X-ray mag

GLOBAL EDITION
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COVER PHOTO BY DEB FUGITT

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COVER PHOTO
Two different species of fusiliers at Mios Kon
Raja Ampat, Indonesia. Photo by Deb Fugitt

contents

Schools of anchovies and silversides. Raja Ampat, Indonesia


DEB FUGITT

plus...

columns...

I love tuna

Tunaholics embrace

Ah, summer! I don't know about the rest of you, but after a long dark and damp winter at our 55°41'north latitude, summer is like a feast. Exams are over, projects concluded and contracts signed. We all want to head out into the countryside, the sooner the better, to be with our families and enjoy the long days and romantic white nights. It is also the time for "summer foods", lighter courses based on the fresh produce from the kitchen gardens—a much welcomed change of menu from all the old stale imported stuff we get in the winter.

One of my favourite meals is Salade Nicoise. For the uninitiated, it is a tuna salad with green lettuce, hard boiled eggs, olives, feta cheese and a lot of other good stuff—very tasty and very healthy like other tuna dishes are. It is also an almost perfect food. It is inexpensive, easy to prepare and the source of many important nutrients.

Tuna is high in protein and low in fat, meaning that you can snack on a can of tuna throughout the day without having to worry about adding excess pounds. It is low in sodium but contains the essential omega-3 oils plus lots of iron and taurine, which promotes decomposition of cholesterol in the liver. It is also a good source of Vitamin B12, phosphorus, niacin, selenium and what not.

Tuna is one of the tastiest, most nutritious meals you can find, and it could probably save society a helluva lot of problems with cardio-vascular disease if we all ate more tuna instead of beef. Great stuff, so is there a problem here, Officer? Eat more of it, right?

Wrong. Yes, there is a problem. Tuna is being hunted and fished to extinction. And one of the root causes is our little innocent daily routine of picking up yet another can of tuna off the shelf in the supermarket.

We are emptying the oceans and the populations of big species are collapsing at an alarming rate. Ninety percent of the big fish are now gone. At this very moment, fleets of fishing vessels are still out there combing the ocean with huge trawlers for the remains of a steadily dwindling resource just to satisfy my taste for this fine fish.

So the sad conclusion, it seems, is

Adrian's gourmet kitchen
www.adriansgourmetkitchen.com

editorial

Chargrilled Tuna with Chilli Oil: The tuna is marinated in lemon juice, fresh thyme and olive oil, then given a fierce brief searing in a cast iron ridged griddle pan. This lends some great flavour to the outside, leaving the inside just cooked —exactly as tuna should be. It's then served on a bed of rocket with oven-dried cherry tomatoes and drizzled with a mild chilli oil dressing.

that I will have to be weaned from my culinary addictions. No more sushi on Saturday nights either. Tunaholics Anonymous, here I come.

History seems to repeat itself. When I was a kid, cod was a regular course at the dinner table. Cod was cheap and plentiful in those days. Not any more. Not that I really miss eating cod all that much—every other mouthful was so full of small bones that my palate felt like a pin cushion afterwards, but that is beside the point.

Cod was an important species for everyday consumption and of significant economic importance. Now, it is an expensive luxury and a rare sight on dives. Cod stocks collapsed with dire consequences for both economies and ecosystems in some countries, and the population won't just bounce back because we stopped fishing them. Meanwhile, something else took their place in the ecosystem.

We seem so eager to put war criminals on trial for genocide, but what about specicide? Putting a whole species out of existence is, more or less it seems, just considered a casualty, however regrettable, of the economic competition between nations who can't or won't restrict and effectively police their fisheries. Nobody is held responsible. We even use tuna for pet food.

It was as long ago as 1798 when the economist, Thomas Maltus, wrote his famous *Essay on the Principle of Population* in which he stated that populations grow geometrically while food supplies only increase arithmetically. In other words, we can't keep up feeding a steadily faster growing population.

Until now, improvements in technology have, fortunately, enabled food production to keep up with the growth in global population. Sure, people in the third world are still starving and malnourished, but that is a distribution issue. Overall, there is enough food to go around.

However, as the Millennium Assessment clearly stated, the global ecological system upon which everything else we rely on rests, is starting to buckle and squeak in every corner.

But what about specicide? Putting a whole species out of existence is, more or less it seems, just considered a casualty, however regrettable, of the economic competition between nations who can't or won't restrict and effectively police their fisheries.

So what is the answer here? Forget tuna and revert to eating turnips and potatoes? Skipping a level in the food chain by eating vegetables ourselves rather than feeding them to our livestock would indeed be a far more efficient way of utilising our food calories. But we all know that this not going to happen.

Ecology is about economy too, both in a literal sense and in regard to how the dynamics work. Our ecosystems, and consequently our food production, are in all practical senses ultimately based on photosynthesis wherein solar energy is used to build biomass, which are then passed in a pyramid-like structure with fish at the apex. And there are, obviously, limits to how much this system can produce in a sustainable way.

Modern open seas aquaculture, where tuna and other important species are cultivated, could perhaps hold the answer and alleviate the pressure on natural populations. Aquaculture is, however, fraught with its own difficulties—it is tricky and, financially, a high risk and often quite polluting, but the technology has come a long way recently.

We consumers have been so worried about the dolphin by-catch in tuna fisheries and have demanded "dolphin-free" tuna, but now perhaps it is the time to reconsider our incessant consumption of wild tuna overall before they are all completely gone. Cut back or demand reared ones instead ■

X-ray mag

News edited by Peter Symes

got your sea legs

NEWS

Now, how is that possible?

Date Sunk June 10, 2002	Ship Length 510 feet / 155m
Location 6 Miles off Key Largo, Florida	Ship Type U.S. Navy Landing Ship Dock
Maximum Depth 130 feet / 40m	Commissioned 1956
MinimumDepth (before it was uprighted) 45 feet / 14m	Decommissioned 1989

Achival photo of the *USS Spiegel Grove*, courtesy of Florida Keys Tourist Development Council

Oops-a-daisy

Hurricane Dennis puts tilted Spiegel Grove wreck upright

The former *USS Spiegel Grove*, an artificial reef off Key West and one of Florida's best known wrecks, suddenly flipped upright after the core of hurricane Dennis passed well over 200 miles (320km) to the west.

Mother nature has then set right what the project organizers behind her sinking in 2002 originally wanted, which is having it sitting right on its keel. The *Spiegel Grove* has been resting on its side since it prematurely sank and rolled over leaving its upside-down bow protruding from the water. A salvage team then managed to rotate and fully sink the retired *Landing Ship Dock* three weeks later but it came to rest on its starboard side rather than on its keep.

Nonetheless, the 510 feet (155m) long wreck soon became one of the most popular artificial wrecks in the Florida Keys, and there have been an estimated 75,000 sport dives on it since. According to Lad Akins of the Reef Environmental Education Foundation, it is also home to at least 166 different fish species.

Delight

The diving community was enthusiastic and delighted as the news spread quickly through the Florida Keys' sport dive industry. "I'm flabbergasted," Rob Bleser, volunteer project director, according to various newspaper sources, after a dive on the newly oriented *Spiegel Grove*. "Nature took its course and put it where it belongs. This will mean a whole new dive for those that have dove it before. Its highest point is now 60 feet down.

However, at least one federal official was less enthusiastic about it. "It's bad news from my perspective as a resource manager that it moved," said Billy Causey, the Florida Keys National Marine Sanctuary Superintendent. "We have to figure out why."

Matt Strahan, meteorologist in charge at the National Weather Service Office in Key West, said waves at the wrecksite were as high as 20 feet, when Dennis was southeast of Cuba and that waves of that height in close proximity to the reef can produce unusually strong currents with tremendous force.

As of this goes to press, sanctuary officials have temporarily closed the wreck site to sport divers to analyze its stability and replace lost mooring buoys. Further info on this link: **www.fla-keys.com/spiegel-grove/index.htm** ■

Spiegel Grove arrives off Key Largo. Photo courtesy of Florida Keys Tourist Development Council

When the *Spiegel Grove* was sunk it came to rest on its side rather than sit on the keel as planned. Diver Paul Caputo swims near the forward deck of the *Spiegel Grove* June 26, 2002. Photo by Stephen Frink courtesy of Florida Keys Tourist Development Council.

THE USS ALLEN M. SUMNER OFFICIAL HOMEPAGE. WWW.DD-692.COM

Deep Wreck Dive Record

A nine-man technical diver team has set a new deep wreck scuba diving world record of 193 meters (633 feet).

Lead diver Rob Lalumiere reached the deck of the USS Cooper seven minutes after starting his descent, and placed a memorial plaque on the shipwreck to honour the 191 officers and crew who went down with the ship when it was torpedoed by the Japanese during the Battle of Ormoc Bay on December 3, 1944.

Over five hours later, as Lalumiere was completing his last required decompression stop at a depth of three meters, surviving USS Cooper crew 81-year-old Hank Wagener asked to be taken from the surface support vessel to the top of the descent line which was connected to the ship he served aboard 60 years ago. Hank Wagener was in the water for 16 hours before he was picked up by PBY Catalina flying boats that dodged heavy fire to rescue 168 men.

Lalumiere stated that the true significance of the depth of the dive is not the record but the fact that we are gradually expanding the envelope so that research and wreck divers throughout the world scuba diving community can safely explore sites that have always been considered too deep even for the most proficient technical divers. ■

Three sets of depth records

First, South African Gomes plunged to a record 318 m

South African engineer Nuno Gomes still holds the record for the deepest dive in a freshwater cave. In 1996, Gomes descended to 282 in Boesmansgat, in the Northern Cape, South Africa

Technical diver Nuno Gomes, 52, broke the world scuba deep diving record, on Friday June 13. in the Red Sea, Egypt when he plunged to a depth of 318.25m.

The run time of Gomes' dive was 12 hours and 20 minutes and utilized a team of nine support divers and 21 bags of dive equipment including 320m shot line weighing a hefty 56kg, a decompression tree, and four massive buoys to support all staged cylinder and depth tags.

Gomes descended to the record depth in less than 20 minutes but needed 12 hours to resurface after a series of required decompression stops.

The record dive was the end result of months of mental preparations and physical training for the civil engineer. Last year Gomes had dived to 271m but suffered equipment failure. "That was a close call. As Nuno Gomes said at the time: 'It's no joke running out of air at 280m'.

It certainly took all the experience of the team to get Nuno out of the water safely."

The Red Sea was the ideal venue for the dive because of its tepid water, outstanding visibility and availability of hyperbaric infrastructure and medical support, reported the diving website.

Gomes undertook his last acclimatisation dive on June 6 at a depth of 150m before attempting the main dive. Bad weather conditions — strong winds in particular — deterred the four-star CMAS diver from attempting the dive on Thursday, said Setzkorn.

In order for Friday's dive to qualify as a new world record, Gomes had to remain underwater for 12 hours and only resurfaced at about 18:00 on Friday.

The new record must still be verified. If deemed legitimate, the 318.25m will replace Mary Ellyatt's world record of 313m in Thailand on December 18 2003. This dive was an improvement on the late John Bennett's dive of 301m in 2001.

Dr Gareth J Lowndes of the Wits Underwater Club said Gomes did not require any decompression treatment following the dive and the team were in high spirits.

Previous dives

In July last year, Gomes had planned to make his first 16-minute descent to 320m. Despite being "under" for 11 hours to account for decompression stops, Gomes had to abandon his mission at 271m due to technical problems, reported the diving website.

It is not the first time that the technical diver has been named as the record holder for the world's deepest scuba dive. According to a report in Beeld, Gomes holds the record for the deepest dive above sea level — a depth of 282.6m — in the Bushmansgat sinkhole in the Northern Cape in 1996.

It is still the deepest recorded cave dive, but almost ended in tragedy when Gomes nearly got stuck at the bottom. Gomes is to return home on Wednesday June 15. ■

Then, Frenchman Pascal Bernabe went on to claim 330m

PHOTO: WWW.RALFTECH.COM

Just weeks after Nuno Gomes reached 318m, French technical diver, Pascal Bernabe, was reported to have set yet another deep diving record at this time at 330m. This record was set in Corsica, with a descent time of less than ten minutes and at a cost of 529 minutes decompression. The dive was the 41-year-old's fifth attempt at breaking the open circuit deep diving record, which he spent three years preparing for. Dive manufacturer Ralf Tech sponsored the event, which involved a thirty-strong dive team and 12 support divers. The experienced deep diver completed the dive on trimix, carrying seven cylinders – 20 cylinders were also placed on three decompression lines. **www.ralftech.com** ■

New Dolphin Species

Researchers in Australia have discovered a new dolphin species. The Irrawaddy dolphin is an unusual dolphin that has been recorded in the coastal waters and major rivers of Asia and in northern Australia. Until recently it was believed that only one species occurred in these countries.

However, the Australian Snubfin Dolphin has now been found to be a different species.

The discovery was made after examining the skulls and external measurements of both species, as well as observations at sea of the dolphins in seven countries. DNA studies, too, show that there are clear differences between the two populations that had not been previously recognised.

Australian Snubfin Dolphins live in shallow coastal waters in Australia and are generally shy of boats. They appear to be restricted to Australian, and possibly Papua New Guinea waters.

The new Australian dolphin is named after researcher, George Heinsohn, giving it the scientific name of *Orcaella heinsohni.* ■

Solar activity a factor in whale strandings?

Scientists at the University of Keil think that surges of solar activity may cause whales to run aground, possibly by disrupting their internal compasses.

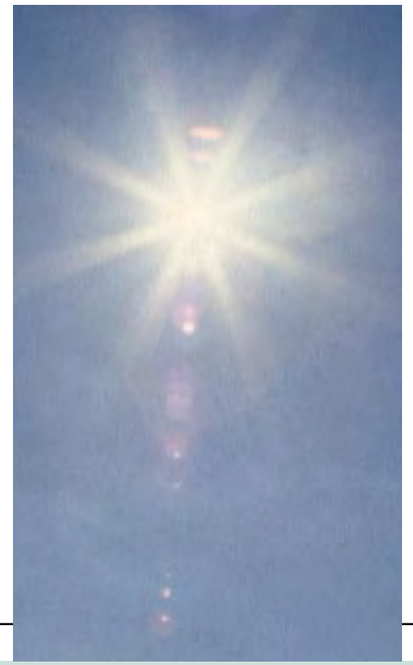
Sightings of sperm whales found beached in the North Sea between 1712 and 2003 were compared with observations of sunspots, an indicator of solar radiation. It was found that more whale strandings occurred when the sun's activity was high.

The cycles of sun activity range from eight to 17 years, with 11 years being the average. Short cycles are linked with periods of high energy output, while long cycles are low energy. These changes in levels of solar radiation have a big effect on Earth's magnetic field. In fact, big solar flares can disrupt telecommunications and power lines, and knock out delicate electronic circuitry on satellites.

It was found that of the 97 stranding events reported around the coastal countries of the North Sea over the 291 years, 90 per cent occurred when the sun cycles were below average in duration i.e. when there was a high solar energy output.

Magnetic sense?

It is thought that whales may have a magnetic sense of orientation like pigeons, which are thought to navigate using small magnetic crystals on their beaks. The male sperm whales, following a migratory path from the Norwegian Sea, could become disorientated by minor changes in the geomagnetic field as they enter the shallow-shelf North Sea. Soft sediments on a contourless seabed may cause a disfunction in their deep-water sonar and other adaptations to their normal habitat.



Previous studies have also suggested that powerful marine sonar could be to blame for whale strandings by disrupting the whales' sense of direction and depth.

In 2003, autopsies carried out on whales that beached in the Canary Islands a few hours after a naval task force passed by, found that the whales had suffered a terminal attack of the "bends". Dissection showed that the livers and other internal organs of the whales were filled with gas bubbles, and that smaller blood vessels had been destroyed.

The injuries were consistent with decompression sickness.

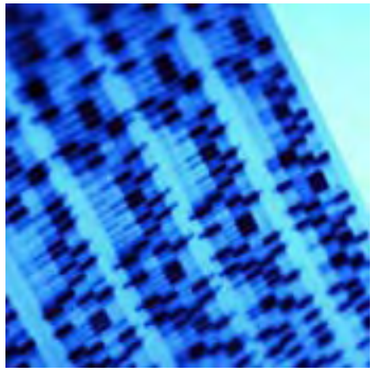
For futher details, see the Journal of Sea Research, published by Elsevier. ■

Brain development of dolphins not dependent on sleep

Is is believed that sleep is critical to the early development of mammals. Most of the mammals so far studied only gradually decrease their sleep requirements as they grow. Sleep is thus an important component of the lives of newborn babies, who in their first month are known to sleep for over 18 hours.

However, it is different with some of the mammals living in the sea. It has been reported in Nature that newborn bottlenose dolphins and killer whales are awake most of the time in their first month. Their mothers manage with practically no sleep at all. This is perhaps because there are no safe places where an animal could curl up and rest and not worry about their predators. Apart from helping to ensure thier survival, not sleeping also keeps them active and responsive, allowing them to breathe oxygen at the surface and help them to grow more rapidly.

These mammals have found a way to cope with sleep deprivation, facilitating rather than hindering a crucial phase of development for their offspring, raising the question of whether humans and other mammals have untapped physiological potential for coping without sleep. ■



New DNA method to estimate the age of whales

Researchers in Australia are developing the first non-invasive and non-lethal method of determining the age of humpback whales. The method, which relies on analysis of collected skin samples, undermines one of Japan's declared reasons for killing the mammals.

The research focuses on using a new molecular technique to determine the age of humpback whales by looking at the DNA present in skin samples. When the whales move around they leave behind pieces of sloughed-off skin from which the whale's genetic code could be used to determine its age.

Previous methods involved analysing the layers of wax inside the whale's ear canal, which could be obtained only when the animals were killed.

Japan says it needs to slaughter whales to understand their life cycles and diets, and to examine skeletons and blubber to determine if they are exposed to pollutants. Japanese whalers are saying they need to kill whales in order to determine their ages, but there is absolutely no scientifically credible reason for killing whales at the moment, and this final excuse for the need to establish the age of the whales will basically be removed as well.

Researchers will spend the next three years working on the $300,000 ageing project. A wide range of skin samples already in the centre will allow a start to be made establishing the technique, with the details of the technique being refined over the next couple of years. A database will eventually be created, detailing the whales' ages and habits. ■

Sponge-wearing dolphins may be sharing culture

When marine biologists first spotted bottlenose dolphins off the coast of Australia, wearing sea sponges on their snouts, they were mystified. An international team of researchers has now produced evidence that this behaviour represents a form of culture. It is believed that the dolphins wear the sponges while foraging for small fish, crustaceans and other food along channels in the sea floor to protect themselves against sharp coral and stinging stonefish. It is a trick that appears to be almost exclusively passed from mothers to daughters.

An environmental cause was ruled out, as other animals in the same area never used sponges. However, the animals that used sponges could be born with a gene that created an instinct for that behaviour. The researchers therefore analyzed DNA samples from 185 dolphins, including 13 sponge users. They found that while all sponge users were related, the pattern of sponge use among them was not consistent with any of 10 possible genetic explanations. ■

Movements of deep-diving dolphins traced

Bermuda dolphin travels followed via GPS, Internet

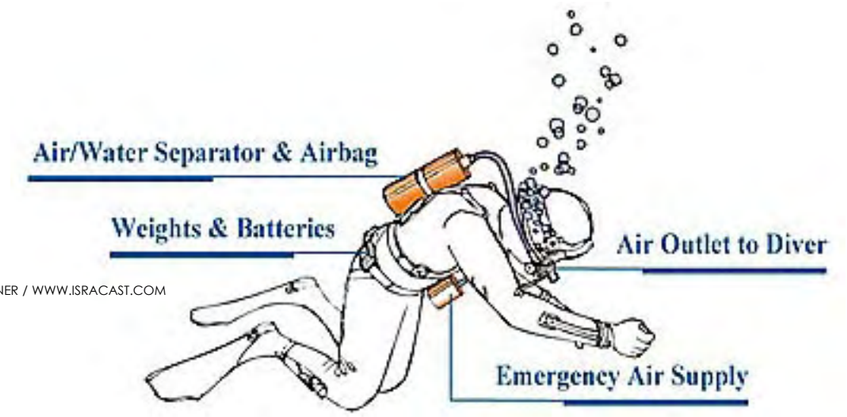
Three wild dolphins living in the Atlantic Ocean off the coast of Bermuda are surprising scientists in San Diego and a worldwide audience following the dolphins' daily swims and dives via the Internet.

The three wild dolphins were caught, fitted with satellite tags and released by researchers studying the offshore dolphin group. Their travels are tracked by global geographic satellite relay technology and posted daily on the research Web site at **www.dolphinquest.org**.

Time-depth recorders measure and report the dolphins' diving behavior. Preliminary data show the female of the three diving to depths exceeding 600 meters, by far the deepest dives recorded for the species. And while much of the dolphins' daily movements appear to be meanderings around the island, two of them have surprisingly gone on a week-long journey to nearly 200 kilometers northeast of Bermuda.

Previous studies of wild dolphins focused on shallow water, nearshore populations. The Bermuda dolphin study is showing that some groups of dolphins are extraordinarily deep divers. ■

GPS Satelitte. Image courtesy of Souhern California Earthquake Center, **www.scec.org**



SOURCE: ALON BODNER / WWW.ISRACAST.COM

Artificial gills finally here?

New breathing device for divers

Israeli Invention Enables Diving Without Oxygen Tank

The real thing. Gills on a nudibranch. File photo: Peter Symes

Israeli inventor Alon Bodner has found a way to use the small amounts of air dissolved in sea water to provide oxygen to divers and even to submarines.

The new device has the potential to overcome limitations imposed on divers by oxygen tanks. The tanks limit not only the amount of time a diver can remain under water, but also affect the diver's buoyancy as they empty out over the course of a dive. In addition, of course, tanks must be brought to facilities to be re-filled. The new invention is a closed system as opposed to the normally used open diving systems where air is inhaled from a tank and exhaled it into the water. This requires a very large quantity of air. With closed systems, the required water flow is small, so this device is very suitable.

Nuclear submarines have long used systems that generate oxygen from water by electrolysis. However, these systems require a lot of energy, much more than can be carried by a diver, and much more than can be supplied by a fish. In order to breathe, fish use instead the dissolved air that exists in the surrounding water. And this is what the new device does.

At a depth of 200 meters in the sea there is still about 1.5% of dissolved air. This might not sound like much but it is enough to allow both small and large fish to breathe comfortably. The idea was to create an artificial system that will mimic the way fish use the air in the water, thus allowing both smaller submarines and divers to get rid of the large, cumbersome compressed air tanks.

The new system uses a well known physical law called Henry's Law which describes gas absorption in liquids. This law states that the amount of gas that can be dissolved in a liquid is proportional to the pressure on the liquid. The law works in both directions, so that lowering the pressure will release gas from the liquid.

In the new invention this is done by using a rapidly rotating centrifuge contained in a lightweight cylinder. Water passing through the centrifuge is thrown to the outside of the cylinder thereby creating a low pressure at the middle of the cylinder. The dissolved air, which contains both oxygen and nitrogen, is thereby released. It is possible to extract enough air from the water for a human to breathe.

The system will be powered by rechargeable batteries. Calculations show that a one kilo lithium battery can provide a diver with about one hour of diving time.

A laboratory model of the system has already been built and tested and, if everything goes according to plan, in a few years the new portable tankless breathing system will be operational. It will be attached to divers in the form of a vest that will enable them to stay underwater for a period of many hours. ■

New Photo Competition in Venice, Italy

We, the organisers, believe that the art of photography, poetry, rhythm, and composition will find Venice the perfect venue to express every culture and nationality.

There are 11 themes but we want a large portfolio of nature - wildlife images submitted. A prestigious panel of judges from Mr Marco Pinna, President of National Geographic Italy, to our very own Associate editor Edwin Marcow, would judge submissions.

Closing Date for Submissions is Aug 31. Report Cards and Notification: Sept. 7.Award Ceremony: Oct. 1-2
The award ceremony will be held in a Venetian palace with cocktails served from 6pm and dinner to complete the evening.
A luxury catalogue book, to mark the award ceremony will be printed. All winning prints will be exhibited in the VIPC World Show Tour 05/06. Venice, Alexandria, Cairo [to be confirmed] Los Angeles, Las Vegas. ■ **www.vipc.it**

New dive show in Hawaii

The 1st annual Hawaii Ocean Sports Expo Feb. 4-6, 2006 at the Hawaii Convention Center will bring together top exhibitors, attractions and attendees from around the world. With the anticipated support and sponsorship of leading industry brands a 30,000 gallon pool for free introductory dive and snorkel lessons and fashion show this consumer based tradeshow is set out to become a success for exhibitors and attendees alike! Located in the heart of the Pacific, the tradeshow combines the modern requirements of a state-of-the-art meeting facility with the beauty, comfort and culture that are uniquely Hawaii. ■ **www.hiexpos.com**

DEMA Art Exhibit

DEMA partners with Ocean Artists Society (OAS) to make art related to the world's aquatic environments more readily available to dive industry professionals. DEMA's Art Innovation Center (AIC), an art gallery at the DEMA Show, provides a place where the beauty of the underwater world can be seen by thousands of people. To maximize the impact of the Center, DEMA has partnered with the OAS, an organization founded by artists, Wyland and Guy Harvey, and photographer, Bob Talbot to foster an appreciation and develop continued interest in the ocean arts. Art on display in the AIC is available for purchase. Any DEMA-member artist can exhibit a specified number of pieces when they donate a separate piece of art to DEMA. Donated art will be placed in DEMA's Silent Auction, "Explore the Underwater World," with a portion of the proceeds of the Silent Auction benefiting the Make-A-Wish Foundation. ■

SOURCE: WWW.WIKIPEDIA.ORG

Common Atlantic cod, *Gadus morhua*

Decline in codfish stocks may not be reversible

According to a new study by Canadian scientists, the marine ecosystem off the coast of Nova Scotia has been altered by the collapse of cod stocks more than a decade ago.

It was thought that the cod stocks, which have plunged 96 percent since the 1850's according to old fishing records, would rebound with the cessation of fishing in the area. But this has not happened. On the contrary, scientists now say that the disappearance of the cod and other large species has led to a phenomena called the cascade effect.

In this process, the fish that the large species preyed upon like herring, capelin, shrimp lobster and snow crab, experienced a population explosion due to the fact that they were no longer being hunted by the cod and other large fish.

In addition, juvenile, larval and cod eggs are now more vulnerable to being feasted upon by a growing population of other fish that are no longer eaten by adult cod.

It is now unclear whether cod can make a recovery in this new environment. Even under the best of conditions, only one out of a million eggs a female cod spawns makes it to adulthood.

Robert Steneck, a University of Maine scientist who has studied the cascading effect in the Gulf of Maine, said, "With overfishing, we are left with babies, and they are not safe."

A trickle down effect has also involved the lowest members of the marine food chain such as algae and zooplankton which are quickly being depleted because more fish are feeding upon them. This raises fears that smaller fish species that rely on algae and zooplankton for sustainance could be in danger of running out of nutrients.

However, there is a bright lining to this dark cloud: seals have less of a struggle to find food since their competition, cod, have disappeared; and fisherman are reaping the benefits of the population explosion of high-priced shrimp, lobster and snow crab. But scientists warn that there could be a repeat performance of species dessimation if the shellfish industry does not regulate overfishing.

"The collapse of cod should serve as a lesson that if you want to keep the populations sustainable you've got to have a conservation ethic in mind," said Ken Frank, a scientist who works for the Department of Fisheries and Oceans at the Bedford Institute of Oceanography. "You've got to resist the temptation to fish so heavily that the stock will deplete itself... It's pretty shocking when you stop fishing, the fish don't return."

Research indicates that the cascading effect may be taking place in other regions of the North Atlantic where cod stocks have collapsed. It was well-known that the cascade effect existed in fresh water areas, but now scientists can prove that it is also found in the ocean. Future studies will investigate whether the ecosystems of the Grand Banks, Labrador Shelf and the Gulf of St. Lawrence have been effected.

The scientific research of Ken Frank, Brian Petrie, Jae Choie and William Leggett, which is based on forty years of data, suggests that the ocean's plants and animals exist in a complex web of relationships that human beings have only just begun to understand.

For more information and source reference, see Trophic cascades in a formerly cod-dominated ecosystem, Science 2005 308: 1621-1623. ■

Basking Sharks Move Up to Scotland

Recent surveys show that an increasing number of basking sharks have migrating to Scottish waters in the last four years. Speculations suggest that global warming is making the sharks venture further north.

The 11-meter, plankton eating giants of the deep arrived early this year with three times the average number of shark sightings in May according to a spokesperson from the Marine Conservation Society, Richard Harrington. He said that sightings have increased by 65 percent, while sightings in South West England, which was the hotspot for basking sharks in the UK, have decreased by 66 percent. ■

NOAA. PHOTO BY CHRIS GOTSCHALK

North Sea Now Too Hot for Some Fish

A new research survey shows that almost two-thirds of bottom-dwelling fish species studied in the North Sea are reacting to the increasing ocean water temperatures by moving to cooler climates.

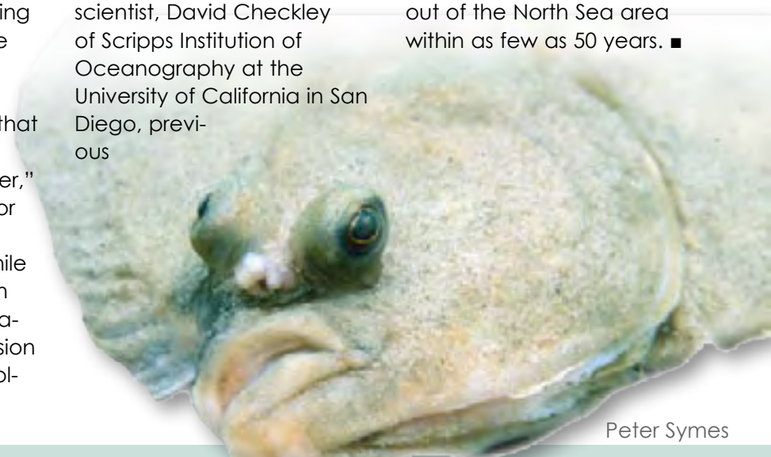
Scientists conducting the study said that if the exodus continues, the North Sea could see in the next 45 years, a depletion of an economically important species. Like a canary in the mine, the smaller, quick-living fish and juveniles are acting as barometers for climate changes in the sea.

"The species that are responding have young that respond (to temperature changes) that much faster," said Perry, the lead author of the research paper. According to Perry, juvenile and smaller fish are much more sensitive to temperature change. This conclusion was based upon data collected in annual scientific surveys of bottom fish every year since 1977.

In addition to the movement of these North Sea fish to cooler latitudes, southern species are in fact moving into the North Sea area. Again, this signals a warming trend of the oceans. What is not certain is how predator-prey relationships will be affected by these changes, said Perry.

According to another scientist, David Checkley of Scripps Institution of Oceanography at the University of California in San Diego, previous research shows cool-water-loving plankton of the North Sea have also shifted northward. He stated that studies of this kind of phenomenon must take place over long periods of time in order to get an accurate analysis.

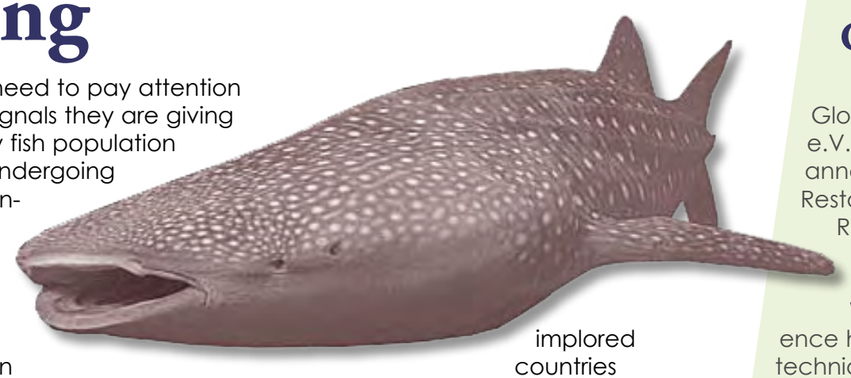
What has been discovered that is important to fisheries, said Perry, is that if sea temperatures continue to increase, commercially important species such as cod and sole could move out of the North Sea area within as few as 50 years. ■



Peter Symes

Edited by
Peter Symes &
Michael Symes

Whalesharks are shrinking



According to a study by Australian scientists, the world's largest fish, the whaleshark is getting smaller.

Records show a reduction in the whalesharks' average size from 7 meters in 1995 to around 5.5 meters today. Although scientists do not know why this decrease is happening, speculation includes suspicions that over-fishing practices in unprotected international waters, a drop in average whaleshark age and injuries to the whalesharks caused by collisions with sea vessels could be to blame.

Very little is known about this elusive, slow growing, plankton-eating, highly migratory oceanic fish, which has been spotted in protected waters at Nigaloo Reef in Western Australia and occasionally ventures to a few coastlines around the world including those along Somalia, Kenya, the Seychelles and India. Scientists include this 'top order' animal as a barometer for the health of the ocean.

At the International Whale Shark Conference in Perth this year, Dr Mark Meekan and colleagues who authored the report said, "They're like the canary in the coal mine, so we do need to pay attention to the signals they are giving us... Any fish population that is undergoing unsustainable mortality usually shows a drop in average size of individual fish, and a drop in abundance. So what we're seeing at Ningaloo is particularly worrying, because these waters are protected."

Scientists at the conference implored countries to work harder to protect the whaleshark and its habitat as well as move away from practices of harvesting the sharks to initiating more sustainable alternatives such as carefully managed ecotourism. ■

Pressrelease

Coral Reef Restoration Workshop on Bali

Global Coral Reef Alliance, Sun & Sea e.V.and Yayasan Karang Lestari have announced the Third BiorockT Reef Restoration Workshop at Taman Sari Resort, Pemuteran, Bali, November 21-28, 2005.

Workshop participants will experience hands-on training in the simple techniques to design, construct, install, maintain, monitor, and repair Biorock reef nurseries.

The BiorockT Process, or mineral accretion, is a revolutionary technology that grows structures and marine ecosystems in seawater. It provides a cost-effective and sustainable method to accelerate coral growth and greatly increase coral survival from environmental stress.

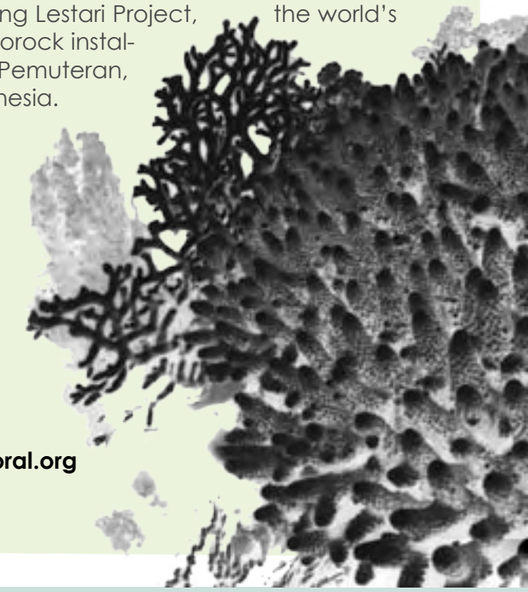
Biorock methods can restore damaged coral reefs, allow highly productive mariculture of corals, oysters, clams, lobsters, and fish, protect shorelines, and provide building materials from sustainable energy.

The workshop will be conducted by Dr. Tom Goreau, President, Global Coral Reef Alliance and Professor Wolf Hilbertz, President of Sun and Sea e.V., as well as several Biorock project managers and staff.

The workshop will take place at the site of the Karang Lestari Project, the world's largest Biorock installation, in Pemuteran, Bali, Indonesia.

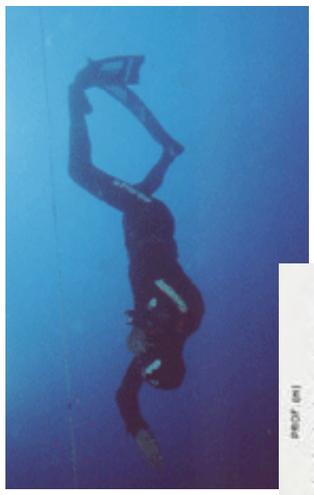
For more information on the event see the Global Coral Reef Alliance website:

www.globalcoral.org



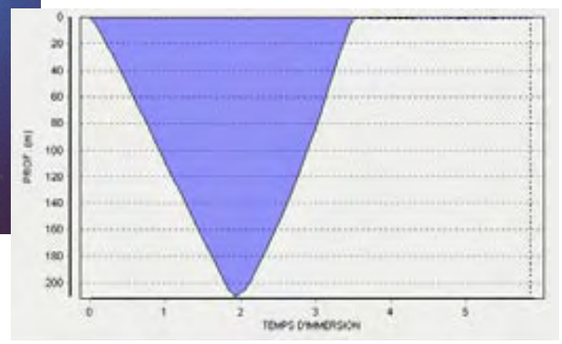
Patrick Musimu freedives to an astounding 209.6m

New record in freediving's No-Limits discipline



Archival photo from **www.patrickmusimu.com**

On breaking the magic 200m barrier, on June 26 2005, Patrick Musimu wrote in his journal: "Today, my team and I have succeeded a historical dive, 200m. Together we have demonstrated to the whole world that there is no limit to the plasticity of the human body in terms of adaptation when submitted to extreme environment. The real barriers are in our minds, we are our worst enemies in terms of future accomplishments. We tend to reject ideas and concepts we do not understand. In fact, ignorance is human worst enemies.



Screendump from the dive computer showing the profile of the 209.6m dive

We tend to reject ideas and concepts we do not understand. In fact, ignorance is humans' worst enemies.

Ignorance leads to denial and fear and as demonstrated through the centuries, this fear of the unknown generates mental conflicts, which in term leads to physical ones and wars"

209.6 meters The 200m dive was the set target but on June 30, after three days of resting, Patrick set out to claim yet another record when he on a dive that lasted 3 min 28 s reached the depth of 209.6m.

Filephoto: www.patrickmusimu.com

Not recognised

While no one questions that Patrick Musimu has indeed become the deepest freediver in the world—the dive was very well documented—there were no officials or judges from AIDA, The Association for the International Development of Apnea, present, and therefore the record cannot be recognised as an official worldrecord.

news

Edited by
Peter Symes &
Gunild Symes

ABOVE: Christopher Columbus. INSET: One of Columbus' ships, the *Santa Maria*

Did Chinese sailors reach America before Columbus?

That's what a new exhibit in Singapore suggests. The exhibit, based on *1421: The Year China Discovered America* by Gavin Menzies, presents new evidence that Chinese exploration to the Americas may well have begun in the time of Kublai Khan and was continued later by the celebrated Chinese Admiral, Zhen He, who completed seven maritime expeditions to the New World between 1405 and 1423 with a fleet of 317 ships and 28,000 men. However, how far he travelled is still a matter of dispute.

According to experts, the Chinese already had 600 years of sailing experience by the time of Admiral He. Artifacts have been recovered from this time period suggesting that the Chinese reached America 70 years before Columbus.

Menzie, a retired British Royal Navy submarine commanding officer, said that explorers of day used maps that were drafted from previously existing maps, some from Kublai Khan's dynasty, which clearly show North America. Kublai Khan's maps, which are thought to be from the late 13th century, were recently found at none other than the US Library of Congress and are now being carbon-dated.

"Columbus had a map of America, de Gama had a map showing India and Captain Cook had a map showing Australia, and it's not my saying; it's the explorers saying it," Menzie said. "None of the great European explorers actually discovered anything new. The whole world was charted before they set sail. So somebody before them had done it... Most of the world had already been mapped by Kublai Khan's fleet."

Not surprisingly, Menzies' statements have stirred up some controversy. But evidence dug up by a Canadian architect, Paul Chiasson, at a new archaeological site at Cape Dauphin in Nova Scotia indicates the existance of a large early Chinese settlement including canals, smelters, mines, Islamic graves and Buddhist tombs surveyed by researcher Cedric Bells. While some argued that this site could be Viking, Chiasson said it was too far away (700 km) from the nearest known Viking outposts, which are much smaller. Evidence of Chinese junks have also been uncovered in Florida, South Carolina, New York and Canada, said Menzies. *For more information, visit*: **www.1421.tv** ■

Taste for Fish Sparks Early Human Migration Out of Africa

Seafood was the lure for the first people to leave Africa according to a new genetic analysis by scientists in Leeds and Glasgow, UK. The new research overturns the standing hypothesis of the first migration of modern humans.

DNA evidence traced through maternal mitochondria, the power packs of cells, provides new insight to the spread of modern humans across the Red Sea from the Horn of Africa, towards the tropical coasts of the Indian Ocean an onwards to the Pacific over a few thousand years.

The first migratory wave may have included fewer than 600 women, who are now considered to be the mothers of all non-Africans including modern Europeans who descended from a group of pioneers that splintered off from the rest of the early modern human population around the Persion Gulf.

Seventy thousand years ago, early modern humans in East Africa lived off big game, but that changed according to archaeological finds that suggest their diets shifted to consist mostly of shellfish. It is thought that early humans in this region were prompted to seek better fishing grounds elsewhere after the Red Sea's shellfish stocks decreased due to climate change. ■

Celebrate the Sea 2005
An Unforgettable Festival

Text by Michael Aw
Photos by Peter Symes

As another Celebrate the Sea festival wraps up, it is clear that with each year that passes, the show grows stronger and stronger. Staged at Singapore's Suntec City convention centre from June 3 -5, this year's festival was truly unforgettable.

The highlight of the event was an unprecedented evening in Asia Pacific on which three super-stars of the underwater world celebrated our oceans. Dr Sylvia Earle jump-started the evening with an inspiring talk on the sustainable use of our seas. She addressed pertinent questions like how can one person make a difference and surely there was not a dry eye in the house as she portrayed the bleak realities of shark finning.

More of a comedian than a maker of deep sea diving equipment, Dr Phil Nuytten then led us down with him through his journey in the depths of the ocean. To close off the evening, David Doubilet, the light magician, mesmerized us beneath the miracle waters of Africa with images captured during his trip to Botswana.

Dr Phil Nuytten in his invention, the *Newtsuit*

Public Access

The festival itself was free to the public, with bustling crowds of avid divers, nature lovers, photographers and shoppers streaming through the exhibitions. There was everything from eco-tour operators to dive resorts, photographic and outdoor equipment, shoes, watches, underwater housings and was even a tank in which one could experience the thrill of scuba diving for the first time.

But as always the focus of the festival is to praise the image makers that continue to capture the many faces of our ocean's beauty in the hope of preserving it. The entries into this year's imagery competitions were astounding; hundreds of adults and children explored the prints in our public galleries while the slide shows and film festival kept viewers enthralled for three days straight.

Each year Celebrate the Sea offers a unique opportunity for divers, photographers and nature lovers to come face to face with the who's who of underwater imagery. In seminars and workshops diving and photography experts like Neville Coleman, Michael Aw, Jason Heller, Robert O'Toole, John Cosgrove and Tay Kay Chin entertained and interacted with their audience. From raunchy discussion about sex in the sea to internet marketing, capturing the essence of sea birds in one image, the latest photography techniques, night romps through Amazonian jungles and how to explore the ocean in an underwater sports car these seminars are crucial in cultivating our knowledge of the ocean.

Saving Sharks

The show was again used as a platform for OceanNEnvironment's Say No to Shark Fin Soup campaign. Our posters, video and life size shark in the foyer all highlighted the plight of the shark as it is slaughtered in the name of culture and nutrition-less soup that gets its flavour from chicken stock. With a Chinese restaurant right next the

Singapore city center

Michael Aw and David Doubilet survey the photographic entries of the Epspn Award Finalists

LEFT: A young staff member hands out fliers for a dive travel booth at the Celebrate the Sea 2005 show

RIGHT INSET: David Doubilet, Al Hornsby, Tay Kay Chin and Peter Symes (behind camera) in the jury room examining entries for the

festival that served shark fin soup, like most in Singapore, the matter could not be more poignant.

"There is a tremendous amount of enthusiasm and really genuine interest in what is going on, specifically with the business of shark fin soup…Singapore can be seen a model of stewardship for looking after the environment," says Dr Phil Nuytten, inventor of the 'Newtsuit'.

A truly international affair, Celebrate the Sea has established itself as the biggest and most exciting festival of its kind in Asia Pacific and will continue to grow in upcoming years. OceanNEnvironment would like to thank all our sponsors, those who attended, those who competed, those who volunteered and most importantly those who came from around the globe to celebrate the ocean with us.

And as for the rest of you, see you next year at the unforgettable festival.

Imagery Competition

As the focus of the Celebrate the Sea festival, this year's imagery and film competition entries were of outstanding quality.

With the overwhelming number of entries in the many competitions judged at the festival, praise was given these artists who have endeavored to capture the ever-changing beauty of the ocean in the hope of preserving it.

The finalists from all the photography competitions were displayed in special public galleries through which hundreds of adults and children explored some mesmerizing images and creative takes on the natural world. Meanwhile, the slide shows and film festival kept viewers enthralled for three days straight.

With up to $50 000 in prizes awarded to this year's winners, the judging was no easy task. Dr Sylvia Earle helped with the judging of the children's painting competition. The Artist of the Sea 2005 was a little girl named Lakshmishree from Bangalore India. Her whole village saved up enough money so that she could attend.

David Doubilet led the judging of the slides, revealing his admiration for photographers who are able to capture 'special moments' as he calls them. As for the films in competition, Dr Phil Nuytten said, "The entries were very good and it was a tough job, but the top notch ones stand out. The winner was crisp, sharp and spectacular."

Thank you to our sponsors and congratulations to those who won and for those who missed out on a prize, better luck next year! ■

Michael Aw, Dr Sylvia Earle and Shahram Saber, marketing manager of PADI Asia-Pacific

Children participate in the Save the Sharks poster contest aimed at raising awareness against the serving and selling of shark fin soup, which is considered a delicacy in Asia

Posters created by children at the Celebrate the Sea 2005 show
www.celebratethesea.com

CELEBRATE THE SEA FESTIVAL 2005

EPSON AWARD OF EXCELLENCE FOR BEST PRINT
Wyatt Chew, Singapore
Prize: EPSON printer model R1800

BLACK AND WHITE PRINTS
Gold Medal: Darek Sepiolo, Poland
Prize: DIVE KOMODO
5-night live-aboard dive cruise
Silver Medal: Alessandro Dodi, Italy
Prize: Long Bow Micro
Highly Commended:
Federico Cabello, Italy

MACRO PRINTS
Gold Medal: Andrey Nekrasov, Ukraine
Prize: 5D/4N Diving package at Sipadan-Mabul Resort for one pax. Plus EPSON R800 printer
Silver Medal: Ernst Seeling, Austria
Prize: Long Bow Mini
Highly Commended: Jeff Yonover, USA, and AB Lee, Malaysia

WIDE ANGLE PRINTS
Gold Medal: Alessandro Dodi, Italy
Prize: 4-day/3-night diving package at Asmara Dive Resort or similar for two
Silver Medal: Andrey Nekrasov, Ukraine
Prize: Long Bow Mini
Highly Commended: Marc Nussaume, Thailand

NIKON AWARD OF EXCELLENCE FOR BEST SLIDE PORTFOLIO
Tobias Bernhard, New Zealand
Prize: NIKON SLR FILM camera set
Silver Medal: Alessandro Dodi, Italy
Prize: 7-day/6-night dive package full board at Kima Bajo & Spa Resort, Manado for one pax
Bronze Medal: Amati Emrico, Italy
Prize: SG $500 Radiator product voucher

MACRO SLIDES
Gold Medal: Amati Emrico, Italy
Prize: 10 day diving trip for two onboard the Citra Pelangi
Silver Medal: Tobias Bernhard, New Zealand
Prize: Angsana two nights at Maison Souvannaphoum Hotel Luang Prabang
Highly Commended: Amati Emrico, Italy

WIDE ANGLE SLIDES
Gold Medal: Alessandro Dodi, Italy
Prize: SG $500 Radiator product voucher
Silver Medal: Tobias Bernhard
Prize: Long Bow Mini
Highly Commended: Viora Alessio, Italy

ROLEX AWARD OF EXCELLENCE FOR BEST FILM
D.Lop and M.Boyer
"Life at the Edge of the Reef"
Prize: Return air Ticket to Mauritius
10-day trip for two and two weekend trip on *MV Grace*

FEATURE DOCUMENTARIES
Gold Medal: Thomas Behrend
"Hunters at the Cape of Storm"
Prize: MINAHASA Lagoon Resort 7-day diving and accommodation package
Silver Medal: Denis Legrange
"Blue Pacific"
Prize: Pulau Sipadan Resort 7-day diving and accommodation package
Bronze Medal: Ballsbio Osvaldo
"Seasons of the Sharks"
Prize: Long Bow Micra

SHORT FILMS
Gold Medal: Carlos Virgili
"Mama"
Prize: Pulau Sipadan Resort 7-day diving and accommodation package
Silver Medal: Josh Jensen and Liz Harlin
"Encounters with Giants"
Prize: 6-day / 5-night diving package full board at Redang Kalong or Diver's Den Resort for two
Bronze Medal: Josh Jensen and Liz Harlin
"Underwater Beauty"
Prize: Long Bow Micra

DIGITAL PORTFOLIO
Gold Medal: Wyatt Chew, Singapore
Prize: ORIS TT1 Divers watch set
Silver Medal: Charles Hood, England
Prize: Nikon Coolpix model TBA
Bronze Medal: Aaron Wong, Singapore
Prize: Epson Printer R800 plus Two-night stay at Raffles Marina

DIGITAL SHOOTOUT
Gold Medal: Tong Nguen Khoong
Prize: EPSON PRINTER R800

OCEAN ENVIRONMENT / ASIAN GEOGRAPHIC ENVIRONMENT AWARD
Viora Alessio for print

BOOK OF FESTIVAL
101 Best Dives
Sea Paradise

BEST WEB SITE
Jason Heller
DivePhotoGuide.com

Lake Kanas is located on the Altai Mountain in Chinas Xinjiang's region.

Divers sent to look for monster in mountain lake

Every continent has them it seems, lake monsters that is. From Loch Ness in Scotland, lake Tahoe in the US and, so it seems, Lake Kanas in China. It is famous for its scenic beauty and for its legendary monsters. After a group of Beijing tourists boating on the lake, saw and filmed two unidentified creatures about 10 meters long, a group of divers will be dispatched in July to investigated matters at a cost of 1.5 million yuan, or 180,000 US dollars.

But some are skeptical that they will uncover a monster's lair. The director of Xinjiang Ecology Institute Yuan Guoying, for one, says after 20 years of study he believes the so-called "Lake Monster" is a type of large fish called a Hucho taimen.

He says the lake's cold water could have made it grow very large. ■

Red Sea Liveaboard goes under, strikes reef

Divers aboard the Red sea live aboard MV Coral Queen were suddenly forced to abandon ship when their vessel hit a reef and sank in the southern Egyptian Red Sea.

The 26m-long liveaboard, which is owned by UK tour operator Oonasdivers, immediately filled with water and began sinking after the collision at the Sha'ab Sataya dive site in Fury Shoals.

Everyone rescued The divers were immediately rescued by another liveaboard, MV Heaven Majesty which were anchored close by. The guests had no time to recover their belongings however.

According to Oonasdivers on www.divemagazine.co.uk, all of the divers escaped unhurt and were taken to shore and transferred to the Egyptian capital to obtain new passports. Oonasdivers also said it hoped to set up an operation to recover the vessel, which settled only 10m below the surface. ■

The *MV Coral Queen* flounders in the water after it struck a reef in the southern Egyptian Red Sea

Ancient Greek Sea Battle Inspires Search

To better understand the battles of the ancient Greeks, experts have begun to search for the ships lost in the Aegean Sea nearly 2500 years ago during the defining victory over Persian forces under King Darius that is seen as the first victory of democracy over tyranny.

One of the main targets of the international team of archeologists is finding the premier warship of the classical age, the trireme, to find out more about ancient Greek civilization as well as how the Greeks won the war over the Persians. Leader of the research team, Shelly Wachsmann of Texas A&M University said, "This is high-risk archaeology. Discovering a trireme is one of the holy grails. Not one has ever been found."

Previous discoveries have only been cargo vessels. Researchers are using the historical texts of the 5th century ancient Greek historian Herodotus to guide them in the search for the trireme ships as well as the latest technology in sonar and submersibles. The head of Greece's department of underwater antiquities and co-leader of the project, Katerina Delaporta said, "This is the first time such sophisticated technology is being employed."

Technological advances in underwater archaeology are being used by the Greek ministry of culture towards a growing body of research. Resources in cluding a 42m oceanography boat and submersible as well as two remotely-guided craft have been provided by the national centre for maritime research, Elkethe, operating under the development ministry.

Several discoveries have been made under this collaboration including over 30 shipwrecks from the Byzantine, Roman, Hellenistic and Classical times at depths up to 550 meters. Artifacts uncovered at some of these wrecks include an ancient bronze statue, groups of amphorae believed to date from between the 5th and 2nd centuries BC. ■

Artists' impression of a trireme ramming another trireme

Triremes

The prow, or front, of the trireme was made of bronze and was used to ram enemy ships. Oars were arranged in three rows with a man to each oar. For short periods the rowers could propel their trireme through the water at speeds of up to 16km/h very fast for human power alone - and fast enough for the ram to hole the enemy's hull. Many Greeks ships had an eye painted near the prow to ward off the 'evil eye' - a motif that can stille be seen on Greek boats today. ■


PETER SYMES

Townsfolk protect 'Nemo' and catch more

Nemo is the colorful clownfish character in the 2003 Disney animation, "Finding Nemo," that introduced moviegoers to the fascinating world of the sea. It also inspired fisherfolk in the Philippines to gather clownfish from various areas of the Panacalan fish sanctuary, a 50-hectare marine-protected area off the shore of this island town, and put them in one corner of the sanctuary. Here, the clownfish proliferate safely and away from collectors of aquarium fishes.

Some fishermen used to illegally collect clownfish and other fishes using cyanide, other poisons and sometimes explosives. The colorful anemones which served as the clownfish's home were also collected for food or to sell as aquarium decoration.

"But since the sanctuary is off-limits to all forms of fishing, legal or illegal, the clownfishes are thriving," said Ben Caasi, a local council member. The Panacalan fish sanctuary was established five years ago by the local government and managed by officials and residents of Barangays Macaleeng and Sablig.

Since then, the fishermen have taken the sanctuary to heart and residents take turns patrolling the area. The Bureau of Fisheries and Aquatic Resources has also given them radio equipment so they could easily go after violators. Through the years, the number of violators has dwindled, presumably because the fishermen have realized the importance of the sanctuary to their livelihood.

The fish catch has also increased. Before, the daily harvest of a fisherman was less than a kilo of fish. Now, a fisherman can catch at least three kilos. Coral cover, too, has grown. ■

75000 celebrated Earth Day 2005

Concerned communities all over the world celebrated this year's Dive In To Earth Day. Events were organized in 71 counties with a total of 75,000 participants from all walks of life including divers, conservation groups, park managers and many others.

The concern for the increasingly theatened ecosystems of coral reefs, lakes, rivers and oceans was the focal point of the united effort to raise awareness on an international level.

Since 2000, The Coral Reef Alliance has helped communities around the world to ensure the underwater world is given attention in the annual celebrations of Earth Day. Dive In To Earth Day now generates around 25 percent of all the international registered Earth Day activities world wide.

For more information, visit:
www.coralreefalliance.org ■

Edited by
Peter Symes &
Michael Symes

Model of Jules Verne's *Nautilus*

American Civil War submarine found off Panama

The dscovery of the remains of an unique submarine that was built around 1864, at the time of the American Civil War, has sparked speculation whether this was the submarine that inspired French novelist Jules Verne to create Captian Nemo's vessel *Nautilus* in his book *20,000 Leagues Under the Sea*.

The remains of the cast-iron submersible called *Explorer* is lying in only three meters of water on the coast of San Telmo Island in the Panamanian Pacific, where it was originally discovered in Panama in 2001.

It was only later, after several studies and comparisons, that Colonel John Blashford-Snell and James Delgado of the Scientific Exploration Society sent to investigate the craft, identified it as the one designed and built between 1863 and 1865 by German engineer and naval officer Julius Kroenhl.

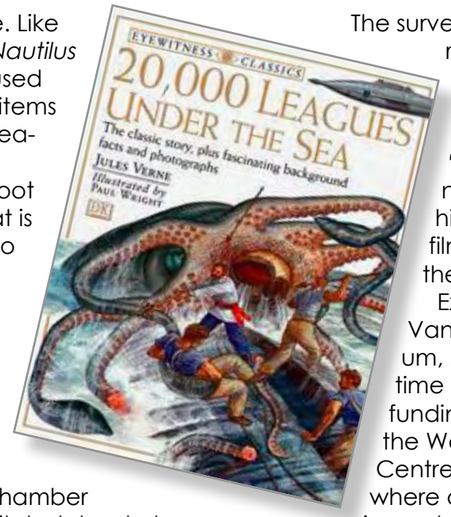
Kroenhl had built the ship with financial support from the Pacific Pearl Company to be used during the US Civil War (1861-1865), but it arrived too late and was transferred to Panama in 1866 where it was used to extract pearls for three years.

She was ideal for this purpose because of an unique lock-out system identical to the one in the *Nautilus* from Verne's book published in 1870.

The lock-out system is a reversible air-lock that enables submariners to leave the vessel, harvest pearls from the sea-bed, and then return to the submarine. Like *Explorer*, *Nautilus* was also used to gather items from the sea-bed.

The 36-foot (13m) boat is believed to be one of the earliest submarines. It has special features such as a lock out chamber that permits hatches to be opened for crew to emerge underwater after it is filled with pressurized air. This feature made it possible for a huge harvesting of pearls after it was rejected by the US Union Navy.

A dark side to the story includes the deaths of the German inventor and eight of his crew when intensive operations took them down to 100 feet (30m). Mariners at the time knew nothing of decompression sickness, and it is likely that it was this that caused their deaths.



The survey of the boat was carried out by British technologist Roger Cooper of Market Harborough. Cooper noted the vessels "strange Victorian engineering" that reminded him of the *Nautilus* in the film, 2000 Leagues Under the Sea.

Executive Director of the Vancouver Maritime Museum, James Delgado, a maritime archaeologist, is seeking funding to lift the *Explorer* to the Warren Lasch Conservation Centre in North Charleston, USA, where an earlier sub is undergoing restoration. ■

FAR LEFT: Illustration of Captian Nemo from Jules Verne's novel, *20,000 Leagues Under the Sea*
LEFT: The Civil War period submarine *Explorer* rests in just under 3 meters of water on the coast of San Telmo Island near Panama

Discover the underwater charms of

Newfoundland

Many millions of years ago, a piece of a land broke away from the ancient continent, Gondwanaland, from the place we now know as Morocco, and traveled a long journey westward until it collided with the North American continent a bit to the south of Greenland. The first Europeans who visited this new world in 986 A.D. were the Icelandic Vikings under the command of Thorfinn Karlsefni, but the newcomers did not settle the area for a long time. Five hundred years later, on June, 24, 1497, eighteen British sailors on the crew ship *Matthew* under the command of Genoese Captain Giovanni Caboto (in English, John Cabot) made the long crossing over the Atlantic Ocean in search of a sea route to China, but landed instead on the coast of an unknown island. They raised the Union Jack—the British flag—on this island and named it New Found Land.

Text by Andrey Bizyukin
Photos by Andrey Bizyukin,
Ingo Vollmer, Debbie and Rick Stanley

*No, this is not French Polynesia –
Here, one can find many times more fascinating and exciting diving adventures!
--- Andrey Bizyukin*

Newfy

PHOTO BY TINA OLIVERO COURTESY OF OCEAN QUEST CHARTERS

LEFT:
Diving with iceberg

TOP RIGHT: Aerial view of Bell Island and Conception Bay

INSET: Curious Newfoundland moose

After coming back to Bristol, John Cabot informed the authorities that "the lands, which I have found, are not rich with gold, but a lot of fish inhabits the seas along coast." For this discovery, King Henry VII awarded John Cabot the premium prize of ten pounds and an annuity of twenty pounds sterling, which established the British claim to this territory until 1949. Newfoundland remained the first overseas colony of the British Empire. Today, the replica of the *Matthew* sits proudly in Bristol Harbor for all to see.

Newfoundland is the biggest of the Atlantic Canadian provinces, the mother land for hundreds of thousands of caribou, millions of birds, the famous breed of black diving dogs and moose, which can be found walking on motorways. Human population on the island numbers half a million inhabitants (many with Irish origins), ten thousand of whom are divers. Newfoundlanders differentiate themselves from the Canadian nation. "The Irish spirit and traditions are still strong here," the old residents tell us with pride. Local residents respond with pleasure to the nickname *Newfy*.

Newfy are benevolent, quiet, socially balanced and relaxed people, speaking one of the oldest English language dialects with the Newfoundland accent.

The capital of the island, St. Johns, is the most eastern port and the oldest city in North America. The city is filled with great history: Water Street – the first and oldest street of North America; the Titanic museum with exhibits of artifacts lifted from the sunken giant; Signal Hill with Marconi's legendary tower—a symbol of the technological achievements of the last century when in 1901 the first transatlantic radio signals sounded in the heretofore silent ether of the planet; Cape Spear—the most eastern extrem-

Whale's greeting—different forms of life have different ways of saying *hello*

ity of America; and the Bay of St. Johns—the first reliable harbour on the ocean away from Europe.

The weather of the northern Atlantic region does not indulge in permanency. The thick fog, snow or rain can suddenly be replaced by strong winds or a storm or by sunshine in the blue cloudless sky above the sea where icebergs race swiftly past the coast. Here, there are plenty of inns and bars, where it is possible to meet adventurers and seamen from around the world.

Natural treasures

The nature here is familiar to me as it is an exact copy of the central part of Russia—birches, fur-trees, mountain ash, lilac, clover and rose-bay. Only the sea and underwater world are unique.

Where two powerful ocean currents meet—the cold Labrador current and the warm Gulf Stream—a unique underwater biodiversity is created.

Hundreds of species—seaweed, fish, sponges, anemones, jellyfish and starfish, molluscs, octopus, lobster and crabs, seals, white whales, narwhales, sharks and slopes—live and breed here. Newfoundland's Great Banks, one of the richest places in the world's ocean for fish, provides a habitat for the largest colony of sea birds on Earth as well as a population of over 5000 whales.

At the end of June and July, the sea giants, who have over eaten capelin and cuttlefish, start to play. They wave huge chest fins, clap tails and jump out of the water, attracting a human

LEFT AND RIGHT: Great diving photo luck—an infrequent meeting with a friendly narwhale

Newfoundland

LEFT: Whale, just before breaching, races upwards towards the surface of the sea

CLOCKWISE FROM TOP: Amazing and exciting moments for lucky "whale-tail-watchers"

audience of enthusiastic gapers.

Aside from the whales' performances, tourists and divers adore the parade of Greenlandic icebergs. Year round, Labrador's current brings hundreds of the ice monsters that have broken away from a continental glacier. The age of some of these icebergs can reach up to ten thousand years, and they can weigh up to two hundred thousand tons. Nine-tenths of icebergs are under water, therefore one must immerse oneself with an aqualung to catch a glimpse of the blue bulky freakish forms of ice leaving the sea abyss. Nobody is left indifferent after such an experience.

Diving with whales

The North Atlantic is an area of risky diving. Too much depends on quickly changing weather conditions. The diving season in Newfoundland is from May until November. During the rest of the year, the bays become covered in ice.

Rick and Debbie Stanley, our kind dive masters and engineers of the Sea Quest Company, have constructed a magnificent two-floor hotel for divers with a great view over the sea bay and islands. Strong wind and rain remind us that it is time to go out and dive. "It is my swimming pool," Rick tells us with pride as he shows us the bay, which is covered with fog. He adores his 18-seat dive boat, and while imitating Schumacher, flies out onto the bay in the huge brightly coloured red inflatable Zodiac with 150-strong Mercury engine, overtaking the wind.

Newfoundland

Rick chases some whales and comes nearer to them—a distance of a few meters. It is possible to observe the behaviour of these sea giants indefinitely—to examine their huge fins, tails and backs and to admire their perfection. With any great divers' luck and a happy coincidence of circumstances, one can also dive together with them.

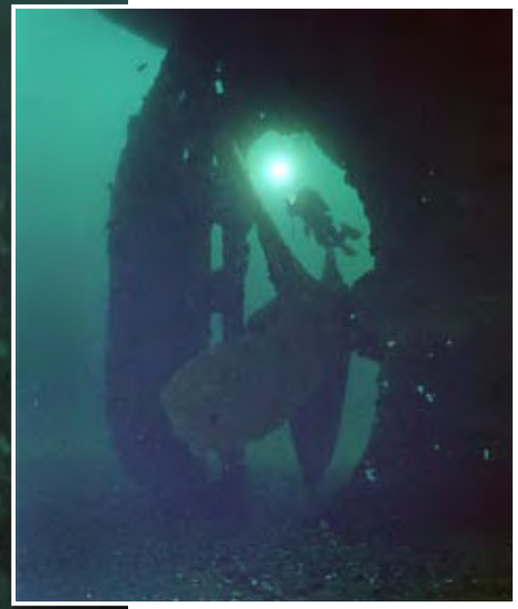
Wrecks

The most popular place for diving is a coastal zone of Bell island, named so because of a rock located near to it that outwardly resembles a bell. Here, at depths of up to 45 meters, four "smart" military transport shipwrecks lie on the sea floor. The history of their occurrence and the events leading up to their sinking are full of drama and military riddles.

During the Second World War, this small island located in Conception Bay, became a strategically important military base. The reason for this was that the largest iron ore mines in North America were located here—huge labyrinths and tunnels located two hundred meters down in the earth were excavated lower than sea level. The mines were a source of ore with an iron content up to 50-60 percent.

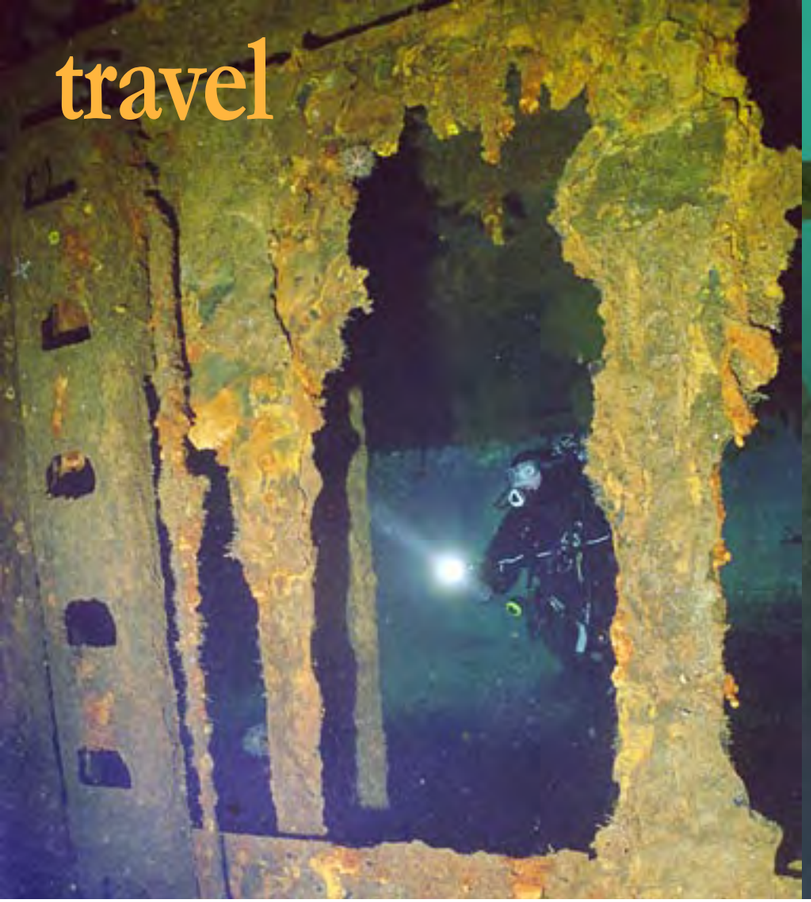
Prior to the war, Germany was a major purchaser of this ore. In 1939, Germans imported more than five hundred thousand tons. Clearly, that was a reason for the beginning of military operations. The role and importance of Bell island ore increased over time.

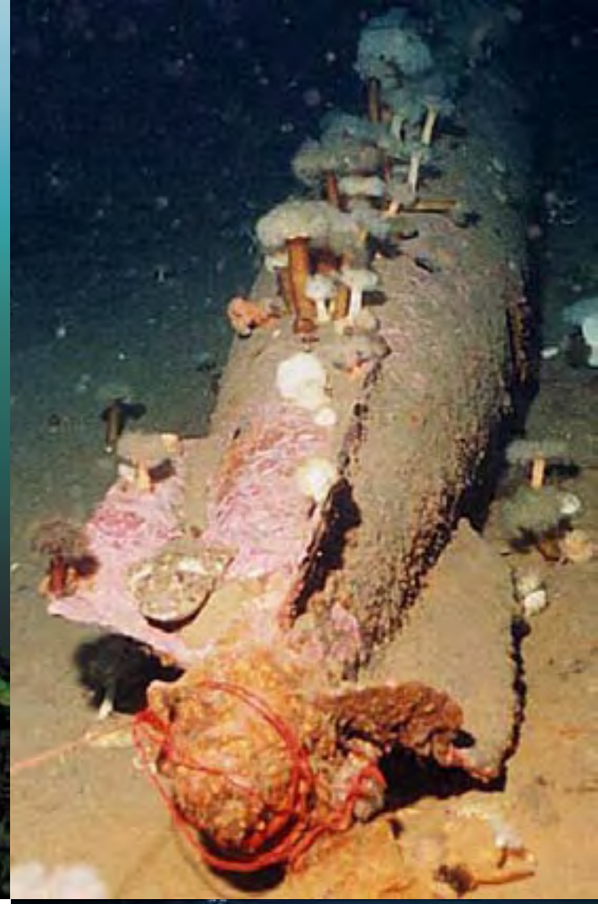
In addition, St. Johns became the gathering place for military transport escorts in the days before transports used the North Atlantic passage to England and Russia. Many Allied ships voyaged between



LEFT AND INSET:
Wrecks of Conception Bay

Newfoundland





ALL PHOTOS THIS PAGE: Sunk wreck treasure of Bell Island - unexplored holds, cannons, unexploded torpedo and collection anchors

Bell, Newfoundland, and the great ports of the world continuously.

The Second World War began for Newfoundlanders on September 5th, 1942, when the British military transport ships, *Saganaga* and *Lord Strathcona,* which were standing at anchor in Lance Cove, were attacked and sunk by the German submarine *U-Boat 513,* IXC-type, led by Captain Rolf Ruggenberg.

Two months later, while taking advantage of the limited measures taken by British and Canadian Navy on navigational protection of ships, another German submarine *U-Boat 518,* of the same IXC type under the command of Captain Friedrich Wissmann, attacked and sunk the 140-meter British giant, *Rose Castle,* and the small French ship, *PLM 27* (Paris-Lyon-Marseilles), in the same place.

Two successful missions of German submarines left four "brilliant wrecks", according to our hosts, and two unexploded torpedoes, which have sunk in the sea, because their accumulators were faulty. Now, they are a source of inspiration and many an exciting conversation among wreck enthusiasts in the diving community.

"Why do you like to dive these wrecks?" we asked William Flaherty, our encyclopaedic erudite skipper and the local expert on the dive sites of Newfoundland.

"Imagine the bird's flight, when you fly in the sky above a city and examine the people, trees, streets and houses below. Precisely the same sensations I also suffer when I plunge into the depths to see the wreck. It seems to me that I see the wreck like a city—a sunken underwater city. I am travelling on it and researching it. This is a unique feeling of flight, the freedom of movement in three dimensions, and the pleasure of the discovery, simultaneously. I have made about forty dives just on *Rose Castle* and still have not exhausted my curiosity as a researcher," said Bill.

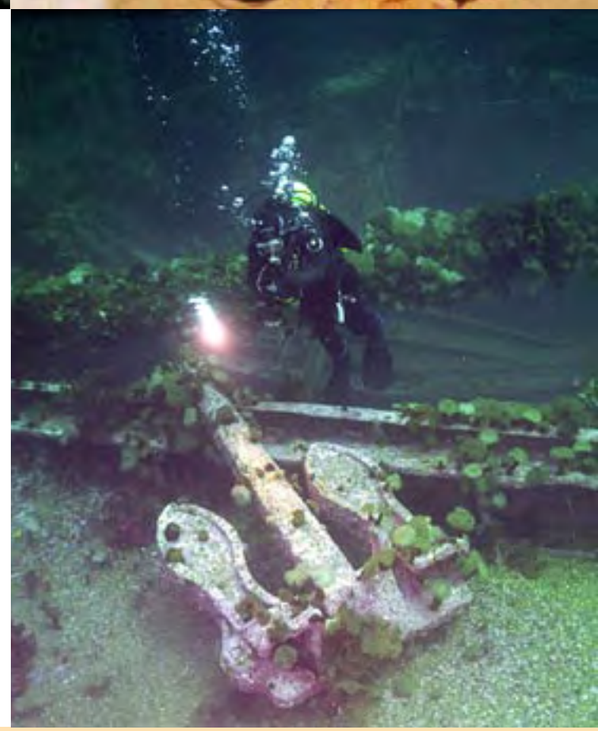
Diving the wrecks

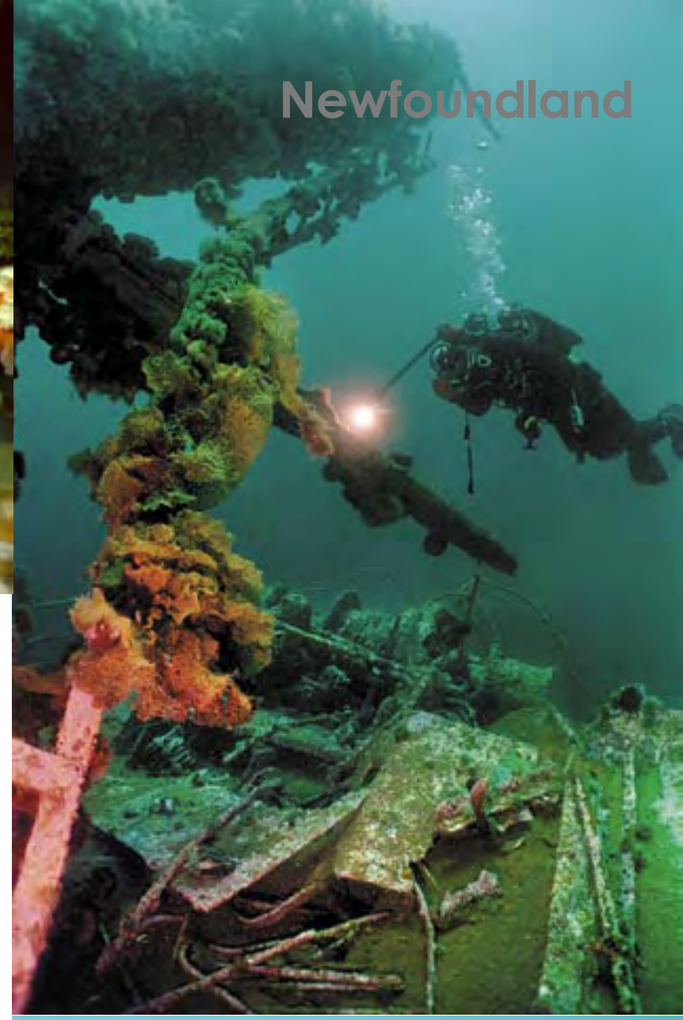
Having heard plenty of these stories, we decided that it was time to dive the wrecks immediately. Heavy fifteen liter tanks with 25% nitrox, a wide step into the water with a loud "pluh!!!" and a big splash of heavy lead-gray coloured water. The dry suit is excellent gear when it is made to measure. How comfortable it makes you feel in any body of water.

Submersion started along a line tied to a bright red buoy on the surface. I admired the unusual transparency of the water and the solar beams that played in the depths.

At the depth of 15-20 meters, we could already see the huge sunken ship below. The bow deck of *Rose Castle* was directly under us. Bow reels and bulwark were visible. They had become overgrown with actiniums. The deck house, cabins, cock boat-beams, masts and funnels were all overgrown with anemones, but were still pleasing to the eye. At 35 meters, the water was so clear that the sunlight penetrated the deep very well, and there was no necessity for additional illumination.

My dive buddy today is the self-proclaimed "slowest trimix diver of Newfoundland" and a former US Navy diver.





ALL PHOTOS THIS PAGE: People, wrecks and fishes, researching each other

He does it all very slowly, for ultimate safety, and fixes a decompression cylinder on the wreck deck. Only after that, do we start our underwater journey.

In the beginning, we find the huge aperture of a hold and after turning on our torches, we are immersed in the gloom. Pipes, ladders, cross-beams, heaps of rusty metal and crystal-clear water. We hang with neutral buoyancy in the darkness of the hold. In absolute blackness, we rummage the sides with the light beams of our torches. We try do not to sift up the silt mud or catch our SCUBA hoses on the wreckage.

A light from the opening of a turned-out section of the vessel is piercing the dark ahead of us. This is the place of the torpedo's impact.

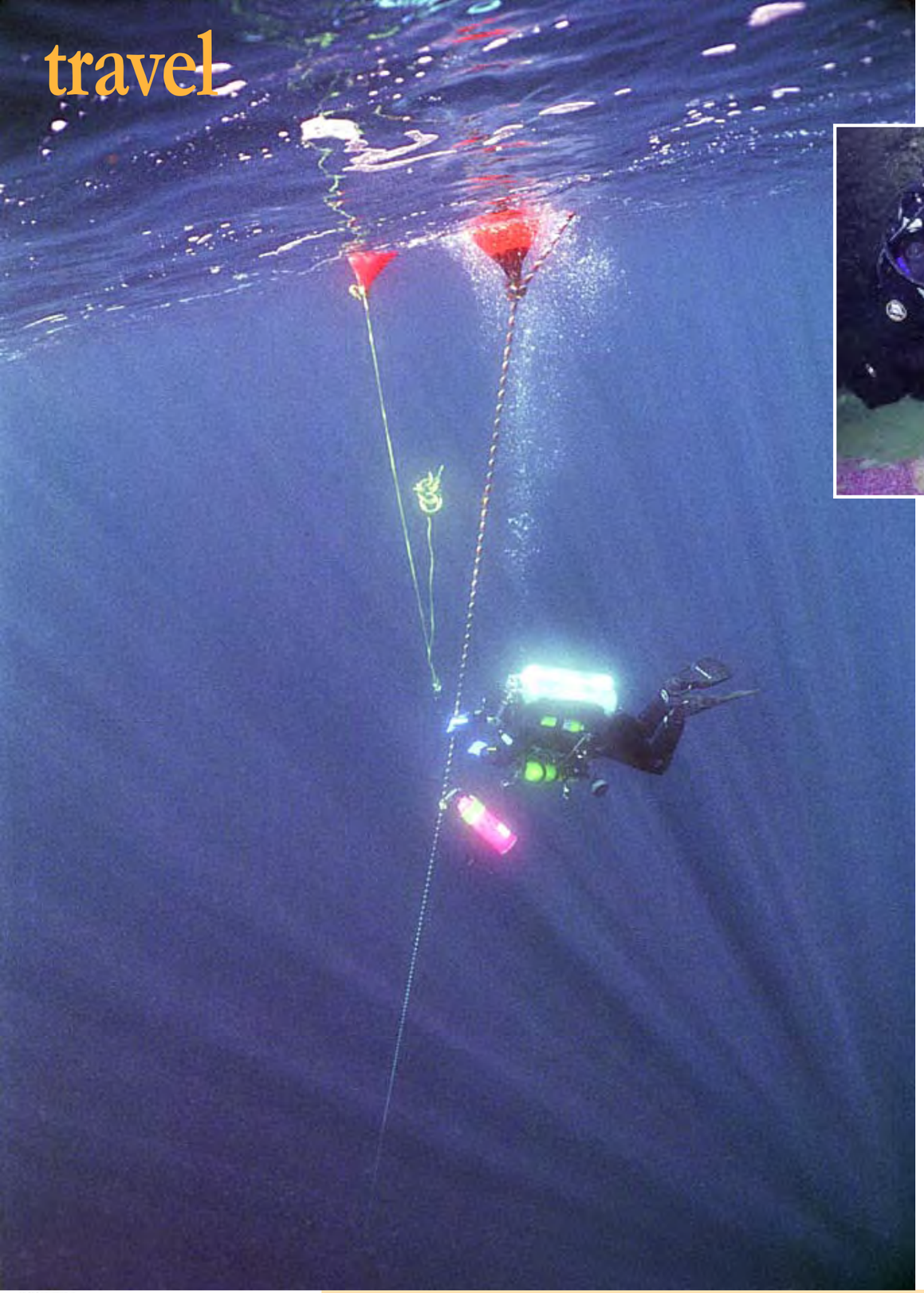
We are not sure if the construction of the wreckage is safe enough to pass here, therefore we decide not to return to the surface through the exploded aperture, and instead, swim back the same way we came inside the wreck.

On the main deck, we are met again by sunlight. We mount our tanks above the deck to reduce the decompression time, check the gas volume and decide to examine one of the top rooms of the vessel.

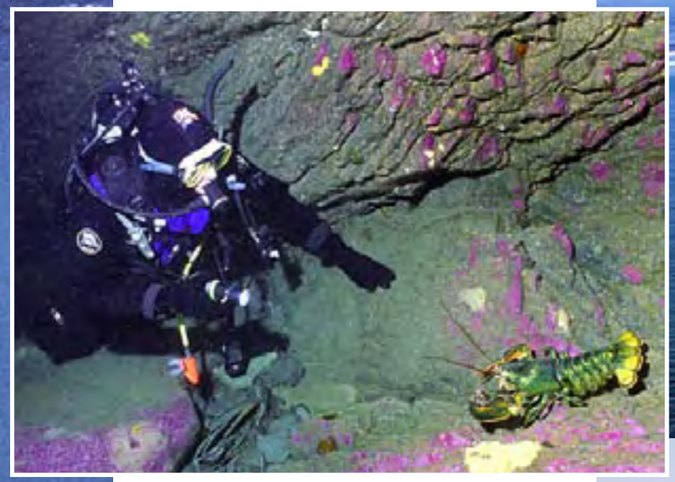
It appeared to be a radio cabin. As in all old ships, the radio cabin, or Marconi's room, was located just above the superstructure of the ship. The door was absent, so we went inside. There were old broken wood boards and a panel with old style arrow galvanometers with scraps of wires hanging on them. Antiquated microphones, or headphones were also visible.

I found out that my dive buddy also happened to be a specialist in wireless radio communications with knowledge accumulated over 23 years of service in the Navy. So, he was ecstatic over this find. His eyes burned with enthusiasm and his happiness about the discovery was boundless. If only he could have touched the history of radio here in this British wreck in the Northern Atlantic, he would have been all the more excited.

Despite language barriers under water, it was simple to understand his exuberance, because I had enough knowledge and appreciation of the topic myself. During that



Newfoundland

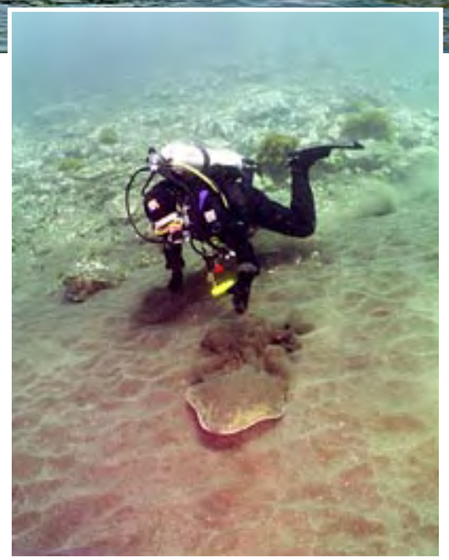


moment however, I was more nervous about the gas pressure in my small cylinder. Decompression time was growing too quickly, so I was the first to give the signal that it was time to go home.

We came up to the sun and warmth very slowly with "deep micro bubble stops". We each retreated into our own thoughts, recollecting the brightest impressions of the dive. After returning to the surface, both of us were in unanimous agreement with our skipper that the ship was a huge underwater city full of fascinating secrets and exciting discoveries. We were full of desire to dive it again and again knowing that we could never completely explore everything in this sunken city.

Newfy Charm

Newfoundland is home to an underwater world full of life—blue ice blocks and brilliant icebergs, whales breaching, mysterious coastal grottoes (which should be checked for hidden pirate treasure) majestic wrecks and the unique, sun lit and clear waters of the North Atlantic. Peering at this wonderful island far below the wing of the plane on my return flight home, the uncontrollable desire to come back here again arose—as with any good fairy tale, you want to read it again—to see 5000 whale tails and to experience once more the underwater charm of NEWFY.



PS: The editors of X-RAY MAG would like to express their gratitude to Rick and Debbie Stanley, skipper William Flaherty and Steve Moore, and Ocean Quest Charters for their hospitality and guidance in the experience of Newfoundland.

www.oceanquestcharters.com ■

ALL PHOTOS THIS PAGE:
Great marine life, great landscape, great views, great diving and … great luck! This is Newfoundland

fact file

Newfoundland, Canada

History Canada is a country of rich natural resources and vast distances. In 1867, Canada became a self-governing territory while retaining its relationship with the British crown. The country has developed economically and technologically in parallel with its southen neighbor along an unfortified border, the United States. After a decade of budget cuts, the country's greatest political issues are improving education and health care services. Recently, the issue of reconciling Quebec's francophone heritage with the rest of the country's population which is anglophone, has receded after a referendum held by the Quebec government failed to pass in 1995. Government: confederation with parliamentary democracy.

Geography Located on the northern half of the North American continent, Canada is bordered by three oceans: the North Atlantic Ocean on the east and the North Pacific Ocean on the west, as well as the Artic Ocean to the north. After Russia, Canada is the second largest country in the world. It has a strategic position between Russia and the US on the north polar route; about 90% of Canadian are concentrated in the area within 160 km of the border with the US. Terrain: wide plains with mountains in the west and lowlands in the southeast; Natural resources: iron ore, nickel, zinc, copper, gold, lead, molybdenum, potash, diamonds, silver, fish, timber, wildlife, coal, petroleum, natural gas, hydropower; Natural hazards: continuous permafrost in north is a serious obstacle to development; as a result of the mixing of air masses from the Arctic, Pacific, and North American interior, cyclonic storms form east of the Rocky Mountains and produce most of the country's rain and snow east of the mountains.

Economy Canada closely resembles the US in its market-oriented economic system, pattern of production, and high living standards. It is an affluent, high-tech industrial society. Agriculture: wheat, barley, oilseed, tobacco, fruits, vegetables; dairy products; forest products; fish; Industries: transportation equipment, chemicals, processed and unprocessed minerals, food products; wood and paper products; fish products, petroleum and natural gas.

Climate varies from temperate in the south to subarctic and arctic in the north

Population 32,507,874
Ethnicity: British Isles origin 28%, French origin 23%, other European 15%, Amerindian 2%, other, mostly Asian, African, Arab 6%, mixed background 26%; Religions: Roman Catholic 46%, Protestant 36%, other religions 18%

Currency Canadian dollar (CAD) Exchange rate: 1 CAD = $ .82 USD / € .63 EURO

Language English 59.3% (official), French 23.2% (official), other languages 17.5%

Web sites

Newfoundland and Labrador Tourism **www.gov.nf.ca/tourism**
Newfoundland&Labrador.com **www.newfoundlandandlabrador.com**

Dive Operators

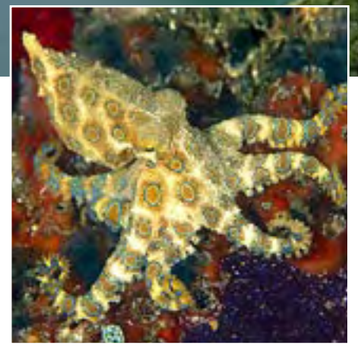
Ocean Quest Charters
www.oceanquestcharters.com

Deco Chamber

Centre for Offshore and Remote Medicine (MEDICOR)
Faculty of Medicine,
St. John's, NF, Canada, A1B 3V6
Telephone: (709) 737-6433,
http://www.med.mun.ca/medicor/pages/nasa.htm ■

Diving Indonesia in Style

Raja Ampat Liveaboard



LEFT: *SMY Ondina*, a Spanish owned ship built by hand using the traditional methods of South Sulawesi, was designed for diving
ABOVE: Wayag's Rock Islands top Palau for beauty
RIGHT: Red-orange starfish on blue tunicates; Blue-ringed octopus; Elegant squat lobster on soft coral

Text and photos by Deb Fugitt

Raja Ampat in Indonesia is dotted with tiny islands scattered like beads across an area of sea and surrounded by large platform and fringing reef systems. The seas here are calm much of the year due to light winds and the shelter provided by nearby islands and reefs. Everywhere one looks, potential dive sites beg to be explored and with a water temperature always in the 27-28° C range we would be happy to spend many hours per day doing so. Strong currents are very common on reefs throughout the area. This is a good thing as the current diving provides us colourful soft corals and packs the huge schools of fish into dense masses. The currents also bring nutrients for the small creatures. Raja Ampat is becoming well known for its diverse marine life by scientists and divers alike.

Raja Ampat

A pristine white sand beach on Gam Island

As a still photographer, Raja Ampat appeals to me for its wide angle opportunities, video being the only better tool to capture the area's wonders. No where else I've dived offers such consistent mind boggling vistas of fish and corals. Yet, focusing down to a smaller level there are macro creatures galore.

Areas of mushroom shaped rock islands seem to harbour some of the better dive sites and make for beautiful and interesting topside scenery as well. This area is destined to become a World Heritage Site.

Dr Gerald Allen declared recently that "Raja Ampat represents the bulls-eye of biodiversity in coral reefs" and recommended "we protect the reef at all costs, because it represents the baseline to which all other reefs in the world be compared."

Raja Ampat is considered remote. Located off the Northwest "Bird's Head" Peninsula of New Guinea Island, Raja Ampat is a cluster of over 1500 small islands, bays and shoals surrounding the four islands of Misool, Salawati, Batanta and Waigeo. Named after the "Four Kings" of these islands, Raja Ampat is a part of the West Papua province of Indonesia which was formerly Irian Jaya and is now its own district with its own government.

"Remote" depends on your definition. While much of the area is unexplored, it is easy enough to fly by jet into the local Sorong airport from Manado or Makassar (Ujung Pandang) where you are collected by ship to travel an hour or so to the diving areas.

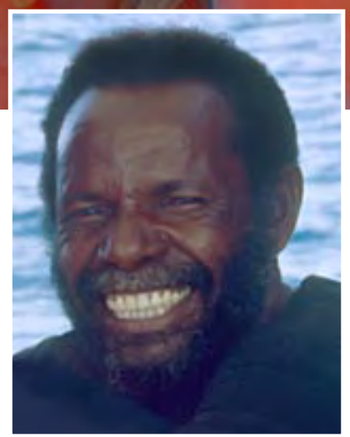
LEFT: Orange gorgonian fans, red soft corals and golden cup corals grow within inches of the rainforest overhanging The Passage

ABOVE: Ghost pipefish can be found on night dives around Waigeo, Fam, Dampier Straits, Misool

LEFT: This beautiful Ctenophore, *Coeloplana astericola,* is found on the arms of starfish in Raja Empat

BELOW: Blue Tail Surgeonfish and Barracuda. Small schools of barracuda often hang near or mix into schools of surgeonfish and other species

Raja Ampat



Michael

Bear hugs and big fish

"Michael!" We cried out in unison as we hopped aboard *SMY Ondina*, our liveaboard home for the next month. Stepping agilely across the deck, sidestepping bewildered looking new passengers, crew and luggage, Michael reached my companion, Tony, quickly. Wrapping his powerful arms around Tony's waist, Michael hoisted Tony in a giant bear hug spinning him effortlessly in a circle while carrying him across the deck. A joyous reunion with an old friend portended great adventures for our first liveaboard charter in the Raja Empat islands.

When Tony Matheis and I began coming to Raja Ampat in '99, it was Michael who, after two weeks of so-so diving with other guides, put us into the water in the conditions that we now recognize as optimal for seeing the reefs and fish life at their finest. Opting for diving with him from a longboat instead of with the other tourists on the dive boat was the best decision I had made in years.

Michael has an uncanny ability to know the conditions underwater, where the fish are schooling and the direction and force of the current, all necessary skills to get the most out of a dive in the current-swept areas of the enormous reef systems in this hot new dive destination. Thanks to his years of experience in the area, we came home with some of the best images in years.

Our guide dropped us into immense schools of Pale or Blue Tail Surgeonfish. As we plunged headfirst toward the bottom we scattered huge schools of bannerfish

Raja Ampat

and streams of fusiliers so as to get in front of the reef before the current carried us over the top. The surgeonfishes hanging effortlessly in the current were so densely packed, they were like black and blue walls stretching from the sand to the top of the reef. When separated by less than 10 meters from my buddy, I could not see him or the flash from his powerful strobes.

Over and over, we jumped into the fishiest dives I had ever seen. Again and again, we left our secure current-less spot in front of the reef out of film but not bottom time. We soared like gliders over the tops of immense reefs surveying the life below until we slowly surfaced a hundred meters or more away from our site and were met instantly, and incredibly, by Michael, who hoisted me up with his muscular arms back onto the longboat.

The longboat is a sort of overgrown wooden canoe equipped for transporting material through the islands, not for divers. While the men with their natural upper body strength climbed easily aboard, I had to be lifted.

After the first day and multiple bruises on hip bones, I worked out a successful, if rather comical, alternative method that always put the men into fits of laughter. After handing up my fins, I would lay back in the water and throw my legs over the edge, then two of the men would grab my arms and sit me up into the boat. Hey! At least the bruises were all behind me now.

That was when we fell in love with Raja Ampat's diving.

Ah, those were the good old days! We survived on peanut butter, bread and canned tuna and kept on coming back to dive as often as we could.

The Liveaboard Trip

For our month long trip, I chartered *SMY Ondina*, a traditional Phinisi ship built in Bira, South Sulawesi, Indonesia, of exotic hardwoods. She is a Spanish-owned ship whose interior layout was designed by the on-board owner and cruise director, Ricard Buxo, who also supervised the ship's construction. Ricard's careful design makes Ondina function as though it is a much larger ship. Cabins are spacious, and the dive deck is well organized. There are tables, charg-

ABOVE: Lionfish on red fan coral

CLOCKWISE FROM LOWER LEFT INSET: Kaboi Bay, as well as many other areas of Raja Ampat, is filled with small rock islands

SMY Ondina is outfitted in exotic wood and decorated with Indonesian art

Ondina has a large table for working on cameras, deep storage for cameras underneath and two fresh water padded camera rinse tanks

There is plenty of light in the cabins and individual AC units

ing and camera rinse facilities for the photographers, and there is room for guests to spread out. Numbers of guests are limited, so that divers can get in more dives.

Ondina's Captain Ambo worked in Papua for five years on a different ship and now has a total of seven years experience in the area. He is quite skilled in navigating the treacherous reefs and helps plan our flexible itinerary estimating times and possible routes when we want to make a change.

Although *SMY Ondina's* crew is quite experienced, Michael and one other Papuan guide were asked to come along to help with the dive schedule, which included more dives per day than a normal trip.

Michael fished these waters with his father before showing the first dive operator in the area the best reefs for fish as well as the location of many WWII wrecks. Every trip made is geared toward photographers, and entire days are often spent at one site alone diving the sites as many times as desired. Bottom time is not arbitrarily limited.

The crew is happy with our arrangement, as the guests can dive and the crew can still get a bit of rest during the day. Michael, however, is always watching the divers and somehow knows which diver is where on the reef—although I would swear he cannot see them.

Dampier Straits

First, we headed out to the Dampier Straits to dive the long, fishy reefs there. Depending on the current, dives are best at one reef or another. There are several world-class sites within a 15 minute ride. When the current is running, the best location is chosen, divers are dropped just in front of the reef and then the current carries them back into the sweet spot just in front of the boat.

In this area, we expect to see lots of fish, turtles, manta rays, schools of large bumphead parrotfish munching the corals and plenty of fish. Oh, and did I mention there are quite a lot of fish here?

First Dive

The red and white inflatable dive tenders ferried us out to the reef where fortunately there was a manageable current running. Falling backward over the side, I did a complete underwater somersault and surfaced briefly for Michael to hand in my camera.

I made a quick survey from the top which showed so-so visibility but plenty of fish and diver activ-

LEFT: A beautiful green anemone is host to a pair of brilliant red Spinecheek Anemonefish
RIGHT: A frilly-edged Tasselled Wobbegong Shark rests on a table coral

ity. Clouds of tiny fish surrounded some of the coral bommies while up and down the steep slopes of the site, schools of four-lined snappers, sweetlips, fusiliers and rabbitfish wandered amongst red and purple soft corals, leather and black coral bushes.

The divers from the first tender were already busy. From my vantage point, I saw several divers waiting around an overhang to photograph a frilly-edged Tasselled Wobbegong Shark, which rested underneath; others lining up shots with several intermediate batfish in front of coral covered bommies; and our trip's anemonefish addict, Marylou, setting her sights on a beautiful green anemone that was host to a pair of brilliant red Spinecheek Anemonefish.

The current split at the point of the reef. I let myself be carried down current to check out some coral-encrusted bommies on the white sand bottom that are very colourful places to make a horizontal image. Afterwards, I stayed low, ducking behind corals and large fans, playing eddies created by the current so as to get back up to the point without an exhausting swim in open water.

Just to the other side of the point, yellow streams of four-lined snappers swarmed over the slope like yellow rivers, parting around coral islands and pausing beneath towering table corals. These docile fish allowed me to swim right into their schools, coming within inches of my camera lens. The school flexed and finally parted to let me pass.

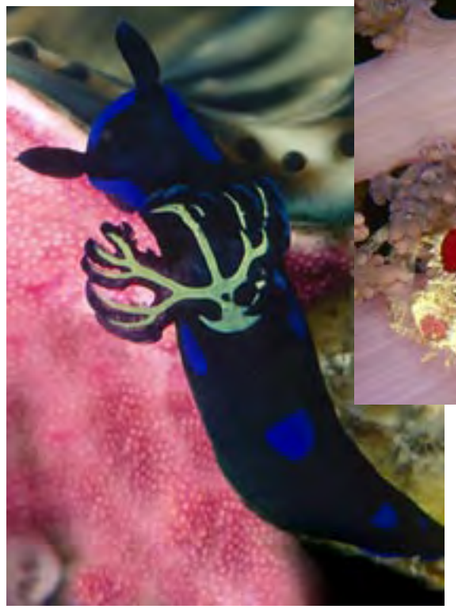
I made a brief visit to a large soft coral covered bommie with a horizontal V-shaped crevasse underneath to see that it was, as usual, filled with several large batfish, some oriental sweetlips and a few smaller fish.

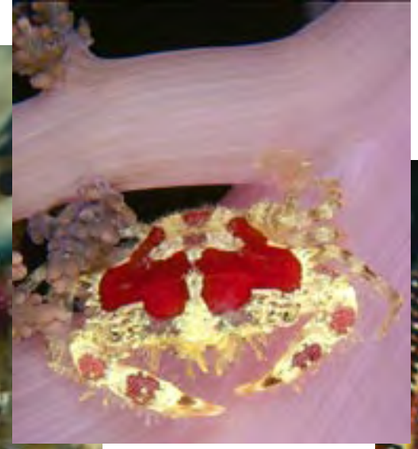
Turning back toward the point, the area most densely covered in life, I spotted a giant clam on top of the point. The spot must have been a great place for filter feeders as the clam was huge. But it was also a tough spot for a diver to stay still. I ducked down behind the bommie beside the clam and waited for schools of fish to pass over and behind the clam to catch a more interesting wide-angle scene on film.

Favourite Sites for Small Creatures

One of the favourite macro photography sites on the trip was in

Raja Ampat





LEFT TO RIGHT: Orange Pygmy Seahorse; Tambja morosa Nudibranch on Giant Clam; Juvenile crab on pink coral in silty bay of Batanta; Blenny on soft coral; Flatworm on Gold Sponge

a deep bay on the western end of Waigeo where a long wall alternates with a steep slope both covered in corals and anemones and shadowed by rainforest from the island above. The site is populated by orang-utan crabs, ghost pipefish, a great variety of nudibranchs, several species of lionfish and of course, pygmy seahorses.

Pygmy seahorses seem to be everywhere, so we restrict ourselves to looking for them on designated *macro* days when we are diving in calm areas.

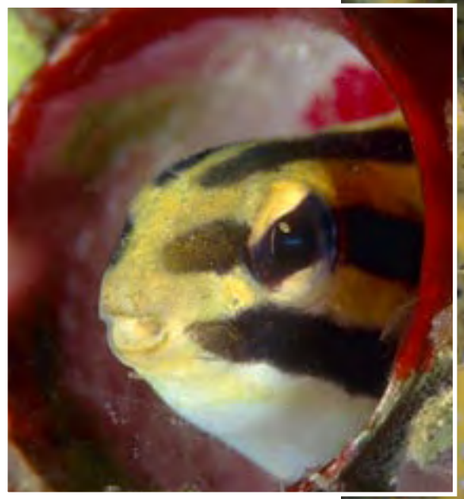
This site could be dived from 30 meters to the surface so bottom time was no problem. We took advantage of this by spending the entire day at this site, most of it in the water. Highlights were the abundance of orang-utan crabs, striking orange 'pygs' (pygmy seahorses) on a matching fan, a giant zebra crab on a fire urchin, and bizarre Phyllodesmium species nudibranch, juvenile egg cowries and both robust and ornate ghost pipefish.

The dive site is long and protected. Although there occasionally was a current, there was no chance of getting lost or being swept away and there was always a sheltered area.

What we found immediately were schools of silversides so dense they would turn day into night when overhead. Even in the brightest part of the day, I would need a light to enable me to focus on the robust ghost pipefish or on the tiny crabs in the fire urchins.

Every bubble coral had its orang-utan crab. Nudibranchs and flatworms were scattered like confetti over much of the site. There was always something interesting to be found on the soft corals, among the algae or in the holes. Rainbow-coloured mantis shrimp would sit up and watch as divers swam past then dart toward their hole when approached. Certain areas were covered in the small yellow holothurians (sea cucumbers) that are common in Indonesia as well as an orange and green coloration that

Raja Ampat



I had never seen before.

Divers came and went as they pleased all day changing locations as they learned what others found in their explorations, trading information on critters, their depth and landmarks to find them.

On the second dive, I came upon a beautiful orange sea fan perched on a sandy ledge in the wall. It was such a beautiful colour that I searched it carefully for any small creature to use as a subject for a photo composition. Imagine my surprise when I found three nice-sized pygmy seahorses! I marked the fan with a nearby stick that had fallen from the rainforest above, sticking it vertically into the sand. Other divers were able to locate the fan and get some photos of these cool 'pygs'.

After a lengthy night dive at the site, we started the long overnight leg of the cruise. Everyone sat down for a dinner of Indonesian specialities inside *SMY Ondina's* air conditioned dining room and lounge.

Night diving

In Raja Ampat, the stems of the tiny mushroom-shaped islands sit upon a shallow plateau, or ridge, and are covered in soft corals, fans and tunicates. These are also among the most favourite spots for night dives and small creatures. During the day, vertical schools of fish often drape these islands' sides or swirl across hard coral covered plateaus. Divers search the tunicate laden sides of the islands for nudibranchs, flatworms, blennies and scorpionfish.

At night, even spots that looked barren during the day come alive with small crabs, shrimps and other night creatures. In the dark with our vision narrowed to the beam of our dive lights, we focus on tiny creatures crawling across most of the corals and crinoids. Decorator crabs, hermit crabs, squat lobsters cling to the corals and are happy to grab and eat the tiny worms attracted by our lights.

At one site where I noticed a beautiful yellow gorgonian in daylight, I was pleased to find now-conspicuous tiger cowries crawling amongst its branches at night. Raja Ampat is home to a huge variety of molluscs, so it is very common to find allied cowries and other species of shells moving at night.

ABOVE: Chromodoris Koi nudibranch in The Passage
INSET TOP: This blenny made its home in a deserted worm tube
INSET BOTTOM: Night is the time to find crabs, shrimp, lobster, eels and molluscs. Decorator crabs can be quite funny with a top hat of coralimorph or upside-down jellyfish

TOP: Sargassum Frogfish live in floating sargassum weed
BOTTOM: Bright Red Orange Sponge and Orange Tunicates

Raja Ampat

TOP LEFT: Nude pygmy seahorse
TOP CENTER: Tiger cowrie
BOTTOM CENTER: Black coral shrimp
RIGHT: Pregnant shrimp on Bubble coral

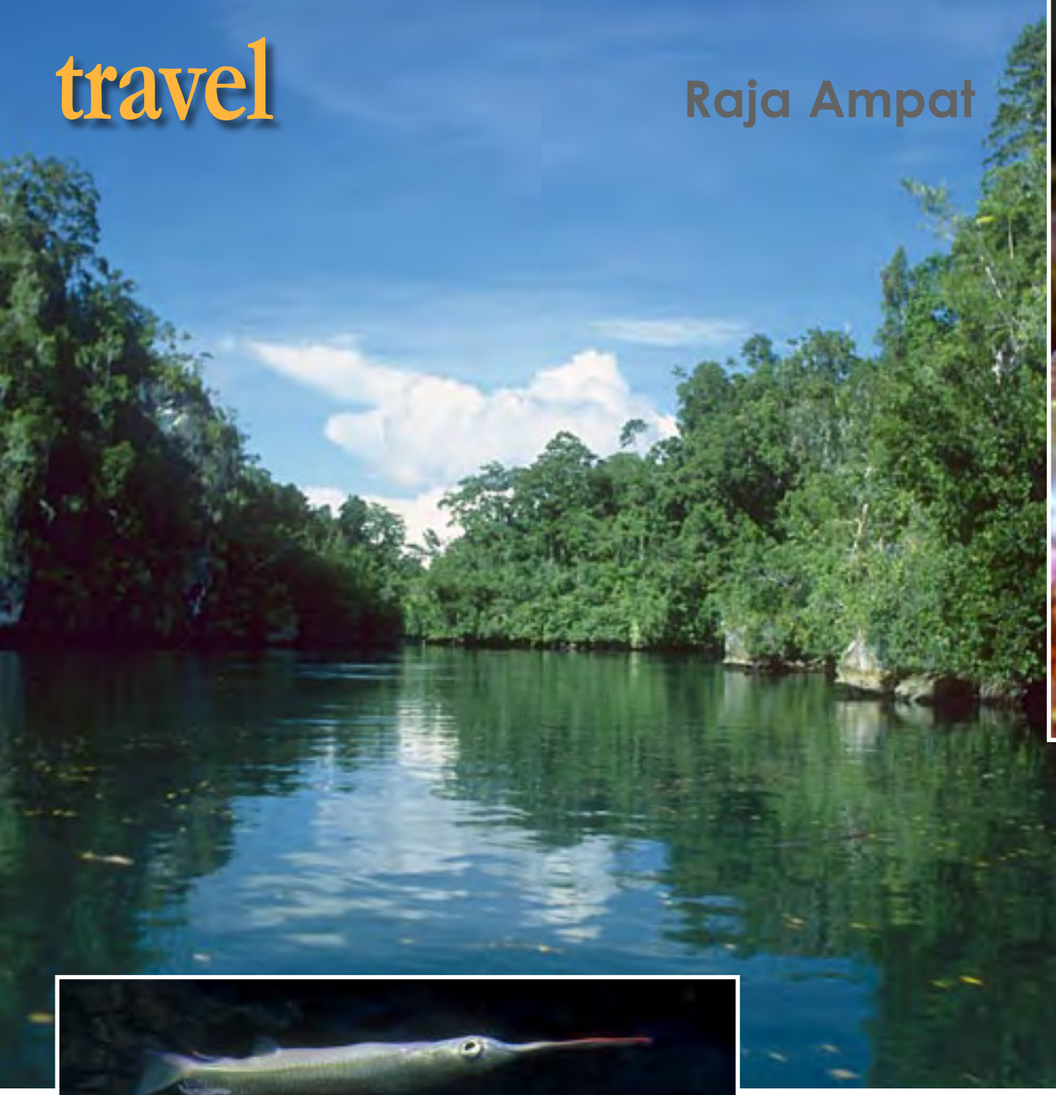
Unusual Dives

No story on Raja Ampat diving can be complete without a mention of the narrow passage between Gam and Waigeo Islands. A channel, so narrow it seems to be a small river, divides the two islands and runs into Kaboi Bay, a bay which at first seems to be a large lake. On both sides of the channel dense rainforest overhangs the water. The channel is shallow and at times has a ferocious current with mini whirlpools in the larger bays. The best dives here start at the open end of the channel in shallow water during a period when the current is running toward Kaboi Bay and before it gets too strong.

In the shallow water, delicate lettuce leaf corals grow just beyond reach of the current. Small soft red corals cling to the bottom out in the channel. Let the current carry you along while you manoeuvre to stay close to the side. Otherwise, the dive will be over in minutes.

Along the channel, divers pass areas of golden cup corals, red and pink soft corals that line the channel's sides. Tuck inside a shallow bay for a relaxing look around. There

Raja Ampat



CLOCKWISE FROM INSET LEFT: Halfbeak. The Passage, Waigeo and Gam

Entering The Passage. A narrow channel between Gam and Waigeo is a short cut for boat traffic and an excellent dive site. This site must be dived near slack tide

Tunicates and hydroids are food for nudibranchs and flatworms. *Nembrotha purpureaolineolata* feeds on tunicate

Archerfish skim along just beneath the surface watching the leaves above for bugs. They can shoot a bug with a stream of water knocking it into the sea

in the calm water, pinnacles covered with tunicates host many flatworms and nudibranchs. Soft corals and fans grow on drowned logs while the sun paints the dark water with streaks of light. Inside these mysterious bays where the water's surface is very calm, one can look up past brilliantly coloured sea fans to see rainforest where archerfish seem to fly through the green leafy branches of trees.

In some places, corals are only inches from leaves. We've joked that the only thing missing to complete the perfect reef and rainforest photo, would be a Wilson's Red Bird of Paradise perched on a branch just above the water. This bird lives nearby so it is not a completely unreasonable hope.

Back out in the channel, Bumphead Parrotfish, large tuna, turtles, jacks or sometimes sharks seemingly come out of nowhere, swerve to avoid divers and continue on out of sight. Everything in the channel is on a mission. Divers can continue this journey, in and out of the current and quiet bays until they reach a large bay where they finish the dive in a sandy shallow area with many species of shrimp gobies.

If the day is overcast and dark, photographers can concentrate on shooting scenes of archerfish, polka-dot cardinalfish, flatworms and nudibranchs.

The Passage is a short cut for boats in the area, so one can often see families of Papuans while anchored there. We were visited by entire families who live on a covered raft, catching and drying fish on the roof. One of the crew bought a Cockatoo from them, which was quickly adopted by some of the women on the trip. They cleaned and nursed the poor creature for the remainder of the journey.

Overview

The only long passage on our trip was from Waigeo to Misool, about a 10-hour overnight voyage, but always comfortable as the waters in Raja Ampat are very protected from rough seas by the abundance of islands. Misool's dive sites are certainly the most densely covered with the most colourful soft corals, fans and tiny fish that I have ever seen and are excellent for colourful coral shots and for macro, particularly at night. However, we do not see the variety of larger fish found in northern Raja Empat or the variety of underwater structures there. On other days, sailing time lasts from 30 minutes to no more than 4-5 hours after the night dive.

Conservation

Raja Ampat is a relatively small area with a huge number of world-class dive sites and more waiting to be discovered. Each dive site is large and there is such variety and diversity on each one that a long article could easily be written about each site. I encourage everyone who wants to experience this area to do it quickly while this it is still relatively untouched.

There is currently no effort at conserva-

Raja Ampat

LEFT: Blue-ringed octopus are smaller than a hand
ABOVE: Scorpionfish are often well camouflaged among the corals and sponges. Be careful what you touch!
INSET: Underwater photographer and diver, Deb Fugitt

tion in the area, and it is likely to be years before any effective conservation plan is in place to protect this amazing ecosystem. We hope the new Raja Ampat district government will resolve some of these issues and help to protect the people, reefs and rainforests of this remarkable and unspoiled area. Only time will tell.

Our Raja Empat dive guide, Michael, eagerly anticipates this year's voyage with *SMY Ondina's* superb ship and crew for another month in Raja Empat. He has new places to show us. We are keen to see new sites and to spend time with our gregarious Papuan friend. We anticipate more bear hugs from him, which are given generously to us and to those who have also caught the Raja Empat "bug". We will meet him again in Papua.

Deb Fugitt is an underwater photographer and owner of an Internet marketing company that designs web sites for travel, dive and photography businesses. For more information or to make reservations for one of Fugitt's special Raja Empat trips organized a few times each year, see: ***www.cityseahorse.com/rajaampat***

Visit ***www.smyondina.com*** *for liveaboard trips to Papua and other destinations within Indonesia with SMY Ondina.* ■

Soft Corals at Slacking Tide. When there is no current, Raja Empat's dive sites change in appearance. The current is slowing to a stop in this photo. Some of the corals have started to droop and shortly they will be difficult to see

fact file

Raja Ampat, Indonesia

History Humans first settled New Guinea at least 50,000 years ago, when it was connected to Australia by a land bridge. A British attempt at colonization in 1793 colony was evacuated within two years. The Dutch were next, proclaiming in 1828 that the natives of the western half of New Guinea were to be subjects of the King of the Netherlands. They opened Fort du Bus to protect their lucrative trade with the spice islands from other European powers, but abandoned the area after only 10 years. No continuous settlement was established in West Papua until 1897, and no substantial development was undertaken within the country until the 1950s. In 1949 the Dutch ceded sovereignty of Dutch East Indies to the Indonesian Republic, but excluded Dutch New Guinea (West Papua). A long and tortuous history followed. The controversial West Papuan version can be examined at **www.newint.org/issue344/history.htm**.

Government Republic of Indonesia, Papua is one of 27 provinces with its capitol in Jayapura. As of late 2004 Raja Empat has a separate district government.

Geography Southeast Asia. Raja Empat is the most western district of the Indonesian province of Papua. Raja Empat consists of an area surrounding four major islands off the western coast of the Bird's Head Peninsula of New Guinea Island, the western half of which is Indonesia and the eastern half, Papua New Guinea. The province was formerly called "Irian Jaya".

Climate Tropical, hot and humid. The water temperature is normally 84-86F / 28-29C year round, with an occasional "chilly" 82F / 27C spot. We've had no problem with cold when diving 4 -7 long dives per day in 1mm neoprene suits, however some people prefer 3mm.

Environment Logging. The rainforests within the combined West Papua/Papua New Guinea land mass are second in size only to those of the Amazon, making it 'the lungs of Asia'. In 2001 there were 57 forest concession-holders in operation around the country and untold other forest ventures operating illegally. Mining. Tailings from copper, nickel, and gold mining are real threats.

Currency The currency is the Indonesian rupiah. ATM machines generally offer the best exchange rates, dispense rupiah and are readily available in most major cities or where there are many foreign visitors. Large denominations ($100 bills) of cash in US dollars is fairly easy to exchange, however all bills must be issued after 1999 and certain series of bills are almost impossible to exchange. Travelers' cheques are becoming quite difficult to use except at banks.

Visa cards, and cash in major currencies are widely accepted at banks, money changers and hotels in major cities and tourist destinations. When visiting Raja Empat it is unlikely you will have an opportunity to use an ATM or exchange money. Check with the dive operator for forms of currency they accept, or bring cash in rupiah for tips and purchases.

Population All of Papua Province - Total population: 2.1 million (2.5 million). Indigenous: 1.3 million (1.5 million). Migrants and transmigrants born in other parts of Indonesia: 350,000 (850,000).

Language Bahasa Indonesian, in addition to 253 tribal languages. West Papua and its neighbour, Papua New Guinea, contain 15% of all known languages. English, Spanish, German are spoken on the ship. Bahasa Indonesian and English generally spoken at hotels and airports along the route and in Sorong.

Security Although they are in an active Independence movement in Papua, tourists have not been impacted.

Electricity Standard electricity is 220V, 50Hz. A few hotels and liveaboards have transformers to provide 110V. Bring smart chargers for rechargeable batteries. The plugs have two prong round plugs.

Health & Vaccinations
Nearest decompression chamber: Manado. Malaria is common in the area. Check with WHO or your dive operator for prophalaxis recommendations. Larium is not effective in Papua. Be prepared with insect repellents containing DEET. International Certificate of Vaccination required for Yellow Fever required if arriving from infected area within five days.

Visas & Permits A 30 day visa-on-arrival facility is available to nationals of the USA, UK, most European countries and many Asian countries. The fee is currently $25 for visitors from most countries. Check with the Indonesian Embassy or Consulate nearest to you for a longer visa. All passports must be valid for a minimum period of six months beyond your intended stay. To enter Papua, you need a *surat jalan* which is issued by the local police. This can be arranged by your dive operator who will require a copy of the photo page of your passport and the visa-on-arrival or visa page from your passport. ■

Edited by
Andrey Bizuykin
& Peter Symes

POINT & CLICK
ON BOLD LINKS

What's hot...what's next

Equipment

T2 from Atomic Aquatics

Says Atomic Aquatics on their web-site: "The T2 is designed to be the best performing and best looking regulator on the market—PERIOD. Built in durable and leightweight titatanium this sleek looking 300bar reg comes with a lifetime corrosion warranty. Can be used with Nitrox up to 40% without modifications.
www.atomicaquatics.com

Personal Locator Beacon

OK, so you are lost, stranded or in serious distress, stranded, injured or otherwise in need of rescue but your cell phone is out of reach of the network and you don't carry a radio either. What do you do? Enter this Personal Locator Beacon which use satellites to not only relay your distress call to the Search and Rescue services, but also provides them with a fix on your position. This Aquafix 406 GPS GPB comes a suggested retail price of USD 650
www.acrelectronics.com

Buzz Off

No, we are not being rude. Buzz off is the apt trade name of these special garments. They are insect-repellant, and as such, will come in very handy for any traveller that goes to areas where there are mosquitoes and other nuisances - as divers sometimes do. The are several different models, sizes and colours for ladies, gentlemen and kids. Typical pricerange usd 35 to 85 seen as seen at Ex Officios webshop. **www.exofficio.com**

Radiator

A new type of wetsuit material technology. It's a 4 layered construction, comprising a 'slipskin' inner lining reflecting body heat, a closed cell neoprene rubber core, a titanium lining which acts as a highly efficient barrier to the cold and a nylon jersey outer layer for durability. Put simply, you can now wear less. Radiator were selected by ISPO, the world's largest sport's trade fair, as the best new sportswear in their "Brand New" section in 2004. **www.radiator.net**

Fashion statement

This eye catching dive computer, Xtender Lady, is an exclusive special edition of the probably smallest dive computer available on the market at the moment, the Scubapro Extender. Suggested retailprice is € 579,- Euro
www.Scubapro-Uwatec.com

Out to dry

This portable, lightweight drying rack from H2Ice will not only store your gear between uses and keeps equipment dry and odor free. Their patented drying system, which comes with one or two blowers, will dry out even the wettest wetsuit in the matter of a few hours. From usd 225 **www.h2iceonline.com**

Hello?

Ocean REEF has some adjustments to their The GSM (Global Submarine Messenger, underwater communcation unit for their Neptune full face masks and others') to make it louder and clearer than ever! The GSM has a new microprocessor that removes "dirty frequencies" such as noise from bubbles, water brushing rocks, boat motors, etc. **www.oceanreefgroup.com**

MK17AF

Scubapro writes about the new MK17AF that it is their most advanced overbalanced diaphragm 1st stage today and the first of a new generation of diaphragm first stages that offers exceptionally high performance in its class (up to 8000 liters/minute flow at 200 bar), close to the unrivalled overbalanced piston design.

www.Scubapro-Uwatec.com

The Inevitable

With steadily more mobile phones being equipped with digital cameras it was just a thing waiting to happen: An underwater housing for cells phones with MMS capabilities. It it is depth-rated to 20 meters and there cases for Nokia, Siemens, Sony-Ericsson and Samsung - and in various colours. Check Wave cases' website for pictures taken this way.

www.wavecase.de

Singaporean ScubaPunk T's

Looking into making a different sort of dive fashion statement? Check out ScubaPunks streetwear inspired collection of t-shirts with an attitude. **www.scubapunk.com**

Clogs...erh.. Crocs

Ever needed some footwear, say on a diveboat, which you could easily slip into, which can get wet without being ruined and has a non-slip sole. Well crocs may be the answer. This model, the Highland, is "closed-top, portless, durable design ideal for cold, wet climates and/or bio- hazardous environments. Ventilated, fashionable and really, really comfortable." **www.crocs.com**

InView goggles

Keep track of your swimming laps with goggles these that displays lap count and time on the inside of the goggle lens, directly in the line of sight of a swimmer. An exiting new project from Katie Williams, an industrial design student at London's Brunel university. No production details yet, but nice thinking. Source: The Engineer Online

Nightvision?

A filter set from Night sea in front of a divelight, and one of these visors is all you need to experience one of the most amazing underwater sights: Corals' flouresence. Filter to fit onto your divelamp (not) shown and visor comes in packages priced at usd 135. Seperate visors cost usd 20 **www.nightsea.com**

Seek and ye shall find

The new UWATEC navigation slate is a real allrounder when it comes to precise underwater navigation. The slate with non-slip handle and pen holder can be used for your notes, directions, reef descriptions or simply your dive plan. But the main attraction is the angled rim that holds up to two different instrument capsules. You can read your notes easily and watch your most essential instruments like a compass and your dive computer at the same time. Fits the Aladin Tec and Aladin Prime, the Digital Bottom Timer as well as the Standard Depth Gauge. **www.scubapro-uwatec.com**

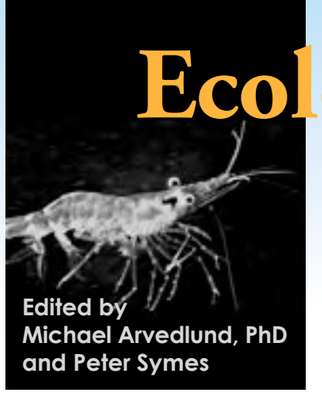
From the inventor of the VR3-computer

The Ouroboros rebreather is a fully closed circuit, rear mounted counterlung unit. Designed as an electronic control unit will full manual override. Advances in CO_2 canister design have been incorporated into the unit. A radial scrubber, the counterlungs and other sensitive parts are all enclosed in a carbon kevlar case. Electronics comes with a primary wrist mounted display, Head-up Display (HUD) a rear facing display and a completely redundant passive oxygen display showing true real time pO_2 independent of the main electronics.

www.ccrb.co.uk

In case of emergency apply ICE

East Anglian Ambulance Service have launched a national "In case of Emergency (ICE)" campaign with the support of Falklands war hero Simon Weston and in association with Vodafone's annual life savers award. The idea is that you store the word " I C E " in your mobile phone address book, and against it enter the number of the person you would want to be contacted "In Case of Emergency". In an emergency situation ambulance and hospital staff will then be able to quickly find out who your next of kin are and be able to contact them. It's so simple that everyone can do it. Please do. Please will you also forward this to everybody in your address book, it won't take too many 'forwards' before everybody will know about this. It really could save your life. For more than one contact name ICE1, ICE2, ICE3 etc

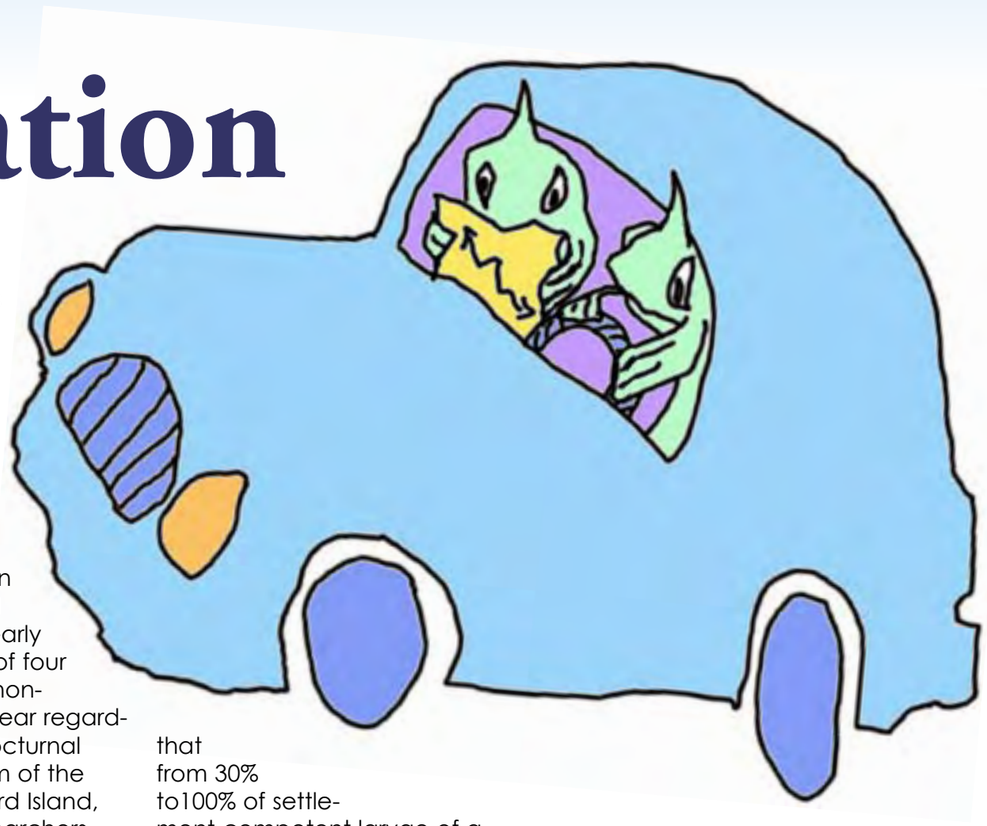


Edited by
Michael Arvedlund, PhD
and Peter Symes

ILLUSTRATIONS BY GUNILD AND PETER SYMES

Coral Reef Fish Larvae

Masters of Navigation



Coral reef fishes have a life cycle that is divided in two. They begin their life after hatching with a pelagic larval phase, lasting from a week up to two months depending on the species, and ends with a benthic phase, when the fish larvae settles to the coral reef one night. For decades the pelagic phase has been a black box to researchers. Only recently has the lid to this black box been opened.

In a recent article in X-RAY MAG, we looked at the astonishing swimming ability reef fish larvae have. However, long distance swimming is of little use without navigation. Orientation is necessary if a pelagic reef fish larva is to find a reef by other than chance, and orientation requires not only cues and the sensory means to detect a coral reef, but also the ability to determine the direction from which the cues originate. Recent research has shown that the swimming behavior of reef fish larvae on the open ocean indicates that they do orientate rather than just cruise about haphazardly. But exactly what cues reef fish may detect and use is not so obvious.

The well-known coral reef fish researcher Dr Jeff Leis, the Australian Museum, have in recent years caught, identified, and then followed released reef fish larvae off shore in many research projects, determining direction and swimming speed of reef fish larvae.

Some reef fish larvae swim away from the reef, out of sight of it, and then return. This behavior implies either a good memory for reef location, or the aptitude to detect a reef tenuously and return to it. For example at Lizard Island, the northeastern Great Barrier Reef, Dr Leis and his research team analyzed the swimming directions of a group of fish larvae of several coral reef fish species, each released individually, and showed that individual swimming patterns of most were not random but significantly towards one particular direction, and that on average, these swimming patterns differed among three locations on different sides of the island, and were offshore at each location. This implied that the fish larvae – all less than a few centimeters - could sense the Lizard Island from over 1 km offshore.

Recent research has shown that the swimming behavior of reef fish larvae on the open ocean indicates that they do orientate rather than just cruise about haphazardly

At an oceanic atoll in the Pacific, Dr Leis and his team found that nearly all swimming patterns of four reef fish species were non-random and usually linear regardless of location. In a nocturnal experiment, within 50 m of the coral reefs, also of Lizard Island, the Australian researchers Dr Stobutzki and Dr Bellwood could show that the majority of fish larvae swam toward the nearest reef indicating they knew the way to the reef.

Settlement

The transition from the pelagic (open water) environment to a reef, i.e. the settlement, is complex. Reef-fish larvae are highly selective about where they settle. Dr Leis and his team also found that from 30% to100% of settlement-competent larvae of a given species may reject a given reef and swim back into open water.

For example, some species will settle only on lagoonal reefs, whereas others reject shallow lagoon reefs, but accept deeper ones. Once over a reef, selectivity about settlement sites can also be great: some species only settle on live coral, whereas others only settle into schools of similarly-sized recent recruited, now juvenile reef fish. So ready-to-settle fish larvae certainly do not simply settle onto the first reef they bump into.

The above research on settlement behaviour was done during the day, and we have no idea how settlement behaviour might differ at night.

The combination of habitat selectivity and swimming abilities means that settlement-competent reef-fish larvae have the potential to actively examine a variety of reefs at scales of tens of kilometers to find a suitable settlement site.

But as Dr Leis expressed the situation for researchers studying the interesting life of reef fish lar-

Larval Navigation

LEFT: Goby larva, *Psilotris batrachodes*, 6 mm. Photo courtesy of Dr Benjamin Victor. **www.coralreeffish.com**

vae, "*matters are yet even more complex*." Behaviour also varies within a species depending on the situation. For example, larvae of a number of species released nearby to reefs swam much slower when approaching the reef than if they swam away from it, and larvae of one damselfish consistently swam faster in open water in an atoll lagoon than in ocean waters surrounding the atoll.

Vertical distribution

Vertical distributions can also differ between locations. For example, fish larvae may swim deeper in the ocean than in an atoll lagoon, or they may swim deeper off the windward than off the leeward side of a reef. We can expect that behaviour differs between night and day and probably at different stages in larvae development. This kind of behavioural flexibility further complicates any attempts to make realistic mathematical model dispersal – models which are very popular among researchers, because they may be an important tool in e.g. coral reef park management and fisheries management. However, it is of course necessary for these models to be based on correct assumptions.

Sensational Senses

But what senses enables minute reef fish larvae to navigate in such astonishing complex ways and over several kilometres? Dr Leis suggests that many possible cues associated with reefs could provide clues for navigation. These include smells and sound which comes from reefs; differences in wind- or wave-induced turbulence; gradients in abundance of fish, plankton, or reef detritus; and differences in temperatures of lagoonal or reef flat water flowing from a reef. In some cases, a magnetic compass or sun compass could help in increasing chances of fish larvae encountering a reef (e.g., a larva in the Coral Sea would increase its chances of encountering one of the reefs on the Great Barrier Reef by swimming to the west), but it seems unlikely either could assist orientation toward a particular reef.

One possible exception is that a magnetic sense could allow a fish larva to detect an oceanic basalt island (or, some volcanic islands on continental plates) on which reefs were growing, because basalt islands have a magnetic anomaly.

Although fish can sense via the lateral line that they are moving through water when they are swimming, unless they have an external reference, such as a view of the bottom, they will be unable to determine that they are being moved by and with the water, as when being carried along with a current. Therefore, currents are potentially detectable using vision near the bottom or near a reef, but it is unlikely that currents or movement by them will be detectable in blue water, i.e. offshore, and thus they are unlikely to be an aid to orientation.

Some of these possibilities seem intrinsically more general and therefore more likely in a evolutionary sense to have been utilized. For example, sound is almost current independent, travels in all directions from the source, and spreads over long distances, so it could be a very general cue.

Smell

In contrast, smells are current dependent, must travel with water movement, and would be of little use "up-current" of any reef. However, where currents are weak, each reef might be surrounded by a diffusion-maintained "halo" of smell that could provide cues that a reef was near, and a similar halo could be established by current reversals such as those caused by tides.

Electromagnetivity

Magnetic anomalies are current independent, and more likely to be associated with reefs on oceanic islands than with continental-shelf reefs. Most reef fish species have wide distributions i.e. they live on a variety of island and shelf habitats, and in a variety of current regimes that differ in their predictability over many scales. In addition, changes in sea level over time can result in radical changes in reef systems and associated currents. Therefore, it seems likely that any cues to which reef fish larvae have become adapted to use in finding reefs would be general ones, useful over much or all of the range of the species.

However all these predictions based on theoretical arguments should be treated with caution until they can be tested with reef fish larvae. Reef fish researchers have been misled by similar theory-based predictions in the past.

Owing to Oders

Olfaction has the potential to operate over larger scales, as has been known with salmons for many years. If odors are carried by currents and structured by fronts between water masses, olfaction operating at a small scale could result in orientation over larger scales.

This may also be the case with temperature differences. Damselfishes, among them the popular anemonefishes, have been shown to use chemical cues to locate settlement sites over relatively small distances, i.e. a few meters. Are coral reef fish larvae of species that are symbiotic with anemones particularly good at using olfactory cues to select settlement habitat?

Two points about these experiments are important: first, they show that olfaction can operate over scales of up to a few tens of meters - perhaps even much longer distances; second, they were done over the reef habitat.

We do not know yet if olfaction can be used in the pelagic environment in the find reefs. Olfaction is clearly important in the location of specialized habitats such as anemones or corals, and in the location of conspecifics all over

INSET: Juvenile pipefish. Photo: Peter Symes

Larval Navigation

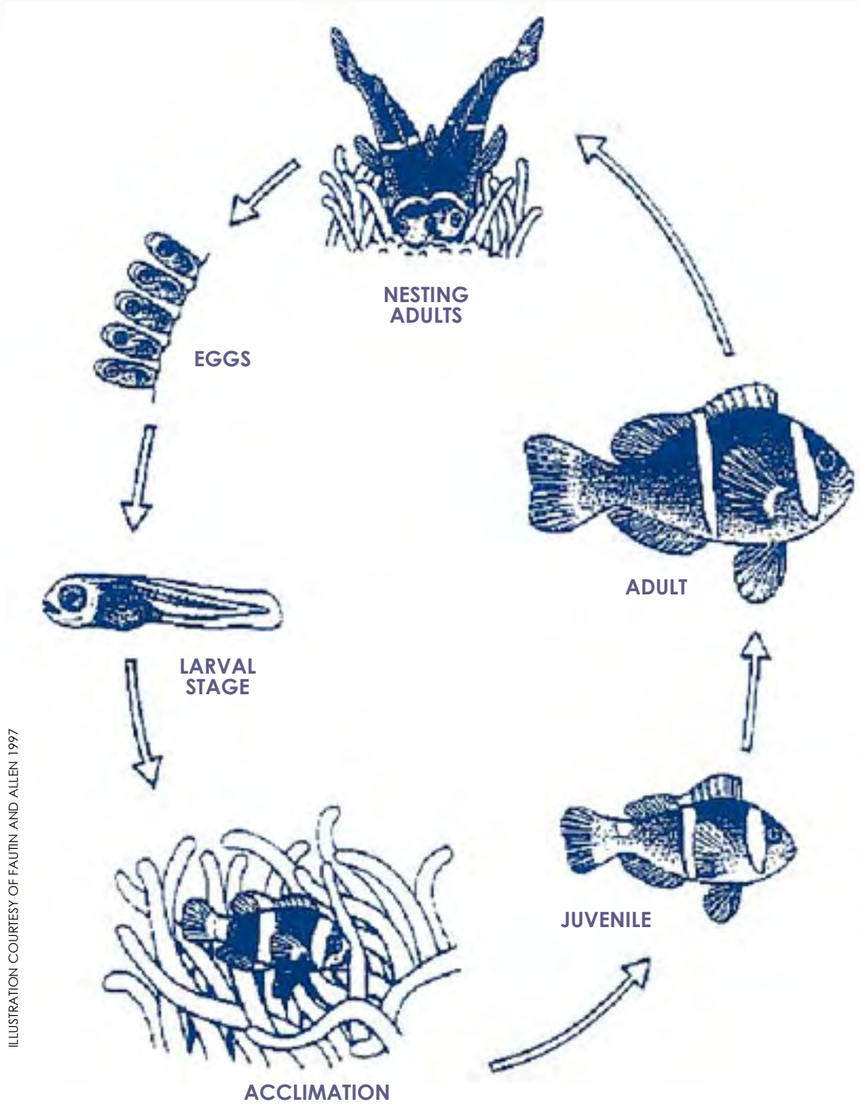


ILLUSTRATION COURTESY OF FAUTIN AND ALLEN 1997

Figure 1. Coral reef fish life cycle, exemplified by an anemonefish

small scales within reef habitats.

Use of olfaction for orientation by other than a few species of pomacentrids, or over larger scales, or in the pelagic environment, is a real possibility given the results to date, but this has not yet been demonstrated by reef fish researchers.

Sound

Reefs are noisy places and sound has the potential to provide orientation cues over a wide range of scales. The lateral line is sensitive to water movement, but is capable of detecting this over only small distances, on the order of 1–3 body lengths. Vision is used by many reef fish larvae on short distances, i.e. less than 50 m and even at night in dim light. A magnetic sense could potentially operate over a variety of scales, from very large (oceanic), as has been shown is the fact for some species of tunas and salmon, to relatively small (local), as shown in hammerhead sharks. It is likely that different cues are used at different scales even by a single individual: a possible scenario is use of sound to locate the reef, vision and the lateral line to avoid predators near the reef, smell to locate the settlement habitat, and vision to locate the settlement site in the habitat.

Sound has proven one to be a cue used by some reef fish larvae. By playing bio sounds from the reef, i.e. sounds from snapping shrimps, fish grazing and fish making sounds with the swim bladder, from underwater speakers next to light traps, which are known to attract many reef fish larvae, and then compare with light traps without bio sounds, Dr Leis and several other researchers have shown that reef bio sounds provide useable cues for settlement-stage larvae searching for settlement sites.

Conclusion

As with the olfactory cues, many details remain to be determined, including when in the development the ability to hear and use sound for navigation develops, and what sounds (frequencies and intensities) larvae can hear and use, and over what scales. It is, however, clear that sound and chemical cues can be an important orientation and navigation cue for larval reef fishes in both temperate and coral-reef environments.

Summed up, aside from olfaction, hearing, and vision, none of all these cues mentioned has yet been shown to be used by reef fish larvae for orientation, and even with these, the use has been at either relatively small or unknown scales. However, based on our current knowledge of the very complex biology of reef fish larvae, researchers are looking forward to conduct many more experiments with these fascinating creatures. It is certain that they have yet many more surprises waiting for us. It is a research area only in its very beginning.

RIGHT: Albacore larva, *Thunnus albacares*, 5.2 mm. Photo courtesy of Dr Benjamin Victor.
www.coralreeffish.com

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Text and photos by Andrey Bizyukin, PhD
and Svetlana Murashkina, PhD

The Cressi Empire

Portofino, Italy, the Cressi-sub motherland

Cressi-sub sets itself apart by being a company that is entirely controlled by one Italian family, the Cressi family. Since it was founded, to the present day, it has been built on a principle of not basing business on bank loans but on family money alone.

Great diver of the world, Mr. Antonio Cressi, owner

The classical philosophy of Italian diving

The huge mountain valley, the majestic bridges, the many cars and motorcycles, and people rushing to work are all first impressions of the industrial zone of Genoa. Here, we find the headquarters of the Cressi empire and their factory.

The Cressi trademark draws attention from afar, and the enormous building, located directly in the foothills, is impressive, with its hundreds of square meters of industrial workshops and many huge warehouses, nine meters high, well stocked with various sorts of techno polymers and boxes with finished products. In a three work shift cycle, the plant is kept in continuous operation around the clock producing, among other items, more than a million masks, making the Italian brand one of the most popular in the world, supplying snorkels for scuba divers and a hundred thousand of the most well-known models of Cressi fins.

The plant

The plant is virtually fully automated. Along the conveyor belt, robots seem to do everything. Computers are everywhere. Fins and masks are seen on the screens. The staff on duty have only to enter into the computer the type, the sizes and the colours of fins, masks or snorkels, to start the manufacturing process by simply pressing *Enter* on the keyboard.

We see how smart machines, not unlike giant vacuum cleaners, soak up polymer granules, which are heated up and melted into a liquid that is then filled into a pressing form. After cooling, the mould opens, and a robot moves the component onto the conveyor belt bringing it to the next process.

Every fin from Cressi-sub consists of three components, and consequently, it passes three sites on the conveyor belt. Thee-component fins have better characteristics and are more effective and durable than simpler and cheaper models.

The Cressi fins have variable elasticity depending on the direction and force applied to the blade. Underwater, it becomes visibly clear that Cressi's fins are strong, elastic and have a powerful spring action. They are easy to use, even in strong currents, making them a real pleasure to wear. Snorkels and masks are manufactured in a similar manner. Pure liquid silicone (clear or black colour) is injected into a special mask mould under high pressure.

Every accessory for fins, snorkels and masks such as fasteners, straps, holders, glasses and other little items are also made here at this plant.

The most expensive components of this method of manufacture are the moulds of which there are several types and colours for the fins, masks, and snorkels respectively. The quality, smoothness and functional characteristics of the items all depend on the quality of the mould. Therefore the creation of each mould from design to a finished model that it is good enough for production can easily run into the tens of thousands of dollars. This is an area where Cressi-sub excels.

The company has put huge capital investments, millions, into the manufacture and develop-

Brilliant quality built with pride under the Cressi logo—top fins made in Italy

The Cressi-sub empire building

manufacturer

RIGHT TO LEFT: Cressi rebreather; World famous Cressi-sub wetsuit designer Marino Bernardino—Cressi's "Armani"—with two Russians admirers; Mr. Antonio Cressi prepares for a test dive with new equipment designs

ment of the top quality diving equipment. They take pride in being an entirely Italian manufacture and, as a symbol of quality and reliability, all Cressi-sub products come with a lifetime warranty.

Cressi-sub has become the legislator for diving fashion

Cressi history

Many of the old manufacturers have a company museum, but when you ask the question why Cressi doesn't have one, the employees just shrug their shoulders. Their stance seems to be a practical one: "Here, we have spacious industrial workshops and the research laboratories are crammed with smart technology, the warehouses are full of raw materials and finished goods; offices with employees and a showroom with new product samples—in essence, everything that the strict laws of the effective manufacture require. But a museum, on the contrary, is just nostalgia and poetry that does not increase production speed."

However, all the employees, from the bottom up, feel like they belong to one big Cressi family and take pride in the fact that the company has already existed for almost 60 years. Everyone seems to be quite familiar with the key moments of the family and company history.

In the beginning

It all began as far back as 1940, when Egidio Cressi developed, in his home, the first mask, called Sirena. Then in the following years, from 1941-1945, the two Cressi brothers, Egidio, who was the diver of the pair, and Nanni, who was the business representative (and the father of today's "boss", Antonio Leopoldo Cressi) began the production of underwater equipment in their home.

In 1946, the business extended into the establishment of the company Il Pescatore Subacqueo Cressi, later to be renamed Cressi-sub Spa. It is a little known fact that in 1947, the company created their first rebreather called ARO 47.

For some reason this and some of the other activities in the post-war years seem to be kept a family secret, although the developments of rebreathers apparently continued. The ARO 57B was later introduced in 1956. Also in 1947, we saw the first full face masks, the Medusa G1 and G2, with integrated snorkels. The next significant step came in 1951 when the first modern fin, the Rondine, came to light. It was the first fin with an inclined blade and an open foot-pocket.

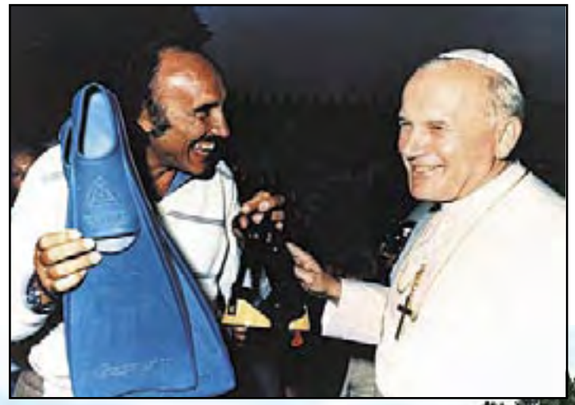
At that time, the project manager at Cressi was Luigi Ferraro, who later went on to found Techni-sub, another one of the big old dive equipment manufacturers. Also, at this same time, a former officer in the Austrian army, Ludwig Mares, came to the Rapallo to open a little shop, and later to found the Mares company.

In 1953, the first mask with optical lenses and a nose within the skirt was introduced. This was the Pinocchio, which is still in production today in more modernized forms.

In the middle of the 1960's, the company created their first regulator and then decided to go into the creation and production of a full line of diving equipment including masks, fins, snorkels, neoprene suits, regulators, rebreathers, cylinders, knifes, spear guns, harpoons and torches.

For the first time, a diver had the choice and the opportunity

Mr. Francesco Odero, manager



INSET: Cressi-sub meets the Pope. ABOVE: The Mediterranean sea is full of beautiful bays that make attractive places for holidays and pleasure diving

Mr. Luca Falco, manager, demonstrates the top quality of the Cressi-sub fins

to be equipped totally with Cressi-sub equipment from top to toe. And as time has later shown, this was a good idea. In 1970, Cressi also made a splash when they marketed, as one of the first, a BCD that had an inflator hose connected to the first stage.

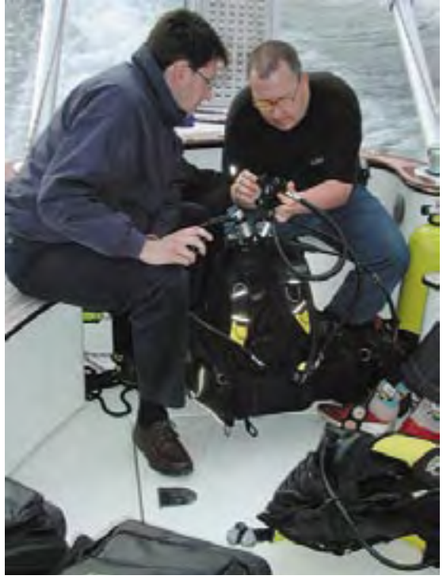
Cressi's history can be characterized as one of creative work, new ideas and experiments all aimed at the development and popularization of scuba diving. Persistence, enthusiasm, belief in correctness and passionate desire to make the world's best diving equipment have occupied the minds of the Cressi family throughout their company history.

Cressi-sub today

The many current successes of the company can be attributed mainly to one person, Mr. Antonio Cressi, who has headed the company for two decades. Mastering all the stages of manufacturing, logistics, sales and business management, he can be said to have graduated from the manufacturing floor. He is not hiding in a fancy office either, as a business executive would often do, but leads, as an expert, where all the action is.

In the early morning, it is possible to meet him practically in any of the production "hot" spots: at the conveyor-belt, in a warehouse, at the workshop where the suits are manufactured, in the shipping department or at orders and deliveries.

Without any much ado, he warmly greets the employees as he makes his rounds of the factory, dynamically solving questions and giving necessary instructions on the fly. The factory now has 16,000 square meters covered with sophisticated robotic production systems, and their highly specialized R&D department is equipped with the latest computers and testing equipment.



Dive writer, Andrey Bizyukin, checks out the new Cressi regulator construction before the first check dive

Nonetheless, like his father before, Antonio believes that any new product, even if designed by today's computers, must pass the test of extensive use in the sea before it qualifies to carry the name of which he is so proud. "Do not drop the majestic name of Cressi," is the motto and philosophy of the company.

Today the company is recognized as one of the global leaders in dive equipment design from masks, fins and snorkels to suits. Cressi-sub has also just opened a completely new venue in the production of dive masks. Only safe non-allergenic silicone is used. It is profoundly changing the quality of

Cressi-sub

sealing, new shapes of masks, glasses, frames and even the snorkel-holders.

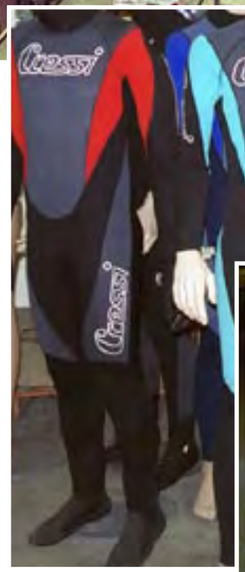
The use of new technologies has allowed Cressi to combine three types of materials in one product and to make new composite types of fins, which among other things are about 30 % lighter, than the competitor's models, yet they pack a powerful stroke and offer less resistance in the water. Cressi fins are created especially for the ocean, for diving and swimming in currents with less fatigue. They do indeed stand out with their ideal shapes, magnificent design, surfaces as smooth as mirrors, faultless quality and a lifetime guarantee. These are the fins of the new century, and they are technological marvels.

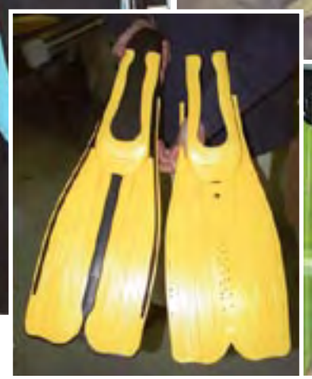
No right to make mistakes

Cressi-sub, being one of the world's largest private dive equipment manufacturers, also has a high influence on diving fashion. But how are decisions made as regards to which models and what equipment will appear on

manufacturer Cressi-sub

Cressi-sub masks and regulators on the conveyor belt





ALL PHOTOS THIS PAGE: Scenes from the Cressi-sub manufacturing plant

the diving market? What are the secrets behind Cressi's successes?

Luca Falko, from Cressi's export department explains:

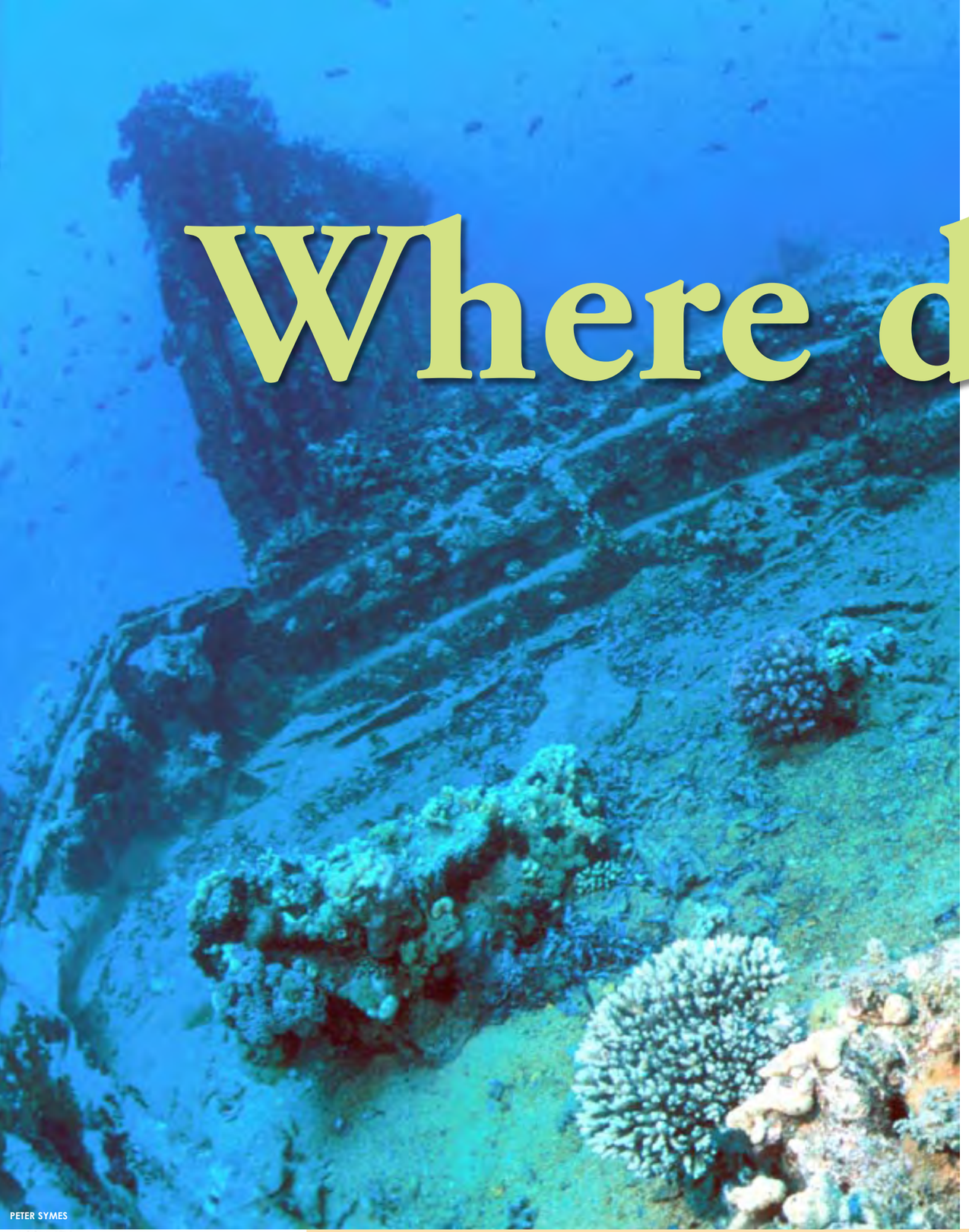
"Cressi is a family business, and if our company is going to start production of some new dive equipment, we want to be absolutely sure that we get a positive result. We should be certain that our innovations will be well received by divers, and here again, quality equipment should be irreproachable, it should have great looks and faultless long-term quality. A private company, such as Cressi-sub, does not have any right to make mistakes. New samples of equipment are tested thoroughly, sometimes for months or even years. All products, regardless of being tested rigorously by machines or on special equipment, will also be tested personally by the boss. Mr. Antonio Cressi wants to be absolutely sure that the quality, reliability, convenience, stylishness and operation of the equipment are flawless for all types of diving.

"The next very important aspect of our philosophy has to do with the opinion and responses to the use of our equipment by world famous people. So, Hollywood stars Chuck Norris and Pierce Brosnan, dive with Cressi-sub. National Geographic teams use Cressi-sub equipment in their projects. Free diving world champions, Umberto Pelizzari and Deborah Andollo, have all chosen Cressi-sub. This also contributes to the basis of the family business, which is determining the success for our company."

Future Cressi

Millions of people in the world go to the seaside for recreation. Consequently a mask, fins and a snorkel are already an integral part of equipment for many a holidaymaker. Diving with a complete set of ABC equipment is the first step into the underwater world and a way to introduce the wider audience to scuba diving. And here, Cressi-sub is an undisputed global market leader. As the number of holidaymakers and active divers worldwide seem to grow from year to year, Cressi's future seems to be quite bright.

For more information, please visit:
www.cressi-sub.it ■



PETER SYMES

Where did she go?

The Quest for the Yolanda Wreck

Text by Mark Andrews
Dive photos by Valentina Cuchiera
Archival photos of *Yolanda* wreck supplied by Leigh Cunningham
File photos of Yolanda reef by Peter Symes

I was on a deco stop in the cold waters of the national dive centre in the UK when my thoughts turned to diving the warmer waters of the Red Sea and particularly the wreck of the *Yolanda*, or should I say, to the question of where the wreck of the *Yolanda* came to rest.

That same evening, I e-mailed my deep diving buddy, Leigh Cunningham in Sharm-El-Sheikh, and suggested we searched for the wreck of the *Yolanda*. He immediately responded with a "cool-cool," his usual reply to something that sounds like a good idea.

The search was planned for the week of May 21st, and while I undertook some deep, dark and cold warm-up dives here in the UK, Leigh was busy down in Sharm planning the logistics for the week. The Red Sea is not short of highly skilled technical divers wanting to be involved in such a project and as such a multinational team was quickly put together.

Mark Andrews, the author (right) with buddy Leigh Cunningham, our technical diving columnist

Yolanda reef is a very well known dive location in Egypt's famous Ras Muhammad national park, which is at the very tip of the Sinai peninsula, and not far from Sharm el Sheikh.

For most holiday divers this spot is virtually unforgettable due the fact that a ship's cargo (the *Yolanda's*) of sanitary porcelain, most notably toilets, have been spilt and strewn across the shallows between some coral heads where they sit as somewhat grotesque and misplaced sculptures—an odd sight, but nonetheless, a quite amusing one.

The *Yolanda* herself was a Cypriot cargo vessel of 75m in length and is believed to have had engine trouble resulting in her being forced upon the reef at Ras Mohamed on the first of April 1980. She rolled onto her port side with her stern resting in 25m. It seems that she has been regularly visited by divers until sometime in 1985 when she, following a storm,

LEFT: The *Yolanda* wreck as it once was before it slipped off the edge of the cliff


PETER SYMES

Yolanda

LEFT: Glorious sunsets can be enjoyed on the Red Sea
RIGHT: One of the infamous porcelain artifacts found on the *Yolanda*


PETER SYMES

slid off the reef and down into the abyss never to be seen again.

The plan

The plan for the weeks of diving was to spend the first two days preparing the equipment and generally getting comfortable at depth with the dive rigs.

On Sunday, the 22nd, both Leigh and I made up our dive rigs. Leigh's rig was a 12L twin set with a single 12L strapped to either side of the twins. Added to this were a further two 12L tanks carried as stage cylinders making up his familiar six-tank rig. My own dive rig consisted of a 12L triple set and two 12L stage tanks—a dive rig that I often use in UK waters.

Our main problem with these large dive rigs is that the profile they offer in the water results in a need for substantial amounts of lead both in order to enable us to leave the surface in the first place, and, more importantly—due to the positive buoyancy of an empty alloy cylinders—to enable us to remain at our shallow decompression stops without being dragged towards the surface.

Once we were weighted correctly, we made an 80m check dive at a local dive site, Ras Katy. The dive went perfectly, and we were both happy with the dive rigs and the weight. Monday the 23rd saw the team at another local dive site, Far Garden.

This time we planned to go a little deeper, and we were both shocked to discover a wall at a depth of 100m. As we swam along the edge, we looked at each other with a knowing thought that the other was also wanting desperately to go over the edge and check it out! However, at this stage, we both simultaneously gave the up signal and reluctantly headed back up the slope toward the reef wall.

Once on the boat, we couldn't get our gear off quickly enough to begin talking about the drop off and how it must be a dive for the future.

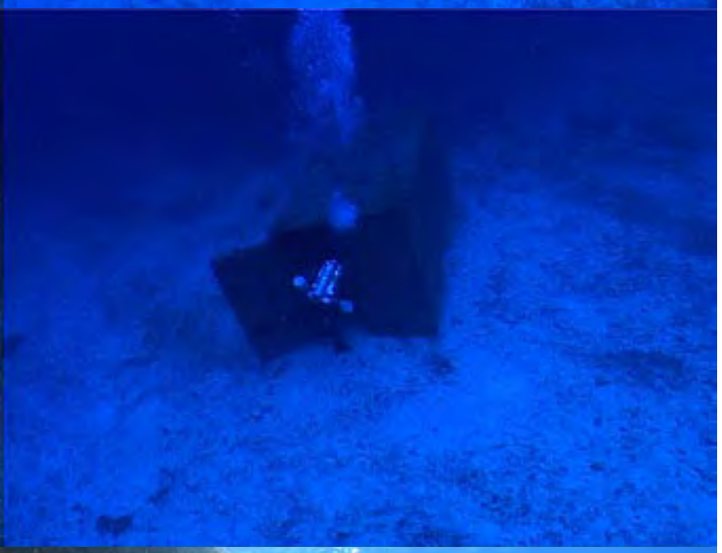
Check dive at Ras Katy. Leigh Cunningham in front with his typical six-tank configuration. Mark Andrews follows in back

Tuesday 24th saw us out at Yolanda reef, the site of our goal. Yolanda reef is a very busy dive site with many hundreds of recreational divers spilling from dozens of day boats all over the reef like a swarm of bees to a honey pot. We stationed the *Colona* dive boat away from the crowds and the ever present long swell to kit up in comfort. We decided to hit the water around 12:00 pm, which is when most of the recreational divers return to their day boats for lunch.

Leigh and I would each be accompanied by two safety divers and a videographer, who in turn each have their own safety diver. Getting everyone ready for such a dive can be a logistical nightmare and is the sole responsibility of the dive co-ordinator. In our case, we were fortunate to have Doozer, a well seasoned and experienced organiser of deep dives as well as an accomplished deep diver himself.

Skipper Yassir works his magic as he expertly maneouvers the dive boat to the perfect entry and exit points for the dive team

The preparation for the dive was run with military precision, as on this dive site we did not have the luxury of a mooring and had to rely on all the support divers to be ready to jump on the given signal by the skipper, Yassir, who skilfully manoeuvered the *Colona* boat into position some 100m away from the reef to assure us a deep water drop. The count down began, and each team made their way to the back of the boat where Leigh sat on the dive platform in full kit, exposed to the scorching sun in his O'three dry suit. As I am a lot more susceptible to the heat, I positioned myself just behind him, also fully kitted up in a drysuit and swamped with dive tanks.



Yolanda

RIGHT TOP TO BOTTOM: Leigh Cunningham checks out a second container; large gargonians decorate the wreckage; Leigh and Mark meet

Yassir, the skipper, sounded the horn, which was the signal to jump, and the back of the dive boat erupted into action with heavily equipped divers entering the water on Doozer's signal.

Leigh and I followed shortly and were immediately met by our support team who proceeded to make the all-important bubble check on our dive rigs. Once completed, Leigh and I gave the descend signal and vented the air from our wings. We slowly slipped into the silent liquid world. We both feel more at home here than in the noisy hustle and bustle on dry land.

The sea was warm and clear as we descended into the dark blue waters past shoals of inquisitive fish. We descended roughly 30m apart and occasionally gave each other the okay signal to show that all was well. As I looked down from 40m, I could see the wall in front of me some 50m away and a sandy bottom in the depths below.

The bottom came rushing up towards me at 50m per minute and we slowly pulsed air into the wings to bring ourselves to a halt just short of the bottom.

The condition that she was found in was surprising to us all and definitely warranted further investigation

The Wreck

As I turned, I immediately saw a large intact ship's container. I couldn't believe that we had dropped directly onto the wreckage, and as I looked further down the slope I began to see more and more wreckage.

Leigh headed off to the left of the container, while I swam inside to take a look. This first container was at a depth of 73m and was completely intact with one door open but empty of all cargo.

I exited the container to find Leigh some distance down the slope in deeper water, so I decided to head off to the right and explore a separate area. I quickly came across a large scour in the seabed heading off into the dark area below me. I came across a further container this time, broken up at 86m and surrounded by wreckage of various shapes and sizes.

Ascent

I ascended slowly up the sandy slope and met one of my safety divers and gave him the okay signal that all was well with me.

As I ascended, I was also met by one of the videographers. We came across a very large Danforth anchor at 63m and a hospital stretcher at 55m along with some very large batteries.

After completing the majority of the decompression schedule, I bumped into Leigh and his safety divers at 15m on the reef wall where we compared our dive slates.

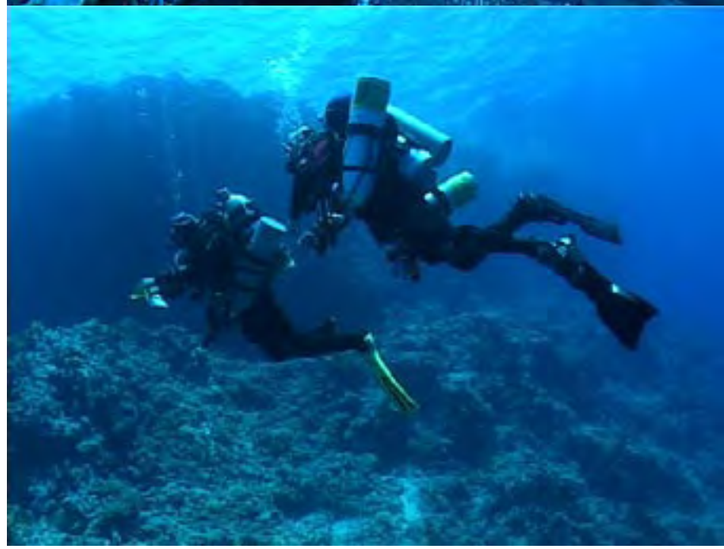
Leigh had been to 100m but slightly to the left of where I dived. He had come across a large metal plate with a rope attached that ascended to who knows how far, but not much else in the way of wreckage. He had, however, seen a further drop off which began at 110m and quickly dropped away at almost a 45 degree angle.

We completed our decompression stops around the remainder of *Yolanda's* cargo, which most Red Sea divers have visited at some time. It consists of toilets, wash basins and bath tubs scattered along the reef amongst parts of the ship's superstructure.

The decompression was complete after 90 minutes, and both Leigh and myself surfaced with our respective safety divers. Yassir, the skipper of the *Colona* dive boat, again masterfully manoeuvered the large dive boat stern towards us for an effortless pick up.

The safety teams, well-versed in removing our large dive rigs in the water, handed up our rigs piece by piece to the ever ready boat crew and surface support team.

The post dive de-brief was full of excitement and amazement of just how much wreckage there was down there. Each team member gave an account of the items they saw and the depths they recorded. We were very quickly able to draw a rough map of



LEFT TOP TO BOTTOM: Mark Andrews checks out an intact container; looking inside; on the way down

Yolanda

wreck debris. From this rendering, an obvious path of the main wreck soon emerged.

Wednesday 25th saw the team return to the site of the wreckage minus myself who was now laid up in bed with stomach cramps from the local Egyptian cuisine.

While I spent the day backside on the toilet and head in the sink the dive team was busy preparing for another adventure.

Leigh decided to make a dive to 115m and follow the deep scour in the seabed.

Grim reminder

As Leigh descended, he noticed that he had dropped too far to the right of the scour, and as such, needed to make a substantial effort to swim his large dive rig in the direction of the wreckage.

Approaching his bottom time, he found himself at target depth looking over a steep slope. Leigh stared hard into the darkness below willing his eyes to make out some form of recognisable shape, but what appeared below, although recognisable, was definitely not a ship wreck. As Leigh's eyes focused on the object 20-30m below him, the shape of a human figure emerged.

The body of a diver lying on the sandy bottom at a depth of around 130m was a stark reminder of what can happen when things go wrong.

Leigh's ascent and decompression time passed by without incident, accompanied by the usual entertainment provided by the local dive guides who were herding customers along the reef edge like sheep.

Thursday 26th After spending 28 hours in bed, I returned to the dive boat. I was unable to dive, but I would rather be ill and with company than spend another day staring at the green walls in my hotel room. This was to be the first mix dive of the project with a planned depth of 150m.

The problem here would be hitting the depth within the planned run time. All the dives are being made as free descent and ascent. No shot line is used due to the fact that we do not know where the wreck rests and have no access to echo sounders. Besides, this part of Ras Mohamed is also one of the busiest dive sites in the area, and as such, shot lines and large buoys are not a viable option.

We rely entirely on the information gathered from previous dives to determine the drop site and the skill of the skipper to place us right on the mark.

Bull's eye

Once Leigh and the team were ready, the boat positioned and the horn sounded, the divers hit the water at 11:00 am. Leigh descended into the blue.

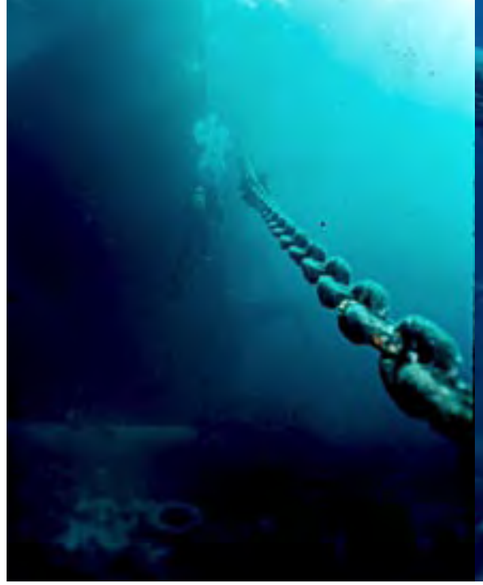
He found himself descending too far to the right of the scour and decided to head out into the blue before hitting the slope, this would be the only way to assure obtaining the depth required. Concentrating on swimming, he took in very little of the surrounding sea bed. Then, he reached 150m with 1 minute to spare on his run time.

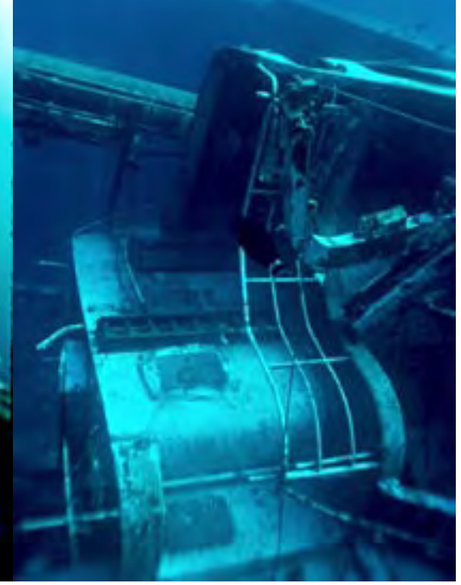
Focusing his eyes to the dimmed ambient light, he scanned the sea bed below for any signs of wreckage but could see nothing until he turned to his right and noticed a crack in the sea bed with two different levels. Thinking this was bizarre, Leigh took a closer look and noticed a number of metal protrusions emerging from the sand. The more he looked, the more it became obvious that this was in fact the wreck of the *Yolanda*.

Time to go had come around all too soon, and Leigh had to start his 103 minute ascent to the surface looking on the way back for any signs of the body sighted on the previous day's dive, but it was no longer there. The decompression schedule went without complication, and he emerged safely from the water with the good news that the *Yolanda* was truly re-discovered.

An amazing facility

That evening, the team met up at Rawasett to undertake the important task of gas blending for the following day. The facility provided for the project was Mix unlimited run by Chad Clark. It is the most amazing gas blending facility I have ever laid eyes on. It consists of two membrane compressors





ALL PHOTOS THIS PAGE: Views of the *Yolanda* wreck as she lies in her new resting place on the ocean floor

Yolanda

Mark Andrews and Leigh Cunningham meet to make air and equipment checks


EGYPT SIS

GUNILD AK SYMES

ABOVE: A white ibis stealthily crosses the beach at the Red Sea
INSET: Aerial view of Ras Muhammed, Red Sea, Egypt

severe gastro-enteritis. What a week of torture I was having, listening to Leigh talk about the wreck brimming with excitement and all the time looking at my dive rig bone dry on the back of the deck.

Safety first

Friday 27th, the team assembled on the *Colona* dive boat as usual and started assembling dive kits. The boat motored out toward Yolanda reef on a calm blue sea. The excitement mounted as the reef drew nearer.

As Leigh prepared to enter the water, the search and rescue team boat (SAR) appeared on scene to provide medical safety cover and fast evacuation in case of an emergency. This was backed up with doctors Adell and Ahmed back at Travco in the Chamber facility.

We had provided them with a copy of the gasses used and the dive plan so as to be sure, in the case of an emergency, the appropriate treatment would be administered quickly. Nothing on this project, or any of the other deep dives we undertake, are left to chance.

Leigh entered the water shortly after his safety divers, and it was instantly apparent that a strong current existed along the reef. Leigh made an instant decision and began his descent. His safety team followed in hot pursuit and positioned themselves at their predetermined depths to wait for his return.

As he descended, Leigh could see that this was a better drop than the previous one and descended straight into 130m of water. After getting his bearings, he swam down and along the reef at a depth of 160m. Slowly, the wreck came into view and he was able to settle on the wreckage and take a good look around.

Wreck check

The wreck itself is almost completely buried in the sand with very little remaining above the sea bed except some of the twisted superstructure and, off to the left, the crows nest. Below, on the slope, lies scattered poles similar to those we had seen in the shallow water whilst decompressing.

The visibility was almost infinite and the ambient light enough not to require a dive light. Leigh looked up the slope and could easily see the ship's path down to her deep-water resting place. He could see the outline of the deepest container at 86m—some 74m shallower!

The time to leave came around all too soon. The12 minute leave time and a push on the wing inflator saw the beginning of the ascent and almost 2 hours of decompression.

Bang on time, the surface support team spotted the DSMB (Delayed Surface Marker Buoy , ed.) on the surface, but out in the blue and not on the reef as expected. Due to the strong current, Leigh had been unable to reach the reef wall and was forced to make a blue water ascent.

The next shift of safety divers were already kitted up on the back of the boat when the DSMB surfaced and were dropped right on top descending down to spend the rest of the decompression time with him should he want for anything like spare gas.

The decompression went without a hitch and two hours after entering the water, he surfaced with the safety divers and film crew to be met by the SAR team to make sure all was well before they departed back to their base quarters.

On deck, we drew out the new information on to our rough sketch and discussed the next phase of the project.

The next step

We will be returning to the *Yolanda* in August to film her stern to bow and survey the wreck to try and capture her demise as best we can. The condition that she was found in was surprising to us all and definitely warrants further investigation. ■

The cast and crew of the *Yolanda* wreck project aboard the *Colona* dive boat

DUE CREDIT

The *Yolanda* wreck project was a complete success due to the team effort and the professional way it was run. It had the full support of the SAR team and the doctors at the Sharm chamber facility. We thank you all and look forward to the next chapter.

DEEP DIVERS

Mark Andrews is a Professional Scuba Association (PSA) instructor trainer examiner and the technical director for the London School of Diving in Chiswick and can be contacted at : **technical@londonschoolofdiving.co.uk**

Leigh Cunningham is a TDI instructor trainer based in Sharm-El-Sheikh and can be contacted at **highpp02@yahoo.com**

DIVE TEAM

SAFETY DIVERS:
John kean (England)
Doozer (England)
Schniffer (Scotland)
Adrian Curran (Australia)
David Wilke (Australia)
Robert Bohlin (Sweden)
Mattias Andersson (Sweden)
Johan Nilsson (Sweden)
Per Nielsen (Denmark)

VIDEOGRAPHERS:
Valentina Cucchiara
Tracey Medway

PHOTOGRAPHER:
Adam Butler

GAS BLENDING:
Chad Clark

SEARCH AND RESCUE CO-ORDINATOR (SAR): Sammy

CHAMBER SUPPORT:
Doctors Adel and Ahmed

BOAT CREW:
Captain Yassir
Mahmoud
Mohamed

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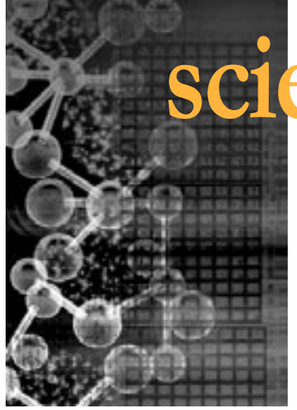


Walking on Water

Marine Insects

—and the strange case of the Halobates

Sea skater, *Halobates*. Photo courtesy of Scripps Institution of Oceanography, La Jolla

Text by Michael Symes
Photos courtesy of Dr Lanna Cheng, University of California-San Diego and Scripps Institution of Oceanography-La Jolla

When we think of the animals of the oceans our first thoughts are generally of whales, sharks, dolphins, tuna fish, and perhaps octopusses. All these have been in the news lately, also in this magazine, for reasons regarding their behaviour or exploitation. These are large animals, and like the lesser food fishes such as salmon and herring, we have many reasons for our interest in them. However, even the very small acquatic creatures such as krill and zooplankton are important because they are at the bottom of the food chains of the larger fish which themselves again are food for those at the top of the chains, we humans. Thus, all marine life in someway or other is important to us.

A Marine Chironomid (midge)
Photo by Dr Lanna Cheng, University of California-San Diego

There is one important common factor in the examples of marine life given above. They all have their prime existence *in* the water, i.e. at least partially below the surface. We rarely, if ever, consider the other sort of animal life associated with the oceans, that which lives by or on the ocean but not in it at all. Here I am thinking about the marine insects.

According to an excellent, newly published book (Evolution of the Insects, D Grimaldi, M S Engel, Cambridge University Press) there are approximately 926,400 described species of extant hexapods i.e. insects. Estimates of the total number of insect species vary from about 2 million species to 30 million species and more. However, an estimate of about 5 million species is probably the most accurate. (Gaston, KJ. 1991. The magnitude of global insects species richness. Conservation Biology 5: 283-96). Thus, only about 20 % of the global insect fauna is probably known and named.

Big numbers

Insects comprise more than 75 percent of all described animal species. Some 30,000 to 40,000 insect species, i.e. just 3 to 4 percent of all insects, are aquatic, or have aquatic larval stages, and live in all sorts of watery habitats. About 9,000 species (mostly bugs and beetles) have all stages under or on water. In about 30,000 species only the larval stage is aquatic (flies, mosquitos).

Insects are found throughout the world except near the poles and, with but a single exception, pervade every habitat except the sea. Some are found at depths of 1,300 meters in Lake Baikal, some are to be found only in rain-filled tree holes, while others inhabit caves and underground aquifiers.

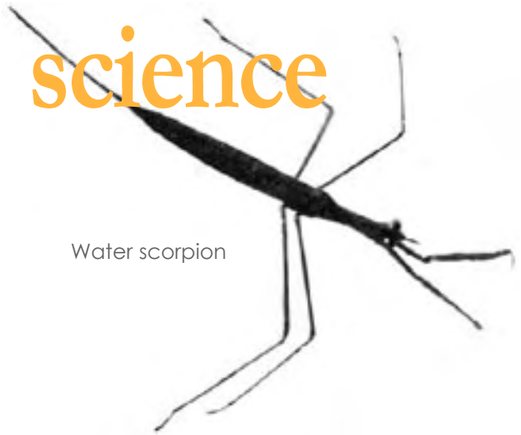
Freshwater habitats are the only aquatic habitats where insects dominate. In saltwater and brackish habitats, crustacea (the next most numerous arthropod) dominate. Although only 3% of all insects are aquatic for some part of their life cycle, insects make up more than 90% of small creatures found in mountain streams.

Map of A Marine Chironomid (midge) habitat. *Pontomia* are found only in lagoons or tide pools in the Indo-Pacific. Illustration courtesy of the University of Nebraska-Lincoln Department of Entomology

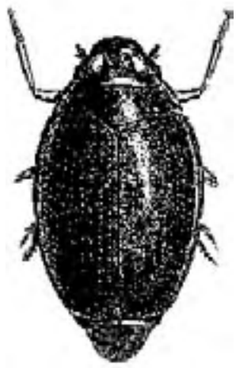
Impact

Despite their low numbers compared to the terrestrial insects, marine insects still have a tremendous impact on man. Flies

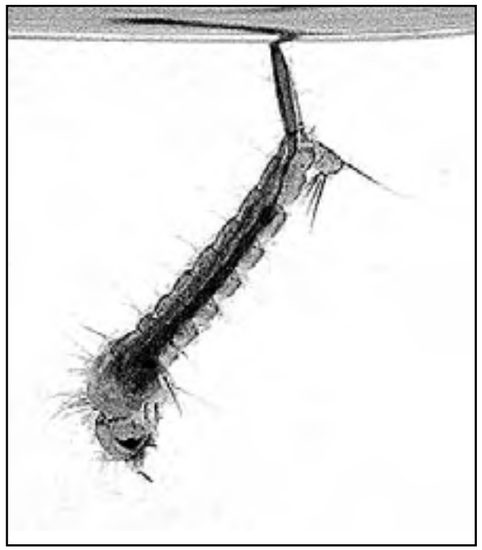
Marine Insects



Water scorpion



Whirligig Beetle live on the surface of the water at the edges of lakes and streams. They are 5-25 mm long and are named so, because they swim in circles



A mosquite larva uses a snorkel-like breathing tube at the posterior end of its abdomen

are the most numerous and economically important species of marine insects. The disease-bearing mosquitoes, biting horse flies, deer flies, and midges have impeded the human development of enormous areas of coastal land. And other marine flies can transmit diseases such as Leishmaniasis.

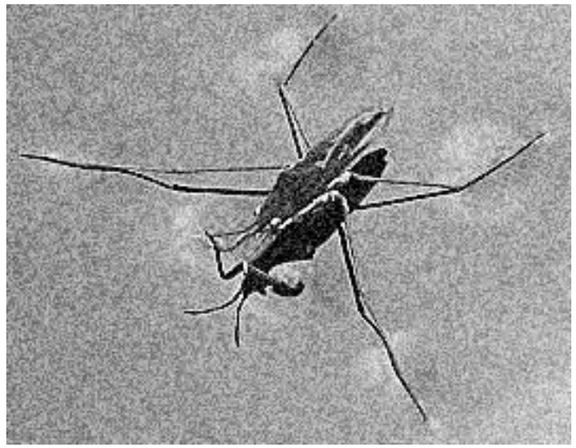
Unlike the dominating land-based insects, however, the marine insects have additional problems to overcome in their fight for survival. For example, how do aquatic insects avoid drowning? Most insects that land on water are trapped by the water surface tension and tiny ones can even drown inside a water droplet, unable to break out of the bubble surface.

Aquatic insects cope by having a waterproofed skin so the water doesn't get into the body. Many are covered with a water-repellent waxy layer. They also usually have hairy or waxy legs which repel water so they don't get trapped by the water surface tension.

The oxygen problem

There is very little oxygen in water (as low as 0.4% and often zero). Water contains less oxygen the warmer it is. This is why there is often more life in a cool pond shaded by trees and in temperate climates. There is much more oxygen in air (20%), and water is much heavier than air.

So, to extract oxygen from water, an animal will have to process a lot of water to get the same amount of oxygen. That is probably one reason why adult aquatic insects continue to breathe air instead of developing gills. Usually only aquatic insect larvae develop gills to absorb oxygen from the water. So, how do aquatic insects obtain their oxygen?



Pond Skater

Like mosquito larva and water scorpion, they can snorkel with a breathing tube. The end of the tube usually has bristles to break the water surface tension and keep the tube open. This method, however, doesn't allow the insect to travel far from the water surface.

Others have a scuba tank. These "divers" create an "air tank" for greater freedom of movement underwater. A skin of air that is trapped by hairs on the body or under the wing covers (Water Beetle). The insect breathes the air in the bubble through the holes in its abdomen (spiracles) just like other insects.

Making the best of both worlds

Living on the margin of water and air, many aquatic insects have developed ingenious ways to sense the world and to move around.

Most aquatic insects are sensitive to water ripples to detect predators or prey. Some even create their own ripples on the water surface and process the returning "echoes" to detect prey. Many also create ripples to find mates and communicate with each other (Whirligig Beetle, Pond Skater).

In a double-vision adaptation the Whirligig Beetle has eyes divided horizontally to see both under and above water. This is very useful when predators can attack you from both below and above.

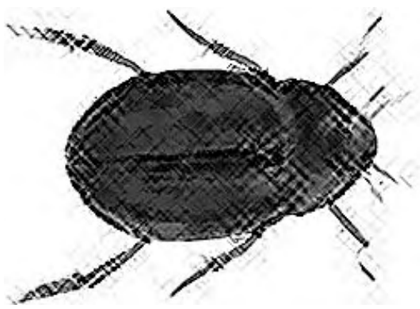
Many paddle underwater with oar-like legs. These legs are long, flattened and fringed. The hairy fringes spread out on the power stroke increasing the surface area, and bend in on the

Marine Insects

Marine Skater Eggs on a floating Spirulla shell. Even though *Halobates* live their entire lives on the ocean, they require floating objects upon which to place their eggs. These objects can include floating seashells, sea bird feathers, pieces of wood, plastic or lumps of tar. The eggs, which are often crowded on small objects due to the lack of available egg deposit sites, are rather large in size compared to the body size of the female who produces 10 to 20 matured eggs at a time. Photo by Dr Lanna Cheng, courtesy of the University of Nebraska-Lincoln Department of Entomology

return stroke to reduce water resistance. (Water Beetle, Water Boatman). These insects usually have flattened streamlined bodies or are torpedo-shaped.

The Camphor Beetle (Stenus) also skates on the water surface but has a neat trick to enhance its speed. When alarmed, it releases a chemical from its back legs that reduces the water surface tension. In this way, the water surface tension on the front pulls it forwards. It shoots forwards on its front feet which are held out like skis, and steers itself by flexing its abdomen. This tiny beetle is the size of a rice grain but can travel nearly 1m a second this way. It doesn't hunt on water, but at the water's edge, and saves this trick to escape predators.



Lesser Water Beetle

The *Halobates*

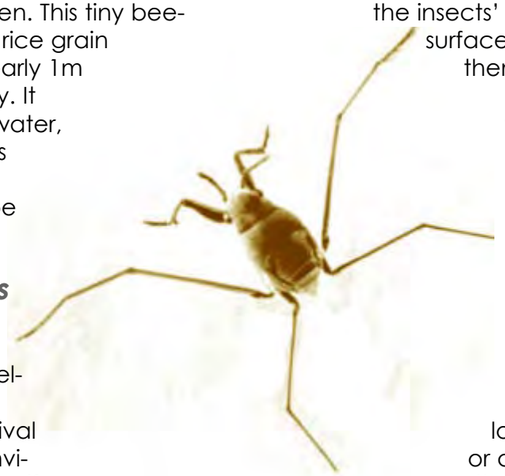
As we have seen above, marine insects have developed succesful strategies for survival in an aqueous environment. However, if we read further in 'Evolution of the Insects' (referred to above) one finds the very surprising statement (page 317) "*Halobates* is the only pelagic insect"—i.e it is the only insect that lives on the open oceans!

Halobates, or sea skaters as they are called, are a group of wingless insects that can "skate" on ocean water. Sea skaters feed primarily on zooplankton trapped at the sea surface, grasping their prey with their short front legs and sucking them dry. They have never been observed breaking the water surface to feed—i.e they do not dive.

While members of the coastal species deposit their eggs on fixed materials such as mangrove tree trunks or rocks, open-ocean species lay eggs on just about anything that floats, including empty seashells, wood, feathers, seeds and even lumps of tar.

Walking on the ocean

Among the most interesting aspects of the *Halobates* is how they manage to walk or skate across the surface of the ocean. The secret is the tiny water-repellent hairs on their legs and feet that allow them to "tiptoe" across the surface of the water. These hairs also help to spread the insects' weight over a larger surface area, preventing them from sinking.



The surface tension of the air-sea interface allows them to stand or move on the water at a speed as fast as one meter per second. As long as the surface tension is maintained, sea skaters are able to move normally. If the surface tension is lowered by pollutants or detergents, they flop on the surface and eventually sink. Tiny hook-shaped hairs, about 1.5 microns long, also cover the sea skaters' bodies. These trap a layer of air surrounding the insect, making them buoyant. Thus, they are basically enclosed in an air bubble; if they are pushed under the water, they quickly pop up again. If sea skaters are caught in rough seas and trapped beneath the surface for short periods, this jacket of air provides them with enough oxygen to survive.

No other animal on Earth lives in such a vast two-dimensional habitat. They are the only marine invertebrates constrained to traveling, feeding and reproducing only at the surface of the ocean. Among the dificulties of living in such a vast world is how the *Halobates* find each other to breed and lay eggs.

A map of the world-wide distribution of the marine insect, Sea Skater, *Halobates.* The known distribution is displayed in white. There are five known species of *Halobates* distributed around the earth approximately between latitutdes 40-degrees south and north of the equator. Questions remain about whether the insects require the warm ocean waters in this region or whether they are distributed more widely but scientists have not yet been able to find them through sampling. It is also not clear why there are only a few species and how they live in a habitat where no other insects are found. Some hypotheses state that the insects may be currently adapting to life on the ocean and *Halobates* is just the first to make the transition. Illustration courtesy of the University of Nebraska-Lincoln Department of Entomology

Just one genus living on the oceans

But why is there only just this one single genus of insect living on the open oceans? The five known species of Halobates are distributed around the world roughly between latitudes 40-degrees north or south of the equator. Do Halobates require these warm waters, or are they more widely distributed but have not yet been detected? Why are there so few species, and how do they live in a habitat where no other insect occurs? Given the diversity of insects in freshwater, it might be thought that the Earth's oceans would support an almost infinite number if insect species. Only 0.0091 percent of the Earth's surface water is contained in lakes and rivers, and 95.96 percent is in the oceans. Nearly 30,000 insects inhabit freshwater yet only five species belonging to one genus are adapted to living freely in the world's most vast ecosystem. This is very strange indeed.

Hot hypotheses

Dr Lanna Cheng, a well-known long-time expert on marine insects at the University of California, San Diego, with others, gives several hypotheses as to why this is so.

The first hypothesis suggests that insects are limited by salinity. While this may be true for the majority of insects, many flies have effecient osmoregulatory mechanisms that allow then to tolerate salinity in excess of 3 times that of the ocean.

The second hypothesis suggests that ocean depth limits an insect's ability to complete its development. This is true of many insects and yet chironomid fly larvae survive at depths below those that even the deepest diving mammals can

INSET IMAGES: A sea skater, *Halobates.* Photo courtesy of Scripps Institution of Oceanography, La Jolla

Marine Insects

Marine Skater, *Halobates*. Photo by Dr Lanna Cheng, University of California-San Diego

reach.

The third hypothesis suggests that the combination of salinity and depth imposes a further limitation of oxygen content in ocean water. Again, certain fly larvae are able to survive months without oxygen, and numerous aquatic insects survive in polluted waters with similar or lower oxygen concentrations.

Finally, a fourth hypothesis considers the fact that insects were successful because they colonized land. By moving away from the ocean, they adapted to a terrestrial existence while their major competitors the crustaceans stayed in the sea and continued to adapt. As millions of years passed, insects lost their ability to successfully compete in the ocean while crustaceans have had only limited success in invading land. Dr Lanna Cheng believes that this is the most likely explanation for the abscence of insects in the oceans. As potential evidence, it is noted that the only insects that live on the open ocean, live on its surface. As such, they never come in contact with the crustaceans living beneath its surface.

Final thoughts

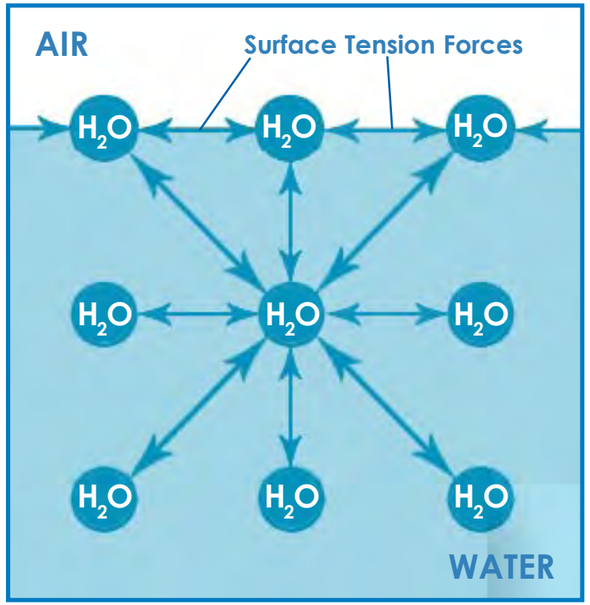
There are many questions still unanswered about this strange case of the *Halobates*. How come that they alone of the so many insects managed to adapt to life on the oceans? Whatever hypothesis is true, though, if any of them are, the *Halobates* are a really remarkable example of marine life rarely, if ever, to be observed by divers.

For more information on marine insects, visit the Marine Insects Home Page of the Department of Biology at the University of Nebraska at Kearny: **www.unk.edu**
Or visit the Marine Insects page of the Department of Entomology at the University of Nebraska at Lincoln: **entomology.unl.edu** ■

A DIVING BELL

The Water Spider (Argyroneta aquatica) is not an insect, but it is an aquatic expert. It lives underwater by creating an underwater air chamber. It gathers a small bubble of air from the surface on its hairy hind legs, then releases it into a web woven among water weeds. It waits inside this underwater lair to catch passing prey. The spider mates and lays eggs inside this air chamber which works like a gill and allows the insect to absorb oxygen directly from the water. As the insect uses up the oxygen in the bubble, dissolved oxygen in the water diffuses into the bubble so the insect actually get more oxygen than originally in the bubble. However, nitrogen must be present for this to happen. The nitrogen provides stability to the bubble (it diffuses more slowly out into water than other gases). So, the insect goes back to the surface to replenish nitrogen rather than to get fresh oxygen. In an experiment, an aquatic insect provided with pure oxygen survives only 30 mins underwater, while with air it can survive 4 hours. ■

Water Strider



Model illustrating bond forces of water

Text by Micheal Symes

Water Facts

Surface tension

Surface tension is a quantity which we often meet in daily life without thinking too much about it. It plays a large role in washing and cleaning procedures, for example, as well as in lubrication, cosmetics and rainwear. Among the numerous anomalous properties of water is its very high surface tension. This has great consequences for all life forms, both human and otherwise. In the article on Marine Insects in this issue of Xray-mag the ability of insects to 'walk on water' is ascribed to its surface tension. The effect of this phenomenon is thus of vital importance to these insects.

Surface tension has properties resembling a stretched elastic membrane. This is due to the fact that water molecules at the liquid–gas interface have lost potential hydrogen bonds directed at the gas phase and are pulled towards the underlying bulk liquid water by the remaining stronger hydrogen bonds, of which there are many. (An explanation of hydrogen bonding was given in the previous number of Xray-mag.)

In the bulk of the liquid each molecule is pulled equally in all directions by neighbouring liquid molecules, resulting in a net force of zero. At the surface of the liquid, the molecules are pulled inwards by other molecules deeper inside the liquid, but there are no liquid molecules to balance these forces, so the surface molecules are subject to an inward force of molecular attraction which is balanced by the resistance of the liquid to compression. There may be a small outward attraction caused by the air molecules, but as air is much less dense than the liquid, this force is negligible.

As the forces between the water molecules are several and relatively large on a per-mass basis, compared to those between most other molecules, the surface tension of water is large.

Surface tension is measured in newtons per meter (N m^{-1}) and is defined as the force along a line of unit length perpendicular to the surface. At 20°C it has the value 7.29 x 10^{-2} N m^{-1}. For comparison, mercury, in which the intermolecular bonds are electrostatic rather than hydrogen bonding, has the value of 46 x 10^{-2} N m^{-1} i.e. about 6 times greater. This is why mercury forms bigger spherical drops than water on, for example, a glass surface.

Dimensional analysis shows that the units of surface tension, N m-1, are equivalent to joules per square meter (J m^{-2}). This means that surface tension can also be regarded as a surface energy. Energy is required to increase the surface area so it is minimised and held under tension. As a sphere has the smallest surface to volume ratio i.e. the least surface energy, this will make the sphere the most stable shape for a bubble.

The hydrophobic legs of a water strider

A water strider can walk on water because its feet do not break through the surface. This is because its feet and legs are hydrophobic i.e. water repelling. It has been shown that the water resistance of the legs is due to their special structure, being covered by large numbers of oriented tiny hairs with fine nanogrooves. It is this physical structure that is more important than the chemical properties of the waxy coatings of the legs. It has been calculated that the maximal supporting force of a single leg is 0.00152 newton, which is about 15 times the total body weight of the insect. This shows that the surface of the leg is strikingly water repellent. It is no wonder, then, that these insects are so good at dashing around on the surface of water. ■

Leigh Cunningham

Divetables, Computers or Bottom timer?

Leigh Cunningham is the technical manager and TDI Instructor Trainer for Ocean College, Sharm El Sheikh.

Probably best known for his records - Leigh once held the record for the deepest dive in the Red Sea - and attempts of reaching extreme depths, he also has a wide range of teaching credentials to his curriculum:

TDI instructor trainer, DSAT Tech Trimix instructor, PADI MSDT IANTD Technical diver instructor CMAS 3 star instructor.

During our initial open water training, we were all shown how to use a dive table. But did we ever use it again - and is the right tool?

Doing the table excercises during our first open water course, we could establish an NDL (No Deco Limit) and pressure group, find a repetitive pressure group based on our surface interval, and see how long we could safely spend on our second or next dive, without exceeding the NDL, and what not.

Few instructors, however, remember to mention at this point that dive computers or bottom timers can do all this, easier faster and safer. And in reality, on the next adventure into the abyss, most will be indeed be equipped with a computer and/or be supervised and led by a dive master anyway.

So what are the chances that we will actually look at any tables again?

The dive table

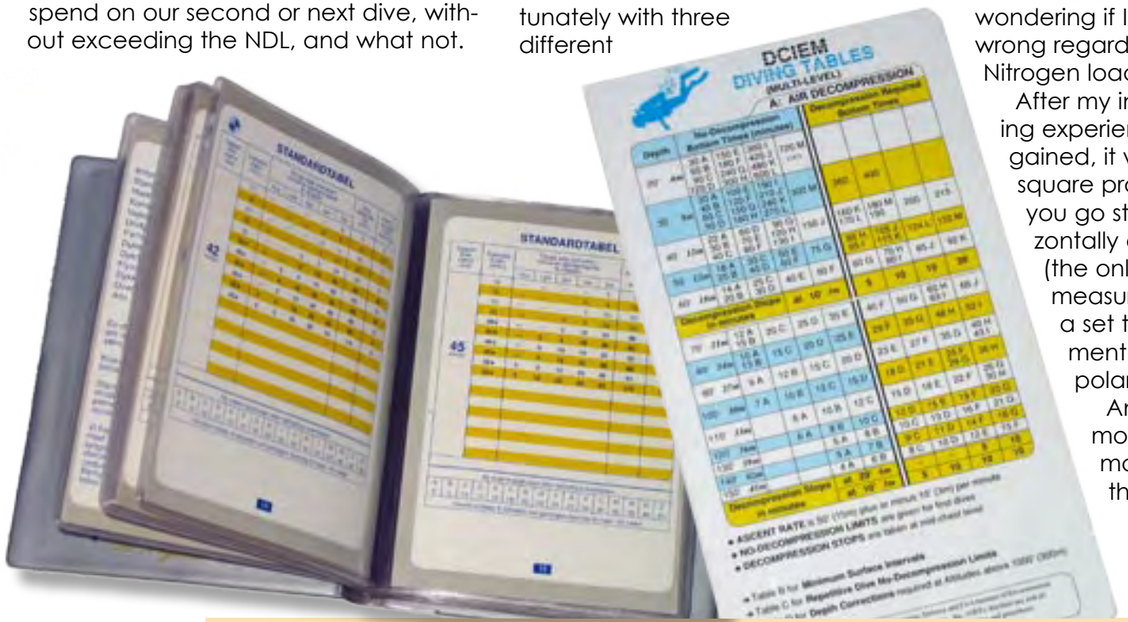
Looking back into my own experiences, I remember shortly after completing my own first diving course, CMAS one-star in Eilat, Israel, unfortunately with three different instructors, that spoke English as well as I speak Hebrew, I started working as a chef on a liveaboard dive safari boat. Unfortunately, there wasn't so much in the way of dive leadership on this boat either, but it was a long time ago, and that's another story.

So, after trying to plan initial dives with my nice new shiny table, I came to the realisation that I didn't speak Hebrew, and this table wasn't much use for planning the multi-level profiles, which the other recreational divers on the boat were planning.

I therefore soon put the dive table to the bottom of my dive bag and started following other divers around wondering if I'd got the whole story wrong regarding decompression, Nitrogen loading and DCS.

After my initiation, with some diving experience and knowledge gained, it was clear to me that square profile diving—in which you go straight down, swim horizontally and then go straight up, (the only way to accurately measure nitrogen loading with a set table)—in this environment was about as rare as a polar bear in the Sinai.

And for good reason—most of the corals and marine life were located in the first 20 meters.



ALL PHOTOILLUSTRATIONS BY PETER SYMES

The dive wheel

A number of years later, I was introduced to the PADI wheel (a method of planning multilevel dives with a set table, see illustration next page)—*fantastic*. Later still, I had the pleasure of instructing students in the use of the wheel. After a short while, I noticed numbers fading on this high tech device due, I think, due to the combination of sun and sand that seemed to get in everywhere.

Particularly for new divers who are diving in warmer water reef environments and following the dive master or leader around, it is a good idea not to exceed the planned depth, ascend to a decreasing depth level and when you reach 100 bar cylinder pressure, head to your five meter safety stop with around 60 bars left.

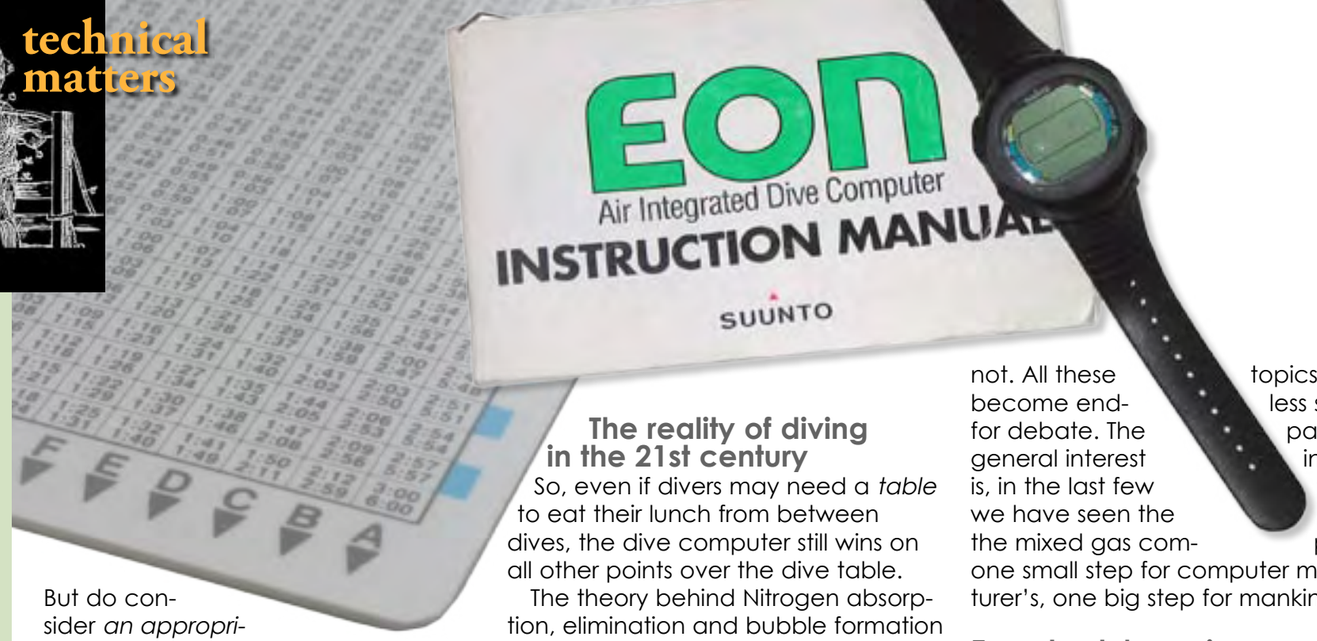
No more talk of pressure groups, and you didn't seem to get bent. But let's get on to the next rung on the ladder of technical evolution and get digital

The dive computer

Let's begin with a word of caution: The only way to really gauge nitrogen absorption and elimination, establish an accurate NDL and predict residual nitrogen levels, which needs to be taken into consideration on repetitive dives, is to wear, or have somewhere on your person, *a dive computer*. It's better to be safe than sorry and have an annoying itch and a blotchy red rash.

If you don't have a dive computer and this sounds like your type of profile or dive plan, or for anyone whose actual dives do not accurately simulate the pre-planned, depth and time plan—GET A DIVE COMPUTER.

Buy one before your next dive trip. ▶



But do consider *an appropriate computer*—which is one for your experience level and the type of diving you will be doing in the near future. The most expensive computer in the dive shop may not be your best choice. I would recommend a "single mix", that is a basic nitrox computer to begin with. With recent advances in technology, all but the most basic dive computers will have an FO_2 (Fraction of Oxygen in breathing gas, usually set as %) selection option.

This also enables divers to track both Nitrogen and Oxygen parameters (such as CNS toxicity, time and partial pressure limits) accurately, in blends from 21% Oxygen (regular air) through to EANx 50 (Nitrox with 50% Oxygen), based on the exact mix the diver is breathing.

Shortly after entry level training, more and more divers are making the wise choice to enroll in a basic nitrox course, making the optional FO_2 selection computer the best buy.

The bottom timer is an electronic depth gauge with a few basic functions. It doesn't do any computations as regards to decompression or limits

The reality of diving in the 21st century

So, even if divers may need a *table* to eat their lunch from between dives, the dive computer still wins on all other points over the dive table.

The theory behind Nitrogen absorption, elimination and bubble formation can be gained without the necessity for dive table explanations and use during the entry level course.

Entry level diving courses with some training agencies include dive computer explanations and use instead of the dive table which is now optional reading. In the future, all training agencies will consider set tables to be optional and eventually deem them obsolete.

Technical diving

For the technical diving community, tables have been obsolete for many years—although some tech divers will keep them in the dive bag as they are useful for drawing straight lines on the dive slate.

The tech diver is, however, consumed by the world of somewhat nerdishly interesting decompression software packages, dive computers and bottom timers.

Discussing V-plan over Z-plan, Gue over Gap, Pyle, WKPP, modified stops by changing gradient factors, Nitek Helium vs VR3 computer and what not. All these topics have become endless subjects for debate. The part of general interest in all this is, in the last few years, we have seen the birth of the mixed gas computer—one small step for computer manufacturer's, one big step for mankind.

Everybody's a winner

Aside for the faithful bottom timer, which has been cruelly rejected by divers, the blessing has been the mixed gas computer.

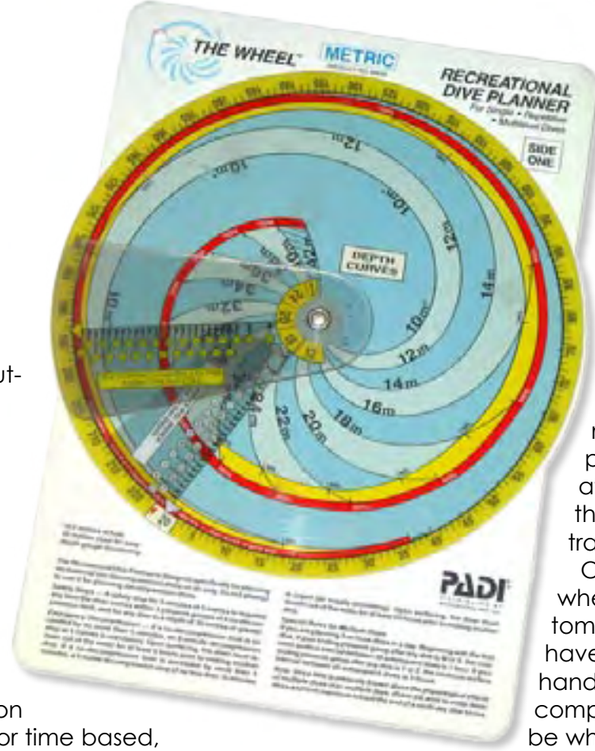
No longer will mixed gas divers need to carry wet tables with an array of back up plans or back up slates.

No longer will mixed gas divers need to spend hours generating numerous bail out plans taking into consideration exceeding planned depth or time, loss of gas scenarios and appropriate checks along the way.

No longer will mixed gas divers need to travel into the unknown *hostile abyss* without the added security of having a computer on their wrist that is tracking gas absorption and elimination based on a mathematical formula or algorithm that simulates the rate at which our body tissues absorb and eliminate He and/or N_2.

Dive tables and the dive computer offers a simulatation only. Diving an accurate plan is no absolute guarantee DCI will not occur

With up to 10-mix pre-programmable gas switch options and whatever ratio of He to N_2 you so desire, the mixed gas computer is the true *Ferrari* of dive computers. Divers now have a re-adjusted plan based on the exact digression from the primary plan, whether the digression was depth or time based, or due to loss of a particular gas ie because of equipment malfunction. With this in mind, the dive can now be treated the same as an air/EANx decompression dive with the diver using two multi mix air/EANx computers.



Have you ever thought of this: The Wheel is actually an analogue computer

Another word of caution: Don't slip into the habit of making a plan on the fly—deciding upon exact depth and time during the dive. The mixed gas computer could encourage this bad habit. Trimix diving must be shown the same degree of respect. Dives must be executed with the same high degree of accuracy and maturity as they always have been.

The Bottom timer

So where does this leave the bottom timer? *A paper weight*—much more useful than the dive table. *No!!!*

The bottom timer will always deserve its rightful place as a very good back up depth/timer for the recreational or technical diver and for the new mixed gas divers whose budgets might not stretch to two-mix gas computers directly after paying for the formal Trimix training.

One minor area where a bottom timer may still have the upper hand over the dive computer could be when divers are pushing the depth envelope. The diver may not agree with the specifics regarding modifications to the algorithm that a type of computer incorporates, which dictate the type of schedules generated by the computer. Or, the computer may simply not have the required range. A depth timer or the computer in gauge mode may have greater range than the dive computer itself or the computer in computer mode.

Conclusion

In my opinion *set* dive tables are a thing of the past. The appropriate computer for you and your type of diving has to be the way to go. The bottom timer has got it hard, but still a very useful tool.

One last thing: Dive tables and the dive computer, if used correctly, ***simulate*** the rate at which our body tissues absorb and eliminate nitrogen based on a number of theoretical tissue compartments. *Diving an accurate plan is not an absolute guarantee decompression illness will not occur.*

P.S. Keep fit and drink lots of water. ■

LEFT: A close-up view of the newly discovered siphonophore reveals several of the glowing red lures and tentilla

INSET: Close-up view of the lure. It closely resembles a swimming copepod

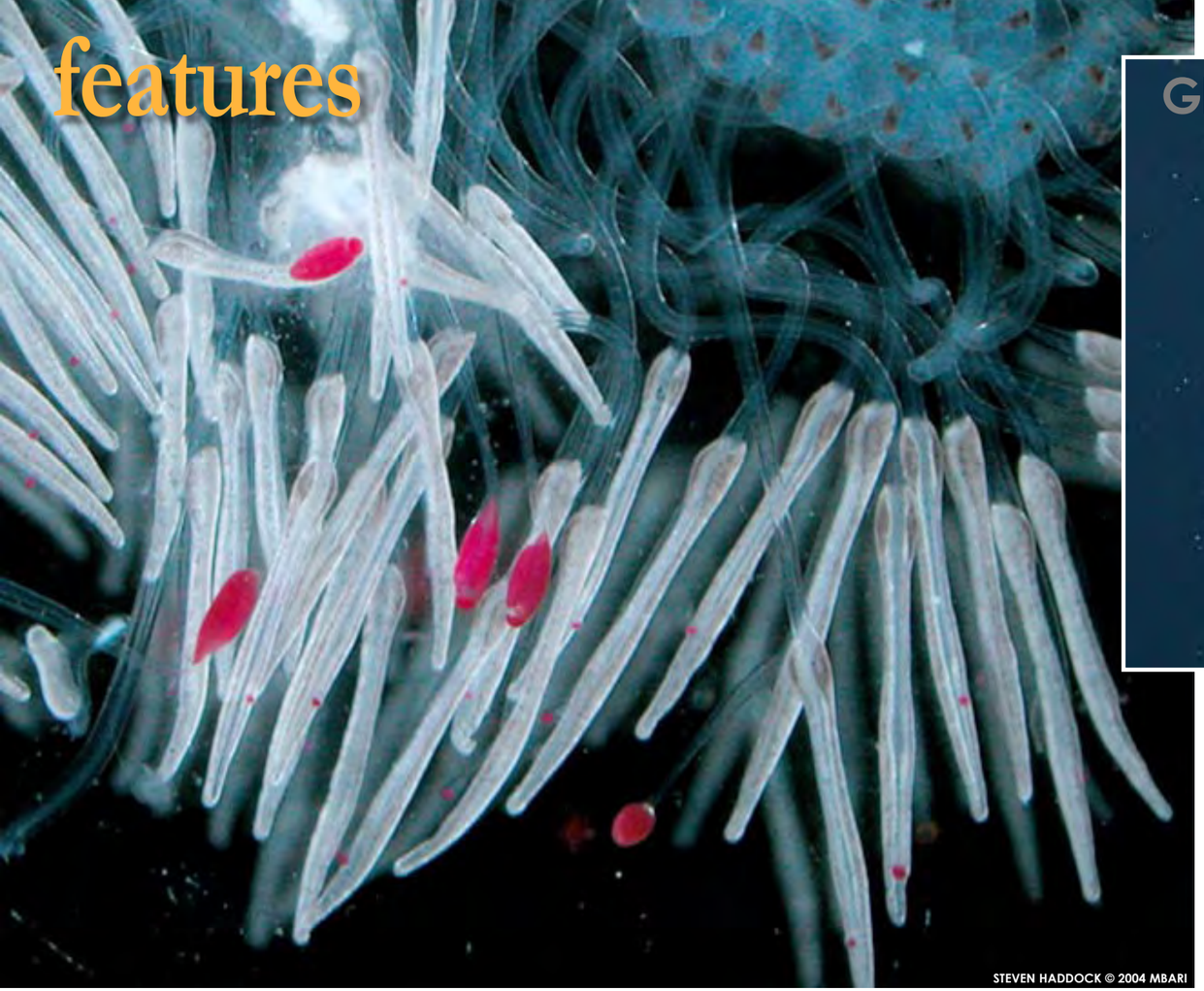
Text by Michael Symes
Photos courtesy of Monterey Bay Aquarium Research Institute

Glowing Jellyfish

Glowing red lures are used by deep-sea jelly to catch fish

ROV observes siphonophores in their native habitat

Probably about 90 percent of deep-sea animals are bioluminescent. Some jellies use bioluminescence as a defense, i.e. they glow when disturbed in order to light up their predators, making their attackers vulnerable to even larger animals. A few deep-sea fishes and squids have glowing organs that look like lures, but even these animals have never been observed actually using their glowing organs to capture prey.



A microphotograph of the newly discovered siphonophore shows a tentacle with tentilla—tiny filaments branching off the main tentacles. Each tentilla has thousands of stinging cells. On separate stalks are red lures that move up and down. In this manner, they wiggle to look like swimming copepods, which are a typical food of small midwater fishes

Glowing Jellyfish

LEFT: The deep-sea siphonophore is around 45 cm (18 inches) long. Swimming bells that pulse like jellyfish make up the upper half of the colony and keep the colony moving through the water. White stinging tentacles make up the lower half. The tentacles capture small deep-sea fishes

Now a new species of jelly-fish has been discovered in the deep sea that attracts fish by wiggling hundreds of glowing red lures. This is the first time any marine invertebrate has been found to use a bioluminescent lure or to display red bioluminescence.

Marine biologist Steven Haddock of the Monterey Bay Aquarium Research Institute (MBARI) has studied glowing marine animals, focusing on gelatinous animals such the siphonophores. Related to the typical round "jellyfish" that sometimes wash up on beaches, siphonophores are colonial animals, arranged in chains that in some species can be dozens of meters long. The members of a colony specialize at different tasks. Some form swimming bells, which pulse slowly, pulling the colony through the water like a long, fluid freight train. Others specialize in feeding, and sport stinging tentacles. Siphonophore colonies are difficult to study as they often break into pieces when disturbed or captured, and they were therefore also studied in their native habitat, thousands of meters down, using an ROV.

The siphonophore discussed here, an unnamed species in the genus Erenna, lives at depths of 1,600 to 2,300 meters, where fish are few and far between. It was therefore surprising to observe small fish in their guts because how could these jellies capture enough fish to survive in their sparsely inhabited environment. Most siphonophores set a big web of tentacles to catch animals that happen to swim by. But this jelly doesn't deploy its tentacles very far. It uses deception to attract fish instead of casting a wide net to capture them.

Microscopic examination showed that interspersed among their stinging tentacles were thin rod-like structures which were tipped with red, glowing blobs. Several lines of evidence eventually led to the conclusion that these red blobs served as lures for small deep sea fish. The first clue lay in the siphonophore's behaviour. Jellies that use bioluminescence for self defense tend to have lights distributed all around their body, which flash brightly when disturbed. The Erenna siphonophores, however, keep their bioluminescence very localized and under tight control, suggesting that their lights had an entirely different function.

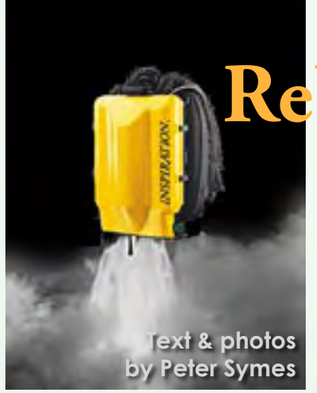
In addition, the red, glowing blobs were shaped remarkably like the bodies of deep-sea copepods, a major food item for small deep-sea fish, and were flicked back and forth repeatedly so that the glowing lures darted through the water just like swimming copepods. Finally, at least one siphonophore's digestive system contained both fish and lures, suggesting that the lures were ingested along with the fish.

Erenna's glowing red lures may also force scientists to take a new look at the role of red light in the deep sea. Red bioluminescence is extremely rare, and the prevailing view among marine biologists has been that most deep-sea animals cannot detect red light at all. However, because deep-sea fishes are so hard to bring to the surface intact, we know very little about their physiology. Haddock's work suggests that some deep-sea fishes may not only see red light, but routinely use it in finding food.

It is strange that in the deep sea they are using red light, which doesn't travel very far. Possibly the red light might be drawing in fish because they could be mistaking it for the red glow that comes from the algae in the stomachs of shrimp-like copepods, their prey.

The red fluorescent lights of Erenna are only found on the animals' fully grown, branch-like stalks. When the stalks are immature they only give off blue-green luminescence, but as they mature, the blue-green luminescing parts become surrounded by tissues containing red fluorescent material.

Further details can be found in the July 8, 2005 issue of Science magazine ■

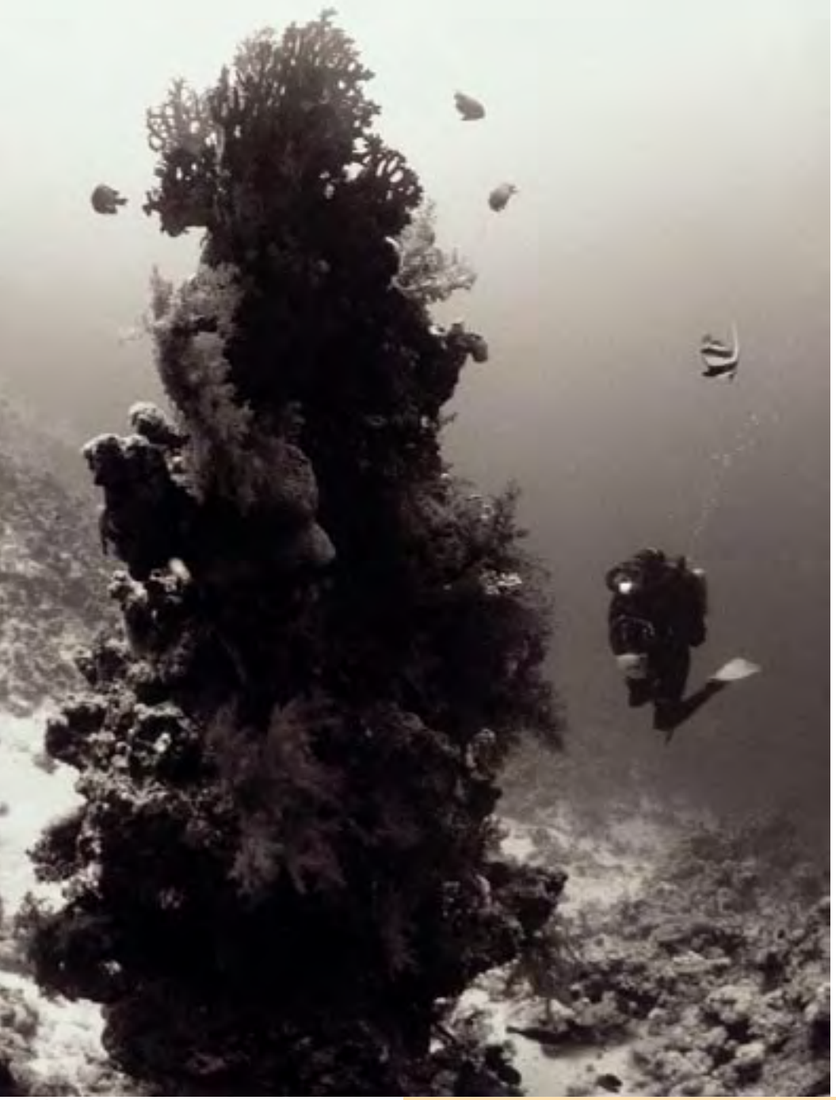


Text & photos by Peter Symes

What is it like?

Diving Rebreathers

Why bother?



Rebreathers look cool, glitzy, technical and heralded as the future of diving, right? We read a lot about their impressive performances concerning duration of dives, gas economy, extended no deco limits and what not. But isn't it a bit like watching Jeremy Clarkson from BBC's car program, *Top Gear,* whiz around in fancy Ferraris and Aston Martins with a goofy, happy grin on his face and reeling off a string of excited superlatives? Yes, they look fabulous and sound fabulous, but you're still not sure what all the fuss is all about and what's in it for you... and whether you could actually afford one.

Rebreathers aren't exactly an impulse buy, but they don't quite require the same deep pockets as a super car. So, you could actually own one if you put your mind and piggy bank pennies into it.

They do come with the same sort of built-in bragging rights and can still gather a crowd on a beach. However, the glitz factor shouldn't be the only reason for getting one—there are easier routes to impressing members of the opposite sex.

Diving experience

The reason to go with a rebreather should be their performance in the water, and that they provide for a much different and richer diving experience, which, in the first place, is why we go in the water ourselves rather than watching dive movies on *Animal Planet* from the comfort of our reclining chair at home. However, as we all know, there is no such thing as a free lunch in diving either. There is a trade-off, and you will have to consider if it is still worth your while despite this.

It is not merely a matter of comparing technical matters, performance and parameters when pitting rebreathers against the open circuits (regulators and tanks). It is easy to be blinded by dazzling numbers and facts on how much longer you can stay under water with no deco-obligation and so on, but consideration should also be given to the sensation and experience of diving rebreathers.

I think these subjective matters have been grossly overlooked in textbooks and articles. Yet, how can we put words to them?

Why?

Wine connoisseurs have a whole weird vocabulary to describe all the flavours of wines, but describing diving the rebreather experience to an open circuit diver still feels somewhat like trying to describe a sunset to a blind person: "*It's... erh... just really cool and... uhm...*"

Any piece of equipment is just a means to an end and not the end itself. It is a means of transporting you down into the underwater realm so you can have an enriching experience by witnessing, first hand, this magic realm. So, as far as I am concerned, if someone invented human gills and a thin hide to cover and keep me warm, my twin-set would surely be left to rust in the attic for good.

I just want to see fish and other underwater life. I want to get as close as possible without disturbing the creatures, and for me, this is exactly

Dräger Ray semiclosed rebreather. Behind, an open Inspiration fully closed rebreather

Black goby, Baltic sea

Aaah! Silence at last—and the *Unbearable Lightness of Being* starts to sink in

Up close and personal. This squirrelfish almost sat on my mask

Rebreathers

what all the fuss and hype is about with these gizmos.

I am a photographer, so aside from the better personal experience, I can also get better pictures when I don't blow or scare all the critters away. For me, the longer no-deco times that these units give me are great but not a prime concern. Although, I have on more than one occasion, appreciated the fact that I could just stay down there at depth to get my shot far longer than an open system would have permitted me.

Other CCR divers may have other uses and other subjective reasons for liking their units. For instance, rebreathers have also become quite popular among some wreck enthusiasts, technical divers and cave divers.

Hearing

Another major reason why I have a richer diving experience on my rebreather is that I can hear better—no noisy breathing apparatus or bubbles—and so, can more keenly sense what is going on around me, even when I do see it directly. I have a much more acute sense of the three dimensional space around me and what is in it. But let me get back to that later.

On a rebreather, I often get the sense that I can hear what is going on behind me

Comparison

Let's go on a dive and compare how open and closed circuits perform. In the following, I will use a fully closed system for comparison rather than the more widespread and more economically accessible semi-closed system since the fully closed systems are the thoroughbred of rebreathers, and because I am better acquainted with this type of system.

Before we even get to the water, there is the matter of transportation. If you are going to the beach in your own van, there is not much difference in hassle when it comes to transporting a scuba set with tanks and regulators or a rebreather.

But if you have to travel by air, we are talking about a completely different ball game. Going by plane, the open circuit diver can bring along his or her regulator and BCD, or the diver can opt to hire everything at the destination. The diver doesn't have to worry about carrying tanks either, so there is not too much excess baggage.

Rebreathers are different story.

The check-in challenge

It isn't quite the same for the poor rebreather diver who might have to schlep quite a bit more hardware onto the plane. It is not an issue to be taken lightly these days when airlines are less and less tolerant of passengers who do not head weight limits and bring along overweight bags.

The rebreather diver must rely on the destination dive centre to fill his or her oxygen tank, and if the diver is lucky, the dive centre can also supply CO_2-scrubber and rental tanks. If not, well… let's hope that overweight charges aren't an issue for you.

Rebreather-friendly dive centres & locations

Do check the list of so-called rebreather-friendly dive centres before you go. It could save you quite some hassle and money. You can find these dive centres on various lists, ie. online bulletin boards and web sites. For example, you could use this one at the Ambient Pressure web site: **www.ambientpressurediving.com/ccrdbint.htm**)

So far, it seems that open circuit systems lead closed circuit systems 4-0 in the why-bother score due to the hassle factor.

Before the dive

OK, we are now at the waterfront with all our gear spread out, rigging up. Mr. Open Circuit mounts his BCD on a tank, regulator on top, opens the air and he is ready to dive in a minute or so, save the odd popping o-ring experience. No complications here.

Ms. Re Breather, on the other hand, has a lot more equipment assembly to do, some testing on top of this, and then some "pre-flight procedures" to undertake.

After assembling the unit, we first have to do a *negative pressure test*, where we, under eye-popping strain, suck all the air out of the unit, close the mouthpiece and watch it to see whether the counter-lungs remain deflated and squashed like vacuum-packed coffee.

After that, we then do a *positive pressure test* where we inflate the unit fully and make it look like an over-blown tire to see if it holds pressure

and remains stretched like a drum-skin. If not, we have to go over all the seals and joints once more.

The open system now leads the score 5-0.

Next, comes the fire-up sequence where the rebreather diver stares very intently upon the unit's handsets (the controllers). *Do not distract her at this time!*

The electronics on the handset are taking the diver through a "pre-flight" sequence of actions and tests, and she must respond to these accurately and observe closely that the rebreather responds correctly. By *pre-breathing* the unit, the diver makes sure that it operates properly before entering the water.

During the start-up sequence, the breathing loop is filled with 100% oxygen to calibrate the sensors, so we have to

Rebreathers

Weight can become a real issue when travelling with your rebreather. If possible, sort it ot beforehand. Sometimes you can negociate a fair price on overweight before you go - or buy some extra allowance.

observe that the oxygen partial pressure drops down from 1 bar to stabilise at 0.70 bar partial pressure, which we have chosen as our *low set point*.

This is the oxygen level with which we start the dive. Any wrong or erratic behaviour of the oxygen sensors will show in the readings or produce an outright error-message, of which you must strive to find the cause and correct before you can dive.

Finally, we can hit the water. Upon entry, or slightly into the descent, it may be our habit to clean our masks. We let a little water into our masks, and then clear it by an exhalation through the nose. On open systems, this is just something you do, and many divers exhale through their nose on a regular basis. On a rebreather, this is a big no-no, as it means venting precious gas out into the environment.

On rebreathers, you clear masks very carefully and sometimes in a cross-eyed manner as you try to watch exactly how much air is required to just push that last drop of water out of the mask without losing any air.

As you descend, the increasing ambient water pressure also starts to squash your counterlungs flat. They have about the same volume as a BCD, but need a constant volume in order for you to have something to inhale.

Unless you add some more air (or *diluent*, which can also be some other breathable gas) on your way down—either by manual injection where you do a series of small bursts, not unlike what you do with your drysuit, or by the means of an ADV (Automatic Diluent Valve)—you will soon enough find yourself sucking very hard for no air... not so comfortable, so you only do that once.

Some 5-6 meters down, or if you are at the bottom of a somewhat shallow coral reef, you pause and look up for the tell-tale streams of bubbles that might indicate a leak. You can also ask your buddy to look around for you.

If everything's fine, you may proceed and switch to the higher set point, where your oxygen level is kept at 1.3 bar partial pressure. Only below 3 meters at which time the ambient pres-

Hovering becomes a delicate skill when diving rebreathers. You need to be far more accurate in regards to how much air you have in your wing or dysuit. But once you get it right, you will lie completely still—even while breathing in and out

WWW.CUSTOMREBREATHERS.COM

The Megalodon is another popular CCR-rebreather on the US market

A couple of worthwhile rebreather resources:

www.therebreathersite.nl
www.rebreatherworld.com

Some manufacturers:
www.steammachines.com
www.customrebreathers.com
www.ambientpressurediving.com
www.ccrb.co.uk

(Above list is not exhaustive)

STEFAN BESIER, WITH PERMISSION FROM STEAM MACHINES

Prism CCR from Steam Machines as it was presented at DEMA 2003

The ADV (Automatic Diluent Valve) on a Inspiration CCR, makes sure that more air gets automatically added into the breathing loop upon descent

sure is at least 1.3 bar, can the system maintain a 1.3 bar partial pressure of oxygen, hence, the need for a lower set point at the surface. (On newer rebreathers, like the Evolution, this set point switching can be set on automatic.)

It is, after all, this bother that permits the rebreather to flourish and deliver its promises. This is where it picks up on all the points leading to an enhanced diving experience.

First of all, there is this amazing tranquillity—you can't hear a sound except, maybe, noises from your buddy's equipment. And this is what I treasure most on the rebreather: you regain the practical use and sense of hearing. You are not cocooned any more in cascades of bubbles and heaving, wheezing, whining valves.

You'd be amazed how much noise open circuits actually make, but it is hard to fully appreciate this before you try and experience the alternative yourself.

I haven't seen this change of noise level given much mention in various text books. This feature allows you, all of sudden, to hear or sense what goes on behind you. It provides you with a 360° awareness that is not so unlike what you have on land. On land, you can usually hear when somebody enters an area you occupy even if you are reading a book and facing another direction.

Buoyancy issues

Continuing on our journey, we swim, down a slope. As I sink, I compensate for lost buoyancy with squirts of air into my wing, and then, to halt my descent completely, I take the traditional deep inhalation, which would, if I were on an open circuit, have halted me just above the bottom. Not so on a rebreather.

This time, I most ignominiously plough straight into the muddy bottom flat on my face. The reason? My lungs and the counterlungs on the rebreather maintain a constant total volume, so when I inhale, I just empty the counterlungs with no effect on overall volume and buoyancy.

Boy, does it make you feel stupid when you bite the dust this way.

Buoyancy on a rebreather is a more delicate thing. Because you can't use your lungs to fine tune your hovering, nor will your breathing disturb your position, you won't bob up and down with each breathing cycle, which is really great once you have nailed it and want to lie completely still with a pygmy seahorse in the cross hairs of your camera viewfinder.

For the very same reason, a rebreather diver will prefer to swim *around* an object rather than over or under it. Ascending means venting gas, which you lose for good.

At depth, I have several other advantages over my open circuit buddy: I won't run out of gas any time soon.

My on board gas supply will last me 10-12 hours, although the CO_2-scrubber shouldn't be used more than 3 hours. And with lots of non-deco time to go around at medium depths, it also gives me peace of mind and no stress.

It is the Zen of diving. Should a school of hammerheads parade by 45 minutes into the dive when my buddy's open circuit system would be down to 40 bar, I can still just hang around to make the most of my roll of film.

But unlike my open system buddy, I do have to watch my handsets, my controllers, at regular intervals to make sure that I am still getting the right Nitrox blends. On a closed circuit rebreather, I always have to know which gas mix I am breathing and that it can sustain life at a given depth.

On open systems, once you have the regulator in your mouth, you only have to breathe it and you are set. Not necessarily so on a (CCR) rebreather, which is a mobile nitrox mixing unit. As such—if anything goes awry, God forbid—it can serve you a gas mix too lean or too rich in oxygen for your own good.

Too little oxygen leads to hypoxia, and you will faint. Too much, and you run the gauntlet of oxygen toxicity, which brings along with it uncontrollable cramps. In either case, drowning is imminent. This is why knowing at any given time what you are breathing is one of the golden rules of CCR-diving.

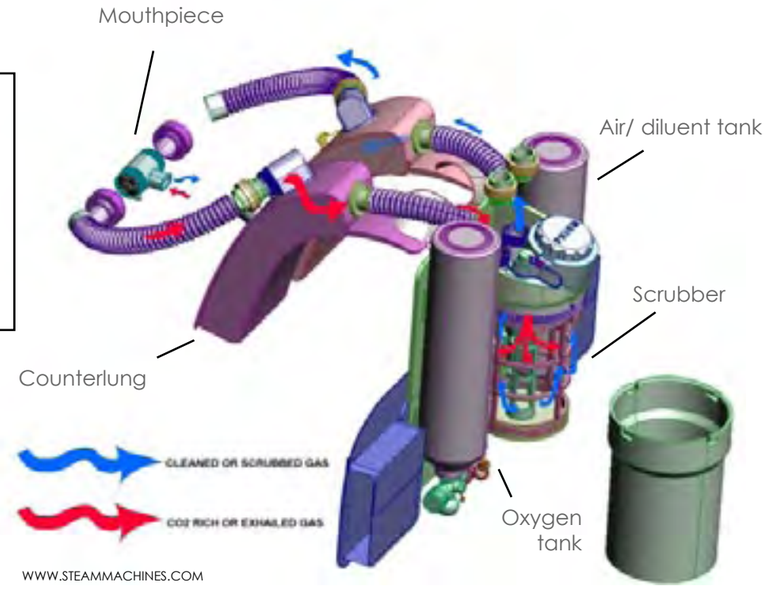
If I am ever in doubt, I may first perform a strangely looking exercise called a "diluent flush", where I flush the whole breathing loop with air from my air (diluent) tank. With one hand, I keep pressing the inflator button down injecting air, while I pull the cord to keep open the over-pressure valve that is venting air. I do this for say, 10-15 seconds, after which the entire atmosphere in the breathing loop should be exchanged with air, which I know I can always breathe. Needless to say, this procedure is quite wasteful of your relatively small gas supplies.

If I am still in doubt for some reason, the golden rule is to "bail out". That means switching to open systems, which is either a regulator connected to the rebreather's air (diluent) tank, or a completely separate system, ie. stage tanks.

If I switch, it is paramount that I remember to close the mouthpiece, otherwise water will enter the breathing loop and replace the air resulting in a very considerable loss of buoyancy.

So, what should you know and be able to do? What should your buddy, on an open system, be able to do to assist you in case you run into trouble?

A CCR rebreather diver can become unwell for all the same reasons that an open circuit diver can, plus a couple more things can happen including hypoxia, hyperoxia and hypercapnia. (too little oxygen, too much oxygen and too much CO_2).



Flow-diagram and main components of a Prism Topaz CCR-regulator. The diver's lungs and the CCR's counterlungs, scrubber and hoses has a constant total volume

"Artist's impression" of the 360° awareness sensation

Diluent flush maneuvre. Illustration adapted from Inspiration manual (Ambient Pressure Diving) Simultaneously pressing the diluent feeder and pulling the over-pressure valve chord allows air (diluent) to replace whatever gas was in the breathing loop before

This little green knob is the valve to the O_2-tank. Buddies should know how to check and open it

If I am in trouble and appear unresponsive, it is first of all, important to ensure that I don't drop the mouthpiece for the reasons just mentioned and to prevent me from drowning. It could also be beneficial if you know how to perform a diluent flush on my system. So, before we enter the water, we should perform a little drill. Also you should know how to open my O_2 valve, in case it has become closed and caused my problem. Other than that, all the usual drills and techniques taught at any advanced or rescue diver course applies.

On the ascent, the rebreather diver will once again become more busy. As the breathing loop contains a substantial amount of gas, this also has to be vented in a controlled way along with that of the wing or drysuit in order to perform a controlled ascent and to do the required safety or decompression stops.

Before I go shallower than 3 meters, I also have to ensure that the rebreather switches back to low set point, so it will not over-inflate and make me float up like a zeppelin.

At the surface, I will not switch to snorkel as some open circuit divers do, but keep breathing on the unit, mouthpiece in place, until I am safely out of the water. This also gives me lots of oxygen in the meantime. Also, I must not power down the unit while I am still breathing from it as the injections and continued replenishment of oxygen is being controlled by the unit.

Maintenance & cleaning

After the dive, there is also a bit more to do and hassle when it comes to

Rebreathers

maintenance and cleaning of the unit. Rebreathers need to be disinfected at regular intervals because the unit has recycled air that has been in and out of your lungs numerous times.

The verdict?

It seems that you will have to endure a bit more bother and complexity when diving rebreathers. Which brings us back to the main question: Is it worth it?

Yes, it is. Rebreathers are certainly not for everyone. The ease and uncomplicated aspects of the open systems will still make open circuits a better option for many as well as a certainly more economical and accessible one, ie. when you bring your family along on a trip.

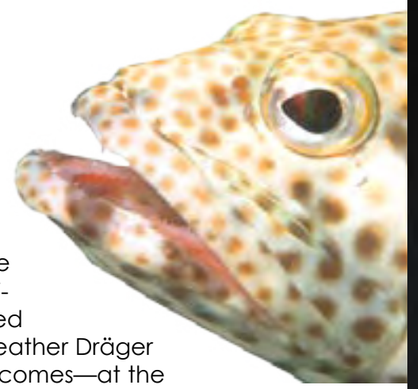
But for those who are willing to go those extra nine yards to fully appreciate what it is like being down there soundless, bubble-free, the way nature intended, the rebreather is the thing that will get you hooked for good. (Don't say I didn't warn you)

I have already mentioned the soothing silence, but the ability to be in the water and have a sense that you are truly part of the environment rather than being the noisy intruder, is the priceless part. The wildlife acts differently—your presence is somewhat accepted. I wouldn't go so far as to say that marine life acts indifferently, but the rebreather certainly lets you get far closer, and the critter behaviour seems far more natural and less apprehensive.

I have had blennies sitting right on my mask. This is the closest I have gotten to feeling like a human fish. It gives you the same sort of Zen experience as when you freedive, yet it gives you the time duration of open systems and then some.

Footing the bill

OK, now we come to the serious question: What is this going to cost me?



The Semi-closed rebreather Dräger Ray comes—at the time of this writing—at a suggested retail price of around US$ 2,000, making it just a little bit more expensive than a complete scuba set for open circuit diving, that is, regulator, BCD and tanks.

The fully closed rebreathers are more expensive and will, as a rough guide, come in the US$ 5,000-10,000 range for the most popular consumer models. This is, admittedly, not exactly pocket change for the average blue collar worker, but not totally out of reach either, if you really want one.

It all comes down to a matter of priorities. Do you want to have the kitchen refurbished, or one of these great machines? Well, that is a matter for you and your partner to sort out. Safe diving! ■

The Ourosboro rebreather by Kevin Gurr is one of the newest CCRs on the market. See the New Equipment section for more information

Text and photos
by Dan Beecham

PRODUCT SHOTS COURTESY OF OCEAN OPTICS
WWW.OCEANOPTICS.CO.UK

Digital Underwater Photography:

Cameras And Housings

In the last issue we looked at the advantages and disadvantages of digital underwater photography compared to traditional film systems. Now we're going to look at what kind cameras and housings are available on the market today, the costs involved, and which one is right for you.

To help simplify matters, we're going to group cameras into four different categories, these are;

- Compact Cameras and Housings
- Digital Underwater cameras
- Entry Level DSLR's and Housings
- Professional Level DSLR's and Housings

Compact Cameras and Housings:

The production of cheap poly carbonate housings for consumer level cameras such as the Olympus C7070 and Canon S70, has made it inexpensive for the first time to submerge camera's which offer features which in the past were only available on more expensive SLR's. Housings for compact cameras are produced by the cameras own manufacturer, and also appeal to the outdoors market, making them much cheaper than if they were just being used by divers.

WP-DC40
Compact cameras and housings are now so popular that nearly all divers carry them

Because compact's offer so much flexibility at a fraction of the cost, they occupy a large part of the market, and nowadays nearly all divers have a camera and housing, often small enough to fit into a BCD pocket.

D70 housing with 70-180mm macro zoom lens

Using a compact camera and housing means you can use the same camera that you use on land, whilst diving. This saves costs, and means you only have to travel with one camera. There's also a huge range of accessories available for compact's, including filters, external flash units, and supplementary wet-lenses that can be removed and replaced underwater to suit your subject. Another great thing about compacts is that the LCD screen can be used for composition, not just reviewing images and navigating menus like an SLR.

Compact cameras are easy to travel with; we hear more and more about divers in disputes with airlines over fares for excess baggage, and underwater photographers are often caught out whilst struggling to get their heavy equipment to and from their destination. A complete compact camera system can weigh as little as three or four kilos, which means it is easily transported in a rucksack.

There are many cameras and housings on the market at the moment, but most people agree that Olympus are the most versatile systems available. Filter threads are

D70 housing with fisheye As you can see with a camera and housing you can use a wide range of 'ports' to accommodate a range of lenses, from a 10.5mm fisheye lens for photographing large subjects such as wrecks or scenic's, right through to a 70-180mm macro zoom lens for photographing small shy subjects from a distance.

a standard feature on the Olympus range, which leaves you much more choice in the range of accessories that you can attach in the future. This also stops you having to use adapters to add accessories, which can be expensive and often introduce many more parts into the system.

Whichever system you choose to go for, check that the camera offers you aperture and shutter priority modes; the majority of compact cameras only have fully automatic exposure systems, which do not offer enough flexibility for use underwater. Also check that the housing will accept any accessories you may need to use in the future. For example, if you plan on photographing very small critters such as nudibranchs or pygmy seahorses, then you'll need to make sure the system you're looking at will accept a close-up or macro lens, otherwise it will not be appropriate for you.

Disadvantage

The main disadvantage of a compact camera is shutter lag. This is a small delay between pressing the shutter release button, and the camera actually taking the picture. When you first use a camera with shutter lag it can be very distracting, especially if you're used to the instant shutter release on an SLR. If the camera is very slow it can stop you getting the picture you wanted. If you plan on photographing fast moving subjects, a compact may not be the best route to take.

Compact's suit most peoples needs, they can be carried on every dive for a quick snapshot if the opportunity presents itself, or they can be kited out as a complete system for more serious photography.

One of the hot cameras at the moment is the Olympus C-7070. A 7 megapixel compact which offers you plenty of control, excellent image quality, and a housing which will accept a range of accessories. The camera and housing together should cost you around £500 (US$875).

Digital Underwater Cameras

Also known as amphibious cameras, these are systems which are designed specifically with underwater photography in mind. Cameras such as the newly released Sea and Sea DX8000G, offer an 'all in one' solution to an underwater camera, and often include handy features such as built in colour corrective filters.

Amphibious cameras generally offer the same sort of functionality as a camera in a housing, in fact that's exactly what an amphibious camera is, a normal digital camera built into an underwater housing. There's nothing special about the camera which makes it more suited to underwater photography.

Compact cameras and amphibious cameras share many of the same advantages and disadvantages, they both suffer shutter lag, yet they both offer you the versatility of being able to change lenses underwater.

The Nikonos V is probably the best known amphibious camera and the model which many famous photographers started. It went out of production 4 years ago but left a lasting legacy

Sea & Seas newly released DX8000G

photography

Which brand? The Canon versus Nikon debate is stronger than ever at the moment.

Even though they sound ideal, amphibious cameras are often not the best systems to go for. One of the problems with an amphibious camera is that if the worst happens, and you manage to flood and destroy a camera, or if the camera develops a fault for some reason, the whole unit is useless. With a housed compact camera its easy to replace the camera if you need to, and in fact many photographers carry a backup camera with them, just incase. With a camera and housing you have a camera which you can use more effectively on land, also compacts are generally cheaper.

DSLR's and Housings

Modern DSLR (Digital Single Lens Reflex) cameras such as the Nikon D70s and the Canon EOS 350D are now so cheap on the high street that more and more photography enthusiasts are using them on land, unfortunatley the cost of getting one underwater is very high. For this reason DSLR's generally appeal to very enthusiastic photographers who want to utilise the unique features that a DSLR offers the user over an amphibious or housed compact camera

Beside costs there are some other major differences between SLR's and compacts, as well as differences in the housings. As previously discussed, housings for compact cameras are produced for the mass market, and as a result are very cheap. SLR housings are a completely different ball game. Some housings are so specialised and appeal to such a small market that they are made in batches of 20 or less, hence the cost.

Unlike a compact, when using an SLR you must select which lens you plan on using before you begin the dive. When working with an SLR you travel with a range of 'ports', these accommodate different lenses. You use flat ports for macro lenses, (for shooting small subjects) and dome ports for wide angle lenses (for shooting large subjects). The lens quality and final image quality on an SLR is generally much better than that of other systems. Depending on where and how you use your pictures, this may make an SLR more suitable for you.

Some high end housings also offer the option of a viewfinder magnifier. These can be especially useful with modern DSLR's that generally have very small viewfinders, which appear to be even smaller when viewed from inside a housing and from behind a dive mask. Magnifiers significantly increase the cost of a housing, but also massively increase functionality. Many professional underwater photographers simply will not work with a housing which does not offer this feature.

There are many different housings available for DSLR's, ranging in price and functionality. There are two main types of SLR housing; these can be reffered to as box, and glove housings. Brands tend to specialise in one or the other.

Glove Housings

When a new camera is released, a company such as Subal, Seacam, or Nexus will design a brand new housing from scratch. This means the body of the housing has a very snug fit around the camera, with very little dead air space inside.

Seacam housing

Glove housings fits the camera very snugly

When you pick up a glove housing all the controls fall in the same position on your hands as if you were using the camera on it's own. This offers you the highest level of functionality. Because the housing is designed from scratch, they are a lot more expensive. A housing body can cost more than £2000 (US$3500), and a system fully kitted out with ports and flash units could easily cost more than double that.

Box Housings

As a general rule, box housings tend to be a lot larger and heavier than glove housings. This is because manufacturers use the same basic hull for many different cameras, and adjust the placement of controls for different models. This means there is a lot of wasted air space inside the housing, making it buoyant, and so additional weight must be added to get it under the water. This also means that the controls are not positioned very conveniently on the housing, and you can be distracted by your equipment rather than being able to concentrate on getting the image you want.

Box housings tend to be available much sooner than glove housings, simply because they do not take as long to develop, if you're in a rush to get one of the newer cameras under the water, a box housing may be a better choice for you.

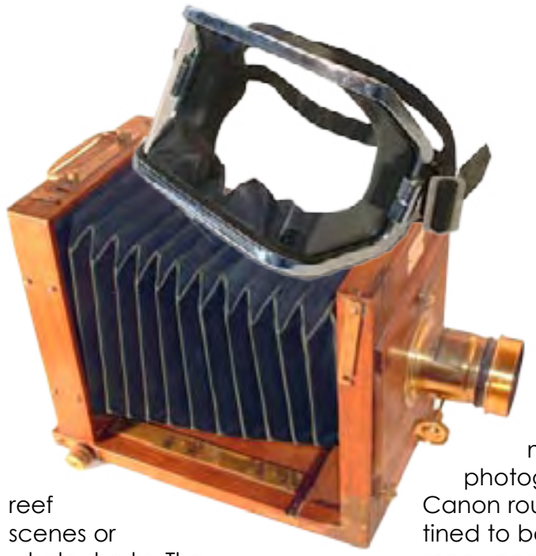
Enlarger for a view finder

Box housings are also great if you're working to a tight budget. You can normally get a system up and running with a range of lenses for less than half the cost of a top of the line housing. However do bear in mind that because the system will be heavier than a glove housing, there could be potential costs in transporting your equipment on a dive trip.

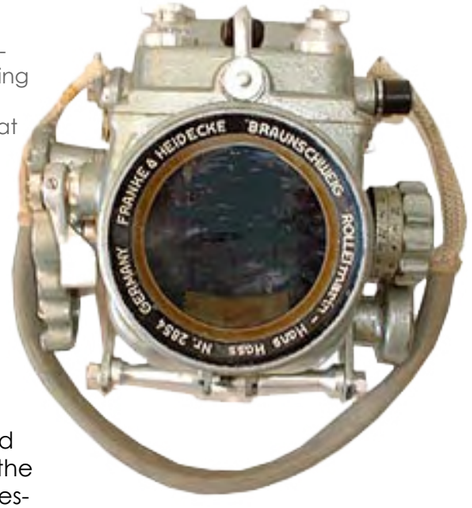
DSLR's offer excellent level's of flexibility, resolution, image quality and control, but this all comes at a price. There is no cheap way to get an SLR under the water, all housings are expensive (some a lot more than others), and you also have to invest a lot of time into the maintenance and preparation of your equipment.

The most popular cameras at the moment are the Nikon D70s and the Canon 20D. The D70s currently costs around £600 (US$1050) usand the 20D around £950 (US$1650) (camera body only). Many divers are choosing to go with the Nikon, this is because there are two different wide angle lenses available, a 12-24 mm zoom lens and a 10.5mm full frame fisheye. This offers the user more flexibility when choosing which lenses to use underwater.

Fisheyes are very popular, allowing you to capture large subjects such as wrecks,



Underwater photography is nothing new. This is the Rollei housing that the legendary Hans Hass used



reef scenes or whale sharks. The Canon 20D is a better camera in terms of resolution, speed and build quality, but at the moment there is no fisheye available.

Professional level DSLR's

Cameras such as the Canon EOS IDS mk II, and the Nikon D2x are the tools of professionals, and carry price tags which are way outside most peoples budgets. With a system fully kitted out, a photographer could be entering the water with more than £10,000 (US$17,500) worth of cameras equipment. Professional level DSLR's offer the handling, build quality, and speed that many were used to with top of the line film cameras, as well as resolution and image quality that meets the needs of professionals.

With regards to high end cameras, the Canon versus Nikon debate is stronger than ever at the moment, it seems that the majority of underwater photographers are taking the route of the Nikon D2x, a 12 megapixel camera which renders excellent image quality and carries a price which is very competitive to the top of the line Canon cameras. Many divers are taking this route because they owned Nikon's in the past and so they have a lot of money invested in lenses, however most professional land photographers are taking the Canon route. The IDS Mk II is destined to become a cult camera, many people believe it was the first camera which allowed us to say that digital is actually better than film, and the results that it is producing underwater are truly stunning.

Most underwater photographers need not consider professional level DSLR's, lower end cameras such as the Nikon D70 offer more than enough in terms of control, flexibility and resolution. There are however a select few, mainly professional underwater photographers, who can justify the expense of getting these systems up and running,

Hopefully we've now cleared up a few of the questions about the questions that you may have had about the pros and cons of some of the cameras which are available on the market today. ■

Where the pros go, camera tables tend to get a little cluttered

In the next issue:

Let there be Light

Remember all the stunning colours you've seen in countless underwater photograph's, and now wander why it's not in yours? We'll look at how to get colour in your shots through the use of flashguns and filters.

shark tales

Text by Edwin Marcow
Photo by Peter Symes

The time has come to repay the debt

A suggested new revolutionary dive levy

There have been three shark attacks in Florida recently; Armin Trojer, 19, was bitten in chest-deep water; Craig Hutto, 16, lost a limb while fishing in Cape San Blas; and Jamie Marie Daigle, a14 year old girl, was killed as she swam on a boogie board.

Shark attacks happen, but they are rare events, and are usually due to mistaken identity. But it is always greatly regrettable when such terrible incidents do take place. One can hardly imagine the terrible pain and anguish of those poor families, especially for the family of Jamie Marie Dagle, the teenage girl whose life ended so abruptly.

The closer we come to the day when we have electronic barrier protection for bathers and swimmers, the closer we will come to having a human and a healthy shark population living side by side without tragedy.

Jaws

It was after human intervention in the 70's, particularly after the Jaws films, that all sharks were vilified as killers. Divers with a misguided sense of bravado went about decimating shark populations throughout the world. The problem today has become so great that the population projection for the gray nurse shark is quite depressing. The extinction of this magnificent animal in eastern Australian waters could be a reality 10 years from now.

Rare

Shark attacks are rare and loss of life worldwide only numbers a handful of people annually. More fatalities occur from elephant stampedes in India but without the same emotive and chilling headlines, or sense of panic.

We live in an ever-changing world, with our climate and the oceans on which we depend being in a state of flux. Sightings of basking sharks are up 65% off the Scottish coast since 2001, but are down 66% in south-western England, their natural habitat. The reason for this abrupt and dramatic change, with rising sea temperatures, is that the distribution of plankton has been severly changed from its usual pattern. The whale sharks are simply following their food source into new waters.

The impact of man on the natural world has had a far-reaching effect, for we have upset the natural balance and placed many animals, the gray nurse shark included, on the endangered list. It is now time to repay the debt!

Shark attacks happen, but they are rare events, and are usually due to mistaken identity

Shark Tax

A revolutionary idea has taken shape in Australia. Primary Industries Minister Ian McDonald has championed the cause for 'pay as you dive'. In certain critical gray nurse shark locations a charge of 20 Australian dollars per diver, per day, would be levied. Divers would also be required to dive with only specially licensed commercial dive operators who would adhere to a code of conduct and various other practices.

The money raised from this levy would be directly used for an artificial breeding program. Test tube sharks in fact. Embryos harvested from female sharks in the wild would be reared separately in artificial wombs to prevent "intrauterine cannibalism" (this takes place where embryonic sharks feed on one another within the womb), and to increase the odds for successful healthy births.

This would go a long way to help, as there are believed to be only about 460 gray nurse sharks remaining in eastern Australia, with a low birth rate of only two pups every two years. The mathematics speaks for itself. With so few gray nurse sharks remaining, and a low birth rate, most scientists believe the population cannot regenerate itself naturally.

With the population in such a critical stage of its fight of survival, and the regrettable and shameful past of divers indiscriminately killing sharks for sport, would not every one agree with this revolutionary idea? However, objections have come from – most surprisingly – Australian dive operators, the very people who should be more environmentally aware.

They fear that these extra charges would put people off diving. I believe, though, that in 10 years from now, if there are no more gray nurse sharks in eastern Australia, the diving industry will suffer even more than the recent 30% drop the industry has suffered in the last two years. Why? The answer is simple. Love them or hate them, most people, especiality divers, are drawn to sharks, all sharks.

We need to be magnanimous, brave, visionary and, above all, live with a good conscience. Save our seas, and we will perhaps save our world. ■

File image of black tip reef shark from the Kattegat Aquarium in Grenaa, Denmark. **www.kattegatcentret.com**

media

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Edited by Peter Symes
& Gunild Pak Symes

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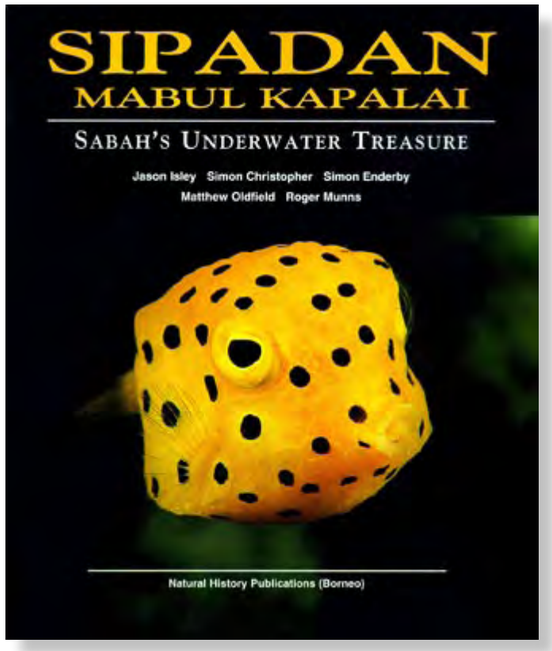
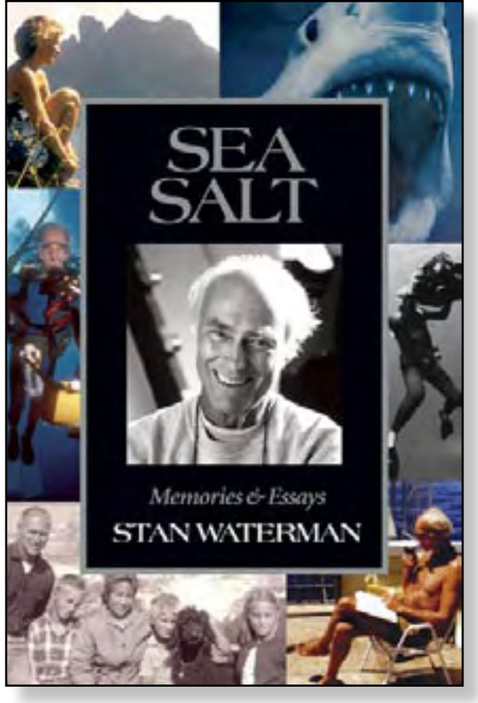


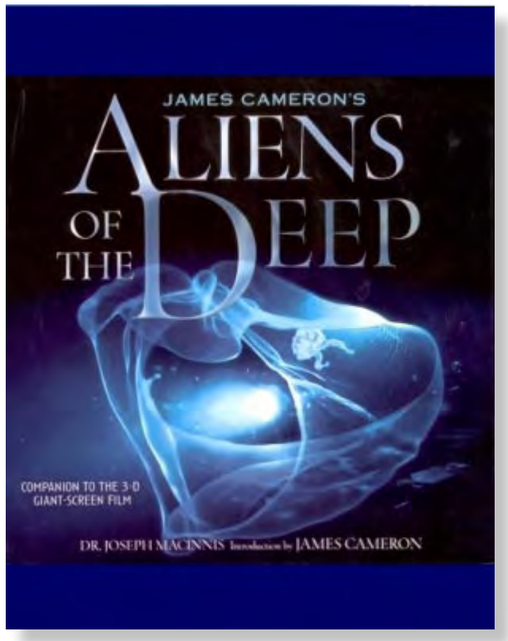
Sipadan Mabul Kapalai: Sabah's Underwater Treasure

by Isley, Jason; Simon Christopher;, et al
Hardcover: 202 pages
Published: 2005, Malaysia, 1st Edition
ISBN: 9838120944
Price: US$79.04 (S$132.00)
Ignored by the rest of the world until the 1980's, the three small Malaysian islands of Sipadan, Mabul and Kapalai, are home to one of the most diverse underwater ecosystems in the world. Five passionate divers who have spent the last seven years in and around these islands document this remarkable ecosystem in this book with superior images and text that provides insight into the day-to-day activities and behaviors of the flora dn fauna of these islands. While the region is at risk for environmental impact from global climate change, the future holds that the island of Sipadan will soon be recognized as a World Heritage Site.
www.selectbooks.com



Sea Salt: Memories & Essays

by Stan Waterman
Hardcover: 320 pages
Publisher: New World Publications
Published: October 20, 2005
ISBN: 187834840X
Price: US$30.00
This book holds a treasure chest of memories and stories by the author, famed filmmaker, adverturer and explorer, Stan Waterman, collected over his 50 years on, under and exploring the sea. Great tales of exciting adventures with Great White sharks and other magnificent creatures riddles the book with profound insights and poetic exposés of the natural underwater world and the author's experience with the amazing creatures of the ocean. **www.amazon.com**

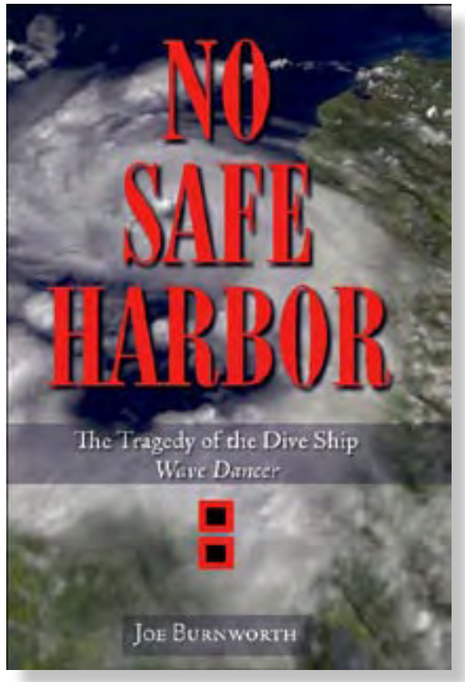


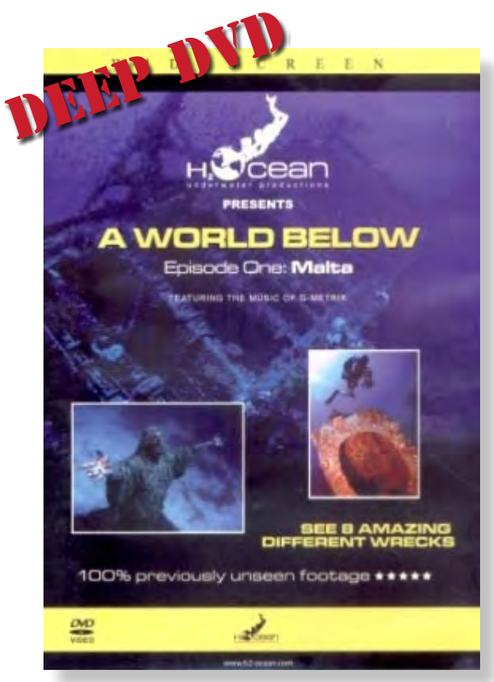
Aliens of the Deep

by Joe MacInnis, Lisa Thomas (Editor), James Cameron (Introduction)
Hardcover: 192 pages
Publisher: National Geographic
Published: February 1, 2005
ISBN: 0792293436
Price: GB£19.99
James Cameron, director of *The Titanic*, offers this companion volume to the new 3-D giant-screen film. The book follows a team of NASA scientists on their exploration of the deep ocean vents in the Atlantic and Pacific Oceans. Earth's most hostile and inaccessible environments are revealed as we catch a glimpse of the remarkable inhabitants that exist in these strange ecosystems.
www.amazon.com

No Safe Harbor: The Tragedy of the Dive Ship *Wave Dancer*

by Joe Burnworth
Hardcover: 254 pages
Publisher: Emmis Books
Published: June 20, 2005
ISBN: 157860219X
Price: US$13.59
The author of this book, Joe Burnworth, has created a gripping page-turner focusing on the worst accident in sport scuba diving history. A true adventure book, *No Safe Harbor* provides a dramatic account of the events that turned a carefree scuba diving vacation in Belize into disaster and tragedy as Hurricane Iris captured a group of divers in her mighty path.
www.amazon.com





A World Below: Episode One Malta

DVD Published: April 2005
Price: GB£14.99
This DVD gives viewers the ultimate audio visual experience of shipwrecks through a fusion of spectacular underwater scenes and an amazing musical score. With essential information of each shipwreck provided in a unique format, this is the first part in the H2Ocean series that takes viewers to the Mediterranean island of Malta. The island's strategic location placed Malta in a pivotal role during WWII where several battles left the island's shores littered with an abundance of interesting wrecks.
www.aquapress.com

Often fished but rarely dived, Connemara loughs are bog diving territory at its best

Ireland's Connemara

RIGHT: Killary fjord, Connemara
BELOW: Tube worm feeding

Text and photos
by Jerome Hingrat

Sliding into brackish water riddled by a seasonal downpour might not be everybody's idea of a week-end in the Wild West...but for the frustrated winter diver that I am, there is sometimes nothing like the peaty waters of Connemara.

The region of Connemara on the West coast of Ireland is famous for its scenery and fishing. It has inspired many artists and attracts tourists every year from all over

the world, in particular the United States, Germany and France. The town of Clifden, in particular, is a popular place for fishing—sea and fresh water—golf, and hill walking. With a low density population, wild scenery and friendly people, it is one of those places where you can truly get away from it all.

Connemara loughs are like proverbial watering holes: there is no shortage of them. Water is not exactly a rare commodity around here, above and below, out of the heavens it comes in every colour, salted, fresh, not so fresh or with a seasonal Guinness tint. In late summer, a plankton bloom and peat water conspire to create visibility averaging chowder-like conditions, at best. To cap it all, clouds of jellyfish pulsating by don't help improve the visibility. What a contrast with the clear waters of the Atlantic nearby!

Fed with seawater and fresh water from nearby rivers, sea loughs can bring together an odd mixture of life resulting from the interchange with the sea. A slight current is noticeable with the tide and water clarity can improve. It is a great spot for watching passing shoals feeding by. Shoals of garfish and rainbow trout are not uncommon. Depending

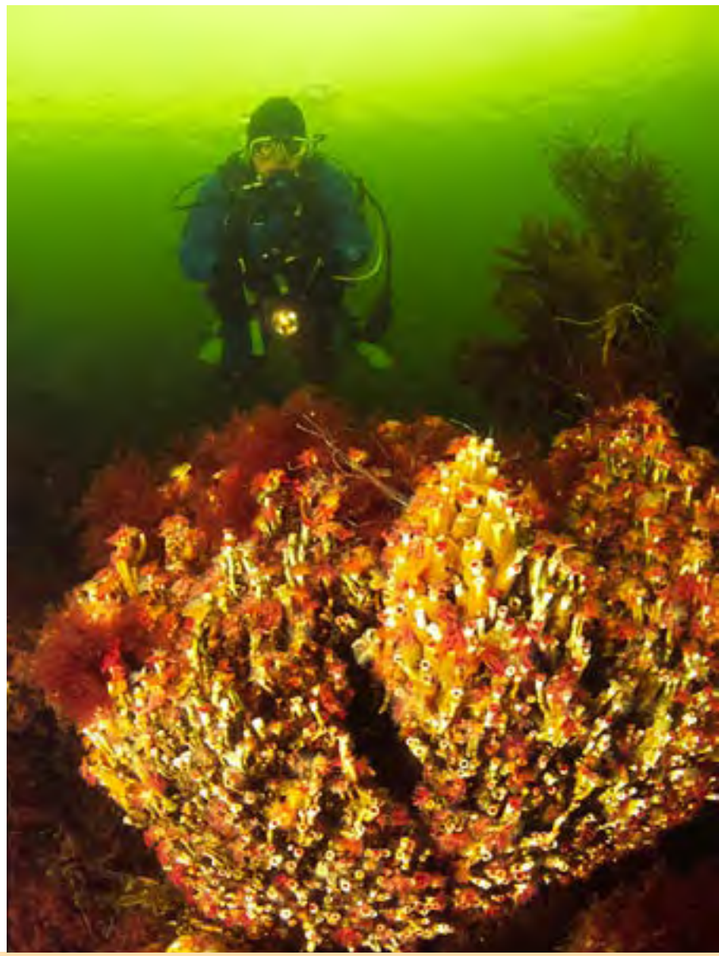
on their relation to the sea, some loughs seem deprived of any visible life, others are just teeming with it. With sea loughs, a layer of brackish fresh water sits over the layer of salt water. In the summer, as the sun filters through the surface, the water takes on an eerie post nuclear glow. The surface halocline acts like a filter and blocks off daylight, soaking up whatever sunshine dares find its way over Connemara.

Mysterious Shallows

Moving along the shallows reveals a sandy bottom of broken shells and gravels. Not the typical mud plain. Beyond the shallows brings you into deeper waters, and in some areas the slope falls sharply into 20+metres. With limited visibility, many dwellers are camouflage experts and blend in with their environment, it takes a while to adjust and spot them. A lot of these mud hoppers are more curious than their sea counterparts, they will come out to gawk at the tourists, stare and hop out of reach.

In places, tubeworms have congregated in huge numbers and developed into full-grown reefs. Clumps of red, orange, yellow and white serpula (tube worms) are fanning themselves in a gentle current. This is the closest I've seen to a live underwater Christmas tree. Sitting on a hard base of white tubes, they really stand out against the muddy lough bed. At feeding time, with the reefs in full bloom, the bottom suddenly comes alive.

These reefs are very much alive and support a variety of animals. The colonies of tubeworms act as a magnet for several species and diversity is the order of the day. Sleepy edible crabs are found



LEFT: Detail view of Tube worms
CENTER: Blennie camouflaged in the shallows
RIGHT: Diver over reefs of tube-worms (serpulids)

Connemara

Connemara is a savage beauty.
—Oscar Wilde

LEFT: Starfish in bog water
TOP INSET: Nudibranch
BOTTOM INSET: Curious blennie
UPPER RIGHT: Clifden, Connemara

nestled among clumps of tubeworms. Starfish and brittle star sit atop or in the centre of the reefs when they're not crawling their way across clumps of colourful umbrellas.

Further along, the reefs are covered with strings of sea squirts in the shape of light bulbs. In places, various weeds and sponges appear to smother the colonies of serpulids, each species competing for space. It seems that the tubeworm colonies has been themselves colonised.

Fish

Fish are not lacking either. Blennies and dragonets are hopping along the muddy bottom, rock cook and wrasse hover around feeding. Blennies are not used to divers and faced with less predators than in the sea. In any case, they show real curiosity, attracted by the whirr of the auto focus - a few oblige by posing. May coincides with nest building for wrasses and the reefs are a busy hive of activity where wrasse can be seen carrying along seaweed twigs. Further along, the reefs have eyes. Scallops are glued to the reefs. Some are attached to glowing pieces of orange sponge or wedged in a crack. Smaller scallops and mussels are buried in many places. They can be hard to spot and it's only after getting close that you'll make out their tiny eyes. Another striking residents are nudibranchs sliming their way across the reefs.

Further along, three lobsters have found a home at the base of a large clump of tubeworms. One of them pops out of its den wielding a pair of claws like garden shears. But they're not all the stay-at-home variety. We turn around to face an even bigger specimen trampling the muck. Amazingly, the wily old beast keeps a steady course. I have to make way as he retreats into a hole hindered by two oversized claws. Eat your heart out Popeye! If the size of these animals is an indication of the nutrients available, then the grub here is five-star.

Macro life

In June, nudibranchs and sea hares enlaced in amorous embrace have colonised the reefs. They are obviously thriving in this environment. It is difficult to imagine all these animals surviving on the muddy lough bed. The reefs provide a habitat for these species that would probably not be found here otherwise. Watching these animals will test your buoyancy and breathing control. Serpulids are extremely sensitive to any light, noise or vibrations. The slightest disturbance and the colorful beasts retreat in a wink. Unlike critters that dart away and never reappear, the serpulid worms are soon out again. They cannot leave the reefs, they are the reefs, and I must have aged taking photographs of them.

RIGHT: Split view of bridge and shallows
BELOW: Portrait of a lobster with diver

Deeper, the atmosphere can be downright spooky. Light penetration is minimal and on cloudier days, almost non-existent. Past 20 m, we might as well be diving in a tunnel. A halogen torch cuts through the first meters of water shrouded by plankton and particles. Looking up, the surface is a faint glow. On a sunny afternoon, we hit 25 m of complete darkness in the centre of the lough. I had never been on a night dive in the middle of the afternoon before. Definitely one for the logbook.

In contrast with the colourful reefs seen only a few minutes earlier, the bottom is a plain of mud. The lightest fin kick raises a cloud of soot-like dust. The kind of particles that stay in mid-water and take all summer to come down.

Back to the shallows, sun rays passing through the surface weeds create ghostly silhouettes. After persistent rain, water droplets float on the surface trapped in an oily film. Run off from the land give the surface a milky appearance. Within the last five meters, the separation line between the layers of sea and fresh water becomes visible. A horizon line runs below the surface. Looking up from 10 metres, the surface seems to have doubled up into two layers. Crossing the layers is like going through an optical illusion. I wonder if I haven't gone cross-eyed. A bit like looking through a magnifying glass that won't focus...After heavy rain, the halocline can be seen up to 5 metres deep.

Dive Center

The nearest dive centre to Clidfen is Scuba Dive West on the Renvyle Peninsula in County Galway. It is a family run PADI five star dive centre established for many years. It is located on the banks of Ireland's only fjord, Killary. It is an ideal base to dive and discover the islands of Clare, Inisboffin, Inisturk, and the many wonders of Connemara.
www.scubadivewest.com

Jerome Hingrat is a professional underwater photojournalist from Brittany. His photographs and articles have appeared in a wide range of publications, including SportDiver (UK), Océans (France), Subsea (Ireland) among many others. His work focuses on destinations and subjects ranging from the Amazon to the Indo-pacific to underwater Ireland. **www.jeromehingrat.com ■**

fact file

Connemara, Ireland

Map of Ireland designating Connemara region

History Connemara's history streches back thousands of years. Local archeologists have found Bann spearheads in Streamstown that are 7,000 years old. The spearheads are evidence that the people of that era were nomadic hunter gatherers. A change from the nomadic lifestyle to that of farming communities is shown in artifacts dated later.

Celtic tribes arrived on the island of Ireland between 600-150 B.C. Norsemen began to invade the area in the late 8th century. The invasions were finally ended when King Brian BORU defeated the Danes in 1014. In the qwth centery, English invasions began and started more than seven centuries of Anglo-Irish struggle of fierce rebellions and harsh repressions. Guerilla warefare was sparked by a failed 1916 Easter Monday Rebellion. In 1921, it resulted in independence of Ireland from the UK for 26 southern counties while six northern (Ulster) counties remained part of the United Kingdom. Ireland withdrew from the British Commonwealth in 1948. In 1973, it joined the European Community. Since then, Irish governments have sought the peaceful unification of Ireland and have worked with Britain to halt terrorist groups. A peace settlement for Northern Ireland was approved in 1998. Its implementation has met some difficulties in recent times.

Government Republic

Geography The country is located in Western Europe, west of Great Britain. It occupies five-sixths of the island of Ireland in the North Atlantic Ocean. Terrain: mainly level to rolling interior plains surrounded by low mountains and rugged hills as well as sea cliffs on the west coast. Coastline: 1,448 km; Elevation: lowest point - Atlantic Ocean 0 m, highest point - Carrauntoohil 1,041 m; Natural resources: natural gas, peat, copper, lead, zinc, silver, barite, gypsum, limestone, dolomite; Environmental issues: water pollution from agricultural runoff, especially of lakes.

Capital Dublin

Economy With growth averaging a robust 7% in 1995-2004, Ireland is a small, modern, trade-dependent economy. Once the most important sector, agriculture is now dwarfed by services and industry. Industry accounts for 46% of GDP, about 80% of exports, and 29% of the labor force. Exports remain the primary engine for Ireland's growth, however, the economy also benefits from a rise in consumer spending, construction, and business investment. GDP is 10% above that of the four big European economies per capita and the second highest in the EU behind Luxembourg. The Irish Government has implemented a series of national economic programs over the past decade designed to curb price and wage inflation as well as reduce government spending, increase labor force skills and promote foreign investment. On 1 January 2002, Ireland joined in circulating the euro along with 11 other EU nations. Agriculture: turnips, barley, potatoes, sugar beets, wheat; beef, dairy products; Industry: steel, lead, zinc, silver, aluminum, barite, and gypsum mining processing; food products, brewing, textiles, clothing; chemicals, pharmaceuticals; machinery, rail transportation equipment, passenger and commercial vehicles, ship construction and refurbishment; glass and crystal; software, tourism; Exports: machinery and equipment, computers, chemicals, pharmaceuticals; live animals, animal products

Climate Temperate maritime modified by the North Atlantic Current. Ireland has mild winters, cool summers, constant humidity and is overcast about half the time

Population 4,015,676; Ethnic groups: Celtic, English; Religion: Roman Catholic 88.4%, Church of Ireland 3%, other Christian religions 1.6%, other religions 1.5%

Currency Euro
Exchange rate: EUR 1 = USD 1.21

Language English is the official language generally used. Gaelic or Gaeilge is spoken mostly in areas located along the western seaboard

Web sites

The Killary Centre
k2@killary.com
Maol Reidh Hotel
www.maolreidhhotel.com

Dive Operators

Scubadive West
www.scubadivewest.com

Deco Chamber

Galway Chamber
Galway Regional Hospital
tel. 00 353 91-24222 ■

Lobster on the run. Photo by Jerome Hingrat

PHOTO BY AL GIDDINGS COURTESY OF NATIONAL GEOGRAPHIC

National Geographic
Explorer-in-Residence
DR SYLVIA EARLE

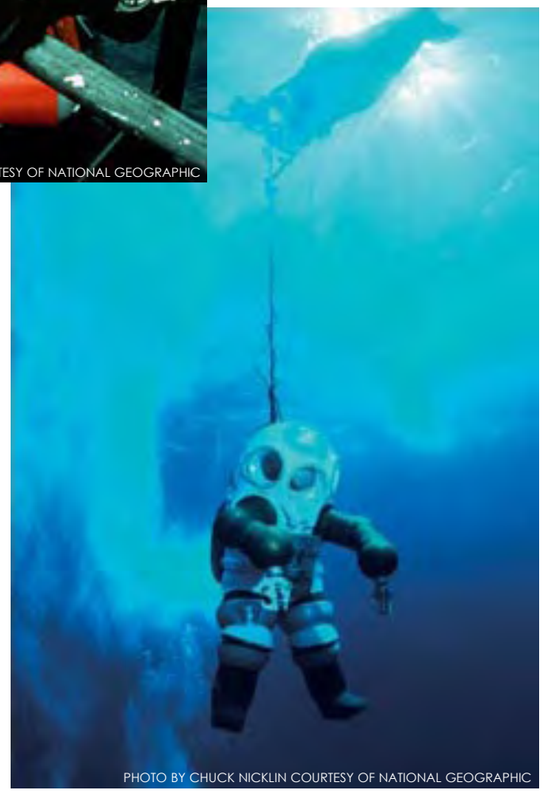


PHOTO BY CHUCK NICKLIN COURTESY OF NATIONAL GEOGRAPHIC

Walk in the Deep
Oceanographer Sylvia Earle gets a fish-eye view of Hawaii's ocean floor as she dons a high-tech diving suit for "a walk in the deep," 1,250 feet (380 meters) down. A tether linked her to a research submarine above; a communications wire wrapped around the tether enabled her to talk with the sub's crew

Text transcribed by Gunild Pak Symes from Dr Sylvia Earle's presentation at the Celebrate the Sea 2005 Festival and Image Competition in Singapore

Photos courtesy of the National Geographic Society, Deep Ocean Exploration and Research, NOAA, NURP

Her Deepness:

Dr Sylvia Earle

Named Time magazine's first "hero for the planet" in 1998, marine biologist Sylvia Earle has pioneered research on marine ecosystems. She has led more than 50 expeditions—that's more than 6,000 hours underwater. Earle has been an explorer-in-residence at the National Geographic Society since 1998. She holds many diving records, including the women's depth record for solo diving at a thousand meters (3,300 feet). Below is a transcription of Dr Syliva Earle's presentation at the Celebrate the Sea 2005 Festival in Singapore.

It was the attitude. The complacency is what prompted me to visit Australia a few years ago when a reporter put the question to me, "Why should I care about the ocean?" She said, "I don't swim. I get seasick. I don't fish. People don't drink salt water. If the ocean dried up tomorrow, what difference would it make to me, or anyone?"—this from somebody who lives in Australia for heaven's sake.

Well, I thought about it, and it occured to me to ask, "Okay, let's get rid of the ocean. What would the planet be like? Think Mars. The red planet was perhaps once blue, but not today. You know, we might set up housekeeping on Mars some day. And a few people think that that's a worthy goal. But not for six billion of us. It's just not a viable alternative to living here. And if we should make it to Mars one day, we'd have to think about things we take for granted here. Where is the water going to come from? The food? The place to live...something to eat.

There's plenty of water in the universe without life, but nowhere is there life without water.
—Dr Sylvia Earle

The ocean governs the way this planet operates. This beloved blue planet. Average depth 2 ½ miles, maximum depth 11 kilometers—about 7 miles.

And here's the thing... Although in the last half century, it is safe to say, we've learned more about the ocean than in all preceding human history. Half a century ago, we really didn't know much about the depths of the sea, and we still don't. But at least we know that there are mountain chains that run like giant back bones up through the Atlantic and the Pacific and Indian Ocean.

You know, there's lumps in the deepest sea, based on observations by a couple of guys who made the descent to the depths of the Marion Trench back in 1916. But ironically, nobody has been back to this deepest part of the sea since, despite the fact that Japan launched a robotic device that made several marinal trips to the deepest part of the ocean. That robot was lost a little more than a year ago.

Plus there were no means for our species to access the deepest sea either with people inside a special submersible or with a robot that can send a camera to the deepest part of the sea. We now have the technology. Why don't we have the will?

It probably happens because of that complacency—the lack of understanding that the ocean really does matter to all of us. That is why this conference is so important and why each of you, as an embassador for the ocean, is so important. We need to get the word out that the ocean, first of all, matters to all

Dr Sylvia Earle

PHOTO COURTESY OF THE NATIONAL MARINE EDUCATORS ASSOCIATION

Books by or with Dr Sylvia Earle

Defying Ocean's End, with Linda K. Glover, et al, 2004

Jump into Science: Coral Reefs, 2003

Atlas of the Ocean: The Deep Frontier, 2001

Hello, Fish: Visit to the Coral Reef, 2001

The Oceans, with Eilen Prager, 2001

Sea Critters, 2000

Dive: My Adventures in the Deep Frontier, 1999

Wild Ocean: America's Parks Under the Sea, 1999

Sea Change: A Message of the Oceans, 1996

Click on the book cover to order from Amazon.com

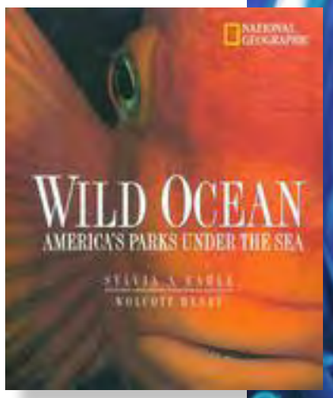


PHOTO BY KIP EVANS COURTESY OF NATIONAL GEOGRAPHIC

Earle studies the creatures of the ocean in a deep sea submersible

humankind. Without the ocean, there would be no life on Earth—certainly not life as we know it. And it may be like on Mars where there was apparently an ocean once upon a time or maybe like on one of the moons of Jupiter—Europa.

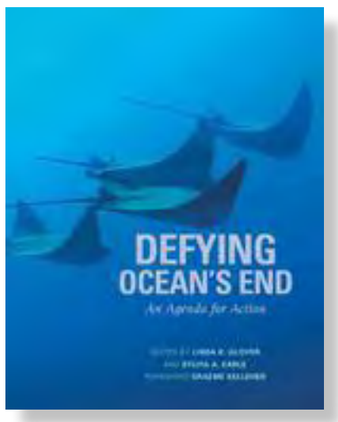
In fact, whereever there is water in the universe, there is a possibility that there might be life, because water is the cornerstone of what makes life possible—the single non-negotiable thing. There can be water without life, but not life without water. So, at the same time as we have learned more about the nature of the sea, it's possible that we have lost more owing to what we are putting into the sea and what we are taking out of the ocean.

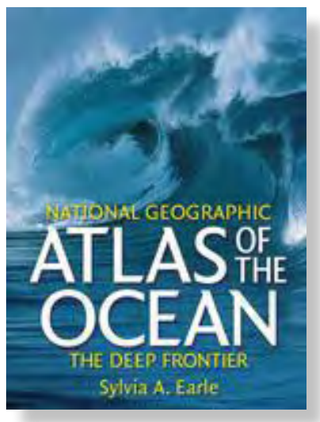
I was asked a few years ago by a group of individuals who were concerned about the complacency concerning the oceans, "How do we change the way people think? How do we get inside their heads and do something about the problems that are taking place?"

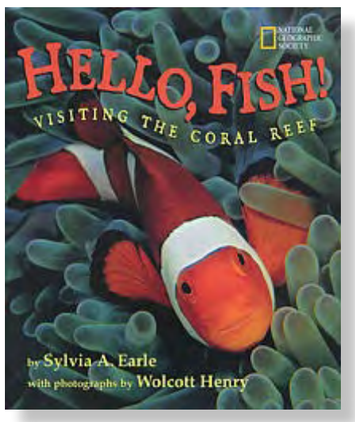
After all, in the last half century, we've probably lost on the order of 90 percent of the big fish in the sea based on a study that was done by Canadian scientists just recently that documents that tuna, swordfish, cod—fish that ran in the deep seas—grouper, snapper, big halibut...The big fish have been extracted from the oceans. The sharks. That has happened in my lifetime, it's happened in the lifetime of many of you. The pace right now is picking up, which is what makes this point in history so important.

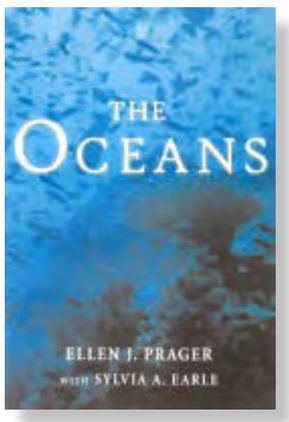
So, given the chance to hopefully guide this interest in doing something to convey to people—not just the scientists, not just the divers, not just those who are curious about the ocean, but the public at large—we dreamed up the concept of doing a film with the National Geographic Society about a fish.

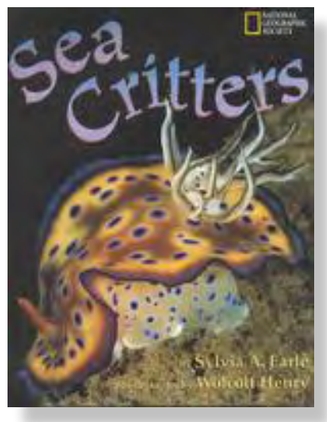
It took some doing to sell the National Geographic Society on the idea of doing

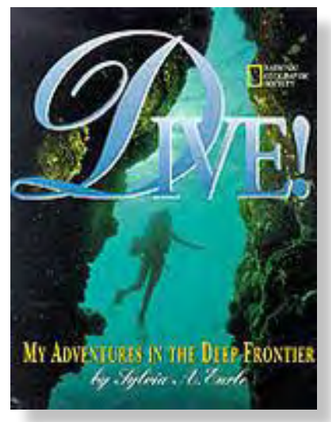


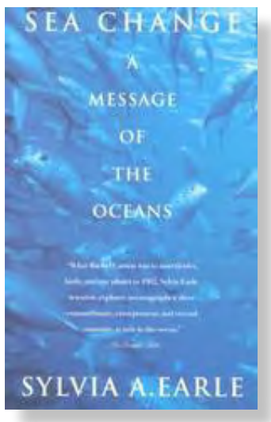












Dr Sylvia Earle

a film about fish. Now, a film about lions... we got lots of films about lions; tigers... lots of films about tigers; sharks...there have been a number of films about sharks. But in this case, we convinced the National Geographic Society to choose one of the other big predators in the sea. And I just want to share with you the opening sequence from this film. It runs a full hour, and I only have a few minutes to stand here in front of you and show you some of these images. But let me start with this one. (The following is the script of the film clip)

NARRATOR: "We call it the blue planet, yet the creatures we know best rule the land. But one of nature's most impressive creatures is an ocean dweller often missed and seldom understood... Swifter than a dolphin... A hunter as bold as the Great White shark... The Blue fin tuna is perfection made real. Designed for speed, it races the currents at 50 miles an hour—one of the fastest swimmers in the sea. A warm-blooded giant, it crosses whole oceans at will spanning the seas on epic journeys."

DR SYLVIA EARLE: "The ultimate fish has to be the Blue fin tuna. Those creatures that can power their way across the whole ocean basin. That has to be the supreme creature unlike any other on earth."

NARRATOR: "But the Blue fin tuna is hunted whereever it goes. And there is a serious debate about the consequences."

SCIENTIST: "I sincerely believe the Blue fin tuna is now in a state of crisis. All our people should know that what we did to the buffalos on land, we are doing to big wild animals in the ocean."

NARRATOR: "On the front line of the controversy is a small group of scientists struggling to learn the secrets of the Blue fin as quickly as they can. For them, there is even more at stake than the legendary animal itself."

DR SYLVIA EARLE: "If the ocean is in trouble, our future is in trouble. These creatures are the lions, the tigers, the wolves, the eagles of the ocean."

NARRATOR: "It is a creature so advanced, its deepest secrets may always ellude us." (end of clip)

Well, there you go. It's the Blue fin tuna—a fish that many people love. It is so rare to see them other than as sushi or sashimi. The taste for tuna in the last half century has grown to a state right now where their numbers have significantly declined.

Imagine that within less than 50 years, we managed to whittle down their numbers from what they were when some of us were kids to a fraction of their former numbers. It is because our taste for them is at a point where our technology has reached a level where we can find and bring to market every last one, should we choose to do so. It seems preposterous.

When I was a child, and even now, many believed that the ocean was infinite in its capacity to yield back to us whatever we wanted to take out and to absorb whatever we wanted to put in. And perhaps the greatest discovery about the ocean in the last century has been first of all that the ocean really is at the heart of what makes the planet work—the cornerstone of our life support system. But the second big discovery is that we do have the capacity to alter the way the it works, to really diminish creatures that once seemed to be infinite in their capacity to rebound no matter how many we extracted.

It's a hard thing for most people to face up to especially when our numbers are growing and prospering at such a rate. Population on our planet has tripled in my lifetime, that is, human population. While all other species, our fellow creatures, are diminishing in their numbers. Not all creatures, but certainly some of them that we have particularly targeted for taking.

So, what do we do about it? The first step is knowing. If you understand that there is a problem, there is a chance that you might care, and if you care, you might do something about it. If you don't know, you can't care. And that is the idea that the ocean is not infinitely preserved; that we do have the capacity to change the way the ocean works. And that it does matter to us, it comes back to us. It doesn't just matter to the fish and the whales and the turtles and the sharks. It matters to us, because we, too, are connected to all that blue stuff out there that governs the way the ocean works.

I want to give you one other example. I know that both in this conference, and over the years that this conference has been carried out, the focal point has been the fate of sharks. Oh, I certainly remember as a kid, the feeling was that really the only good shark was a dead shark. And a lot of people thought they were really doing a great thing if they would exterminate every shark that they could find. And the problem was, you know, that people thought that sharks were man-eaters—of course, I didn't worry about that, because of my gender, I didn't qualify. But now, the problem is, man eating sharks.

You know, lots of them, millions of sharks, are munched on by us. And every once in a while, they turn around

Dr Sylvia Earle and the dive supervisor discuss plans for the next dive

Dr Sylvia Earle

and take a bite out of one of us. But maybe they are allowed when you take a look at what we are doing to them.

Let me just give you this little example from an island that people rarely go to. It's off the coast of South America. It's part of the eastern tropical Pacific seascape—that body of water that sweeps along the coast of Equador, Panama and Costa Rica. It's a small group of islands, a kind of a halo of islands, where until recently, sharks were really, really common. You could count on finding scorpions and hammerheads and other species of sharks... white tips in abundance. However, in just a year, that has changed.

Can we save the ocean? It is hard to tell. To keep the options open, to help the creatures such as those in the South Pacific in 2003, you have help to keep doing your part. The birds in the sky, the fish in the sea, the predators of the ocean—the sharks, the tuna—all of those creatures have a role to play. So do we, of course. But we are supposed to have the brains to be able to figure out how to find a place for ourselves within these natural systems upon which we are living with them. But as of right now, it is clear that we don't get the picture... that we are over-using the life support system that we need to maintain ourselves.

The key though is to do exactly what you are doing—an unique solution—the efforts that you are making to reverse this plan. I figure that the next ten years may be the most important decade in the next thousand years. Based on two things: as never before, we know what's going on and we understand the importance of the natural world, particularly, the ocean to us. But maybe there's never been on the one hand a chance as good as the one we have right now.


DOER


NOAA

ABOVE: Earle, poses in a submersible before a deep sea dive
LEFT: Earle prepares to dive in a JIM suit
BELOW: Earle at work in a JIM suit at depth


DOER

You can say, "Well, 90 percent are gone of the sharks, the tuna, the swordfish," and climb down the long list of depressing numbers of creatures that have real trouble, or you can say, "Hey, 10 percent of those numbers are still out there. They're not all gone. There's still a chance." It's that attitude, that optomistic spirit that I see throughout this conference.

You know, we can do something. We don't just have to sit around and moan and groan. We have the power to make a difference. We can support those who are taking actions, people such as those in government seeking protecting of species in the sea.

profile

I want to get out in the water. I want to see fish, real fish, not fish in a laboratory.
—Dr Sylvia Earle

DOER

Dr Sylvia Earle

I got really excited some years ago about the concept that we can do for the ocean what's been done with the land in terms of protecting areas of national parks. Around the world, some 12% of the land has been embraced by humankind for protection as parks, preserves and wildlife areas.

It's not perfect. It's not enough. But coupled with supporting policies that care about originates, about watersheds, about what we put into rivers, lakes and streams, and certainly, the ocean, we can, however, stabilize the downhill trends, and in due course, if we are really smart, we'll see a change, a turnaround. And find that place where we can actually look forward to an enduring future.

So, when National Geographic a few years ago, asked if I would be interested in coming to Washington D.C. to be an Explorer-In-Residence, my first thought was, "Well, that's great... *Explorer-In-Residence*... kind of a contradiction in terms." But the idea of doing something with National Geographic was something I liked to do. The deal was that for six months they would support you with a supplement for something you would really like to do.

Dr Sylvia Earle and barracuda. Flower Gardens, Texas

But about the same time, I had another opportunity to work with a foundation, which is based in San Francisco, California, on a project for about five years. And they wanted to do it on conservation, on education, on research about the oceans.

So, while putting the two things together, this five-year mission of exploration, research and education, conservation and creation of the Sustainable Seas Exhibitions, another more fortuitous thing happened. And that was that Dr Phil Nuytten, from whom we will hear very shortly, came up with a brilliant concept for a new kind of submersible—one that was so simple, even scientists could drive these submarines around—taking you down to 2000 feet (667m), which covers a fair part of the Continental Shelf therein parts of the United States and continental waters of many countries, actually.

And so the idea of putting this thing together with the resources of the National Geographic Foundation in San Francisco and working with the agency where I served as chief scientist, as a program, we put together this project.

The project grew from six months to five years—I am working on being *explorer-in-perpetuity* right now with National Geographic—continuing beyond the coastal waters of the United States and moving to the waters of the world. Moving to your backyard, to this part of the world, towards the area where the highest concentration of many species in the ocean is about to occur—in the famous coral triangle, this part of the planet where fish and other invertebrets and plants all seem to have a special atypical circumstance. But we know very little about what this world except where divers can go.

But now with new technologies now in the circle, we don't have to look wistfully over the edge at these steep drop-offs or sit at the side of a boat or the shore and just wonder. We can actually go.

There are luckily now, in the United States, some 18 thousand square miles of ocean that have been embraced as protected areas, as marine sanctuaries, although it's mostly in name. A very tiny

PHOTO COURTESY OF THE ACADEMY OF ACHIEVEMENT

ABOVE INSET: Earle diving with jellyfish
LEFT. Earle interacts with a wild dolphin

Dr Sylvia Earle


NOAA


NURP

TOP: Earle in action studying marine plant life
INSET: Earle displays samples to an aquanaut inside TEKTITE

fraction of that small amount of the waters of the United States have full protection in the way that a national park does.

And around the world, although there are more than 3000 places in the ocean being investigated for some form of protection, it's a tiny fraction of that amount that has real protection in a similar way that we think of in a park where in you don't cut down the trees or trap the wildlife or catch the fish.

We use the ocean in mutliple ways including recreation, diving, and all the rest, but many of the ways we use the ocean are consumptively destructive. If we are to have fish in the sea in the future, for whatever reason, to take them out of the sea, we have to do what we have in some ways already done to creatures on the land: protect the breeding areas and the feeding areas. Otherwise, we might breach migration routes, and so on.

In fact, a fraction of one percent of the ocean has any known protection as compared to the land where about 12% has fairly extensive protection.

It was about 100 years ago that people began to get serious about protecting wildlife on the land and protecting habitats where they lived. If people wanted to have ducks and other birds to consume, they had to protect the breeding areas, the feeding areas, the boundaries. Now we need to simply apply these measures for the sea... for tuna, for swordfish, for sharks for heaven's sakes... for anything that is out there, we must, at this stage, seize the opportunity that we have now, but won't have much longer.

You know, all we have is right now. I met a psychic that said that we have a chance like no generation before us to make a positive difference just as our predecessors did years ago when the idea of protecting wildlife on land came with a purpose. Now, it's our turn with the ocean—this time, our time, to make decisions that will resolve the balance through years to come.

Eighteen thousand square miles of US water sounds like alot, but the Great Barrier Reef in Australia is 144 square miles of ocean. And even then, despite that vast area has enjoyed such protection since the mid 1970's, there are some real problems. It's more of a management area than it is a fully protected area.

Good news: a lot of things are better off than they would have been had they been without any protection at all. But just last year, it was at a point where measures had to be taken to really do something more. So, full protection was increased from about 6% to 33%, a good third of that vast system, now has been given better protection.

And in the United States, places that we have had a chance to go to during the Sustainable Seas series of expeditions, is now under consideration to become an even larger body of water under protection—the north western Hawaiian Islands.

But again, when we think about the ocean as a whole—how much there is, how much there is to do—these are baby steps, and we want some giant steps.

So, I first, salute you for all that you are doing, and I challenge you, that when we get together, and I will come back in years ahead, we should be mindful of what progress we can make as individuals, as organizations, whatever it is, whatever talents you have... I get asked alot, "I am just one person. What can I do?"

First thing you do is pick up the mirror and look at it and say, "I take great underwater photographs." Use that talent. Or you can say, "I can play wonderful music." Use that talent. If you are good in math, or you can draw or you have a way with words—what ever it is, use it, so that you can look the next generation in the eye, and you can look yourself in the eye, and be confident that you have done what you can to make a difference. Thank you.

For more information about Dr Sylvia Earle and her organization, Deep Ocean Exploration and Research, visit: **www.doer-inc.com** ■

Books about Dr Sylvia Earle:
Meet My Grandmother: She's a Deep-Sea Explorer
(Millbrook Press) by Lisa Tucker McElroy
Sylvia Earle: Deep Sea Explorer
(Women Explorers) by Susan Tyler Hitchcock
Sylvia Earle: Guardian of the Sea
(Lerner Biographies) by Beth Baker
Sylvia Earle: Deep Sea Explorer and Ocean Activist
(Women Hall of Famers in Mathematics and Science) by Katherine White

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Portfolio

Alex Mustard, PhD

Poetry in Motion

Text edited by Gunild Pak Symes
Photographs by Alex Mustard, PhD

What sets Alex Mustard apart from other underwater photographers is that he is a marine biologist with extensive research under his belt. Alex specializes in capturing the natural behaviour of marine life that many divers miss. Through the images, he shares his fascination of the real lives of the animals. A self-proclaimed non-piscivore, Alex strives to show the personality of marine life to make people less inclined to eat them. He strongly believes that underwater photographs should be taken without harm or harassment of the marine life.

portfolio

Alex Mustard

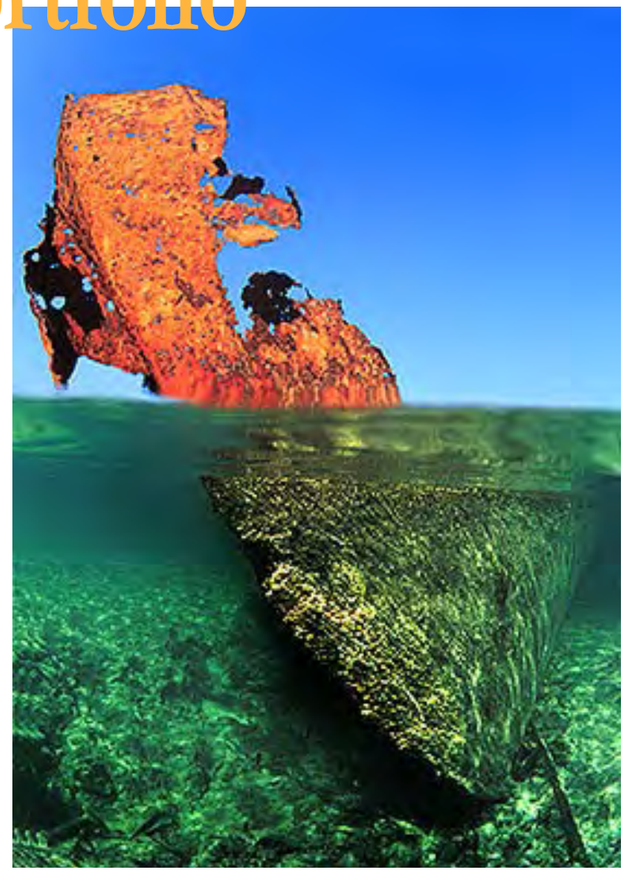
LEFT: Rock Beauty Angelfish courting, Grand Cayman

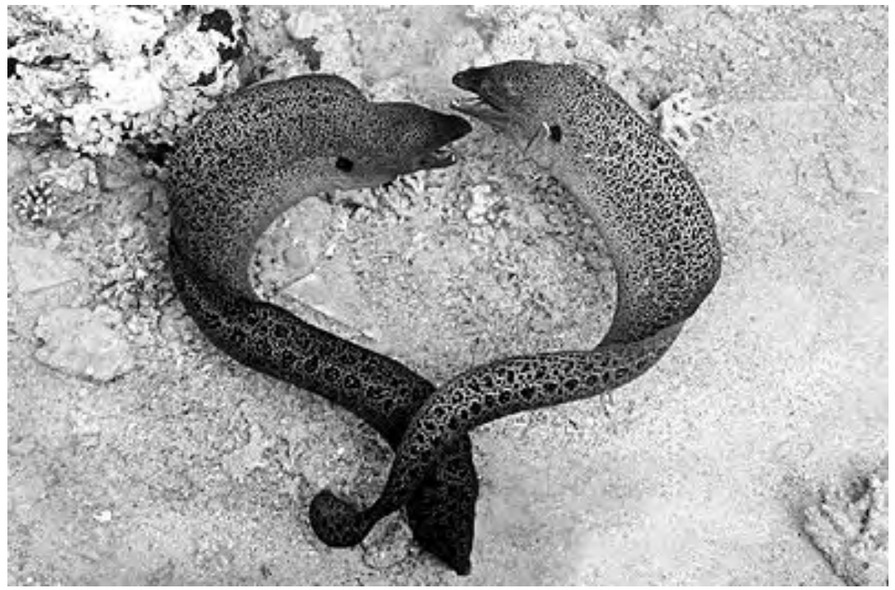
INSET BELOW: A smaller female Peacock Flounder positions herself on top of a male during a spawning rise, Grand Cayman

TOP RIGHT: A diver meets one of Grand Cayman's Stingrays

BOTTOM RIGHT: A kid on a Lilo floats on the sparkling shallows of the Caymans

PREVIOUS PAGE: Stingrays schooling at dawn at Stingray City, Caymans





Alex Mustard

ABOVE: Dancing sea turtle, Cayman Islands

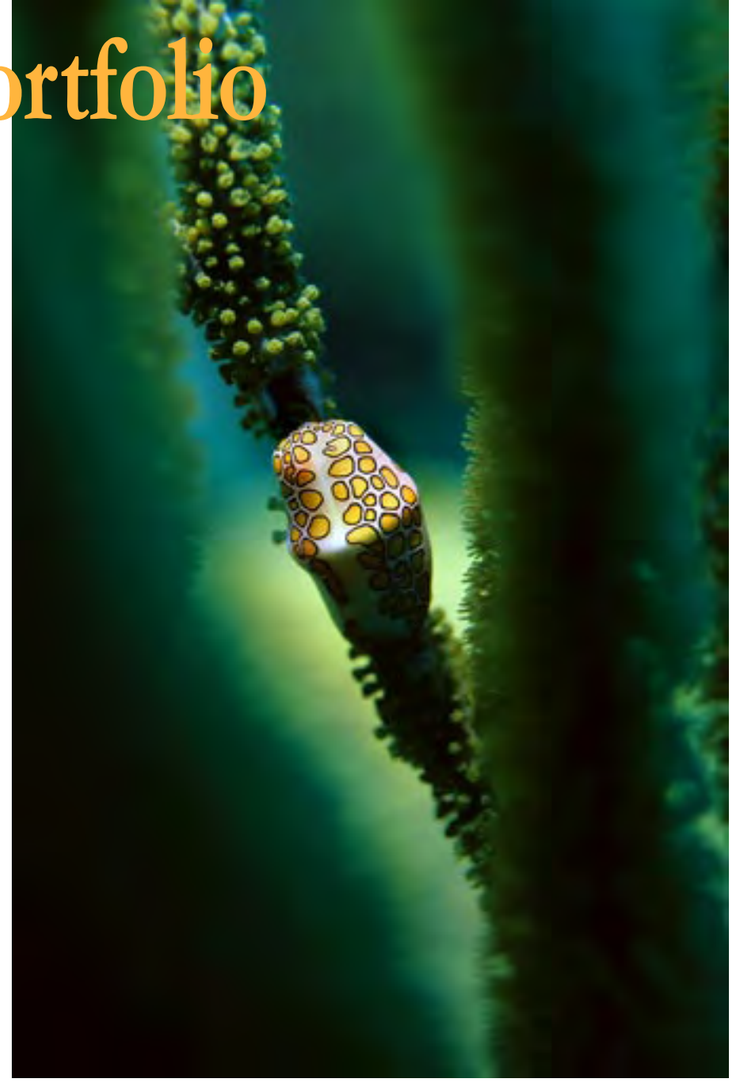
At the tender age of nine, Alex took his first underwater photographs. In his own words, "They were not very good!" Since then, he has achieved recognition as one of the most creative underwater photographers in the UK and has developed a unique style that distinguishes his work from the rest.

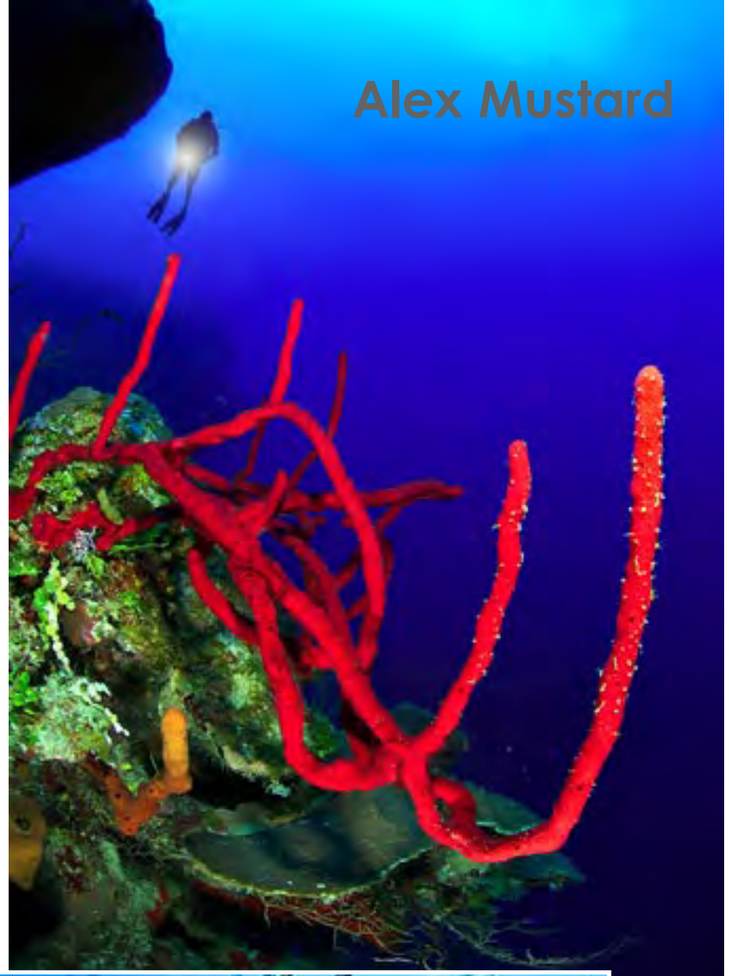
He took up the digital media early in the movement and pioneered many of the specialist techniques now used today. His work has been published in numerous publications in the UK including *The Times, The Sunday Times, FHM, DIVE, Underwater Photography, Amateur Photographer, Diver, Sport Diver, Practical Photography, Digital Camera Shopper, Oceans Illustrated, The Dolphin, Ocean Challenge, Warp, Planet Earth, Horizon* and *Hasselblad News.* Foreign magazines include *Diver* (CAN), *Fins* (SIN), *Tauchen* (D), *Divestyle* (RSA), *Scuba Diving Australiasia* (AUS), *Plongeur* (F), *X-Ray Mag* (DK), *Sportsdykkeren* (DK), *Sukeltaja* (FIN), *What's Hot* (CAY), *Dive Chronicles* (USA), *Skin Diver* (USA) and *Innovation* (USA) among others.

In addition, Alex has worked on a number of book projects including a major contribution to the wildlife section of Maharishi's 2004 magnum opus on camouflage, *DPM - Disruptive Patterned Material,* as well as his own first solo book of photography in collaboration with author Nick Hanna. Alex has already written more than 100 published articles about marine life and underwater photography and his unique photographic work is increasingly being incorporated into various ad campaigns for travel and dive businesses in Europe and abroad.

He has received several awards for his work including the British Society of Underwater Photographers Open Portfolio and Theme Portfolio trophies for 2004-

CLOCKWISE FROM TOP LEFT:
▲ Gamma Wreck, Grand Cayman
► Entwined Hamlets spawning, Grand Cayman
▼ Giannis D Wreck, Red Sea. This image was produced with a new filter Alex Mustard has just invented
◄ Two moray eels entwined, Red Sea





2005 and four awards at the 29th Festival Mondial De L'Image Sous Marine in Antibes, France.

Alex also tests and writes about a variety of equipment for *Underwater Photography Magazine* and *Wetpixel.com*. He uses the Nikon D2X digital SLR camera for most of his images and is now testing an underwater housing for his Subal camera. In addition, he is one of the few photographers that run an underwater Hasselblad medium format system.

For more information about Dr Alex Mustard, to read his Introduction to Coral Reef Ecology or to order prints directly from the artist, visit: **www.amustard.com**

Or click on this link to:
Mustard's Underwater Photography ■

TOP LEFT: A Flamingo Tongue Cowrie feeding on a Gorgonian, , Grand Cayman
TOP CENTER: Funny Hat. Blackbar soldierfish with parasitic cymothoid isopod. Grand Cayman
BOTTOM: Blenny hiding in hard coral

TOP: Red Rope Sponges on Grand Cayman's North Wall
BOTTOM: Lionfish, Red Sea

portfolio

TOP: Commensal shrimp on crinoid. Sulawesi, Indonesia
BOTTOM: Southern stingray at Stingray City, Grand Cayman Island

TOP: Pygmy seahorse swimming. Sulawesi, Indonesia
BOTTOM: Whaleshark, Maldives

TOP: Forter's hawkfish eating a Forter's hawkfish, Red Sea
BOTTOM: Alex Mustard with nudibranch

IN OUR NEXT ISSUE

Diving in Tazmania
The Philippines
Tulamben of Bali

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