ability to learn.

While Gruber was flashing the light, and giving the shock, he was look-

oscilloscope, rather than at the shark, which was trussed up underwater, with an electrode in its cardiac chamber, looking out into the room through a big Plexialas bubble.

at the shark at the moment in which it anticipated the shock, and saw that it

Then one day, he happened to look

Olfactory Tract

ing at the readout on the Examples of shark brains (dorsal views): a) smooth dogfish, Mustelus canis; b) sevengill shark, Notorynchus cepedianus. (Modified from Northcutt, 1978)

winked—the nictitating membrane photograph of the shark's eye closed. This provided another conditioned response to the light, which meant that there was no need for the heart monitoring—all Gruber had to do was observe. Due to the need for the heart monitoring, the sharks had been unable to survive long

> enough for him to get them trained, so his discovery was crucial to the success of this important experiment.

Gruber

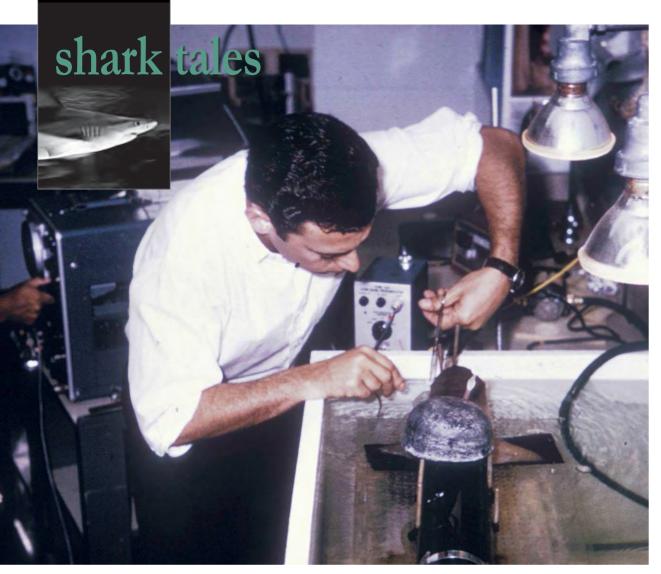
Now Gruber used a World War II infra-red sniper scope to observe the shark in total darkness, and found that after about ten trials, or repetitions, the shark would wink in expectation of the shock. It was a conditioned response that he aot from a shark in only about three minutes!

One session consisted of ten sets of ten trials, and after about 80 trials, the shark was responding 100 percent of the time. The next day it took only three or four trials to get the shark to respond, and it responded 100 percent of the time after 40 trials. On the third day, it had a 100 percent response from the start.



Shark winking nictatans





So it took only about ten trials for the first response, 80 trials to get the 100 percent response, and only three days to the state in which the shark was conditioned long term.

By chance, psychologists had been studying Pavlovian conditioning in cats and rabbits using the same paradigm. They used the flash of light as the initial stimulus, and followed it with a puff of air onto the cornea, instead of an electric shock. As in Gruber's experiment, the conditioned response was the movement of the nictitating membrane, so the experiment was a terrestrial version of precisely what Gruber had been doing with sharks.

What was surprising was that the sharks had learned the relationship between the light and the shock ten times faster than the cats and rabbits! These had taken about 800 trials to achieve 100 percent conditioning, while the sharks had taken only 80 trials. Further, the sharks

remembered what they had learned for over a year, which was far longer than anyone had expected.

Gruber discovered many more interesting things in the course of his research. He found that sharks have different "IQs" and different personalities, and that some are left-handed and some are right-handed. He also found that they have an occlusable tapetum, a further refinement of their vision, as well as a mobile pupil in a variety of shapes, which only sharks and rays, and no other fish, have.

Published

Arthur A. Myrberg, the youngest full professor at the University, took Wisby's place in 1964, and mentored Gruber during the last years of his master and doctorate degrees. While Gruber and his student, Joel Cohen, were studying shark vision, Myrberg and his students worked on their hearing, and others (not at the

Electroretinogram: Gruber with anesthetized shark, 1966 (left); Bonnethead shark social hierarchy (right); Lemon shark (below)

University of Miami), were working on olfaction, taste, and electoreception.

In 1976, the Navy asked for a summary of all of the work it had funded about the sensory systems of sharks, and they put their findings together in a major book, which was published in the government printing offices. Gruber's discoveries about shark vision filled a large chapter.

Ethology

With his findings published, Gruber no longer wanted to work in a dark and damp laboratory, and longed to understand the role sharks play in the marine environment. He dreamed of studying their behaviour in a similar, systematic way, in the wild, and decided that he would find a way to do it, using the lemon shark he had come to know so well, and wanted to understand more deeply.

By then he had become an assistant professor at the University of Miami Rosenstiel School of Marine and Atmospheric Sciences, teaching advanced courses in animal behaviour, tropical marine biology,

and the physiology and behaviour of marine organisms. He had done a post-doctoral study in 1971-72, at the Max-Planck Institute in Germany, under Nobel laureate Konrad Lorenz, the famous Austrian ethologist, just as Myrberg had done a

decade before.

Both men were interested in pursuing their interest in ethology, and as a side project, they had put together an observational study on a captive colony of

FIG. 6. Social organization and dominance hierarchy in a colony of 10 bonnetheads. In the diagram, sharks are ranked in order of descending size. Two diagonal lines are associated with each shark (except

a close

personal

ship that was to

dominated in the encounter. Clearly, larger sharks dominated in the GIVEWAY situation. Yet sex also played a role as can be seen for example by noting the consistently thick arrows pointing to G, SL and SP.

bonnethead sharks, which was published in the journal *Copeia* in 1974. It remains the only ethogram, which is an inventory of the repertoire of behaviour patterns displayed by a species, that was ever published for sharks.

Then in 1976, they gathered together all of their information on shark behaviour for a symposium in New Orleans, and it was published in the journal *American Zoologist*. Gruber and Myrberg developed

friend-

They travelled together as they pursued

their research in Europe and the Mid-

dle East. They dove with Cousteau in

Monaco, travelled through Europe visit-

ing friends and colleagues, and studied

last all their lives.

Gruber

sharks in the Florida Keys and the Caribbean. And when Gruber got engaged, it was at Myrberg's home.

Gruber left Navy research in 1976, and in 1977 he proposed a study to the National Science Foundation, on the role lemon sharks in the tropical marine environment. His goal was to do an autecological study designed to examine many aspect of this species' biology, with an emphasis on behavior and ecology. It was funded in 1978 and is still

continuing today in 2014. At last he was fulfilling his dream, of discovering what a shark is, and what it does in its life in the wild.

Bio-energetics

Gruber chose bio-energetics as way of understanding the biology of the lemon shark. Bio-energetics gives the researmathematical getics cher a method to describe the workings

of a

living system. Like all things in nature, a shark conforms to the laws of thermodynamics, that decree that in a system, the energy that comes out, no matter how it is chan-



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Sharks can learn!
And they learn ten
times faster than
cats. Plus, like elephants, sharks have
long memories and
can remember
experiences a year
later. At right is a
reef shark; below is

neled or converted, has to equal the energy that has gone in.

In other words, the energy that goes into a shark as food, will come out through growth, metabolism, waste, other biological products. The processes of metabolism—the nerves, digestion, muscles, respiration, and other biological processes—will likely burn half of the calories, and such materials as mucus, urine, and faeces can be burned up in a calorimeter to find how many calories were lost that way. The calories consumed must be partitioned within the body into only four unknowns, and the process can be analysed.

As an example, the common practice of dieting and exercising to reduce one's weight, utilizes the principle of bioenergetics to achieve a goal. By decreasing the energy going into the body in the form of food,

we can force it to use stored fat to make up the deficit, and thus lose weight. Gruber described it this way:

"It is possible to make an equation that balances in four unknowns. It is a simple thing to do mathematically and it reveals a great deal about the animal. It shows how they make their living, what they require

for food, their metabolic needs, what they need to digest food, how much of what they eat is assimilated, how much is lost in waste products, how quickly



they grow, and how much food it takes them to grow. That's what you can tell about a shark's life and what it takes to grow a shark in the environment and that's what we did. It

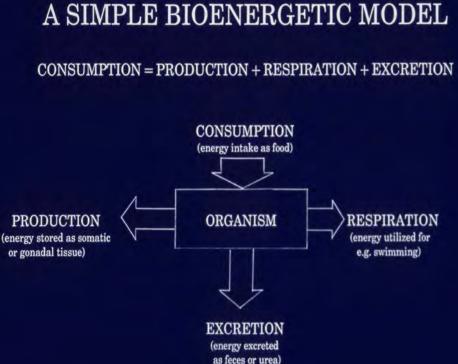
students focused so much research on the lemon shark that they discovered much about its life history characteristics, its population dynamics, its growth, reproduction, and genetics. He was determined to make sure that their experiments were realistic by always comparing laboratory results to what could be learned from sharks in the marine environment.

Coupon Bight in the Florida Keys. Using nets, he and his colleagues would reliably catch 100 to 120 juvenile lemon sharks there, each summer season, which they would work up and release.

But in the early 80's, their numbers began to fall, and in three years he could not catch one shark there. All of the work he had done during all of those years was wasted. He found out that it was due to overfishina. Fishermen had been catching the little baby sharks in the nursery for crab traps and had fished them all out. The mothers that were supposed to be coming back to the place they were born to give birth had been fished

too, so the entire local population of sharks had disappeared.

Gruber knew that the sharks were in trouble again, because this had already happened to him in Florida. So he began doing his research at a small island in the Bahamas at the place where he would later establish the Bimini Biological Field Station.



took us over ten years."
Through a combination of laboratory research and studies in the field, Gruber and his colleagues and

Bioenergetic equation

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Through a combination of laboratory research and studies in the field, Gruber and his colleagues and bioenergetic equation

Through a combination of laboratory research and studies in the field research using National Science Foundation research vessels photograph which were at his disposal from the University of were at his disposal from the University of Photo & VIDEO PORTFOLE

Through a combination of laboratory research and studies in the field, Gruber and his colleagues and bioenergetic equation

Through a combination of laboratory research and studies in the marine environment.

Fieldwork

Initially Gruber studied lemon sharks in were at his disposal from the University of were at his disposal from the University of Photo & VIDEO PORTFOLE

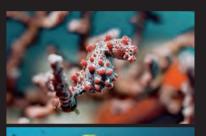
Through a combination of laboratory research and studies in the field, Gruber and studies in the marine environment.

Four times a year, he went there for his field research using National Science Foundation research vessels photograph which were at his disposal from the University of Photograph which were at his disposal from the University of Photograph which were at his disposal from the University of Photograph which were at his disposal from the University of Photograph which were at h



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THIS PAGE: Lemon sharks in the Bahamas; Portrait of Gruber with shark (center); Bimini Shark Lab founded by Gruber (right)

for 22 years, sometimes twice a year; now he teaches five university courses at the station. He had graduate students, built big holding pens at his research facility, and kept dozens of lemon sharks.

Miami. Later, when he had the Bimini field station set up, they could do permanent work there without the need to go back and forth to Florida, which allowed them to expand their research.

The research

The main thrust of Gruber's research was trophic ecology and autecology, the ecology of one species, the lemon shark. Bimini's lagoon was like a marine lake, where the juvenile lemon sharks were obliged to remain, and each shark could be looked at year after year for six or seven years before it left the area. The location was ideal. There were two to three hundred sharks divided between three to four nursery areas, and he tagged nearly all of them, and focused hard on learning all about their lives as he tried to unravel the ecology of the lemon shark. How many sharks were there? How many lived? How many died? How many arew up to maturity? How fast did they grow? What would it take to grow a lemon shark up from a pup to an adult of 80ka?

Each spring, when the lemon shark pups were born, photos Gruber and the students did a comprehensive tagging study. They built a large pen, which could hold up to 150 sharks. Then they caught the sharks in nets, tagged them with an electronic micro-tag, took a genetic sample, weighed them, measured them, sexed them, and put them

in the giant pen. Every year they would catch, tag, and work up between 180 and 230 sharks. The sharks were released, and then the next year the same sharks that survived, could be caught and measured again. The year 2014 was their 20th vear.

After more than a decade of research, they balanced the bio-energetic equation for a young, fast-growing, 2kg lemon shark at 25°C, and discovered that the little shark was an energy conserver, and ate only about seven times its body weight in a year. By comparison, many fish, such as tuna, blow a lot of energy and have to eat a lot of food. And humans, in comparison with lemon sharks, eat an enormous amount.

With the sharks living free in a place where they could be watched from year to year, many experiments were possible. For example, they were able to study their movements, their relationship to temperatures, their food, their place in the ecological system, and their social networks. The nursery was a region of manaroves, and certain little snails called Batillaria were low on the food chain and were the keystone species. The next level was crabs, then fish, then sharks—sharks were on the fifth level.

The countless studies took years and years, doctoral dissertations, and masters theses, and thousands of students all coming to Bimini to study sharks. Gruber taught a University of Miami course there

and useful citizen and have a family. It was all because of the lemon shark. That's why I get so nervous when I think that they are having problems underwater, not only with being overfished, but also with us handling them. So I have not been able to remain objective in

my feelings for them, although I have tried to remain objective

in my research of them."

Stay tuned for Part II of Dr Gruber's remarkable story in the next issue of X-RAY MAG.

lla France Porcher, author of The Shark Sessions, is an ethologist who focused on the study of reef sharks after she moved to Tahiti in 1995. Her observations, which are the first of their kind, have vielded valuable details about their lives, including their reproductive cycle, social biology, population structure, daily behaviour patterns, roaming tendencies and coanitive abilities. Her next book, On the Ethology of Reef Sharks, will soon be released.

And as time passed and he learned of its abilities and capacities, the lemon shark became an animal of complete fascination. To Gruber, the lemon shark had gone from a predatory fish with fins and teeth to being more like a family member. Gruber said:

"As I went through my early career and I got married and we had children, then we got a house and we got cars, I realized that the lemon shark had provided a living for me in the human world, whereby I could become a functional





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New light cast on hidden life of salmon sharks

As the saying goes, you are what you eat. Researchers at Stanford University's Hopkins Marine Station are using this adage to better understand the life history of the salmon shark. An important apex predator and cousin of the great white, this far-ranging species roams the entire North Pacific Ocean, from Alaska to the warm

sub-tropics of Hawaii and the Baia

"Until relatively recently, it's been pretty poorly studied," said Aaron Carlisle, a researcher with Stanford University's Hopkins Marine Station in Monterey. "Salmon sharks just for some reason kind of fell through the cracks."

> the menu Despite their relative obscurity, the sharks are fished in Alaska when they arrive in autumn to feed on congregating salmon. Wanting to know more about the sharks' travels, Carlisle and his team turned to an experimental process in which isotopes are taken of the sharks' vertebrae. Possessing skeletons composed entirely

of cartilage,

annual growth bands are laid

Salmon on

down like the rings of a tree.

By comparing their chemical "fingerprints" to that of known prey items found in different regions of the North Pacific, researchers determined where these sharks were feeding, all the way back to the very beginning of their lives. Research revealed some sharks that visited Alaska turned up near the research center on Monterey Bay, along with Hawaii and Baja California.

Trackina

The team is using the isotope track in conjunction with traditional electronic tagging to get a more elaborate picture of the sharks' travels. "What's really becoming cutting edge," said Hopkins research coordinator Steve Litvin, "is using these advanced techniques together to aive us much deeper knowledge than we ever could with only one." Stanford researchers may also attempt to utilize isotope tracing with other marine life, including white sharks.

Information collected about the sharks could be used by fishery managers to set regulations for shark protection, such as continuing bans on gill nets in areas that salmon sharks frequent. "If you actually want to conserve and manage the population," Carlisle said, "what you really need to understand is the survival."





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NEWS



common type of rebreather used by sports divers because of their versatility. Semi-closed rebreathers are used less frequently. The most common semi-closed system is the Halcyon RB80 used primarily by Doing It Right (DIR) divers including Global Underwater Explorers (GUE). The main reason for using this

son for using this type of rebreather is safety. Semi-closed rebreathers use a single gas mix/diluent that selected for the specific depth of the dive.

Consequently
there is no risk of
unwanted oxygen
injection and a diver

can be certain about his or her PPO₂ even with no PPO₂ display. Manual closed circuit rebreather (mCCR) like the KISS Explorer are also less common. These systems preclude problems with electronic controls as oxygen is added manually. However, they do rely on oxygen sensors.

2. Gather experience and advice before purchasing a rebreather Before choosing a model of rebreather, it's wise to consult various experienced divers, who may be of different or even opposite opinions. And it is recommended to try different types of rebreathers, for example, on one or more

It is recommended to

try different types of

rebreathers, for example,

on one or more try

dives, before making a

purchase.

try dives, before making a purchase.

3. Decide on a configuration. There are plenty of options available. You can choose between a traditional chest-

mounted counterlung, like on an AP Diving Inspiration or Inner Space Megalodon with classical configuration, or a back-mounted or over-shoulder design? Will you wear your bailout bottle or stages on the same side? Use a Hogarthian configuration with a long hose? Determine the size of

Fundamentals of

Rebreather Diving -A 10-Point Guide

Text by Pascal Bernabe Translation by Margarita Solotskaya. Edited by Michael Menduno

Some of these items may seem obvious, but they are based on lessons from accident analysis. 1. Choose a type rebreather that's suitable for your diving. There are several categories of rebreathers for you to consider; a semiclosed rebreather (SCR) which typically uses a single diving gas which is passively fed into the breathing loop, a manual closed circuit rebreather (mCCR) which utilizes pure oxygen and a diluent gas but depends on the diver to

manually add oxygen to the loop, and an electronic closed circuit rebreather (eCCR), which adds oxygen to the loop via an electric solenoid valve in order to maintain a fixed PPO2 throughout the dive. The amount of oxygen that is added is based on the readings of one or more oxygen sensors.

Today, electronic closed circuit rebreathers (eCCR) are the most



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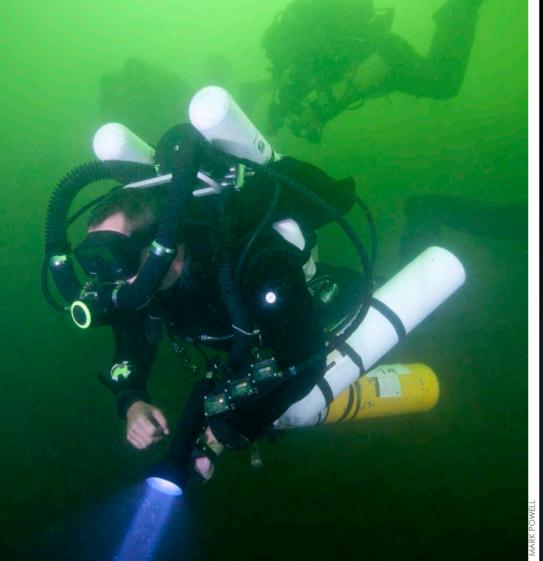
tech talk

Will you wear your bailout bottle or stages on the same side?

your gas tanks? Where you will mount your diluent and oxygen tanks? There are many other essential details and you will have to determine what is most comfortable for you.

4. Use correct weighting. The most frequent error for new rebreather divers is to overweight yourself. Although it can make some sense during first dives with a rebreather, especially if you have trouble managing the buoyancy of your dry suit, wing and breathing loop SIMULTANEOUSLY, the goal should be to determine the ideal amount of lead to be able to achieve neutral/slightly negative buoyancy and so be able to hover, for example, at 3 meter stop with an inflated counterlung.

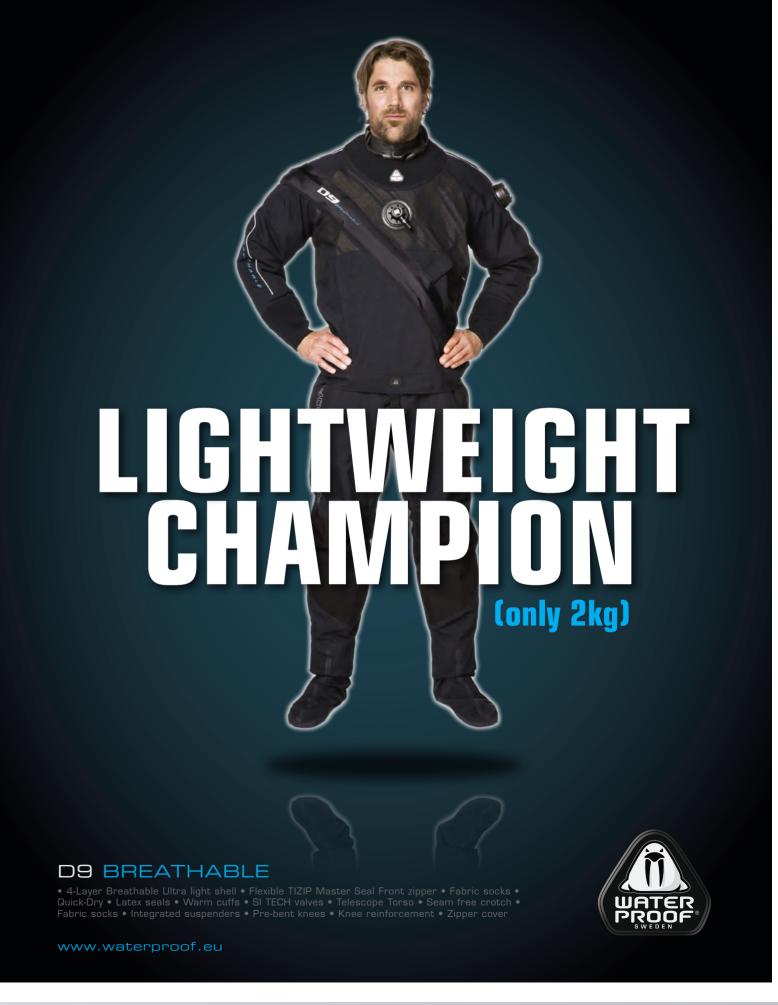




5. Control your buoyancy. The inability to adjust your buoyancy with the help of your lungs as in open circuit diving, coupled with the difficulties with managing up to three sources of buoyancy (dry suit, wing, counterlung) at the same time complicate the task of buoyancy control. You can master this skill only by practicing a lot, making shallow runs as well as saw-toothed pro-

6. Perfect your trim. It is more difficult to achieve good trim with a rebreather than with open circuit system, particularly with







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an eCCR due to the automatic oxygen injection especially during shallower dives. The present trend to limit the set point between 0.7 and 1.0 PPO₂ during shallow dives and or during your descent, and to adjust it up to 1.2/1.3 manually at depth or when required, to reduce the amount of oxygen injected by the solenoid.



7. Plan carefully. When planning for rebreather dives you should calculate your gas requirements not only for the rebreather, but also for the bailout gas that you will need to carry with you. Your bailout gas should be sufficient to allow you to exit the water from the most remote point of your dive in case if the rebreather fails at at very moment. You should also take into account your CO₂ absorbent duration that can also influence your dive plans.

8. Understand the vital importance of redundancy. Rebreather diving requires a suitable bailout system in case your rebreather fails. Explorers have attempted to carry two rebreathers for this purpose, but despite some advantages of this configuration, it possesses some serious deficiencies. Instead, the trend today is to use an open circuit bail out system with sufficient aas to abort the dive and exit the water safely. The bailout can be built in the rebreather system by means of a bailout valve (BOV), which is very convenient in case of emergency. All you have to do to switch to bailout is to change the position of the valve on your mouthpiece.

9. Train and gain proficiency in dealing with PPO₂. Managing one's PPO₂ is one of the main skills that should be

mastered to perfection as it directly affects the safety of your dive. There should be no questions what to do in case if the PPO2 goes too high or too low. There are some other situations that may require your immediate attention during a rebreather dive, but managing PPO2 should be simply automatic.

10. Know your respiratory limits.

Breathing into the rebreather loop usually requires more effort that breathing on open-circuit scuba. This effort is called "work of breathing" and is determined by the number and the nature of restrictions on the loop. The work of breathing is a standardized parameter that can be found on rebreather's technical data sheet and it should conform to one of the international standards.

Rebreathers may seem difficult to operate (just like your first dives in open-circuit scuba might have seemed difficult for you), but with some practice you will easily get used to it. Don't hesitate to try it and you will find that it will open up new worlds in your diving.

Pascal Bernabé of France holds the world record depth on a deep dive using self-contained breathing apparatus. He dived to 330m on trimix on 5 June 2005 off Propriano, Corsica.



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Text and photos by Lawson Wood

Perhaps one of the most difficult, but also most rewarding aspects of all underwater photography is to be able to photograph an animal, or fish, in this instance, in its preferred habitat, without inducing any undue stress or obvious invasion of the creature's life space.

As always in underwater photography, you are moving, the element is moving, the (digital) film speed is usually slow—such as only 50, 100 or 200 iso equivalent—you are generally using flash at a slow shutter speed to get some colour into the frame, and you are trying to capture a creature that swims away from you if you get too close. "Fine," you say, just photograph fish that do not swim away or try to get the picture without getting too close.

Firstly, it is much better to stay well clear of the subject and its habitat, approach the subject slowly and sympathetically, and at least this way you are able to keep off the seabed or wall without causing any unnecessary damage. Use at the least a 60mm macro or 105mm macro lens or similar equivalent in an underwater waterproof housing on your SLR or Micro four-thirds camera. Most compact cameras also have superb zoom qualities, and you are easily able to

photograph a 'macro' subject using the camera's zoom and in-built flash capabilities. Fast tracking auto-focus is a distinct advantage as many small fish move in slight and subtle jerking movements, often as a territorial defence.

Undoubtedly the new style of cameras, which are available for underwater use in

their specifically made underwater housings, are a marked improvement on the old Nikonos amphibious system. Quite a number of manufacturers actually manufacture amphibious digital cameras, including Nikon, which now have a new amphibious camera called the Nikon1 AW1, which is waterproof down to 15m,

with a little more finessing; this may well replace the standard compact camera in its underwater housing.

About the fish

So what type of fish are we looking for from the smallest blenny or goby to one of the largest fish in our seas, the Basking shark? We do have to have some appreciation of the habitat where you are looking for your subject—an idea about how fish behave is not essential, but there are a few easy pointers.

Some fish aggregations are seasonal such as sand eels, mackerel, basking sharks and blue sharks, others are seden-





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Black goby (right) Detail of the eye of an angler, or monk fish (below); Egg case from a lesser spotted dogfish (lower right)

tary. The habitats for fish finding are quarries; rivers and lakes; in open water; rocky reefs and cliffs; under piers; kelp forest and the seabed—sandy or muddy. [Some say that 'muck diving' was first invented in the Scottish sea lochs!1

Fish that swim away from you have little natural defence, other than hiding in a hole or burying themselves under the sand.

and by opening the large cavernous mouth suddenly; the prey is sucked within the jaws and snagged in the multitude of razor sharp teeth.

Flounders on a sandy bottom have superb chameleon like proper-



The kind of fish that do not swim away fall into two categories, those with additional protection such as sharp spines or superb camouflage such as the smaller scorpeonfish, weaverfish or the anglerfish in these temperate waters. These fish sit still and wait for their food to swim in front of them

ties and will sit perfectly still allowing you to get very close to them, it is only when they discover that their camouflage has not worked (when you take their photograph) that they swim away and are quite adept at skimming over low rocky reefs. Not all flounders are bottom dwellers, of course,

and the incredibly colourful topknot is quite at home on steep rocky reefs. Around British shores we can find Dover sole, topknot, plaice, witch, lemon sole and the dab—all of which make great photographic subjects, but all have to be approached with skill and empathy. The topknot is so sure of its camouflage, that it will sit quite still, even when photographed.



Types of shots

Fishy photographs come in several different

There are the open water shots with nothing in the background, often looking like the fish is frozen in time and although this can be regarded as a scientific or stock shot, it can be a superb photograph, yet tells nothing of the creature's life cycle. Basking sharks, the biggest fish

> in in our waters, are almost always found in open water, yet they are usually found in poor visibility as it is the plankton fuelled waters that are its life blood.

Behavioural photoaraphs of fish feeding, being cleaned, acting oddly, fish with personalities and acting in a comical way all add a little sparkle to the finished photograph. Fish with camouflage such as scorpionfish



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Male cuckoo wrasse

Tompot blenny (left); Turbot (right); Saithe or pollock (below)

chumming of one description or another going on, but they can be unpredictable and care should always be exercised.

More sedentary species such as dogfish are easier to approach, and their egg cases make for an additional element when telling the story of the fish in question.

With all fast moving subjects the challenge is to freeze the action, therefore careful timing and panning with the subject





should help to reduce the risk of 'ghost imaging'.

Some fish appear to have personalities, and in many respects, a photograph works best when it looks like the photographer and the fish have made eye contact. It also looks better if the fish's mouth is open—mimicking conversation—or if it happens that the fish is obviously looking away, then a highpoint of interest should form part of the overall composition.

The tompot blenny famously

photographed under Swanage Pier is not only colourful and comical looking, it is easily approached and appears quite happy in its old metal pipe home.

Understanding behavior

Anticipating the fish's movements will also help to yield results, and with quiet controlled breathing, you can move up to a subject obliquely, without any obvious form of pursuit. You may also require the help of a buddy

assistant to 'herd' the subject fish towards the camera lens for those elusive head-on shots. By swimming parallel to the fish, the fish thinks that you are just swimming alongside it or even swimming past. You can then angle your camera towards it and take a couple of photographs before it realises that it has been duped.

Try to avoid taking photographs of fish if they are swimming away from you, unless of course there is rarity of the subject matter. The

more you pursue a fish for that elusive photograph, the more the fish will feel hunted and the faster it will swim away.

Unfortunately several things can happen with this scenario. The photographer can end up going too deep without realising it, or perhaps too far into a cave and become disoriented, and the fish (most of which are normally territorial) can end up in another fish's territory increasing the danger to itself and perhaps losing its nesting site or mate.

may also be camera-shy, others such as weaverfish hide under the sand with only an eye visible and part of the hinged upwards pointing mouth, difficult to spot, but they can be approached very slowly.

Sandeels will disappear under the sand to escape from danger, but they also assume that other great tactic of defence by grouping together in massive shoals.

Blue sharks are also pelagic and divers enjoy the offshore encounters in Cornwall during the summer months. They are easily photographed in situations where there is

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Thornback ray (left); Common skate (far left)

Fish such

Cold Waters

as wolf fish and Yarrell's blennies are quite timid and hide in holes or under rocks during the day, yet come out to feed at night. However, never try and interfere with active night hunters and foragers as again this can interfere with their behavioural patterns.

With most territorial fish, they will move out of their safe area when you approach, but will return when they realise that they are not being threatened and with careful watch of the repetition of their movements and any idiosyncrasies of their habits, you can position yourself to catch the subject as it returns. You will notice that some fish stay within a very small area, whilst others appear to follow a predetermined route, which will eventually bring them back to a start-

gauge
which direction the
shark was
moving
and try and
head it off
at the pass
(but remember that the

open mouth

I could

trations of

by waiting

quietly and

conserving my strength,

plankton, so

and nose are about five metres in front of the pointed dorsal fin).

Gradually the shark's awareness includes you in its forward vision, and by waiting (whilst swimming), the shark will come closer and will avoid you, just like it avoids the lion's mane jellyfish and give you (hopefully) the chance of the head shot with its mouth open, feeding on plankton.

Night photography

One of the best times of day to photograph fish is at night when they are rest-

ing or asleep, allowing you to photograph some fish much easier than during daylight hours. Whilst there is the temptation to fire off lots of (digital memory) film on a particularly photogenic subject, it is imperative that their sleeping pattern is not disturbed.

Wrasse, for instance are always easily approached, but when you shine a light into their eyes, they can become spooked inducing fear and flight in the fish, causing it to blunder about the rocky, kelp fringed shoreline, damaging itself.

Try and line up your shot on a piece of soft coral nearby and then move quickly into position, take a couple of photographs as a maximum on each subject and then turn your lights away.



Basking shark



Basking sharks

It took a while to understand some of

the behaviour whilst photographing the

basking sharks off the Isle of Coll on the

ures to hopefully allow the sharks to get

and the more it will turn away from you,

necessitating you to swim faster and turn

tighter circles with the shark until you are

showed that the sharks would turn circles

anyway, when there were large concen-

absolutely pooped! Closer observation

Scottish west coast and to try meas-

used to me. The more you swim after

the shark, the more it is aware of you

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Two spot goby (left); Ruby sucker and kelp on sea urchin (above)1; Butterfish (right); Fivebearded rockling (lower right)

ing point, other fish retreat into a hole or cave and again will come out; by waiting patiently you can focus on the area that the fish will move into and often have to compose your shot in the fraction of a

> second before the fish realises that it has been duped—again!

Cuckoo wrasse in their mating colours are incredibly colourful, and as they are territorial, their movements can be fairly predictable and more easily photographed.

Baiting

Some photographers prefer baiting the subject with small scraps of food. This is all very well, if those photographers were the only ones to visit the location (i.e. like in an aquarium). Sadly, when the next group approach this same reef, the fish automatically assume that the divers have food for them and soon start to act very aggressively when no food can

be found. It is also totally wrong to kill another underwater creature to 'set-up' a composition, such as breaking open a sea urchin to attract wrasse in to feed in front of the camera lens.

Buoyancy

No special training is required to photograph fish, but underwater photographers should be even more aware of their buoyancy

control to avoid damaging other delicate marine organisms. If you must steady yourself and touch the rocky reef, always choose an area of dead rock and only use one finger to steady yourself. Above all else, you must study the subjects and the photographs that you show must indicate that the fish has not been stressed in any way, that it is comfortable with the photographer, and with good timing,



you should be able to give a new dimension to your photography. Our underwater photographs must show that we are indeed guardians of the seas.

Cold Waters

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



Angel shark

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Don Silcock

PRODUCT SHOTS COURTESY OF THE MANUFACTURERS



Subal GH4 Housing

Subal has announced the release of their new housing for the Panasonic LUMIX GH4 camera. Machined from a single block of aluminum and manufactured to Subal's exacting standards, the housing is with the company's existing ports and accessories.



Nauticam NA-7DMKII Housing

Nauticam has released their housing for the Canon EOS 7D Mark II camera. The new NA-7DMKII housing features a dual function lever for ISO and the M Fn focus area adjustment control, plus and a button to allow the vacuum system to be reset from the front. Nauticam's multi selector pad is provided as standard and, for the first time on a Canon housing from Nauticam there is a lever to activate or deactivate the camera's flash. The NA-7DMkII is available now at a retail price of US\$3,400.

Ikelite Housing for the Canon EOS 7D Mk II

Ikelite has released their new housing for the Canon EOS 7D Mark II. As usual with Ikelite they have released their housing very quickly after the camera's release. Manufactured from the company's trademark clear polycarbonate material, the new housing features their signature circuitry to enable TTL strobe triggering with compatible strobes. The housing is available now at a retail price of US\$1,800.



Sony A7II Camera

Sony has announced the release of its new and highly anticipated A7II camera—the successor to the earlier A7 and the first full-frame mirrorless camera. Although only available in Japan initially, the new camera features the same 24MP "Exmor" CMOS sensor as the A7, but introduces 5 axis image stabilization which enables 4-5 stops of shake correction. The image stabilization is

rumored to be the same as used in Olympus' highly regarded OM-D cameras. The A7II also claims improved auto focus, which

Sony claims is 30 percent faster than on the A7, plus there are also significant improvements claimed on subject acquisition and motion tracking. Unfortunately for owners of existing A7 housings, the body on the A7II has been changed with the

shutter release button moved and there is a deeper grip, which means it is unlikely the new A7II will fit in to earlier housings. The Japanese price of the A7II is 190,000 yen, which puts it around 1,300 Euro or US\$1,600 at current exchange rates.



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Aquatica A7D Mk II Housing

Aquatica has announced that it will release its new housing for the Canon EOS 7D Mk II in early 2015. The A7D Mk II housing will feature improved ergonomics, large control knobs and will be fully compatible with Aquatica's port system and be available with optical, Nikonos or Ikelite strobe connections. The A7D Mk II will retail at US\$2,799.

Three New 4K Camcorders from JVC

JVC has announced they will release three new affordable and handheld 4K capable camcorders in the first quarter of 2015. All three cameras will feature dual SDHC/SDXC card slots, 3.5-inch LCD displays and 1.56 megapixel color viewfinders. The LCD displays and viewfinders will both have smart focus assist functions, and offer two-channel audio recording. The GY-LS300 has a super 35mm sensor with a MFT lens mount and will retail at US\$4,450 and be available in March. The GY-HMI70 will feature





Ikelite D750 Housing

Ikelite responded quickly to the release of the highly regarded full-frame Nikon D750 DSLR and released then first new housing for the camera. Manufactured from the company's trademark clear polycarbonate material, the new housing features their signature circuitry to enable TTL strobe triggering with compatible strobes. The housing also features a rear control that allows adjustment of the overall flash output. The new D750 housing is available now with a retail price of US\$1,800.

Nju System Housing

Andrej Belic, the inventor and owner of Austrian company nju system has announced two new and quite revolutionary housings called the slr and the pro. Both housings are completely controlled electronically using proprietary software developed by nju systems and are designed to be completely camera



system independent—so you can use them with Canon, Nikon, Sony or Panasonic cameras. The housings are also designed to support all strobe manufacturers and, rather than utilizing the camera's viewfinder, use a monitor back to display the camera's Liveview information. The nju slr system costs €4,500 and the larger pro version is €5,000.

Nauticam D750 Housing

Nauticam was also quick to release their housing for the Nikon D750. The new NA-D750 housing boasts all the standard Nauticam features such as their excellent port lock, plus lever access to AF-ON, ISO, image review and video recording. It also has access to the D750's Function and Preview buttons, plus a small lever to access the Info button. The NA-D750 is available now at a retail price of US\$3,500.



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Meredith Woolnough





BOOKS

portfolio PREVIOUS PAGE: A collection of small embroidered pieces inspired by the shapes Giant Coral Fan, by and patterns found in the Meredith Woolnough. natural world, by Meredith Embroidery thread Woolnough, Embroidery and pins on paper, thread and pins on paper 100x120cm

Woolnough



Star Coral Bowl, by Meredith Woolnough Embroidery thread 20cm diameter

Text edited by Gunild Symes All artwork and photos by Meredith Woolnough

Meridith Woolnough is an Australian artist from the coastal region of Newcastle in New South Wales. An avid diver, she creates intricate embroidered traceries of underwater forms highlighting their natural beauty as well as their fragile nature. X-RAY MAG interviewed the artist to find out more about her unusual technique and keen interest in forms found on reefs.

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

MW: I have always loved making things. As a child I was always painting, drawing and creating. So it seemed very natural for me to study fine arts at university once I finished up high school.

I didn't expected to come out of uni and become an artist. That didn't seem like a 'real iob' or a 'proper career', so I did what many art students seem to fall back on and I became a teacher.

I worked as a high school visual art, textiles and design teacher for several years before I started to exhibit my own embroidered artwork as a bit of a side project. The response to my work in these early exhibitions was so overwhelmingly positive that in 2012 I decided to throw in the teaching towel and pursue this seemingly unrealistic dream of making it as an artist.

It's been a rocky road at times but things have kept growing, and I feel like I am finally starting to make it all come together. I have had some really successful exhibitions, won a few awards and people seem to want to collect my work, so I must be doing something right.

Sometimes I can't really believe that I am doing this as a job. I feel like someone will come along any day now and tell me, "Okay, you have had your fun, but now you need to get back to a real job." I hope that day never comes.

X-RAY MAG: Why coral and ocean specimens? How did you come to this theme?

MW: I have always found the ocean to be an incredibly inspiring place. It is so alien and bizarrely beautiful down there. Everywhere you look there is something to see and discover.

NEWS



I vividly remember the first time I snorkeled on a coral reef as a child and the beautiful colours and structures of the coral blew me away. Everyone else was looking at the fish and yes, the fish are amazing and beautiful—but I was fascinated by the corals themselves. I just fell in love with those delicate structures.

This love for coral obviously stayed with me, and I started to work with coral specimens in my embroidered work around 2009 when I created a series of small embroidered pieces inspired by various coral shapes and structures. The series was vividly coloured with the exception of one little piece in the corner that was perfectly white and almost lost in the white paper and frame—a subtle comment on the issues of coral bleaching.

X-RAY MAG: How did you develop your artwork with embroidery and textiles over time?

MW: The particular embroidery technique that I use was something that I developed when I was in my final honours year at university. For that year I chose to work with a process of drawing with a domestic sewing machine onto a water-soluble base fabric so that I could create embroidered pieces that were liberated from the base fabric. By taking embroidery 'off the fabric' I could create very sculptural pieces and the possibilities were endless. I am still working with that same technique, and I keep finding new ways to work with it and push its limits.

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

create your artworks?

MW: My work starts with a clear idea for a design—usually a pattern or a structure that I have seen in nature such as a coral branch or a shell something that sparks my interest. I will then sketch on paper until I am happy with the balance of the overall design, and I'm sure that the structure will translate to embroidery well.

Once the design is finalized, I will transfer the design onto a sheet of water-soluble fabric and embroider the piece. My process is basically drawing with a sewing machine and building up the design so that it is all connected and very dense.

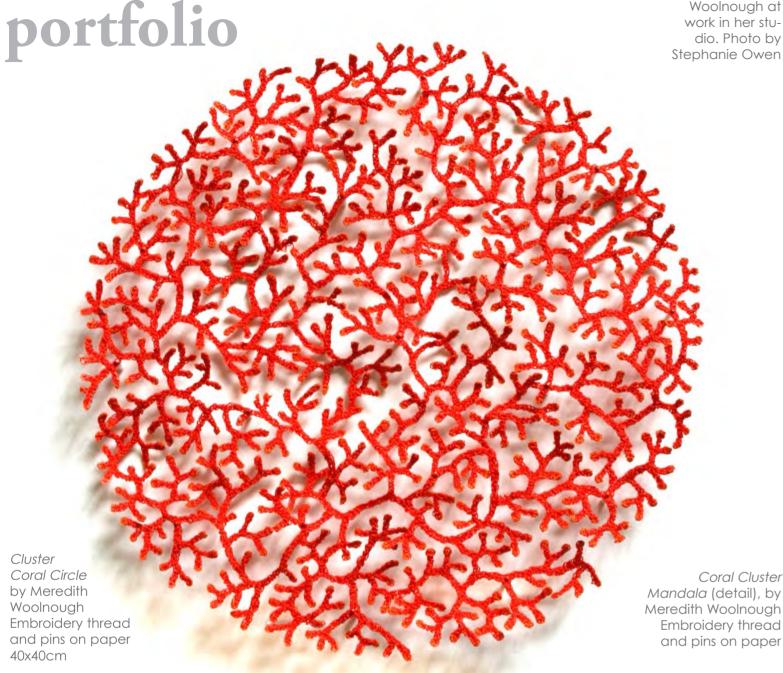
Then when I dissolve the base fabric away, I am just left with my stitched structure. I have developed a way of displaying the works so that they



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TRAVEL

Meredith Woolnough at work in her studio. Photo by Stephanie Owen



appear to float off the backing board, so that they cast dramatic shadows in the right lighting.

X-RAY MAG: What is your relationship to the underwater world and coral reefs? Are you a scuba diver or snorkeler and how has this influenced your art? In your relationship with reefs and the sea, where have you had your favorite experiences?

MW: I have grown up in and around the ocean and always have had a deep love and

respect for it. Hearnt to scuba dive on a holiday to the Great Barrier Reef in Queensland, Australia, when I was 19, and I fell I love with the sport.

Diving gave me the freedom to stay and observe the reef in a totally new way; I could go down and see coral from every angle and to get up close like never before. It was very liberating.

Since then whenever I plan a holiday, I try to go somewhere that will give me a new diving opportunity. Last December I was lucky enough to visit Palau, which

is a magical place, both above and below the waves. The diving there is some of the best in the world, and the quantity and variety of ocean life I saw was phenomenal.

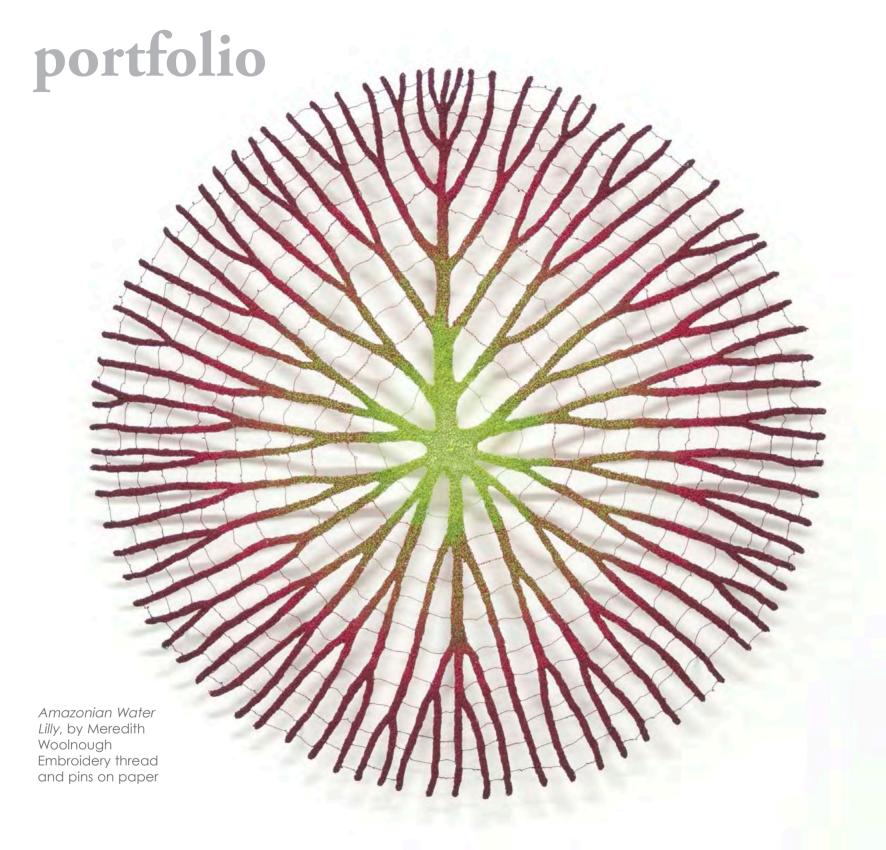
For a coral fanatic like me it was just amazing to snorkel around the rock islands in Palau. Because of the slow moving currents around the islands, the coral grows into amazing unconstrained shapes and forms.

X-RAY MAG: What are your thoughts on ocean conservation





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and coral reef management, and how does your artwork relate to these issues?

MW: Like so many other divers, I am deeply concerned about the threats that our oceans and reefs face, and my work always has a subtle environmental undercurrent through it. My coral work in

particular reflects upon the use of coral as an adornment for our homes and our bodies. The tradition of collecting fragments of the natural world for display in our homes is common, but we rarely stop to reflect on the ethics and the environmental impacts of the practice. I hope that people will see my work as the piece of coral that you can feel good about putting in your home.

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

MW: I hope that when people see my

BOOKS

work they are fascinated by it and want to learn more about not only the artwork itself but also about the life forms that I am depicting. I want people to look closer, to question, and in doing so, discover. My work seems to resonate with people who already have a love for the ocean, but I hope that my work may inspire

people to go and see the reefs for themselves and appreciate the amazing environment that is just beyond our shores.

X-RAY MAG: What are the challenges and/or benefits of being an artist in the world today?

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Woolnough

MW: Trying to make this crazy dream of being an artist a reality has been the most challenging but satisfying thing I have ever done. It's a crazy job, the hours are long, the work is often frustrating, there is very little financial security, and you never know what's going to happen next. I have had to quickly learn how to run a small business and all the marketing and administration elements that go with it—most of which they don't teach you at art school. But despite the difficulties and insecurities, I love that I have found a way to turn my creative ideas and visions into a product that people enjoy—it's a areat adventure.

X-RAY MAG: How do people/children respond to your works? What feedback or insights have you gained from the process of showing your work to various audiences?

MW: People are generally fascinated with my work and can't figure out what it is—which I guess makes sense; it doesn't look at all like traditional embroidery. With some of my coral branches, people often think they are real pieces of coral until they get up close, and then they are often even more confused. I love that my work can instill such a sense of wonder in people.

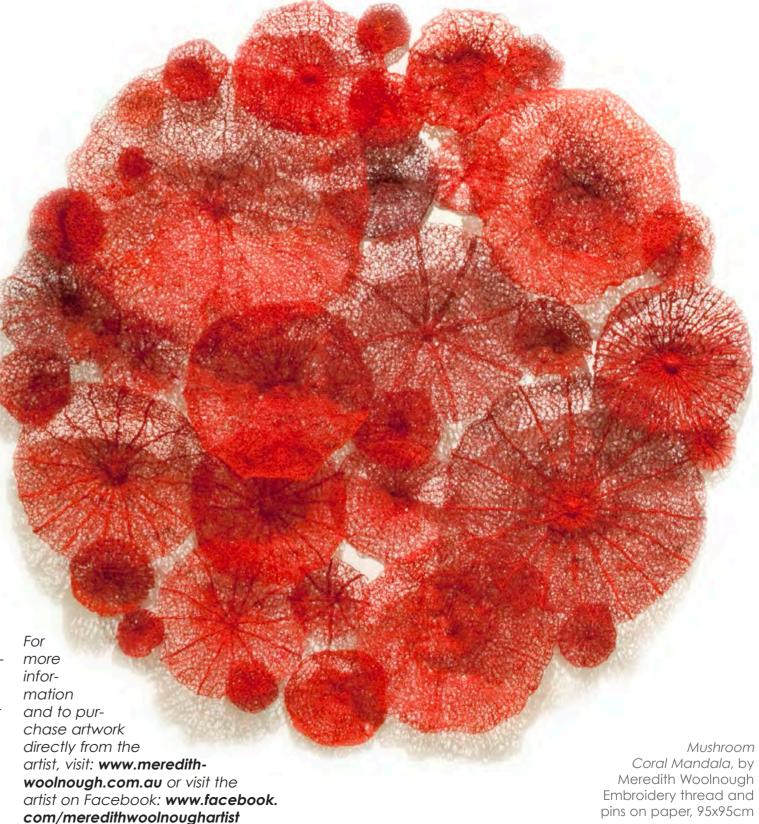
X-RAY MAG: As a teacher what is your approach or philosophy in sharing your knowledge and experience about art, corals and ocean specimens?

MW: Although I am not in the school classroom anymore, I still love teaching and have really enjoyed being able to teach my processes to others through workshops and master classes. Some artists are very protective of their pro-

cesses and techniques, but I enjoy sharing what I have learnt, and it's great to see how people take it into new directions. Funnily enough, when I teach the embroidery process, there seems to be lots of coral inspired embroideries being created in the workshops—I'm not sure if that comes from my influence or if coral patterns just lend well to this particular embroidery technique.

X-RAY MAG: What are your upcoming projects, art courses or events?

MW: I am at a bit of a turning point in my work right now. I am starting to work towards more instillation-based pieces that will be mounted directly onto walls, rather than framed. I'm looking forward to the challenges and opportunities that this type of work will create.



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