



GLOBAL EDITION
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Number 4

Profile
Amos Nachoum
Portfolio
Jon Gross

Cover photo: Jack Connick

Coastal America
**Pacific Northwest
& Alaska**

Canada
Vancouver Island

Honduras
Roatan Sharks

Technology
Rebreathers

Ecology
Fish Sense

Equipment
Apeks

Win the new
Thermocline
garment

DETAILS ON PAGE 69-70

DIRECTORY

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COVER PHOTO
Octopus, Quadra Island, BC Canada
by Jack Connick

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We explore

Lego-blocks, Starfish and Sci-Fi...

Text by Peter Symes

We just can't help being fascinated, can we? The other day while I was tidying up the attic, I stumbled across one of the old dusty boxes containing my old Lego-blocks and other childhood memorabilia, which also included a now mummified starfish. It instantaneously took me back to sweeter times when ice-cream cones were truly gigantic, and there were no mortgages or Osama bin Ladens to worry about.

Back in those less complicated times, life was pure joy, and days were happy on the sunny beach where we built sandcastles. We were full of cheerful curiosity, and we ran around bare-butt in the shallows with our small red buckets catching starfish, shrimps and tiny crabs. I could almost smell the seaweed and taste the salty air again.

But what, aside from the size of ice-cream cones, has changed, really? Decades later, I am now an adult, a responsible citizen and all that. But, first of all, I have to confess that I couldn't help fiddling around with the good ol' Legos for a while before snapping out it of again. And what about this thing with the crabs, the starfish and the sea? With the breaking waves and the rumbling surf?

I still love the beach. I am as fascinated and drawn towards the sea—that mystic realm—as I was as a child. Only now, I also have the option of donning a dive suit, which enables me to venture further and to experience even stranger creatures than the small sand shrimp that my childhood's cheap mask-and-snorkel toy set allowed me to do. It still fills me with a sense of joy and fulfillment.

I guess that the bottom line is that fascination and the urge to explore seems to be a fundamental characteristic of being human. We watch the Discovery Channel and sci-fi movies.

We admire the great explorers and ponder what mysteries lie beyond. And here's the deal: When it comes to water and the deep blue realm, we can all be explorers. A popular saying goes that more is known about the cosmos than is known about our oceans. While this may be just another urban myth, it is certainly true that even today, astonishing creatures—weirder and more exotic than even the most advanced sci-fi movies could describe—are now being discovered on a regular basis. Every day we live on this planet is a chance to get out and discover its awe-inspiring beauty and diversity. ■

Win the new Thermocline garment from Fourth Element

See details on p. 69-70



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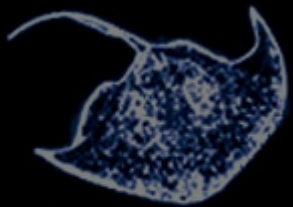
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X-ray mag

News edited by
Peter Symes &
Michael Symes

deep & current

NEWS

Tighter regulations for Red Sea boats and guests



PHOTO BY PETER SYMES

New rules brought in by the Red Sea Association for Diving and Watersports have set stricter requirements for liveaboard and day diving charter boats in Southern Egypt, and the divers who holiday aboard them. The new rules are as follows:

All Red Sea liveaboard dive charter boats need to provide:

- One guide for every eight guests
- One guide for surface support and supervision
- All guides possessing a valid Red Sea Association professional ID card
- All guides carrying an SMB, reflective mirror, strobe and torch

Guests on such holidays will need to:

- Show evidence of at least 50 logged dives
- Each carry an SMB and, within buddy pairs, possess at least one torch, even on morning dives

- Possess medical certification of fitness to dive, issued less than one year before start of the trip
- Possess diving accident insurance from a "reputable company"

All day-diving boats need to provide:

- One guide for every ten divers, where the divers have at least 25 logged dives
- One guide for every six divers, where divers have fewer than 25 logged dives
- All guides possessing a valid Red Sea Association professional ID card

Day-diving guests will need to:

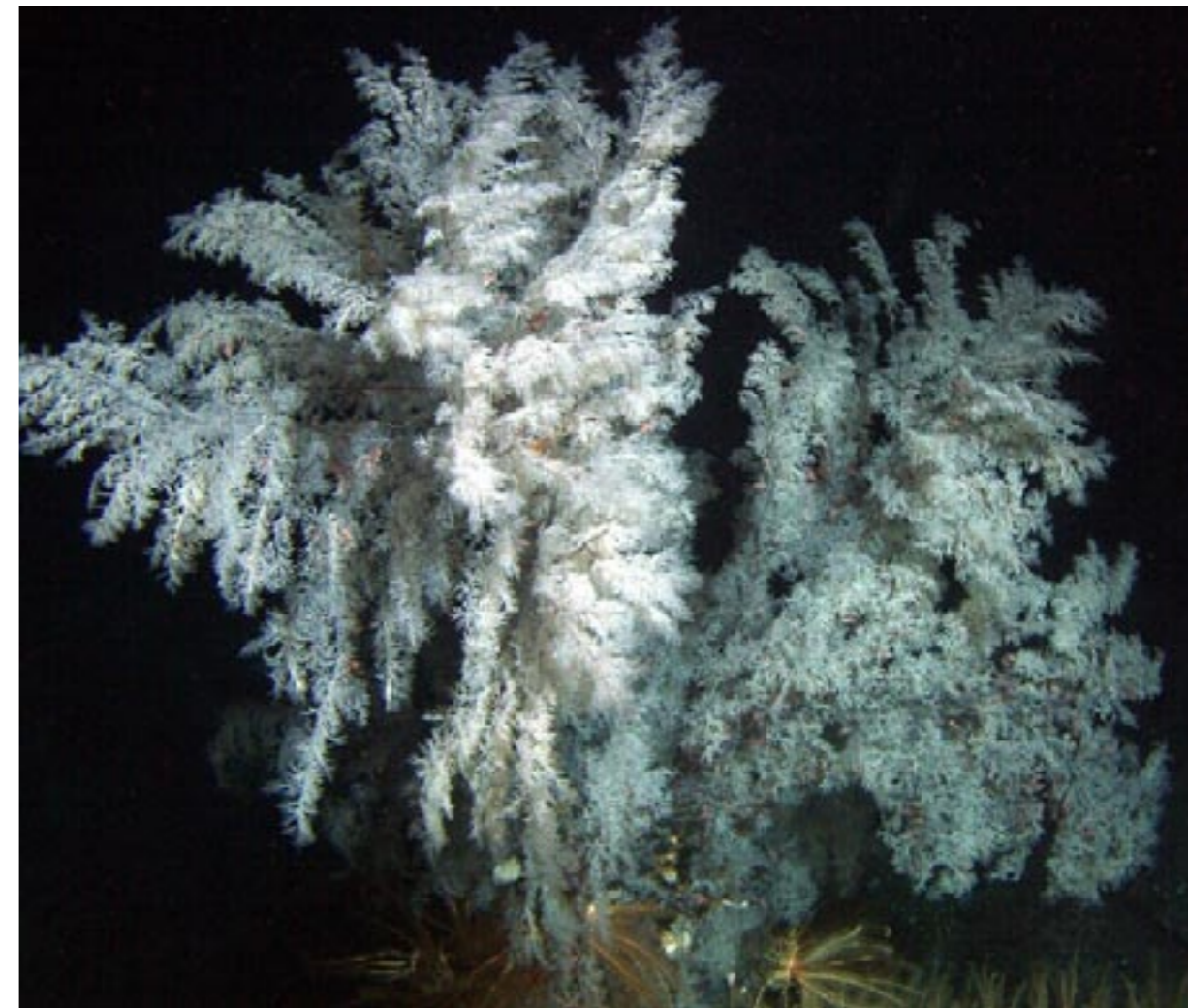
- Present diving logbook and agency certification
- Possess medical certification and accident insurance, as above

The Red Sea Association for Diving and Watersports, association@redseaexperience.com, welcome comments on the new regulations. ■



PHOTO BY PETER SYMES

Due to a series of recent accidents, dive boats and divers enjoying the Red Sea must adhere to stricter safety regulations



NOAA

New species of coral discovered off southern California

Scientists from NOAA has found a giant new species of black coral around the Channel Islands just off the megapolis of Los Angeles

The discovery came during dives by the researchers from NOAA Fisheries in "Delta," the submersible conducting a survey of rockfishes on deep rocky banks about 40 miles off the coast, west of Los Angeles.

The find of the new species, at depths from 100m (300ft) to 220m (725 ft), is being published this week in the **online scientific journal Zootaxa** by taxonomist Dennis Opresko of Oak Ridge National Laboratory. Love have named the new species "Christmas Tree Coral" (dendochristos in Greek) since it grows to a height greater than two meters and resembles pink, white and red flocked Christmas trees.

The complete scientific Greek name for the

new coral is *Antipathes dendochristos*. The word for black coral is "Anti" for against, and "pathos," for disease, a reference to the fact that black coral amulets were once thought to provide protection against disease and evil spirits.

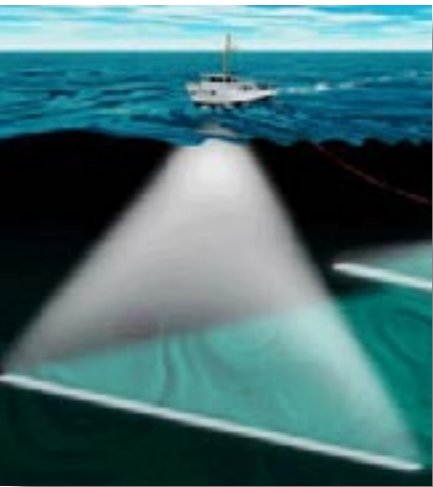
Many of the deepwater reefs in southern California harbor remarkably healthy communities of corals, sponges, and other large invertebrates. This may be the case because, historically, there has been relatively little trawling over reefs in our area. What we need to know is the role that these large invertebrates play as deep-water habitats for fishes and other marine life."said Love. ■

Edited by
Peter Symes &
Michael Symes

NATO urged to reduce use of high-intensity sonar

The powerful military alliance of the North Atlantic Treaty Organization

(NATO), which includes USA, has been challenged to change how it conducts naval exercises, in order to prevent needless injury and death to whales, porpoises and other marine life.



Hull-mounted multibeam sonar

A coalition of international conservation organizations, representing millions of members, has sent a letter to NATO urging its member states to reduce harm from high-intensity sonar systems. These systems blast extraordinarily loud sound underwater to locate submarines and surface vessels. Despite mounting evidence that it can devastate marine life, the use of it has been expanded by the United States Navy and other militaries.

Those petitioning NATO include NRDC (Natural Resources Defense Council), Green Cross International (headed by former Soviet President Mikhail Gorbachev), Humane Society International (HSI), the International Fund for Animal Welfare (IFAW), the Whale and Dolphin Conservation Society (WDCS), Ocean Futures Society and its founder Jean-Michel Cousteau. ■



Ocean color data reveals green pigment of chlorophyll contained in phytoplankton found in the ocean

New internet tool for ocean colour data analysis

A new NASA Internet tool, called Giovanni, allows analysis of satellite-derived ocean colour data. These data provide information about ocean biology by looking at phytoplankton through changes in the colour of the ocean surface. These changes are primarily due to the green chlorophyll contained in phytoplankton, free-floating plants that are the foundation of the ocean's food chain.

Three Giovanni tutorials are now available, demonstrating research with ocean color data.

The first tutorial looks at the chlorophyll patterns in the Gulf of Panama which has a seasonal pattern caused by strong winds that blow through the Panama Canal Zone in winter. The winds mix nutrients from deeper waters to the surface, promoting phytoplankton growth. As expected, the strong 1997-1998 El Niño reduced the productivity of the phytoplankton in this region. In the summer of 2001, however, there were short bursts of higher productivity not seen in other years.

The second tutorial investigates the Red Sea, which has two seasonal patterns, one in the north and another in the south. However, a very small area of relatively high chlorophyll concentrations was also seen near the Egyptian coast. It looked like a small river was entering the Red Sea, but there aren't any rivers near here. It was found that this area was associated with a large coral reef complex on the Red Sea coast.

A third tutorial examines the California coast near Monterey Bay, and discusses the influence of clouds on the data. ■

For more information on this release: For the Ocean Color Time-Series Online Visualization and Analysis System, please visit: reason.gsfc.nasa.gov/Giovanni

Treasure trove of underwater arrowheads

Mi'kmaq artifacts found in Nova Scotia

During repairs last summer to generating stations on the Mersey River, near Kejimikujik National Park, water levels dropped, exposing the riverbed for the first time since dams were built 70 years ago. Suddenly hundreds of arrowheads and tools, some 8 000 years old, appeared in the mud.

There was already a real, functioning civilization here before the Europeans began to come *en masse*, but the evidence for this has mostly been destroyed. Then, suddenly, here was substantial evidence at hand. Pottery fragments, spear points, knives and other items were found around 109 ancient

campsites. And one barbed harpoon appeared to have been used to spear salmon and eels 3 000 years ago.

Although the discovery was kept a secret, the RCMP was brought in to control looting, since the artifacts were lying on the surface. The discovered artifacts have now been placed in a museum, and the Mersey River encampments are now once again under water. ■



Arrowheads found in the waters of Nova Scotia



US COAST GUARD

US Coast Guard to protect ports from scuba divers

U.S. Coast Guard patrols American ports. Concerns about terrorist strikes by scuba divers were raised three years ago, after the FBI announced it was investigating whether al-Qaida operatives took scuba training to help blow up ships at anchor, power plants, bridges, depots or other waterfront targets. The US Coast Guard is therefore seeking to protect the nation's ports from terrorist attacks by scuba divers with a sonar system so powerful it can distinguish swimmers from dolphins. Sonars have long been used aboard submarines but apparently without sufficient resolution to tell divers and other objects apart.

The security device scans port waters, and alerts authorities on land, to any possible divers. A response boat then drops a second sonar below the surface for confirmation and sends back high-resolution images of the diver. Instead of getting an alert from every sea lion, manatee or fish, this system will help identify objects as a diver who just got lost, or someone who intends on doing harm.

No detailed information was available on how the system differentiates humans from animals, how far away it can detect divers, or how many were being used. It is claimed that the device would only be deployed periodically, and that it could prove especially useful to inspect waters during major public events, like welcome ceremonies for military ships returning to port. ■

Edited by
Peter Symes &
Michael Symes

Crabs dine on 'snowfall' of zooplankton

The unusual feeding behaviour of a shallow-water crab that lives off Kueishan Island, part of the Okinawa Arc, has now been explained. Scientists discovered that crabs of diverse sizes feed on vast numbers of zooplankton that are killed by toxic plumes emitted from underwater vents. The vent discharges are sulphur-rich and highly acidic, with pH levels of between 1.75 and 4.60, and temperatures of 65°C to 116°C.

Jeng Ming-shiou, a zoologist from Academia Sinica's Institute of Zoology, said that he had been observing the behaviour of the hydrothermal vent crab, *Xenograpsus testudinatus*, since 1999.

In periods of calm water, thousands of crabs were observed swarming out in a feeding frenzy on the sea floor over an area of a few square meters. It is estimated the population density of the crab exceeds 364 per square meter, in waters ranging from 3m to 30m deep. The unusually massive, dense crab population was what first motivated the research. What are the crabs feeding on, and how could the ecosystem support such a substantial crab population?

After five years were spent on observing the crabs underwater, dissection of



Vent Crab

UNIVERSITY OF DELAWARE

crab specimens revealed that their guts were full of zooplankton. It was therefore concluded that the crabs were feeding on zooplankton.

Jeng stated that the swarming behaviour is seen only during periods of calm water, when the mass of descending zooplankton has the appearance of falling snow. The crabs time their foraging to coincide with these marine "snow falls" in order to maximize their efficiency in harvesting the plankton. ■

Conservation plans for dugongs & turtles

Indigenous communities band together to conserve sea life

Northern Australian Aboriginal communities are working together to develop conservation plans for dugongs and turtles, and the Federal Government has allocated \$3.8 million over the next three years towards this purpose.

The North Australia Indigenous Land and Sea Management Alliance (NAILSMA) stated that some Aboriginal communities were already involved in collecting discarded fishing nets in which dugongs and turtles become trapped.

It is intended to extend these types of initiatives across northern Australia, to include the



UNIVERSITY OF MASARYKIANA BRNO

Dugong of Australia

Kimberleys, the Northern Territory, the Torres Strait and Cape York. ■

Diving vessel home after 4-month detention in Indonesia

Lessons to be learned by European divers

Now, after more than four months of filing the proper paperwork, a diving vessel, the White Manta, has



WHITEMANTA.COM

The White Manta back in port

finally made its journey back to Singapore. The White Manta, owned by Vincent Chew, was intercepted and detained by the Indonesian Navy last October for illegal entry.

Mr Chew, a dive operator, very nearly lost his livelihood when a diving trip turned into a nightmare.

Thirty of his diving customers were stranded after his boat was intercepted by the Indonesian Navy.

The boat was finally released after being charged with a minor offence.

Now that the boat is back in business, its owners are happy to be able to start sailing again. But the lost time has meant lost business in those four months,

for the dive operator could have had at least 16 dive trips during the weekends. During the peak season, there would be about 30 divers on board. But with the boat held at Tanjung Pinang, Mr Chew lost hundreds of customers and thousands of dollars more in income. He hopes to get his boat ship-shape in

time to start sailing again in early March, stating that they now had proper sailing and diving permits to enter Indonesian waters. There are lessons to be learned from this, especially for the European divers who work here. They need to have a visa to enter Indonesia prior to the trip. ■

*Lessons Learned
"Especially the European divers who work here, they need to have a visa to enter Indonesia prior to the trip. We have proper sailing and diving permits to enter Indonesian waters,"
Mr Chew said.*

Sharks appear to flee hurricanes

Sharks appear to have fled the area as hurricanes battered Florida last year, causing a big drop in shark attacks in the state that usually has a third of the world's annual total. It is thought that the drop in Florida was due to the large number of strong hurricanes and a tropical storm.

Florida normally has more shark attacks than most other places because its long coastline, dense population and year-round swimming frequently bring sharks and people together. Last year, however, Florida had only 12 shark attacks, compared with 30 in 2003.

The total number of shark attacks in American waters fell to 30 last year, being the lowest number in a decade peaking at 52 attacks in 2000.

Worldwide, 61 shark attacks were reported last year, slightly more than the 57 counted in 2003, but below the three previous years, when the total ranged from 63 to 78. Seven of last year's attacks were fatal - two in Australia and one each in Brazil, California, Egypt, Hawaii, and South Africa. ■



COMMANDER JOHN BORTNIAK, NOAA CORPS

Hammerhead shark



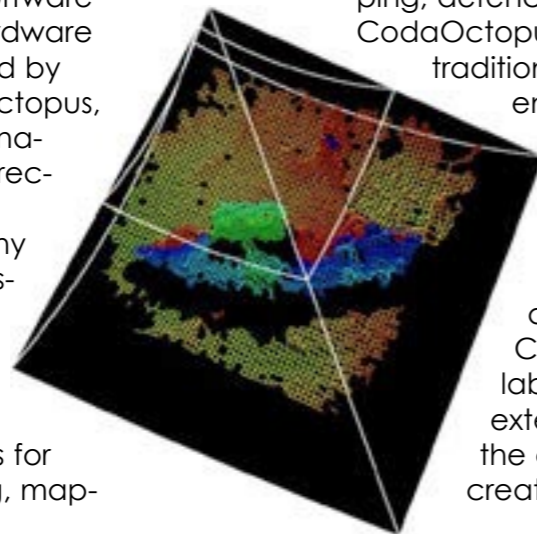
Edited by
Peter Symes &
Michael Symes

Mapping the underwater world in 3-D

Following new investment and collaboration, scientists in the School of Earth, Ocean and Planetary Science at Cardiff University will be able to view the seabed in great 3-D detail.

The University has recently invested over £200,000 in seabed mapping technology from Science Research Investment Fund (SRIF). The impact of this has been enhanced by a further £50,000 sponsorship in com-

puter software and hardware provided by CodaOctopus, an internationally recognised company specialising in underwater technologies for imaging, map-



ping, defence and survey. CodaOctopus has a strong tradition of bringing scientific research into commercial applications.

Little is known about the sea around Wales, and the new CodaOctopus laboratory will map extensive areas off the coast of Wales to create a virtual real-

ity image, allowing scientists to walk the sea bed from the laboratory. It features novel 3-D methods to map the seabed, addressing risks in terms of marine security, the environment and health and safety.

This collaboration will provide visualisation of the seabed for scientists and strategic decision makers for purposes of renewable energy, port operations, dredging and environmental protection. ■

Blueprinting the Malaysian shoreline

Ecologically sensitive areas to be mapped

A blueprint being drawn up on the country's 4800 km shoreline will map out every ecologically sensitive area which should remain out of bounds to development by state governments. The integrated shoreline management plan would identify every aspect of the coastline for development, tourism and even conservation. It would ensure that state governments avoid destroying sensitive areas like

archaeological sites, and not disturb critical natural areas.

Coastlines and land 5 km inland are being studied to develop the blueprint, which will specify what these pieces of land can be used for.

Local authorities considering any projects along the coast would first have to consult the blueprint long before the subject of an Environmental Impact Assessment arises. With this document, local authorities can straight away tell whether



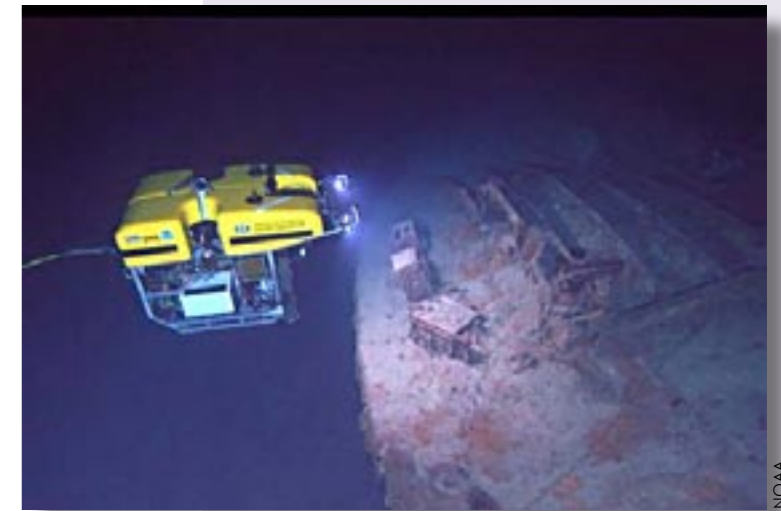
Map of Malaysia and surrounding region

the area being proposed is suitable or not. An example is the Tioman marina project where development was allowed on an environmentally sensitive area. It was thought that some might want Tioman island to be preserved for its nature while others may want to develop infrastructure to accommodate tourists who head there. An attempt will be made to marry the two and at the same time, not disturb the

environment.

Besides environmentally sensitive areas, the blueprint would also map out sensitive areas like archaeological sites to prevent their destruction. For example, the inventory has been started on the coast of northern Pahang and includes archaeological shipwrecks like the HMS Repulse and HMS Prince of Wales off the east coast of the peninsula.

The blueprint also covered the shorelines of Sabah and Sarawak. ■



Deep-Sea HD TV

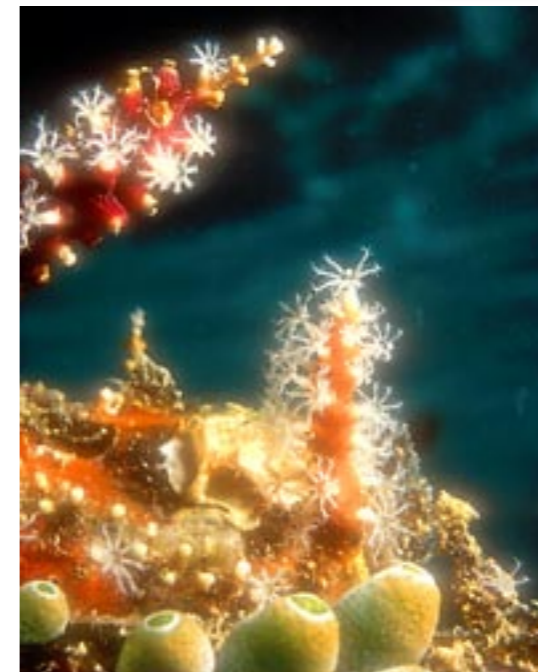
The National Oceanic and Atmospheric Administration (NOAA) is converting a 224-foot Navy ship into a science research vessel that will produce high-definition video from the bottom of the sea. The USNS Capable will be the only ship with a dedicated science-class deep-ocean robot, or remotely-operated vehicle (ROV).

In the new setup, a tow sled will descend on 6000 meters of cable. Thirty meters of separate cable will connect the tow sled to a mobile ROV that can take samples of the water, along with collecting other data and images. The cable will send data back and forth and provide power for bright lights.

Through high-speed Internet 2 connections, scientists onshore at special Science Command Centers will be able to exchange data, and see deep-ocean images and specimens taken by ROVs at the same time as their counterparts on the ship.

With 71 percent of the Earth covered by ocean, and with 95 percent of that unexplored and unseen by human eyes, a good part of the ship's mission will be to just find out what's actually out there.

The conversion is expected to be completed within 18 months. ■



Malaysian corals

Edited by
Peter Symes &
Michael Symes



Map of Great Britain and surrounding seas

THE LIVING EARTH / EARTH IMAGING

Most species are in decline in British seas

UK prime minister Tony Blair calls for a new marine bill

A report published by the World Wildlife Fund (WWF) shows that 13 out of the 16 marine

species in the seas around Britain are in decline. Species that may disappear include the leatherback turtle, the native oyster and the pink sea fan. The report highlights the increasing demand on the seas around

Britain and their marine life from trawling, dredging, and excavation from the bottom of the sea. Horse mussel beds create a habitat for about 100 other species, but they are being destroyed by scallop dredging.

The decline in cod has been well publicised, but skate have also been hit. Not a single example of the species was uncovered in the survey. However, the WWF is most worried that habitats that are the basis of marine life are being destroyed. It blames inadequate planning and poor management by the authorities. Overfishing,

the dredging of the seabed for minerals and the increased traffic in shipping lanes are all taking a heavy toll beneath the surface.

The pink sea fan coral, *Eunicella verrucosa*, is declining in the least likely place - England's only natural marine reserve, off the coast of the island of Lundy in the Bristol Channel, whose waters should be among the most protected in the world.

Tony Blair has signalled his support for a new marine bill to modernise the way Britain manages its marine environment. The bill is likely to create a new agency with powers to crack down on illegal fishing. ■

Leatherback Turtle

Leatherback Turtle



COURTESY OF NPS

Leatherback Turtle



Native Oyster

BIM IRISH SEA FISHERIES BOARD

Native Oyster



CHARMOUTH HERITAGE COAST CENTRE

Pink Sea Fan



Antifouling paints may cause hearing difficulties in marine mammals

It has been reported by the Yale School of Medicine that tributyltin oxide (TBTO), an active component in antifouling paints for ships, affects the mechanical activity of the outer hair cells of whales. These outer cells modulate and boost incoming sound energy to the inner hair cells.

TBTO is known to damage the immune system and the hormonal system of marine mammals. However, this is the first time it has been demonstrated that TBTO could be working directly on the auditory system. Mammals are the only group of animals that have outer hair cells.

Sensitive hearing in mammals relies on cochlear amplification resulting from the mechanical activation of outer hair cells. In guinea pigs, a rapid and profound effect of TBTO was found on the outer hair cells, where chloride ion exchange was affected across the outer hair cell membrane. TBTO bypasses the normal chloride ion pathway, thereby altering the ion's modulating effects of the protein prestin, and this may degrade cochlear amplification.

This observation identifies a new environmental threat for marine mammals by TBTO, which is known to accumulate in the food chain. ■

Vietnam Ocean Institute helps replenish seagrass and coral

Over the past decade, the coral and sea-grass ecosystem in central Vietnam has been adversely affected by the heavy use of dynamite and electricity by fishermen, and also by pollution from different sources. Methods have therefore been developed at the Vietnam Institute of Oceanography, to replenish much of the coral reef and sea grass off the coasts of central Vietnam.

For coral replenishment, coral seeds are planted in dead reefs at strategic locations. Another, more expensive and labour-intensive method, which creates conditions similar to the natural environment, grows coral on iron stakes in a cement foundation.

Seagrass helps prevent

erosion, acts as a polluting filter, and provides an environment where hundreds of kinds of marine animals live, grow and reproduce,

and is therefore considered an important biological component in the sea eco-system. The institute therefore began studying sea-grass in 1997, and later developed successful methods of re-planting it.

The research was carried out under a larger national project whose aim is to improve the sea environment for aquatic breeding, and to protect and restore the ecosystem for coral reef and sea grass. ■



NOAA

Coral trade threatens marine life

Scientists consider coral reef to be the 'tropical forest of the sea', because it has a complete ecology and makes up an important element of underwater life. However, increased demand and over-fishing could mean the end of Vietnam's coral reefs, which could be exhausted in as soon as 20 years. Approximately 80 % of coral off the nation's coast is threatened, the main dangers being over-fishing, shrimp breeding and, in particular, coral exploitation for trade. Vietnamese coral earns a lot in foreign markets.

In the past, residents left the coral alone, but times have changed due to increasing demand. It has become fashionable to use coral for house decoration, and the trend has led to a damaging coral trade in

coastal areas. Shrimp farmers also use coral to make limestone for cleaning their shrimp cages.

Unfortunately, coral protection in some preservation areas has not been implemented seriously or effectively. So, while scientists at Vietnam's Oceanography Institute are working to protect coral reef, products made of coral appear along coastal areas all the way from Da Nang city to Binh Thuan Province. And in some cases, coral is transported to HCM City for export.

Coral exploitation will hurt marine life and habitat, as well as fish breeding, according to the Oceanography Institute. The organisation also predicts negative effects on the coastal ecology in central and southern areas of the country. ■

Edited by
Peter Symes &
Michael Symes



AFP

Tsunami uncovered Ancient Indian City

Underwater excavations have been started on the remains of an ancient city, uncovered by the recent Asian tsunami, near the coastal town of Mahabalipuram, 50 km south of Madras, India. Mahabalipuram is already well known for its ancient, intricately carved shore temples. According to early British travel writers, the area was also home to seven pagodas, six of which were submerged by the sea.

After the tsunami had hit the coast, the force of the water removed sand deposits that had covered the structures. Three, two meter high, rocky structures include an elaborately carved head of an elephant and a horse in flight. Above the elephant's head is a small square-shaped niche with a carved statue of a deity. Another structure uncovered by the tsunami has a reclining lion sculpted on it. Lions, elephants and peacocks were commonly used to decorate walls and temples during the Pallava period in the seventh and eighth centuries. The structures thus appear to belong to a port city built in the seventh century.

The tsunami has also exposed a bas relief which appears to be part of a temple wall or a portion of the ancient port city. ■

Fun and archaeology for divers

Divers to look for Krishna's Bet Dwarka

The Dwarka of Lord Krishna was long believed to exist only in the realm of mythology, before the Archeological Survey of India conclusively proved its existence on the basis of underwater findings. A sports firm, Adventure Sports Limited, bringing Gujarat's first scuba diving project near Bet Dwarka, will combine fun and



Tsunami uncovered Buddha

archaeology in two projects as divers can look for the Lord's abode.

The first project concerns scuba diving off Bet Dwarka, or Shankhodar, the island on which Dwarka is located, with a centre for scuba diving in the Marine National Sanctuary. It will be the first time that people will get a chance to differentiate between mythology and history. Research has proved the existence of the original Dwarka, and with remains of a walled city and remains of pottery still found underwater, divers will get a chance to observe ancient remains.

The second project concerns diving facility centres on Ajod Island, 13 km from the mainland. Adventure Sports Limited is launch-



PAK TRIBUNE

ing scuba diving facilities which will enable the divers to glimpse the underwater Bet Dwarka. The firm will provide the necessary scuba diving equipment, as well as training, if required, to participants as part of packages of varying durations. International certification programmes will be conducted. Lodging and boarding facilities will be provided at the island. The project will work both as a training and certification centre and as a diving facility centre. ■

Baltic Sea in bad condition

Artificial respiration might be needed

Swedish scientists warn that the Baltic is much more polluted than previously thought. If the eco-system is to be saved, it may be necessary to give the sea 'artificial respiration'.

It is stated by the Swedish Council for the Environment that the situation is so serious that the eco-system of the Baltic has probably completely broken down. It is believed that decades of attempting to improve the water environment of the Baltic by reducing the release of nitrogen and phosphorous compounds, have been without effect. On the contrary, the eco-system has in fact has even deteriorated in the deep, central sea areas.

If the Baltic is to be saved then the supply of nitrogen and phosphorous must be brought down to the level at which it was before the advent of

the automobile, artificial manure, and industrialisation at the end of the 1800's.

Ragnar Elmgren, professor in the ecology of the Baltic at the University of Stockholm, states that in order to rescue the Baltic it might be necessary to use a form of artificial respiration in which oxygen is pumped down into the depths.

The Swedish Environmental Minister acknowledges the problems with the Baltic, stating that current voluntary international agreements must be replaced by binding agreements within the EU. All the countries around the Baltic, with the exception of Russia, are now members of the EU. ■



UNEP

www.inmodivers.de

Dive shows

Barcelona, Spain

Salón de la Inmersión

Lately, many of the biggest brands have been absent from many of the international dive shows and Spain proved to be no exception. Only Aqualung, Poseidon and Beuchat were present at the "Salón de la Inmersión" diving show in Barcelona. Nonetheless, the show was a success because of the overall growth in numbers of both exhibitors as well as attendees. In its sixth edition, this 3-day show, had more than 15,000 visitors, a clear indicator that the diving industry in Spain is in good health.

Among the highlights of the show were the many exhibitors representing technical diving, something that was underdeveloped in Spain only few years ago but now seems to have grown into an important market. For the first time different rebreathers were on display. And Dive Rite, one of the leaders in technical diving equipment, exhibited at the De Profundis stand together with Green Force, the Belgian torch maker who demonstrated the latest developments in LED lighting. One of the best stands of the show, however, was the Ralf Tech stand where we saw the nice

collection of dive bags and other interesting products that they distribute in Spain, like the impressive range of Atomic regulators.

Also worth noting is the continued growth in the number of present travel agencies. Two years ago there were just three important dive travel agencies at the show, but this year eight were present a clear indication that also Spanish divers are traveling more and more every year. The hottest destinations were the Red Sea, Maldives, Galápagos and Indonesia, but a few agencies showed some exceptional trips like a trip to Antarctica, which is something completely new for Spanish divers.

Most of the space were occupied by dive centers. Their section gets bigger at every show which shows how attractive the Spanish coast is. The Canary



Islands had the biggest representation with dive centres coming from all seven islands (Tenerife, Gomera, Lanzarote, Fuerteventura, El Hierro, La Palma and Gran Canaria). The Spanish Mediterranean coast was also well represented. We found a large quantity of diving centres from the Costa Brava (North of Barcelona), Alicante, Murcia and the Balearic Islands, some of the most popular Spanish destinations.

It seems that the organizers are planning more activities next year in order to attract more visitors and make the big brands to exhibit again.

Reporting by Jordi Chias



Moscow Diveshow

With the Russian capital still covered in snow the third international annual Moscow Dive Festival took place in the Olimpiyusky Sports Complex during the four days between February 24-27.

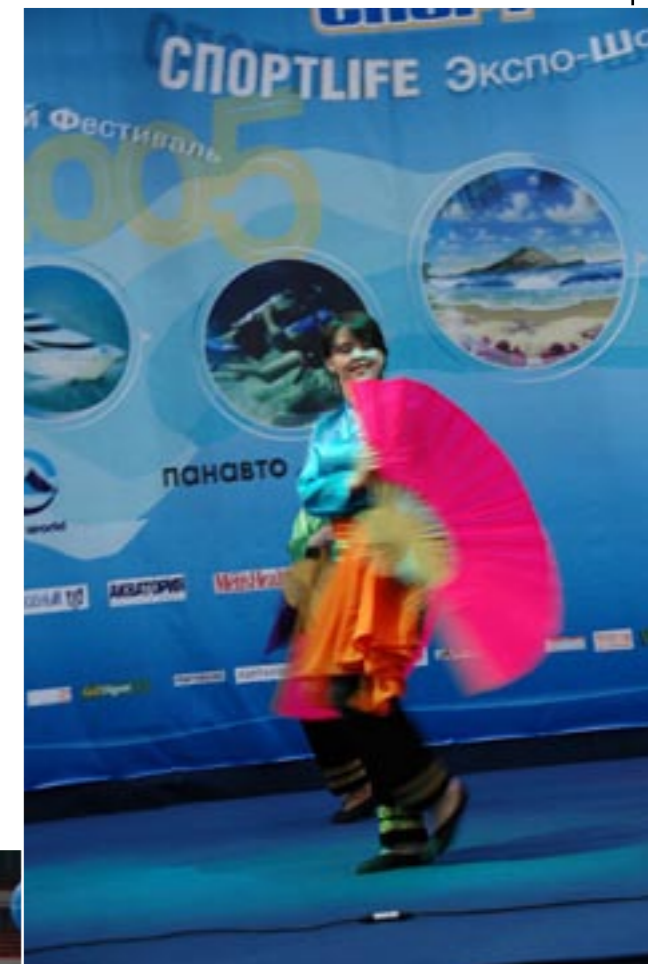
More than 12,000 visitors came to see what the 171 exhibiting companies and the beautiful underwater realm had to offer in various places aided by the film festival and other events. Many of this year's exhibitors came from foreign countries such as Egypt, Australia, Palau, Papua New Guinea, Thailand and the Maldives and DEMAs president Bob Hollis also visited.

A growth in the number of certified divers by more than 10,000 is a remarkable result for a nation that not so long ago was a closed country. This successful exhibition with its large number of attendees is a clear testimony to the fact that Russia also on this area are becoming an interesting growth marked for investors in the diving industry as Russians are gaining influence and presence in the global scuba diving industry.

In contrast to the crisis elsewhere in the industry Russian divers are ready and willing to pay for the best diving equipment available and for exotic dive trips all over our watery globe.

www.exposport.ru

Reporting by Andrey Bizyukin



Edited by
Peter Symes &
Michael Symes

Ominous loss of Antarctica sea ice...

Antarctic iceshelves collapsing

Decline in krill associated with loss of Antarctic ice

The western Antarctic Peninsula is one of the world's fastest warming areas, and, atypically for the southern ocean, winter sea-ice duration is shortening here. Key spawning and nursery areas of krill are thus located in a region that is sensitive to environmental change.

A decline in numbers of the crustacean krill will pose a risk to other marine wildlife that feed on it. Krill, *Euphausia Superba*, is a shrimp-like crustacean that grows to a length of about 6 centimeters and can live for five to six years, and flourish in their billions. In winter, krill depend on thick mats of green algae that flourish on the underside of ice shelves which extend out of the polar darkness into the sub-Antarctic light. As the oceans warm, the winter ice will retreat, and the algae will vanish. Angus Atkinson of the British Antarctic Survey has stated that the amount of krill in the southwest Atlantic has fallen by

about 80 percent since 1979, correlating with a drop of at least 30 days in the duration of sea ice in the crustacean's main breeding ground here.

Open water is bad for krill because there is less food. The food is on the sea ice, so, with the ice melting earlier, there's less time for the krill to feed.

Penguins and whales affected

Changes in the krill population will have profound implications for the Southern Ocean food web. Penguins, albatrosses, seals and whales have wide foraging ranges, but are prone to krill shortage. Thus, even a small increase in sea temperature could dramatically affect a host of marine creatures, stated Professor Lloyd Peck, a scuba-diving expert on the strange fauna of the south polar seabed.

When you have low krill stocks penguins die, and they die when their chicks get to fledgling age. The time when the chicks need food most is just when they are about to go to sea. If the food supply is not enough, you can have up to 99% mortality in a couple of weeks. Thus, if one of the key species in the system goes, then very quickly you can lose a lot of the whole system. For example, fishery areas around the Antarctic would be affected.



MICHAEL VAN WOERT, NOAA

The seaward edge of the floating Ross Ice Shelf

The Antarctic continent is still cold, but the Antarctic peninsula has warmed by up to 3°C in the last 50 years. There have been big losses of ice shelves and glaciers, recession of ice, and new habitable areas for animals have thus appeared, with grass and mosses. Seals and penguins are adapted to dramatic seasonal changes in temperature and travel huge distances for food. But polar life is unforgiving, and small cyclical shifts in temperatures in the equatorial Pacific already cause

huge losses to penguin colonies further south.

Human life could also be seriously affected

Human life, of course, depends critically on a healthy sea life. However, there is also the effect of increasing sea levels. If findings of a team led by Prof Duncan Wingham at UCL turn out to be correct, predictions about sea level rises in the next century may have to be revised upwards significantly. Renewed emphasis has been placed on the expansion of the oceans caused by warming, and has shown that the effects of shrinking Antarctic ice are minimal, though they may soon be significant.

Many millions of people live in areas within one metre of the sea level. If ►



NOAA



USNPS

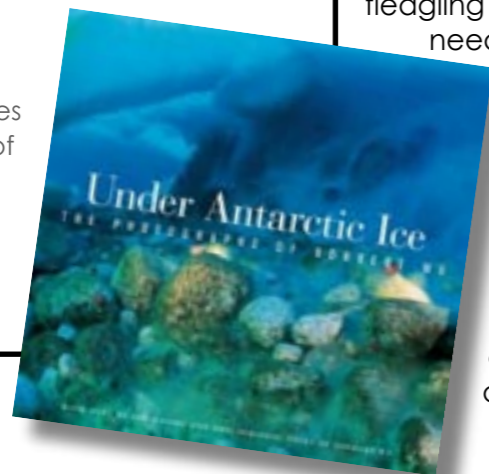


PHOTO BY MICHAEL VAN WOERT, NOAA

PHOTO BY LEE FUJIMAN, NOAA

Under Antarctic Ice: The Photographs of Norbert Wu

by Jim Mastro and
Norbert Wu
Hardcover: 176 pages
Publisher: University of
California Press
(September 1, 2004)
ISBN: 0520235045
See Books Section...



The global warming trend poses a threat to several marine species, such as penguins, whales and seals, by reducing food sources dependent on Antarctic iceshelves which are collapsing

Edited by
Peter Symes &
Michael Symes

models of the thermal expansion of the ocean due to global warming are correct, they could all be under water in two centuries. Over the next 100 years, it is estimated that this thermal expansion will elevate sea levels by 49cm. But new findings indicate that thermal expansion may have already had a much bigger impact on sea levels.

New data show that over the past 100 years sea levels have risen about 18cm. Previously it had been assumed that the shrinking ice sheet could have contributed as much as 14cm. If this scenario had proved correct, the height of the Antarctic Ice Sheet should be falling by about 5cm a year. But these estimates were largely based on very sparse ground measurements. A more accurate



NOAA

estimate has come by using signals from two satellites to measure the thickness of the ice to within half a centimetre. Measurements taken over five years cut the contribution of Antarctic ice from 14cm to 1.7cm.

The results support the view that global warming has so far caused sea levels to rise by thermal expansion, with other factors, such as melting mountain glaciers and the pumping out of groundwater, probably being of minor significance. ■



WWW.THEKAIROS COMPANY.COM

New exciting diving-expedition liveboard in the Mozambique Channel in the making

The Kairos Company Ltd. is to launch a new concept of diving oceanographic expeditions for all in the Mozambique Channel (Tanzania, Mozambique, Kenya, Madagascar, Comores islands)

The concept is to organise five expeditions a year, for a two months period each, with the help of an expedition leader and a highly qualified crew, writes the Tanzania-based Kairos Company in a newsrelease. Each expedition is divided into periods of 7 days, enabling divers to team up with specialists, scientists and professional divers. The Kairos Company uses a real oceanographic research vessel equipped with a large set of professional devices such as Sony PD150 DV camera, Extrem'Vision camera houses, 200w HMI spotlights, rebreathers, facial masks with underwater communication system, scooters, facial masks, Nitrox, Trimix, oceanographic winches, and more.

These expeditions targets divers looking for a new type of active holidays and something from classical liveboards such as real expeditions.

The first expedition (June and July 2005) is lead by Jean Marc Bour who worked with different film makers such as Luc Besson (The Big Blue) and Jean-Michel Cousteau (White Sharks in South Africa, without cage). The objective of this expedition is the making of a TV documentary about Indian Ocean South Equatorial Currents (SEC) and their effects on the marine species.

Departures for divers (1 week) are available from Dar Es Salaam (Tanzania) from May 29 to Aug 7. New expeditions about unexplored wrecks and marine life studies will be scheduled very soon. More information is available on the website: www.thekairoscompany.com or at their Paris-based agent Catherine Dulin tel (+33(6 21 04 00 50 or catherine@thekairoscompany.com)



WWW.THEKAIROS COMPANY.COM

"No experience is needed"

30th April – 7th May

Grand Cayman Adventure Week

Adventure Week is for all levels of fitness and experience to share what they love most in the tropical elements of Cayman.

The Caymanian love of nature and inherent sensibility has ensured that large expanses of Cayman is untouched and protected by the National Trust. For you, this means that the many activities available – snorkelling, kayaking, bike trailing, diving, geocaching and dry-caving – are held in some quite extraordinary surroundings, including the turquoise crystal blue waters that are the signature of the Cayman Islands.

"The geography on Cayman gives us the perfect opportunity to introduce Geocaching or GPS Stash Hunt as part of this Adventure Week", stated Steve Broadbelt co-owner of Ocean Frontiers, one of Cayman's leading Dive Centres and co-arranger of Adventure Week.

"Geocaching is an entertaining adventure game. The basic idea is that caches have been sent up all over

Cayman, with the location of these caches found on the Internet. GPS users can then use the location co-ordinates to find the caches. Once found, a cache may provide the visitor with a wide variety of rewards. Participating in Geocaching is deceptively easy. It's one thing to see where an item is; it's a totally different story to actually get there. You can geocache both above and below the water!

The topside ambience and marine wilderness that defines the East End is definitely reason enough to venture off the beaten track when visiting Grand Cayman. You will be exposed to the best coral reefs and the best wall diving in the Caribbean in a safe, enjoyable and relaxing atmosphere with professional, courteous service and ecologically minded staff. And all tours are operated by certified and experienced guides or instructors, trained in rescue and first aid. For more information check out these web sites:

www.oceanfrontiers.com
www.compasspoint.ky
www.ecoventures.ky ■



OCEAN FRONTIERS



FROM LEFT: PSAI founder Hal Watts, new VP Dave Crockford and PSAI President Joe Odom

Dave Crockford named European Vice President for Professional Scuba Association International

Although PSAI may not be as well known as some other training agencies, key personnel at PSAI have a long accomplished history in the diving industry, and this quality continues with Dave Crockford.

Crockford has been instrumental in developing a wide range of standards for acceptance within the EU as well as involvement with Police Diving Teams, Scuba Industries Trade Association and the Health & Safety Executive. Dave has also acted as an Equipment Diving Techniques Expert Witness for many of Her Majesty's Coroners over the last 15 years. This key inquest role has included the use of rebreathers. In addition, Dave brings a wealth of background from

his previous engineering and diving and rebreather research experiences with Maurice Cross at DDRC (Diving Diseases Research Centre) and technical diving advisory with British Sub Aqua Club.

At PSAI Crockford will be responsible for all forms of business development and technical operations. He joins Mike Ange, VP of the Americas, in bringing the proven PSAI programme to all interested divers and professionals alike.

"I am looking forward to this new challenge", stated Dave Crockford. "Hal Watts maintains an incredible track record and still so keen to learn from others. His philosophy of The 'Safety-Integrity-Knowledge' Golden Triangle still holds true 20 years after introducing it. That spirit, along with fun and the shared experience, reminds me just why I go diving in our wonderful temperate waters! Performance based

diving and truly international support text will be such powerful tools for the discerning professional I just had to say yes!"

PSAI is known in Europe through a small but dedicated group of instructors, but now, with Dave on board, this will bring to the fore the true impact of performance based certification."

Hall Watts,
PSAI Founder

Changes in the dive training industry...

Founded by Hall Watts in 1962, the Professional Scuba Association International is one of the oldest scuba instructional training agencies in the world. For many years it was a small, specialized organization that was predominantly involved with diving training associated with extended range diving. Hall Watts has always been dedi-



cated to developing proven, effective diving techniques for dives to depths greater than the normal recreational range of 40 meters. Thus, in 1968, using the methods he developed, Hal set the World's Record

Depth by diving to 119 meters (390 feet). In 1970, Hal wrote and copyrighted the first manual for Extended Range Deep Diving for instructors.

Little known facts include that he developed and coined the term "octopus" for the additional second stage, to eliminate problems associated with buddy breathing. Rather than sharing a single regulator, which was the standard practise in "the old days", today where we simply pass the "octopus"! Another contribution to safety awareness is his devotion to dive planning. The common phrase "Plan your dive, Dive your Plan" have also ben coined by Hal Watts.

The forerunner

PSAI was already in place as the mainstream technical agencies burst onto the market in the mid-1980's and continued their program of careful selection of instructors and adherence to safe diving techniques. Many of the other agencies recognized the PSAI pro-

grams for the quality and afforded direct cross-over certification, but cross-over certification to PSAI requires careful evaluation as well as a written examination on the history and philosophy of PSAI.

A matter of philosophy

One of the hallmarks of the Professional Scuba Association is that the programs have always stressed high quality in instructors. Instructor Trainers are all hand selected for their skill and dedication to scuba education. At PSAI each Instructor Trainer is fully taught the background of the PSAI philosophy of skill, knowledge and integrity. Due to this process, administrative cross-overs are not practical nor justifiable from a quality and defensibility standpoint.

During the 1990's Hal had long discussions of the philosophy with Joe Odom in this regard. Joe had been chairman of the National Speleological Society's Cave Diving Section and was also well known as an author of technical diving articles and manuals for Technical Diving International (TDI). Consequently, when Joe resigned from TDI in 2004, it was only natural that Hal Watts felt Joe Odom was ideally suited to push PSAI forward.

In early 2005, the PSAI course structure was re-configured into more logical paths of their normal extended range programs, a traditional path of technical deep diving from nitrox to trimix and a rebreather path. This technique gives the students the style and courses that fit their desired training objectives, without any unnecessary diversions. At the same time, every PSAI diver will receive the highest quality training from the best instructors available. ■



Simon Pridmore has taken over IANTD UK

After more than a decade of technical training and setting up IANTD UK Kevin Gurr has now passed the baton on to Simon Pridmore.

In the early 90's Kevin Gurr set up IANTD UK (International Association of Nitrox and Technical Divers), as the first technical diver training agency in Europe.

Simon Pridmore has been involved in diving since 1981 and is no stranger to IANTD, having run IANTD Micronesia, with dive centres in such exotic destinations as Truk, Palau, Pohnpei, Saipan and Majuro. As such Simon brings to IANTD UK a wealth of experience in the fields of customer service and professional management.

"My primary aim is to maintain and enhance IANTD's reputation as a pioneering body at the very top of this sport. IANTD's name was made through its place at the forefront of Technical diving" says Simon.

IANTD UK can be contacted by email on iantdsales@aol.com or telephone +44 (0)1202 - 840 366 ■

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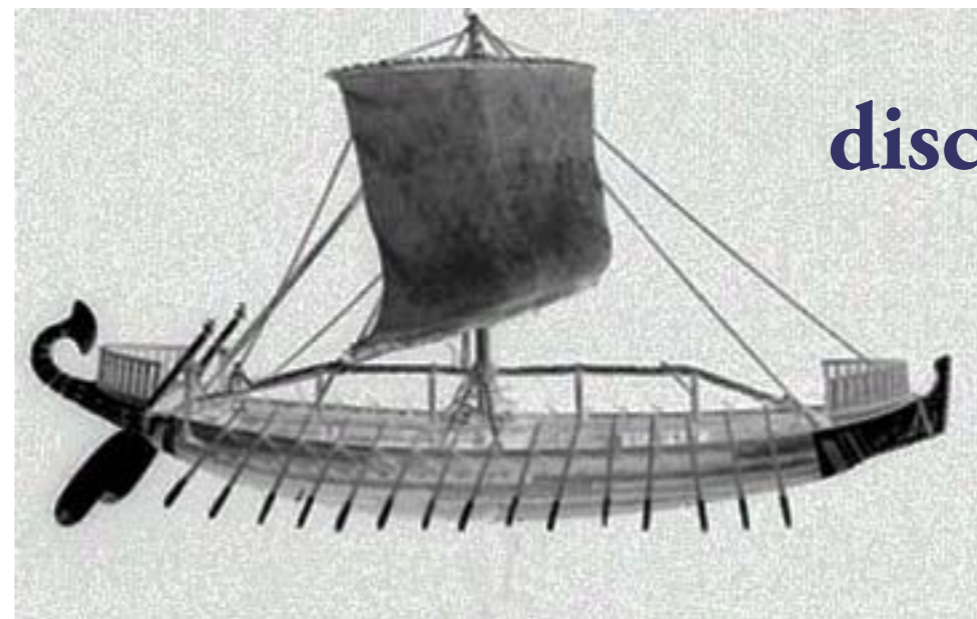
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Ancient ships discovered in Egypt



Archaeologists recently discovered the first ancient remains of Egyptian seafaring ships inside two man-made caves on Egypt's Red Sea coast.

These remains are the first pieces ever recovered from Egyptian seagoing vessels, and along with hieroglyphic inscriptions found near one of the caves, they promise to shed light on an elaborate network of ancient Red Sea trade. Inside the caves the archaeologists found cedar beams and blocks of limestone that were former ship anchors and an assortment of nautical items, among them ropes, a wooden bowl, and a mesh bag. They also found two curved cedar

planks that were probably the steering oars on a 70-foot-long ship from Queen Hatshepsut's famous 15th-century b.c. naval expedition to Punt, a trade destination somewhere in the southern Red Sea region.

"I think it is a very exciting discovery," says John Baines, an Egyptologist on the faculty of oriental studies at Oxford University. "People have tended to assume that the Egyptians didn't do a tremendous amount of long-

distance travel because very few remains of these sites have been found."

Based on texts discovered over a century ago, researchers have known that Egyptians mounted naval expeditions to Punt as far back as the Old Kingdom (2686–2125 b.c.). In Punt they acquired gold, ebony, elephant ivory, leopard skins, and exotic animals such as baboons that were kept as pets, along with the frankincense necessary for religious rituals. ■

Remains of a frozen ocean spotted on Mars

Planetary geologists led by John Murray of Britain's Open University said the evidence comes from pictures sent home by the European Space Agency's Mars Express orbiter. High resolution, stereoscopic images reveal a flat, "plate-like terrain" in the region of southern Elysium Planitia, near the Martian equator, that appears remarkably like fields of pack ice on Earth, they say. The "frozen lake" measures about 800 by 900km and is probably about 45m deep on average, making it similar in size and depth to the North Sea. Murray's team contends the water is the relic of an ocean created from sub-surface ice that was melted by volcanic activity. "If our interpretation is confirmed, this is a place that might preserve evidence of primitive life, if it has ever developed on Mars". ■

Underwater terrorism could be the newest threat

Philippine military intelligence said that terror groups with links to al-Qaida have been training with scuba gear. Two of the most dangerous al Qaeda-linked groups in Southeast Asia are working together to train militants in scuba diving for seaborne terror attacks, according to the interrogation of a recently captured guerrilla. The undersea attacks could target anything from boats to power plants and bridges. The terror suspect also said that the leaders of Abu Saayf, Philippines largest terror group, has direct communication with Osama bin Laden. ■

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New dive trade show to launch in Las Vegas this winter

Press release

DiveBIZ is answering the need in the dive industry. DiveBIZ offers dive equipment manufacturers, service providers, and travel suppliers an affordable opportunity to achieve their tradeshow and marketing goals for 2006.

An exhibitor's and buyer's primary factor should be where to achieve the best ROI and ROO for their company at a tradeshow.

We will assist every DiveBIZ 2006 participant with determining their objectives and finding the best way to achieve them. DiveBIZ announced its Hosted Retail Buyer Program, offering among other items: FREE show registration, FREE transportation to and from McCarron Airport and FREE hotel rooms at the Las Vegas Hilton to qualified buyers. This program demonstrates our commitment to the industry and the value we place on the retailer and the success of the exhibitor.

Trade shows that serve as fund raisers for associations add unnecessary expenses back on to the attendees; our philosophy is a trade event should be an affordable business event for buyers and sellers to interact. Some people believe that having two trade events may be redundant, that would be like saying that more than one certification agency would be redundant. We believe the industry wants options and they want them now.

We are giving the industry a valuable choice. The only membership people need to have to attend DiveBIZ is to be an active business in the diving industry.

We are providing a business trade venue that recognizes the need for cost reduction and the need for a fresh format. We are giving back to the industry by reducing the expense of exhibitors and attendees to participate in a business event and not a social event. We are producing this show because a large portion of this industry has been disenchanted by their current options.

We are excited about producing the event. We chose Las Vegas because it provides the greatest access to the largest amount of people to attend (US and INT). We worked hard on reducing lodging costs, freight handling and others. We firmly believe that having a trade show in the same location at the same time each year is a strong benefit to the industry. Having the show in January is really market driven. Product phasing and not interrupting the selling season were critical factors when we decided to make Jan the constant.

Change is inevitable and the time is right for many reasons. I have enjoyed everyone's input on this forum. I would urge you all to continue to share as openly as you have.

Guy Miller
International Sales and Marketing
Manager - DiveBIZ

www.divebizexpo.com



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North America Pacific Northwest

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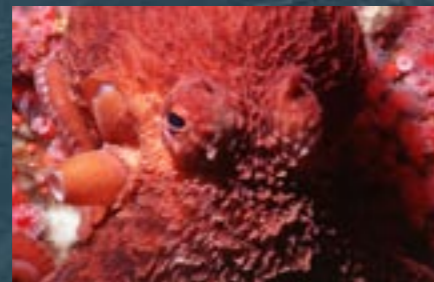
The waters of the northern Pacific coast of North America are some of the richest in the world in terms of marine life and natural resources due to a continual influx of nutrients brought by currents that circulate in the region. Divers will find both awe-inspiring and challenging experiences to enjoy here. Wildlife on the large and small scale is abundant top side and below the surface. Great mountains and rivers reach right down to the ocean, so visitors can enjoy

breath-taking scenery and coastal beauty. It is a region that boasts some of the wildest areas of America as well as several of the most cosmopolitan cities on the continent. While the visibility is more fickle and the water is a bit cooler than most tropical divers can appreciate, those that enjoy a bit of adventure, cold water divers and dry suit divers, will find a wealth of underwater treasures to explore in this region for beginners and advanced divers alike.

FROM LEFT TO RIGHT:

- ◀ Dendronofid Nudibranch
- ◀ Giant Pacific Octopus
- ◀ Swimming Anemone
- ◀ Orange Starfish
- ◀ Lemon Nudibranch
- ◀ Pink Anemone
- ◀ Nudibranch eggs

Introduction by Gunild Pak Symes
Photography by Jack Connick, Jon Gross,
and Washington State Tourism
Map courtesy of The Living Earth / Earth Imaging





UNITED STATES OF AMERICA



Picking the right dive site at the right time of year and the right time of day with the right dive operator, those of us who are avid underwater photographers can capture some fantastic images on film. The people who live in the Pacific Northwest are friendly and casual, helpful folk.

Neighborhood operators, who know the region like the back of their hands because they dive these sights for personal enjoyment weekly, are very happy to help newcomers enjoy the riches of the underwater realm found practically in their backyards.

The complete scope of diving in the Pacific Northwest cannot be covered in one article alone, however, highlights of both well known dive sites and lesser known sites can be provided here for curious dive travelers who are yearning to explore the Wild West.

We start in the Puget Sound, the sea of emerald islands located in the northwest corner of the state of Washington, where the cities of Seattle and Tacoma border the lower and upper sound. Getting the inside scoop from local dive charter operator, Mike Ferguson of Porthole Dive Charters, readers will learn about the numerous places to dive and observe marine life, such as

Orca whales, close to the cities and out among the gentle islands.

We, then, head north to the Strait of Juan de Fuca, Neah Bay and Cape Flattery at the most western point of the contiguous United States where the Makah Nation, the Native American tribe indigenous to the region, make their home. Local diver and member of Marker Buoy Dive Club, the largest dive club in Seattle, Jack Connick, gives us a bird's eye view of the lesser known dive spots in the area.

Continuing northwards, our correspondent, Jon Collins, explores the amazing diving in and around Vancouver Island in British Columbia, Canada, a fascinating place with a complex history that blends European, American and native cultures, nestled in a majestic natural setting.

Finally, we head up to Alaska, where correspondent, Barb Roy, shares her dive adventure in Prince William Sound and points along the

Pacific Northwest

southern Alaskan coast. A land of dramatic extremes, Alaska provides the visitor with a taste of how the planet was in its most pristine state. There, the midnight sun and the Northern Lights are a constant backdrop to the wilderness and remote cities that dot the southern coast of this region, which reaches up into the Arctic circle.

Puget Sound

For folks in Seattle and Tacoma, the Puget Sound is a neighborhood playground for divers, snorkelers, hikers, whale watchers, anglers, kayakers and other outdoor enthusiasts. Because of the nutrient rich currents, the sound is abundant with sea life. Residents in the cities regularly spend time during the work week and weekends enjoying this beautiful area. What follows are a few high points regarding the incredible diving to be found so close to an urban area.



◀ FAR LEFT: Blood Starfish
 ◀ CENTER: Alabaster Nudi-branch and Shrimp
 ▼ BELOW: Rockfish and soft coral

ALL PHOTOS THIS PAGE BY JACK CONNICK



Two great PNW dive resources include these guides by writers who know the area very well: *The Pacific Northwest* by Edward Weber and *Northwest Boat Dives* by Dave Bliss. See www.amazon.com



South Puget Sound



Olympia

Pacific Northwest

mended approach is to dive the West Wall on the flooding tide and then the North Wall in the ebbing tide. The terrain of this site is uneven and full of life. Giant Pacific Octopus, Mosshead Wabonnets and Grunt Sculpins can be found here. Divers can also find Wolf-eel, Striped Sea Perch, Red Irish Lords, Buffalo Sculpins, Brown Rockfish, Ratfish and Painted Greenlings. Orange Sunflower Stars add brilliant color to the seascape. Point Defiance is a popular fishing spot, so divers should be careful of old fishing sinkers, lures and line lying on the seafloor as well as the boat traffic.

Shore Dives

There are popular shore dives in the southern and central sections of the Puget Sound including Three Tree Point, which holds diverse marine life in a "junk yard" reef and eel grass beds—on rare occasions there may be a six gill shark looming here; Titlow Beach, a good place to check out sea life among pilings; Deadman Wall where you may have a rare encounter with eel-like creatures called Red Brotulas; Seahurst Park, a subtle site that is noted for being a fine place to find various large nudibranchs and sea pens; Les Davis Reef where you can find huge schools of perch; and Sunrise Beach, known for friendly Wolf-eels and large-sized Giant Pacific Octopus.

Edmonds Underwater Park

Edmonds Underwater Park is an

artificial reef developed in the harbor of Edmonds by a few heroic members of the community who took interest in marine conservation and diversity. Edmonds is a quaint little northwestern town of small cafés and boutiques on a gentle slope leaning down to the coast a few miles north of Seattle. It is probably the best-known dive location in the state.

The dive park is located just north of the ferry landing at Edmonds. It offers terrific diving for several reasons. At this site, the depths are shallow and there is an absence of strong currents, the beaches are well kept and scenic, the facilities are very good and include showers, there is easy parking, lots of different places to grab a bite to eat between dives, a well-equipped dive shop nearby called Underwater Sports, and close proximity to Seattle. The marine life here is in unique condition and serves as a testament to how it can bounce back if people give it a chance. The dive park is a favorite for beginning divers as it has a whole lot to see in easy dives. The reef is

Rockfish, Plumose Anemones, Pile Perch, Striped Sea Perch, Shiner Perch, gunnels, Sailfin Sculpines, Rock Soles, some Red Irish Lords, Ratfish, lots of shrimp, crabs and massive Sunflower Stars.

Waterman's Wall

Considered one of the best wall dives in the state, Waterman's wall

is located in the Port Orchard area, just south of Bainbridge Island. The terrain consists of sheer faced walls, long ledges, rock piles and

PHOTO BY JACK CONNICK



SOUTH PUGET SOUND:

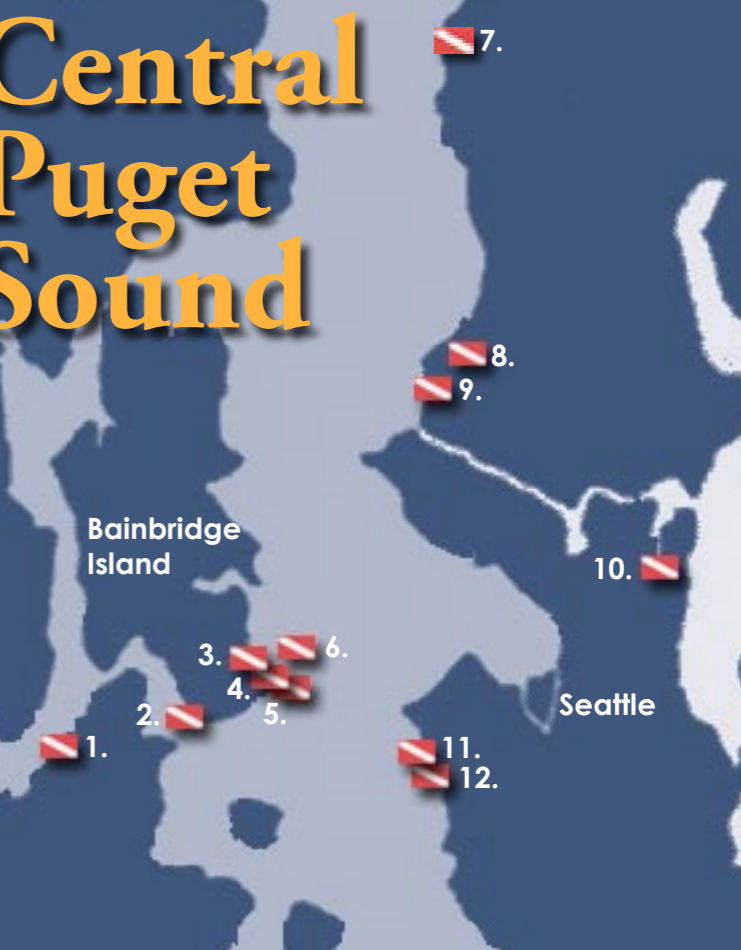
1. Alki Reef
2. Seahurst Park
3. Three Tree Point
4. KVI Tower
5. Maury Island Barges
6. Dalco Wall
7. Sunrise Beach
8. Point Defiance
9. Point Defiance, West Wall
10. Deadman Wall
11. Les Davis Reef
12. Titlow Beach
13. Day Island Wall
14. Z's Reef

Although the northern end of the Puget Sound is known for several outstanding dive sites, south and central Puget Sound also has a good number of interesting sites with diverse and abundant sea life.

Local divers including Jon Gross and Keith Clements, authors of a comprehensive online guide to over 45 sites in the Puget Sound, *The Marine Life Index* at seaotter.com, dive these areas regularly. They point to Point Defiance as one of the favorites. There is a massive shear wall at this site to explore. However, due to depth and currents, it is considered an advanced dive site. The recom-

▶ TOP RIGHT: Crimson Anemone

Central Puget Sound



CENTRAL PUGET SOUND

1. Waterman's Wall
2. Orchard Rocks
3. Blakely Harbor
4. The Boss
5. China Wall
6. Shangri-la
7. Edmonds Underwater Park
8. Golden Gardens
9. Shilshole Breakwater
10. Virginia Mason Hospital (Deco chamber)
11. Alki Reef
12. West Seattle Trench

North Puget Sound

Pacific Northwest

boulders, large cracks and crevices. Marine life on the wall is abundant and representative of why the Puget Sound is considered by many divers to be a Mecca of marine life. Divers can find Giant Barnacles, scallops, and an assortment of sea stars including Leather Stars, Vermillion Stars, Morning Stars, Sunflower Stars and Pink Short Spined Stars. Brown, Copper and Quillback Rockfish are also present here as well as Lingcod and Buffalo Sculpins. Divers should bring a good light torch to enjoy the color of this site where you will also find orange, purple and yellow sponges and yellow Sea Lemon Nudibranchs.

North Puget Sound

There are several spectacular dive sites in the northern end of the Puget Sound. Keystone is an extremely popular site among local divers who crowd there on the weekends. Octopus can be spotted here. Two hours drive north of Seattle

is an inspiring wall dive at Skyline Marina. Experts say that it is a shore dive that provides plenty of subject matter for macro photography as it has a plentiful and colorful array of invertebrate life including Candy-Striped shrimp, Umbrella crabs, Giant barnacles, Crimson anemones, hard corals and sponges.

Divers who know the region say that one of the best dives in the Puget Sound is located at Possession Point Fingers, which can be reached by boat from



Whidbey Island. Considered an advanced dive due to strong currents, the site sports a unique terrain of sheer vertical walls with countless caves sheltering Lingcod, rockfish, Wolf-eel, rather large Giant Pacific Octopus, and a splendid symphony of colorful nudibranchs including Red Nudibranchs, Orange Spotted Nudibranchs, Sea Lemons, White Lined Dironas, Yellow-Edged Cadlinas and Hudson Dorids.

Wreck Dives

Although not a major attraction of the region, there are several wreck dives in the Puget Sound. Large sunken wooden barges can be explored on the northwest side of Gedney Island, a small island situated between Whidbey Island and the mainland. A 70-foot long wooden boat is wrecked at a site called "The Boss" located in Blakely Harbor. A vertical barge and tugboat can be explored at the Shilshole Bay and West Point area. There are also barge wrecks at Seahurst Park and Maury Island.



Sponges, Puget Sound ►



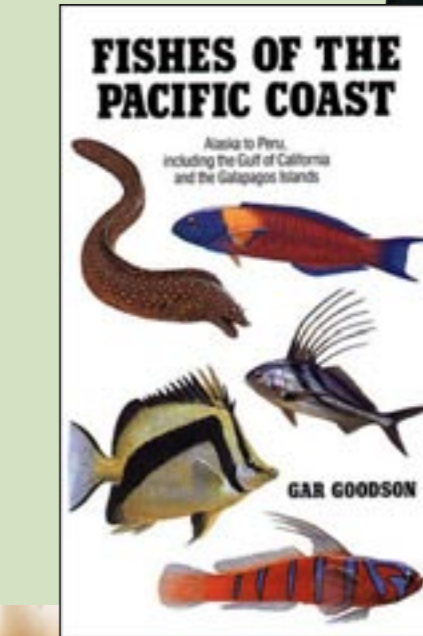
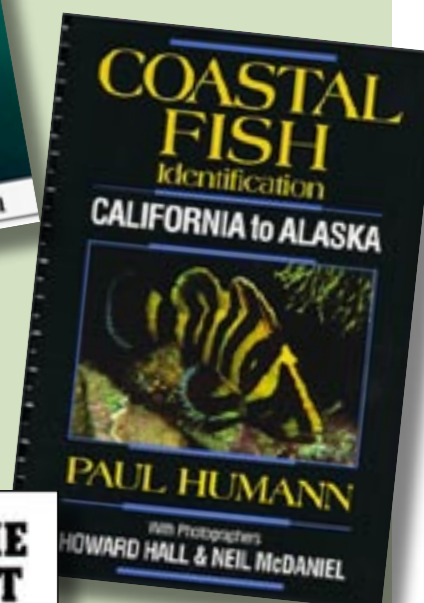
▲ Various invertebrates, Puget Sound



PACIFIC COAST FISHES
BY ESCHMEYER, HERALD & HAMMANN
PAPERBACK: 267 PAGES
PUBLISHER: STANFORD UNIVERSITY PRESS
ISBN: 0804713855

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San Juan Islands



1. Belle Rocks
2. Long Island
3. Goose Island
4. Eagle Point
5. Pile Point
6. Bellevue Point
7. Skipjack Island
8. Parker Reef
9. Puffin Island

- ▶ Harbour seal, San Juan Islands
- ▶ Breaching killer whale, San Juan Islands

San Juan Islands

Local divers describe diving the San Juan Islands as an exercise in variety. According to Dareld and Janine Clark who wrote the guide, *Diving the San Juans* (Evergreen Pacific Publishing), there are over 60 dive spots in the San Juans, many of the more exciting ones accessible only by boat.

Experts describe the strata, which supports plant and ani-

mal life in this area, as a combination of soft mud and sand as well as rocky formations upon which marine ecosystems have evolved. The area teems with life from some of the largest marine mammals, humpback, minke and orca whales, to loveable harbour seals and sea otters, to the tiniest of sea life still viewable by the naked eye.

Divers will find an abundance of colors and textures among the many species that call the San Juans their home including sponges, barnacles, pectin scallops, tiny orange cup coral named stag-horn bryozoa, pink-tipped, white plumed and orange anemones, tiny ostrich plumed hydroids—a close relative to the jellyfish—hairy sea squirts and giant red sea urchins, rockfish, quillback rockfish and kelp greenlings, warty sponges, purple-hinged rock scallops, haunting protrusions of dead

Pacific Northwest

man's fingers, banded feather dusters, tiny creeping pedal cucumbers with bright red tentacles, basket stars and tiny black and white brittle stars, brightly colored rose star and vermillion stars, sea cucumbers, red cancer crabs, nudibranchs and a host of other species.

Fish that live in this area include lingcod, cabezon, painted green-

Pacific electric ray, porpoise and octopus. Bull kelp grows quite large here and sea pens loom up from the depths.

Underwater photographers recommend Goose Island and Skipjack Island, which is a private wildlife refuge, since visibility is often very good between 20-45 feet (6-15 m). Killer whales have been spotted at Bellevue Point and Pile Point, which are regular feeding grounds, and Eagle Point where you can also spot eagles soaring overhead. Sucia Island is a marine state park and is very popular



PHOTO BY SUNNY WALTER. WASHINGTON STATE TOURISM



PHOTO BY SUNNY WALTER. WASHINGTON STATE TOURISM

ling, black cod and flounder. You will also find wolf-eels, brilliant blue striped sea perch schooling among cliffs, grunt and sailfin sculpin, spiny dogfish. There are dungeness and red rock crab, Puget Sound king crab, kelp crab and sunflower stars in brilliant shades of pink, orange and purple, red sea gherkins, sea pumpkins, vari-colored worms, reddish gum boot or giant chiton, Mosshead Warbonnet,

1. Mushroom Rock
2. Waadah Island Fingers
3. Tiger Ridge
4. Third Beach Pinnacle
5. Snow Creek Ridge
6. One Mile Beach
7. Sekiu Jetty
8. Wreck of the Diamond Knot
9. Salt Creek State Park (Tongue Point)



PHOTO BY J. POTH. WASHINGTON STATE TOURISM

for its unique beauty. The sheer numbers of fish make Parker Reef an exciting dive site.

There are several protected wilderness areas and bird sanctuaries throughout the San Juan Islands where you can enjoy wildlife topside including Tufted Puffins, Bald Eagles, Pelagic Cormorants, Arctic Loons and Arctic Terns.

Strait of Juan de Fuca

If you ask avid Puget Sound divers, Neah Bay gets the most votes for the best diving in the state. The clarity of water, diversity and abundance of marine life,



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- ▲ TOP: Aerial view, San Juan Islands
- ▲ BOTTOM: People dining outside, Dockside Restaurant, San Juans

Strait of Juan de Fuca

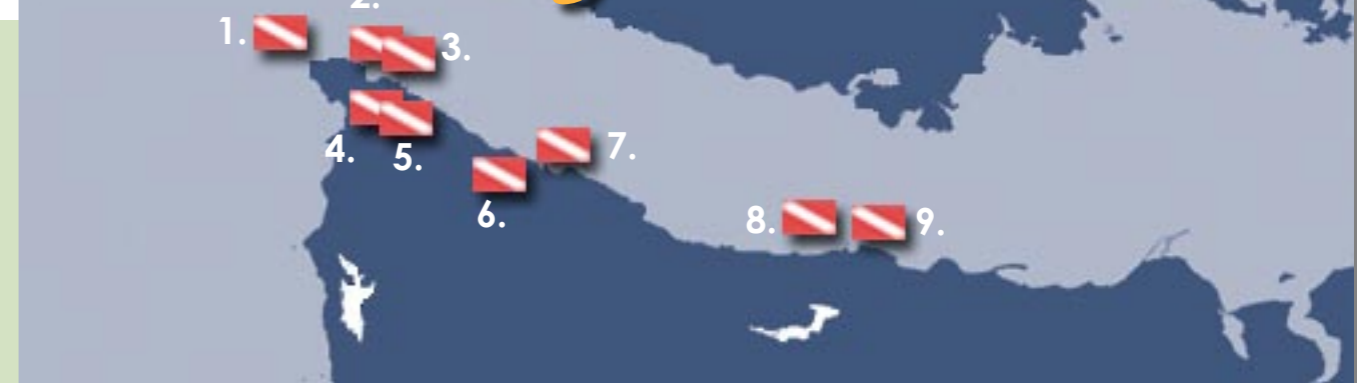




PHOTO BY SUNNY WALTER. WASHINGTON STATE TOURISM

Pacific Northwest

rents, lots of boat traffic and discarded fishing gear such as stainless downrigger cable and monofilament.

This spectacular terrain supports a wide variety of marine life. The canyon walls, which have small caves, deep ledges, some swim-throughs, lots of holes, crevices and cracks, make good homes for an assortment of marine species including Giant Pacific octopus, Wolf-eels, Vermillion Rockfish, rare Yellow-eye Rockfish, hard and soft corals, nudibranchs and various invertebrates.

Ridge Diving

Several other dive sites in the Strait and around Neah Bay have unusual rock formations and dramatic topography that make for intriguing dive experiences. Snow Creek Ridge has a 20-30 ft high (6-10 m) rock ridge. Its walls are teeming with huge schools of Blue and Black Rockfish as well as Canary, Quillback, Tiger, Yellowtail, Copper and China rockfish. Sponges, hydrocorals, nudibranchs, snails and numerous anemones create a colorful show.

Sekiou Jetty is another site with strange rock pinnacles, ledges, caves, crevices and thick beds of

kelp. Here, divers can discover that it is not always necessary to go deep to find a symphony of color and a great diversity of sea life. The species that populate this area include Kelp Greenlings, Copper, China, and Quillback Rockfish; volleyball-sized Brilliant Red and Purple Sea Urchins; massive and glamorous anemones; as well as hundreds of species of invertebrates that one would

be hardpressed to find in the lower Puget Sound.

Other spectacular "ridge" dives include Tiger Ridge and Third Beach Pinnacle where the awe-inspiring mix of unusual underwater topography and ample marine life make for more examples of the typical Neah Bay diving experience.

There are also several shore dives in the strait including Tongue Point at Salt Creek State Park where you can swim through thick kelp beds and find an explosion of color among Green, Red, and Purple Sea Urchins and large, brightly colored anemones along a rocky bottom; and One Mile Beach, a remote location where there are carpets of purple urchins.

The Diamond Knot

In 1946, the container ship the Diamond Knot, came down from Alaska with a huge load of canned salmon and rammed another boat in the middle of the channel. While it did not sink immediately, it did finally find a resting place on its side at about 130 ft depth (43 m) as it was towed to shore.



PHOTO BY SUNNY WALTER. WASHINGTON STATE TOURISM

The wreck is now completely covered with marine life including giant plume anemones, sponges, corals, and a variety of invertebrate life. Divers can also find decorator crab, Sharpnose crab, Ling Cod and the occasional Red Irish Lord.

In addition, there are schools of Black Rockfish, Quillback and Yellowtail Rockfish making their home at this wreck. ■

SOURCES: *Marine Life Index*, by Keith Clements & Jon Gross; *Diving the San Juans*, by Dareld & Janine Clark; Mike Ferguson of *Porthole Charters*.

CLOCKWISE FROM TOP LEFT:

- ◀ Sunrise on the cliffs, Tongue Point, Salt Creek State Park
- ◀ Eye of the Red Irish Lord
- ▲ Seastacks, beach, & tidepools at the Point of Arches on Shi Shi Beach South of Neah Bay
- ◀ Bull Kelp

PHOTO BY JACK CONNICK

topside scenery, challenging currents, thick kelp forests and unique underwater topography add up to an incredible cold water diving experience.

Diving in this area is for experienced advanced divers. This area is exposed to the storms of the Pacific Ocean, which can prevent divers from getting out beyond the Neah Bay breakwater. Locals say the best time to come is summer or early fall when there is more predictable weather. However, it is a good idea to try to avoid the height of the salmon fishing season.

Dive sites in the strait are some of the best kept secrets. Notable sites for their color, diversity of marine life and odd topography due to volcanic formations are Mushroom Rock and Waadah Island Fingers.

At Mushroom Rock, divers spot huge schools of Black Rockfish lounging around in the kelp, large gatherings of krill and shrimp covering the seafloor and plentiful species of seasquirts, nudibranch, and chitons. Giant Pacific Octobups and Puget Sound King Crab can be spotted here as well as Red-Eyed Jellies, various Rockfish and Painted Greenlings. The area is covered with corals, sponges and large kelp forests.

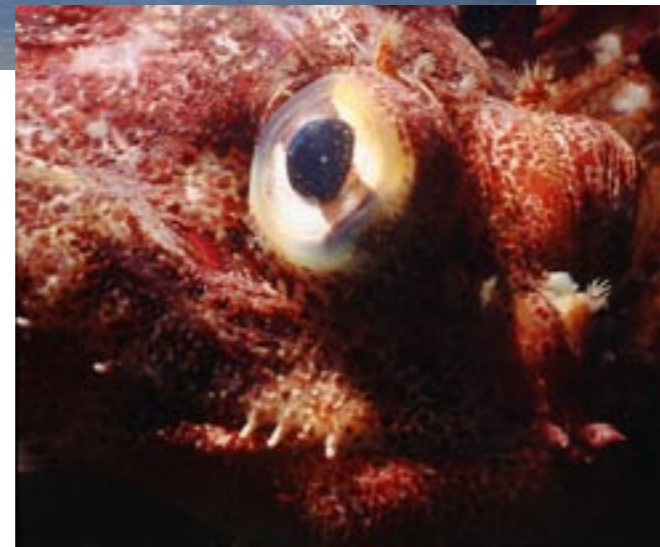


PHOTO BY JACK CONNICK

Waadah Island Fingers

Located just north of Neah Bay, the rugged Northwest topography of Waadah Island Fingers makes it an intriguing site to dive, where it is said one can see more marine species in one place than any other dive site in the Pacific Northwest region. Over millenia of being pounded by strong currents, sheer canyons over 20 ft (6 m) deep and up to 40 ft (13 m) wide in some places have been carved out of the rock. The canyons run parallel to each other and extend far out under the surf.

This site is considered an advanced dive due to strong currents and storms. One must be able to handle over 80 ft (36 m) of free descents, over 50 feet (16 m) of free ascents, surge and strong cur-





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Pacific Northwest Rhapsody in Red

Text by Gunild Pak Symes
Photos by Jack Connick

What wonderfully brilliant red colors one can find in the underwater realm, especially in the Pacific Northwest regions of North America. Why are these marine species so red? How do they get that color? What purpose does it serve? As in many cases in nature, it comes down to simple survival.



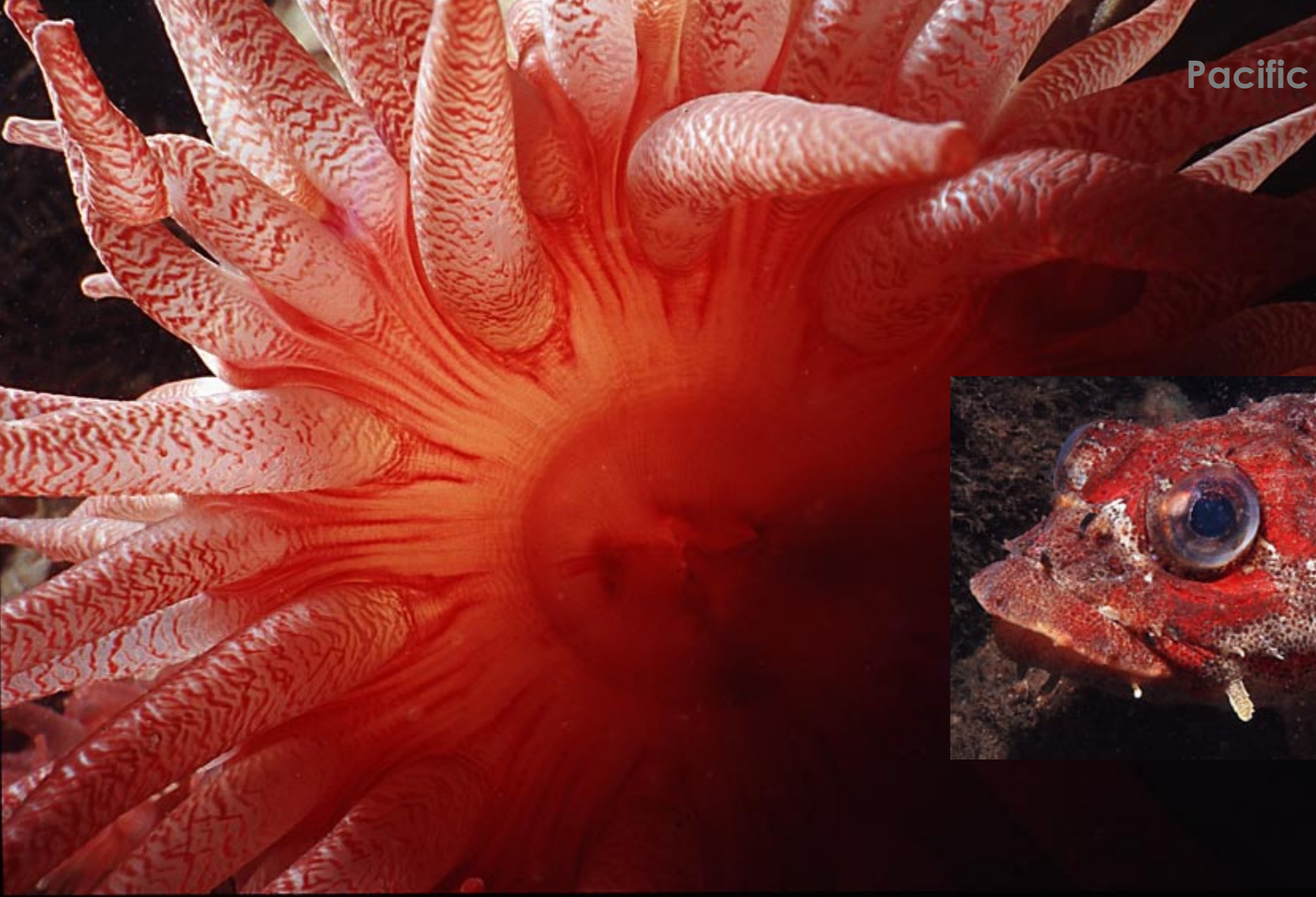
- ▲ Crimson Anemone, Cape Flattery, Washington state
- ◀ Mouth of Anemone, Long Island, San Juans
- ▼ Striped Anemone, Long Island, San Juans



- ◀ Crimson Anemone, Cape Flattery, Washington state
- ▼ NEXT PAGE: Snakelock Anemone, Long Island, San Juans







◀ Pink Anemone, Long Island, San Juans
 ◀ INSET: Red Irish Lord, San Juans
 ▲ Bloodstar, Puget Sound
 ▼ Invertebrates, Puget Sound



According to marine experts, there are at least three possibilities for the red color in many of these creatures. These involve feeding, protection and camouflage.

Food

What creatures eat can dictate how they appear. In the case of the sea anemone *Actinia*, it relies on algae for its nutrition. Algae comes in various colors including red. What give algae, and hence the anemone that consumes

the algae, its red color is a substance called carotenoids.

Carotenoids are a widely distributed group of natural occurring lipid-soluble pigments that are primarily produced within algae, plants, and phytoplankton. They are responsible for the brilliant colors found in nature such as yellow, orange, and red colors of fruits, leaves, and aquatic animals. Although many organisms can synthesize carotenoids, they cannot produce them on their own.

Carotenoids must be absorbed in an animal's diet and then into the animal's tissues. Some fish species such as koi and various crustaceans process carotenoids. The Southern Kelp Crab (*Taliepus*) feeds on seaweeds and kelp. It converts the beta-carotene and xanthophylls it ingests into astaxanthin, a form of carotenoid, which is then stored in its exoskeleton, hence the crab appears bright red.

Marine animals must constantly consume a source of carotenoids to main-

tain their pigmentation, otherwise they lose their red color. This is because carotenoids have metabolic turnover and must be supplied in the diet to be maintained in the animals. Interiors of underwater caves are covered with invertebrate life including aggregation anemones, hydrocoral and colorful sponges. In some caves, there are also a lot of snow-white, giant green anemones. It is the absence of sunlight in these caves that

causes the anemones to lose the symbiotic algae that normally gives color to them, and so they return to a white color.

Almost all red algae live in marine habitats, even though some species are found in damp soil or fresh water. Many types of seaweed typically found growing along the North American coasts



Pacific Northwest

are red algae. Another species of algae called coralline algae, is an important member of the coral reefs. Its cell walls become hardened with calcium carbonate, thereby producing new material and cementing together other organisms which build the reefs.

Algae require light to synthesize food. Red algae, which is found in warm coastal waters and in water as deep as 260 m (850 ft), has adapted to varied water depths by having different proportions of pigments. Chlorophyll is their primary pigment, which is green. They have a secondary pigment, phycoerythrin, which produces their red color, that can absorb blue light, which penetrates to greater depths underwater than other colors of light. In deep waters, red algae can appear almost black due to the large amount of phycoerythrin, but in the shallows, red algae appears green as there is not enough phycoerythrin to mask the green of the chlorophyll.

Protection

Let's suppose you are a bright red octopus. What emotion do you suppose you are exhibiting? Bright colors such as red and yellow in many marine animals are described by experts as warning coloration. This type of coloration is not intended to camouflage the animal, but to make it stand out. The bright color lets their predators or neighbors know that they are not to be antagonized. Some creatures are born with bright colors while others, like the octopus, can change colors depending on reactions to a situation.

Intimidation through color is also used when an organism wants to advertise that it is poisonous. The fire sponge, for instance, displays a

bright red. It has toxins in its spicules.

Camouflage

Creatures that live on the reef have adapted to the reefs environment. One survival scheme used by many animals is camouflage. If you can't see me, you can't eat me! So, species have evolved to display the colors of their homes, and in the case of many reef fishes and crustaceans such as shrimp, that color is red. Look more closely at red corals and kelp next time you go diving, you may discover that there is more life on that innocent looking sponge than you first thought.

Properties of water

There is one more factor that plays an important role in the issue of color underwater. George Campbell, an underwater dive instructor and photographer at Deep Six in New Paltz, New York state, said in his guide, *Diving with Deep Six*, that water acts as a selective filter. White light is made up of a spectrum of colors from deep red, to orange, yellow, green, blue and deep violet. As white light passes through a thousand feet (333 m)

of water, various colors of its spectrum are gradually filtered out selectively, one-by-one. For example, most of the red, some orange and some yellow are gone from the light after 3 m (10 ft). At 8 m (25 ft), most of the orange is gone. At 11 m (35 ft), most of the yellow is gone. This continues throughout the spectrum until the only color left is violet light, which fades out after several more meters. So, at a depth of 333 m (1000 ft), there would be little or no light at all.

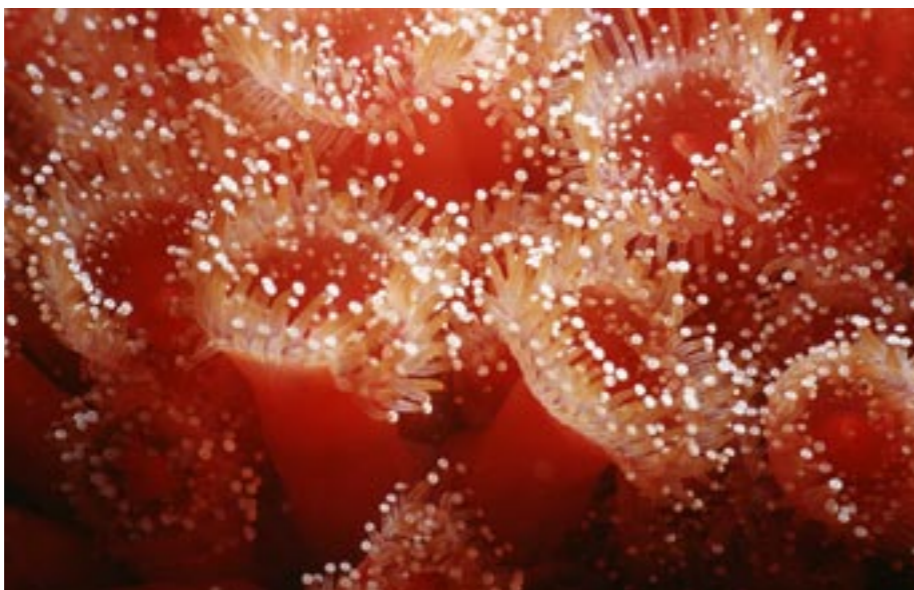
So, if red disappears at depth, does this mean that creatures that are red also disappear? Is this, yet, another survival tactic perhaps? Be invisible, then nobody will eat you. But how do we know which predators can see red underwater? Perhaps, these red species are banking on a theory that many underwater creatures cannot see color, only light and dark shades. In that case, red, which transforms to grey on the shade scale, would cause an animal to "disappear" in the murky depths where only strong shades (blacks and whites) show up.

Selective filtration in the underwater realm creates

◀ Strawberry anemone, Long Island, San Juans



LEFT TO RIGHT:
◀ Shrimp and pink anemones, Long Island, San Juans
◀ Tube Worms, Puget Sound



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Octopus facts

arms from constantly tangling themselves up, each arm has an independent peripheral nervous system and neural circuitry. This allows the brain to essentially give a command—"Arm Four, fetch that tasty crab crawling by"—and have the arm carry out the order without the brain thinking about it again.

This ability is combined with excellent eyesight. Once an octopus spots its prey, it has a remarkable ability to reach out with one of its arms and grab it with one of the suckers that form a double line up each of the octopus's arms.

Some scientists studying octopus arms conclude that they may represent the optimal design for robotic arms.

The brainy mollusc

Octopuses have intrigued scientists for years, because they have both long- and short-term memory, they remember solutions to problems, and they can go on to solve the same or similar problems. They have been known to climb aboard fishing boats and open holds in search of crabs. They can figure out

The Cephalopods

With more than a 250 species, octopuses are members of an ancient group of animals called cephalopods. The giant Pacific octopus (*Octopus dofleini*) can grow to over 20 feet (6 meters) and weigh more than 100 pounds (45 kilograms). The tiny Californian octopus (*Octopus micropyrsus*), by contrast, is no more than half an inch to an inch (1.3 to 2.5 centimeters) long.

There have been numerous accounts of (and searches for) an as yet unknown species of deep-sea octopus that is believed to grow to over 100 feet (30 meters) across and weigh several tons.

mazes, open jars, and break out of their aquariums in search of food.

These characteristics are usually attributed to "higher animals" such as mammals. The Octopus however is a mollusc, related to snails, clams and mussels. Take a closer look: It has a shell (outer or inner) and siphon ■

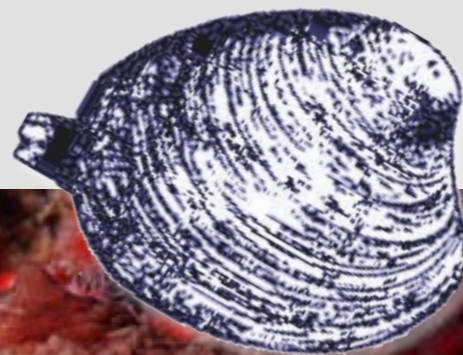


PHOTO BY JACK CONNICK



Arms all over

Right or left-handed?

Most octopuses favor one arm and use combinations of arms in particular orders when handling objects, zoologists at the University of Vienna have discovered. Although all of an octopus' eight arms essentially operate equally, researchers studied eight octopuses and found they tended to use a favorite arm when exploring new nooks or objects. This is the first time the eight-limbed animal has been found to show any preference in choosing which limb to use for a job.

Researchers placed unfamiliar objects into an octopus's tank or presented it with a T-shaped cavity to explore and found each octopus tended to favor front arms to explore and used rear limbs more for locomotion.

They also observed the octopuses used only 49 different combinations of one, two or three limbs from a possible 448 combinations, and they found 92 percent of octopuses use a favored eye, which may dictate which arm is favored, researchers said.

Unlike in humans, the scientists said, right or left handedness was split about 50-50 in the octopuses.

Quasi joints

Theoretically, there are any number of ways an octopus could use its long flexible arms to move an object. But the method they actually use is surprisingly close to how animals with rigid skeletons—including humans—do, scientists say.

When hunting and grabbing dinner, the octopus uses all the flexibility the arm is capable of. But to bring captured prey to its mouth, the octopus turns the arm into a semi-rigid structure that bends to form quasi joints. Just as a human arm has joints at the shoulder, elbow and wrist that allow our arms to bend and rotate, the octopus bends its arm to forming three segments of roughly equal length.

The arms are composed almost entirely of muscle, with no bone or external skeleton—a structure known as a muscular hydrostat. Elephant trunks and tongues are other examples of a muscular hydrostat.

Earlier research funded by the U.S. Navy's Office of Naval Research (ONR) suggests that, to keep the



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April Fools News

THE ENDANGERED PACIFIC NORTHWEST TREE OCTOPUS (*OCTOPUS PAXARBOLIS*) CAN BE FOUND IN THE TEMPERATE RAINFORESTS OF THE OLYMPIC PENINSULA IN THE REPUBLIC OF CASCADIA, PEACEFULLY FROLICING IN THE CONIFER TREES. LEARN MORE ABOUT THIS INTELLIGENT AND INQUISITIVE CEPHALOPOD AT:

ZAPATOPI.NET/TREEOCTOPUS/





Neah Bay

Irish lord ▲
Finger Sponge ►

FAR RIGHT:
Tatoosh Island ►



Text and photos by Jack Connick

Well, it was a long road trip, but we went out to Neah Bay on Saturday night and went out on The Puffin Adventures charter to try to dive Duncan Rock.

We got on the boat after a somewhat less than restful night in a cheap hotel. We got out to the rock right at predicted slack time, in fairly heavy fog and glassy seas, but found a 2-3 knot current that made it less than dive-able. This is one of those very advanced dives, basically a spec of a rock out at the entrance of the straits, that you look at a lot and are able to dive infrequently. We thumbed it and went

over to Tatoosh Island, which has lots of nooks and crannies that are out of the current.

There was a fair amount of surge, and not very good viz, sort of milky water, but cool rocks, kelp, passageways, swim-thoughts and tunnels. Lots of rock-fish, invertebrates and color. Not very deep — 60-70 feet max (20-23 meters). I did shoot some photos of some of the huge beautiful dahlia anemones, etc.





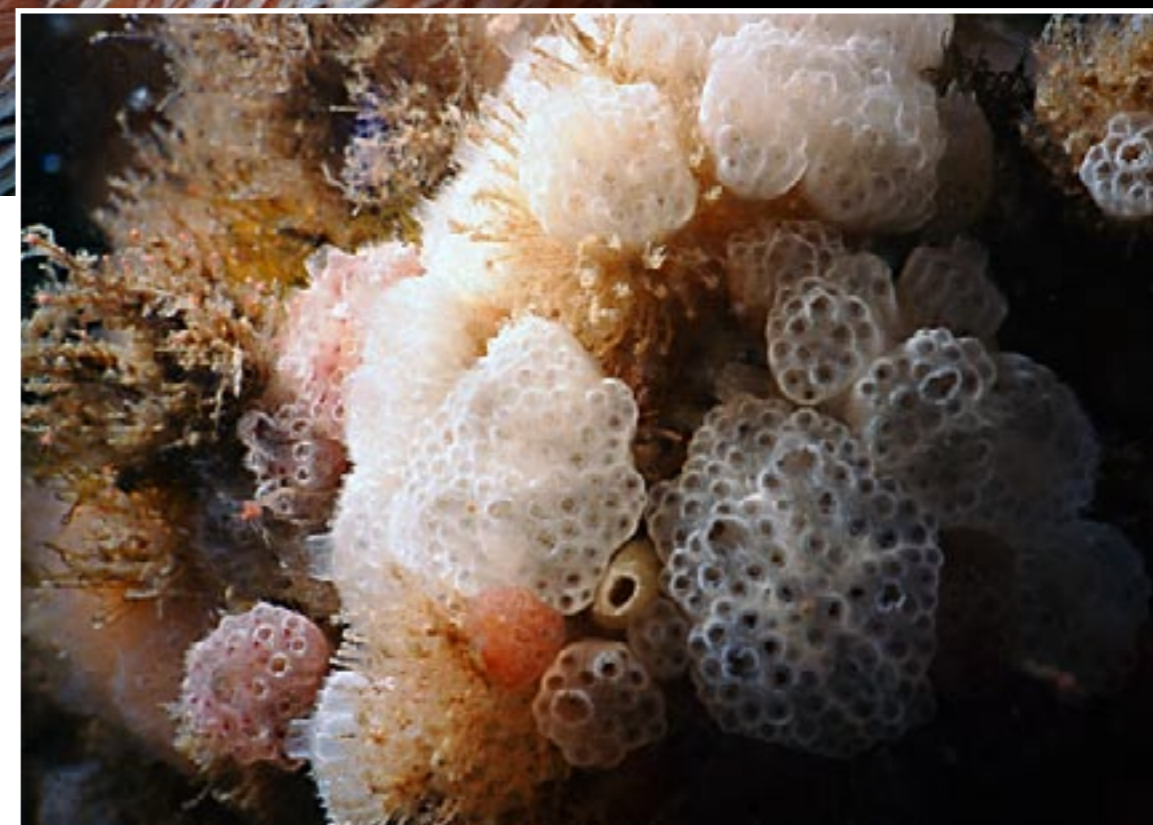
Hole-in-the-Wall, Tatoosh Island ▲
 Dendrobium Anemone ►
 Tunicates ►



Hole-in-the-Wall

We went over to a little nook called Hole-in-the-Wall for our surface interval. After changing tanks and resting a bit out of the swell, we went back over to another corner of Tatoosh Island and dove there.

The viz was better, but not great. There was a couple of long, somewhat deep cuts that we followed and enjoyed swimming about and taking pictures. There was a whole school of black rockfish that we don't see often and one rather large ling cod that was acting territorial — wished I'd had a speargun to make lunch out of him! At the end of the dive, I had some problems with my inflator leaking and had to make a somewhat



Neah Bay



CLOCKWISE FROM TOP LEFT:
◀ Neah Bay
◀ Black Cod fish
◀ Jelly fish
▼ Stellar sea lions

quick, but not an emergency assent.

The boat was on the other side of the rock that was covered in rather large fun seals and huge Stellar sea lions. They were looking at us as intruders and as they are easily 400 pounds (90 kg) or more, I blasted them with my DiveAlert horn to scare them away. About then the boat came around the corner with Steve (the captain, and a bit of a hot-head) yelling at us to get on quickly. All was well, and we motored back to Neah Bay in patchy fog and bright sun. Near Wahah Island, on the outside of Neah Bay, we saw a fairly large grey whale feeding on the krill that had been part of our visibility problem.

We later hiked up to Cape Flattery and enjoyed the view of the rocks and then very heavy fog. Then another long, but scenic, drive home.

Dive notes

The dives we went on were advanced in a fair amount of tidal surge. Duncan Rock is very advanced. If you are an out-of-town diver, I wouldn't attempt it. Cold water experience in drysuits and poor conditions is recommended. ■

Author and photographer Jack Connick is a Seattle-based graphic designer who develops highly-crafted and creative graphic communications. www.deepics.com



Oh Canada!

Diving British Columbia



Stretching from Washington state in the south to Alaska in the north, the 29,000 kilometres (17,000 miles) of British Columbia's tangled coastline provides a wide range of accessible and exciting dive sites for the novice and experienced diver.

Also known as the *Emerald Sea* these waters owe their name to the abundance of microscopic plants which form the basis of the entire food chain, supporting a vast number of species of animals. Variations in topography from the weather-beaten outer coasts with the dense kelp forests and the narrow tidal passages with the surging currents, to the steepwalled fjords with deep still waters sheltered inner coasts, make a wide range of habitats.

Shaped by the relentless pounding surf, the rugged West Coast of Vancouver Island offers a wide diversity of diving experiences.

The coastline between Bamfield and Port Renfrew is known for both the colour and diversity of

the marine life growing on the outer wave-swept reefs and the abundance of early 1900s wrecks. Nicknamed *Graveyard of the Pacific* this is the place to go if wrecks interest you, while offering plenty of safe and attractive dive sites at the back of the various protected inlets, for the new or novice diver.

Barkley Sound is one of the most popular West Coast dive destinations, with a reputation for providing something for everyone. From fields of plumose anemones, rock pinnacles teeming with marine life, to six-gill sharks, octopuses and wolf eel everywhere. Clayoquot Sound to the north is noted for its inland waterways with fields of sea pens flourishing in places with sandy bottoms. Tofino, near Ucluelet, is the access point for exploring Clayoquot Sound. Nootka, where Captain Cook landed in 1788, and Kyuquot Sounds are remote areas further north which are best explored by liveaboard charter vessels. Diving services are available at Port Alberni, Bamfield or Ucluelet.

The inside passage from Victoria to Port Hardy has both varied and protected waters, and provides countless dive sites that can be dived all year, and has something to offer for all levels of experience. The nutrient-rich waters from Indian Arm to Powell River, off the southern coast of British Columbia, boast an "aquarium" unrivaled throughout the world! Frequented by killer whales,

sea lions, harbour seals, false killer whales, and pacific white-sided dolphins, the attractions often start long before you don your suit. Whether you are a novice beginner or a seasoned wreck diver, into technical diving or photography, the Inside Passage, with its unique combination of marine life spread variably throughout, is a must-do diving destination.

Divers have the choice of an array of unique dive locations, and many simply rotate through the magnificent sites stretching from Port Hardy (Browning Pass), Port McNeil (Stubbs Island), Campbell River (Discovery Pass), Hornby Island, Sunshine Coast, Nanaimo/ Gulf Islands and Howe Sound in the south

The Sunshine Coast
The aptly named Sunshine coast, which is just a short ferry ride across from Vancouver, boasts an exceptional visibility which in winter will exceed 30m /100 ft. This is, in part, attributed to the absence of any major freshwater inflow which carries silt, and the huge exchange of water without current. Which could be why the late Jacques Cousteau made a point of visiting the Sunshine Coast to investigate its octopuses and wolf eels.

Here, we also find some of the only hard coral found in temperate waters. Vertical drop-offs,

such as those we find at Agamemnon Channel and Fearney Bluffs, provide fine opportunities to do extended dives in protected waters. A contrasting experience is offered at



A diver experiences a close encounter with a wolf-eel



Diving BC

to see six-gill sharks and it is without strong currents. The large boulders on the steep rocky underwater slopes also make ideal homes for octopusses and wolf eels, two favourite subjects for scuba enthusiasts. A short boat ride from Sidney

you will find the artificial reefs *HMCS MacKenzie* and the *G.B. Church*.

Howe Sound is a favorite dive destination for both visitors and locals, and is host to two shore-access marine protected areas – Whytecliff Park and Porteau Cove Provincial Park. These two parks are arguably the most popular dive sites in the province. Many ships and vessels have been scuttled over the past years to create

awe-inspiring artificial reefs and steep drop-offs provide the perfect environment to explore underwater walls. However, visibility can be an issue, as much of the bottom of Howe Sound is covered in a thick silt.

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Hornby Island The waters around Hornby Island are full of a rich variety of marine life. In any season, you can encounter Giant Pacific octopusses, wolf eels, harbour seals, large lingcod and rock fish, colourful anemones and nudibranchs. Good visibility and gentle currents make the Hornby Island area easy to dive. Drift dives, wall dives, deep dives, and sculpted sandstone reefs are all part of the underwater terrain. Hornby is also well known for its excellent 'big animal' dives. Six-gill sharks are probably the best-known reason to dive Hornby. Swimming beside a six-gill is an experience of a lifetime! During the winter, Stellar's and California sea lions congregate near Hornby to feed on migrating herring. They are curious and love to interact with divers.



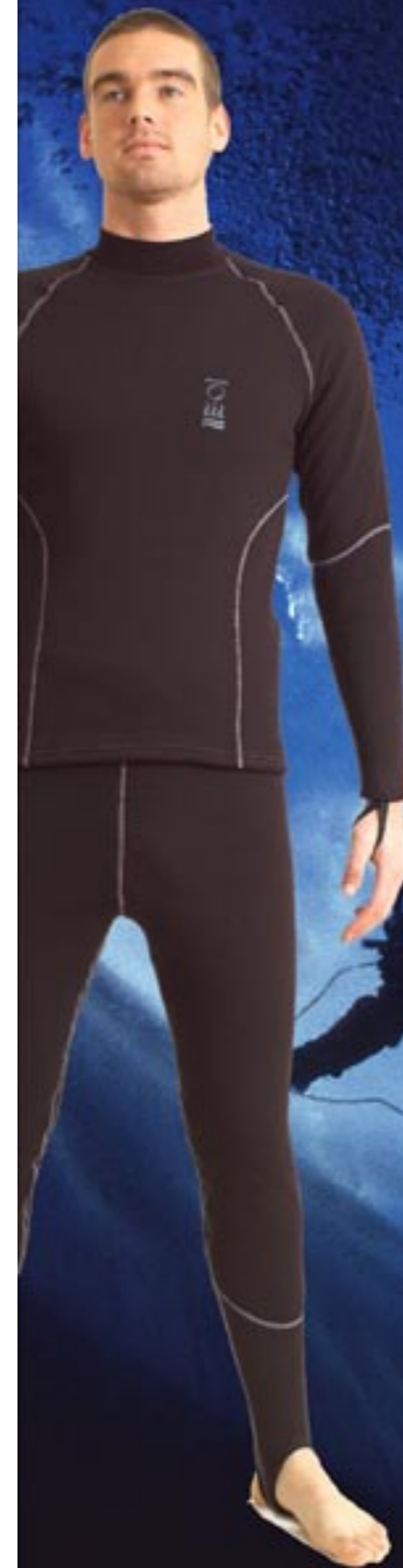
LEIF-GÖRAN HJELM - WWW.AQUA-BILDER.NU

- ▲ Exploring the bottom around *God's Pocket Resort* in Northern Vancouver Island is like walking in beautiful gardens with flowers
- ◀ Also a macrophotographer's paradise - *God's Pocket Resort* in Northern Vancouver Island

In Northern Vancouver Island just the topside scenery is enough to leave you breathless. Wild, untouched and with the blue mountains as a backdrop, and with a deep tranquility is that is all but enhanced by the blows of the passing whales. These more northern waters are cooler and more oxygen-rich, which means more life, producing an extraordinary array of invertebrates and a multitude of fish. Rumour has it, that up to 13 species of nudibranch have been seen on a single dive. Giant Pacific octopusses and wolf eels are abundant and many organisms often exceed the sizes stated in field guides. From the concentration of dives in the Broughton and Blackfish Archipelagos, to the gardens of the West Coast, to the expanses of life around Port

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Phill Short, pioneering cave diver after a 14 day exploration of a cave system in Siberia.

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- | | |
|--------------------|----------------------|
| 1 Port Hardy | 16 Duncan |
| 2 Port McNeill | 17 Cobble Hill |
| 3 Telegraph Cove | 18 Shawnigan Lake |
| 4 Quadra Island | 19 Galiano Island |
| 5 Campbell River | 20 Mayne Island |
| 6 Courtenay | 21 Sidney Area |
| 7 Union Bay | 22 Brentwood Bay |
| 8 Hornby Island | 23 Victoria |
| 9 Parksville | 24 Sooke |
| 10 Port Alberni | 25 Bamfield |
| 11 Lantzville | 26 Ucluelet |
| 12 Nanaimo | 27 Tofino |
| 13 Gabriola Island | 28 Tahsis |
| 14 Ladysmith | 29 Zeballos |
| 15 Chemainus | 30 Greater Vancouver |

Skookumchuk Rapids – the second fastest tidal rapids in North America harbouring spectacular sea life. The destroyer *HMCS Chaudiere* was scuttled here in 1992 to create an artificial reef.

South Vancouver Island

has too many great sites to mention, but one of the most well known areas around Victoria is Race Rocks, only minutes away by boat from downtown Victoria. It is a spectacular area above and below the water, and with good chances of diving with sea lions. Close by is the Saanich Inlet, which is a great site



Diving BC

80 side- and stern-wheelers steamed around the extensive lake system leaving numerous wrecks to dive, including the *S.S. Whitesmith* and the *M.V. Lady Rose* in Shuswap Lake, several wrecks in the Kootenays and numerous other small craft including houseboats, barges and tugboats. And not to forget a 1920's Chevrolet towing five sleighs full of in mail in Shuswap lake. In Pavillion Lake,

the beautiful crystalline turquoise water acts as a catalyst for the development of fresh water stromatolites, structures formed from fossilized remains of microorganisms in various shapes and sizes. The stromatolites are currently being studied by scientists. As the lake is extremely sensitive to human interaction the Underwater Council of BC is applying to have Pavillion Lake recognized as a protected area. It is recommended that you contact a local scuba shop for information and assistance in diving this site.

Other unique dives include the world famous Adams River Sockeye run which takes place in the fall. Hundreds of thousands of sockeye salmon form a virtual wall of fish and is an amazing sight. ■

Hardy and Browning Pass and the magic that is Haida Gwaii – these seemingly infinite stretches of coastline offer equally endless dive opportunities.

The interior is maybe not something that naturally springs to mind when it comes to scuba diving, but the interior of British Columbia actually boasts a number of historic wrecks, underwater cave systems, ice diving, current dives and large marine life. Adams Lake offers cave systems and walls of peculiar limestone formations that begin high on the mountainside and continuing underwater, to include chimneys large enough for a diver to ascend through.

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Text by Michael Symes

The current issue of Xray-mag has as a theme the western seaboard of the USA, including Alaska. This coastal area is part of what is known as the Ring of Fire, an arc of volcanos and oceanic trenches partly encircling the Pacific Basin, forming a zone of frequent earthquakes and volcanic eruptions. This activity naturally has a large effect on the marine-biological diversity of the region.

It will be seen from the map that the Ring of Fire stretches from New Zealand, along the eastern edge of Asia, north across the Aleutian Islands of Alaska, and south along the coast of North and South America. It is composed of over 75% of the world's

active and dormant volcanos. More than half of the world's approximately 1500 active volcanos above sea level are part of the ring. And about ten percent of these are located in the United States.

This huge ring of volcanic and seismic activity was noticed and described long before the invention of the plate tectonics theory. It is now known that the Ring of Fire is located at the borders of the Pacific plate and other tectonic plates.

TECTONIC PLATES

Tectonic plates are like giant rafts of rock floating on the earth's hot, soft mantle. These massive rigid plates are about 80 km thick, but change

size and position over time, moving at speeds of between 1 cm and 10 cm every year. As the plates move, intense geologic activity occurs at the plate edges, where one of three things may occur; the plates may be moving away from each other, leaving space for the creation of new ocean floor; the plates may be moving towards each other, causing one to submerge beneath the other; or the boundaries of the plates may slide past each other without much disturbance to either plate.

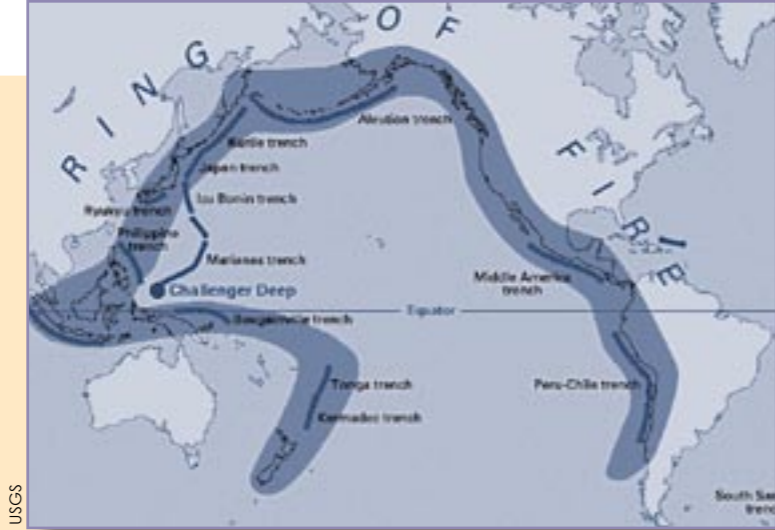
There are 7 major plates and 8 minor plates, named according to where they are positioned on the earth's surface. For example, we have the Nazca plate which is colliding with

the South American plate to form the Andes and the volcanos Cotopaxi and Azul. The major plate covering the Pacific ocean area is called, not surprisingly, the Pacific plate.

Around the Ring of Fire, the Pacific plate is colliding with and sliding underneath other plates. This process is known as subduction, and the volcanically and seismically active area nearby is known as a subduction zone. There is a tremendous amount of energy created by these plates and they easily melt rock into magma, which rises to the surface as lava and forms the volcanos of the Ring of Fire.

Between Northern California and British Columbia, the Pacific plate,

the Juan de Fuca plate, and the Gorda tectonic plate have built the Cascades and Mount Saint Helens, which erupted in 1980. Alaska's Aleutian Islands are growing as the Pacific plate hits the North American plate. The deep Aleutian Trench, with a maximum depth of 7679 m, has been created at the subduction zone here.



SAN ANDREAS FAULT

Although plates may slide past one another in opposite directions without much disturbance to either plate some may cause major earthquakes, affecting thousands of people. This is the case with the infamous Californian San Andreas fault, where the Pacific and North American plates interact, whose shift caused the enormous earthquake in San Francisco in 1906.

EARTHQUAKE IN SAN FRANCISCO

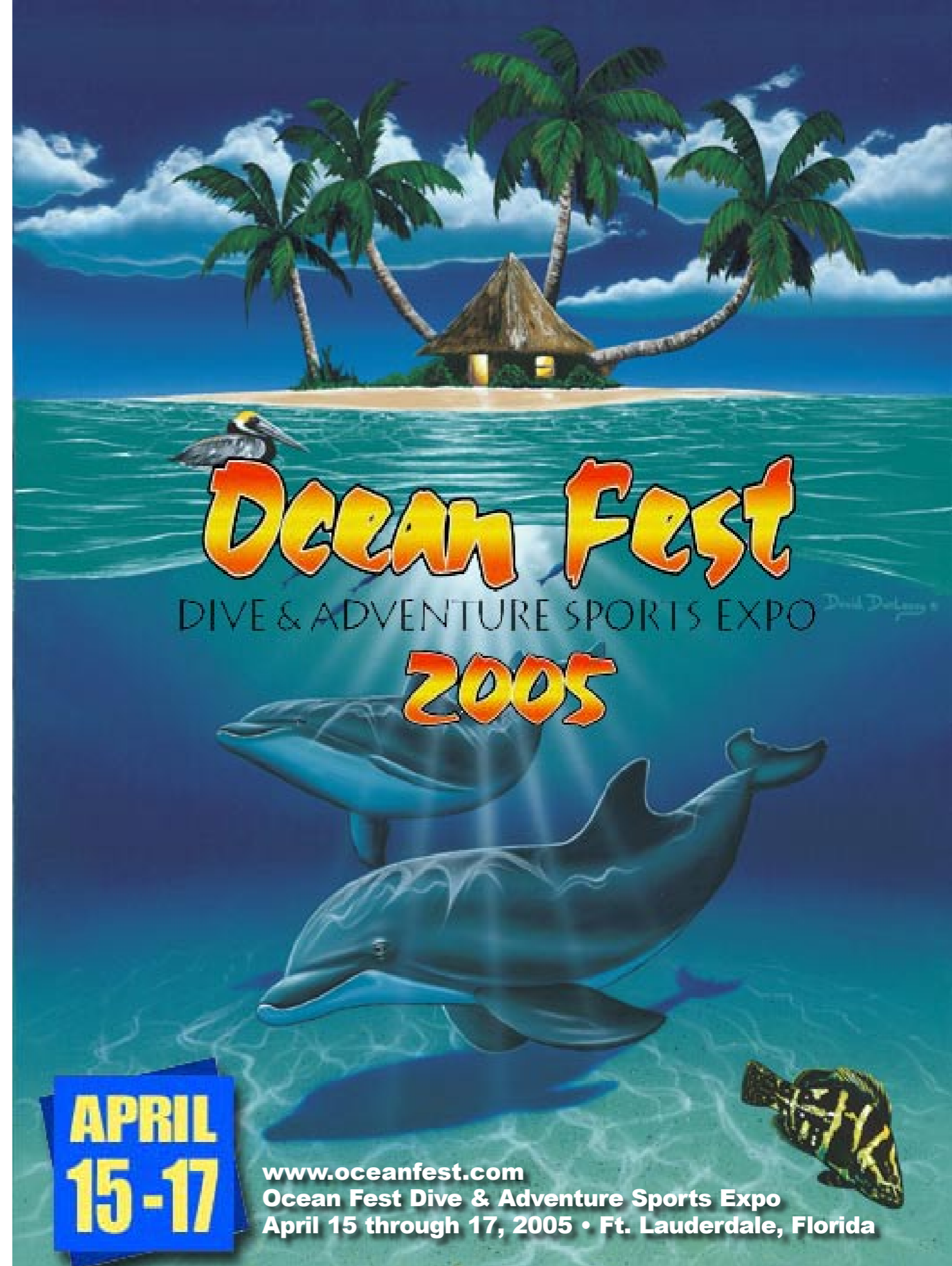
On April 18, 1906, shortly after 05:00,

a great earthquake struck San Francisco and a long narrow band of towns, villages, and countryside to the northwest and southeast. Many buildings were wrecked, hundreds of people were killed, and electric power lines and gas mains were broken. The ground had broken apart for more than 400 km along the San Andreas fault. The country on the east side of the fault had moved southward relative to the country on the west side of the fault. The greatest displacement had been 7 m about 50 km northwest of San

Francisco. As the plates never stop moving there is a fearful expectancy that a new major earthquake will occur in the near future.

TSUNAMIS

It is the earthquakes occurring in the more intensely inhabited land areas that generally cause the greatest devastation, like that in San Francisco. However, when there is an earthquake under the sea, one side of the ocean floor can suddenly drop downwards, beneath the top edge of the subducting plate. The resulting vertical fault will then generate a tsunami. The movements of the plates usually allow little warning for those at risk in coastal areas. One warning of a tsunami is that there is a rush of water away from the coastline, but this predictor may mean the forthcoming seismic wave is only minutes away. ■



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Vancouver Island



Text and photos by John Collins

The vast Pacific defines our water planet, when viewed from space. An seemingly endless blue mass, it covers half of spaceship Earth. In doing so, all of the ocean habitats are contained within it. Of its temperate waters, those along the western seaboard of North America have the greatest diversity and sheer mass of ocean life.



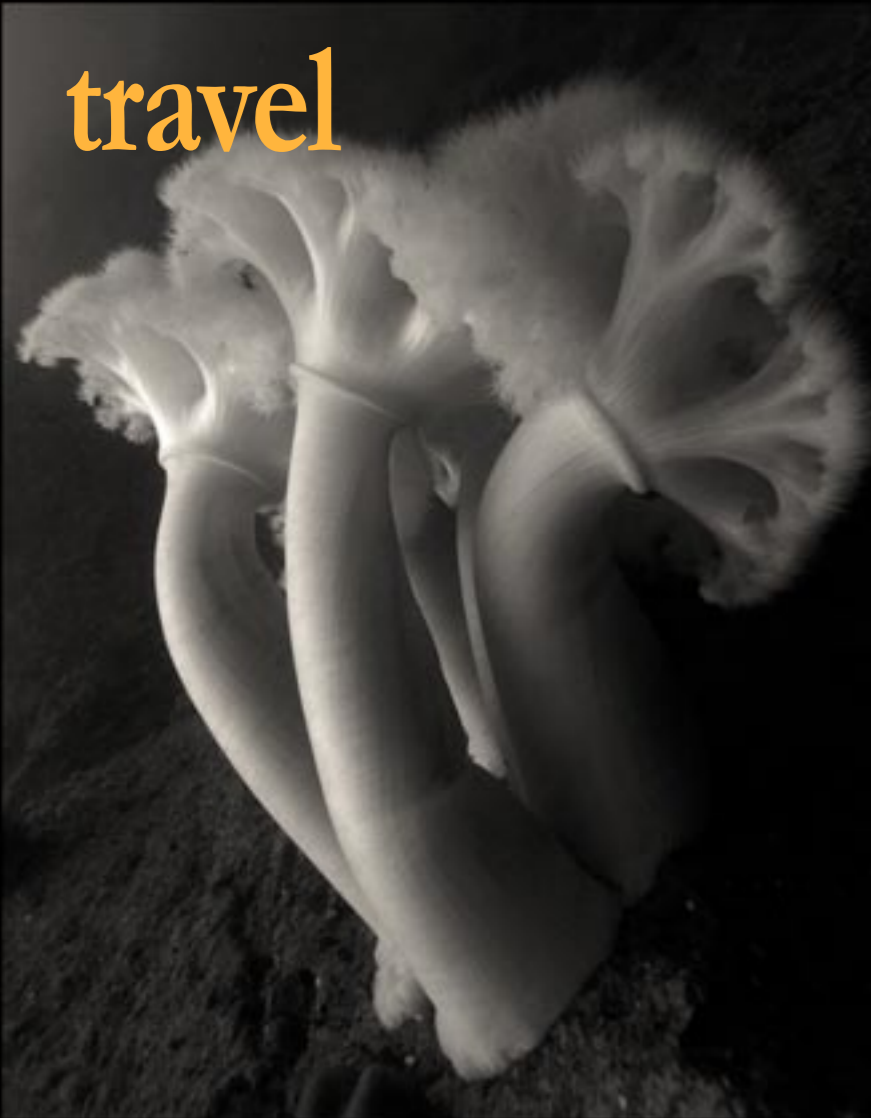
Without the warming effect of the Gulf Stream, these waters are colder than comparable latitudes in Europe – a chilly five degrees Celsius in winter. The cold is invigorating, not just to the intrepid diver, but to the life in these rich seas. It brings oxygen and nutrients from the deep ocean that are distributed by upwelling currents and tidal streams along the coasts, from Alaska to California. Vancouver Island, off Canada's British Columbia is bathed by particularly lush seas. In

▲ ABOVE: Red Anemone

CLOCKWISE FROM TOP LEFT:

- ▲ Vancouver Island
- ▶ Lighthouse on Vancouver Island
- ▶ Sculpin portrait





Vancouver Island

early summer, as the plankton growth explodes, the sheer quantity of life is staggering. Thanks to modern diving equipment and dry-suits, diving here is especially rewarding.

I made the journey to Vancouver in early June, when this action was at its peak. Joining a live-aboard boat, the Nautilus Explorer, we were going to circumnavigate the island, diving as we went. It would take eleven days. As we steamed north from Vancouver city, the quiet wildness of the island was a welcome contrast to the hustle of city life. The steep, forest-covered

coast tumbles quickly to depth beneath the surface. I inhaled the rich aroma of the cedars, preparing for the first dive in the fjord-like waters off Andersen Island. In the first few meters, the water was a dense emerald green. A single liter of this planktonic soup contains millions of tiny plants and animals. Suddenly, at depth, the curtains part and a darkened landscape emerged. Walls of cloud sponges, bright yellow, appear in the dive lights. A community of busy fish life



moved among its folds and shadows, feeding and sheltering. The cold can make these dives short however, without the right equipment.

Advances in scuba gear have brought about great changes in how we can visit even the coldest waters. The Rebreather, a forerunner to the popular aqua-lung, has made a comeback in modern times. By re-using the diver's breathing gas, dive times can be greatly extended. The exhaled breath is scrubbed of carbon dioxide with soda lime – a process that generates heat.

- ▲ Plumose anemones
- ▲ Lost rifle, Tahsis, Vancouver Island
- ▲ Wreck of the Vanlene of Austin Island
- ◀ Detail of anemone



Vancouver Island



- ▲ Giant Nudibranch, *Dendronotus iris*
- ◀ Sea Pen, *Ptilosarcus gurneyi*
- ▼ Opalescent Nudibranch, *Hermisenda crassicornis*

- ▲ Sun star, *Solaster stimpsoni*
- ◀ Mug-shot of friendly Wolf-eel, *Anarrhichthys ocellatus*



The enriched gas is thus warmed and prevents heat loss through the lungs. This comfort, along with that from modern insulating fabrics and electrically-heated vests worn under the dry-suit, allows dives of an hour or more in cold water. My lips and face were starting to feel the chill after that first dive, as I spun around at the surface to look for the boat. A rising full moon had just appeared in the twilight sky, sending pastel reflections along the water's surface. The cold was forgotten, among anticipation of further exploration in these special waters.

Much of the cliff hanging anemones and other plankton feeders are similar to those seen in northern European waters.

It's the size of everything that is different. Flower-like anemones go from blossoms to bushes, dahlias to dinner plates. Their size causes them to hang limp from the rock faces, the super-rich plankton giving everything a steroid boost. It is most noticeable in areas of strong tides, as billions of liters of water are channeled through the narrows and islets twice daily. The dive sites at the northern end of the island are best known for these forests of invertebrate life. The coral-like filter feeders blanket every surface and whole walls are color-washed red and white. The diffuse light, having penetrated the plankton layer is soft and subtle giving the large white anemones



▲ Detail of totem pole
▶ A gift from Spain, 1957, this stained glass window marks the reunion in 1792 of the Spanish captains Quadra and Vancouver who led exploratory and diplomatic expeditions to the Vancouver Island area

Vancouver Island



a glow. It immediately feels black and white to my photographic eye and I turn off flashguns and torches to savor the moment

Port Hardy The best-known area on this north eastern part of Vancouver Island is that around Port Hardy. Here, sites such as Dillon Rock and Browning Pass are probably the most sought-after dives along British Columbia's 29,000 km coastline. Diving these remarkable walls of soft coral, the blanket of color goes from unbroken red to dazzling white. Every possible space is taken in this thriving metropolis of sea life. Residents such as the shy, giant Pacific octopus and inquisitive wolf eels bring a big animal experience unlike any other. When we were forced to stay in this area longer than planned, due to bad

weather, nobody tired of these fantastic dives.

Eventually we round Cape Scott on the northern tip of the island and enter the greater Pacific. We are greeted with large swells, after several days of rough weather. This wild coast endures harsh winters, however, evidenced by the lack of any visible settlements. An experimental drilling platform witnessed the severity of the winter storms here, and measured one wave at 35 meters high.

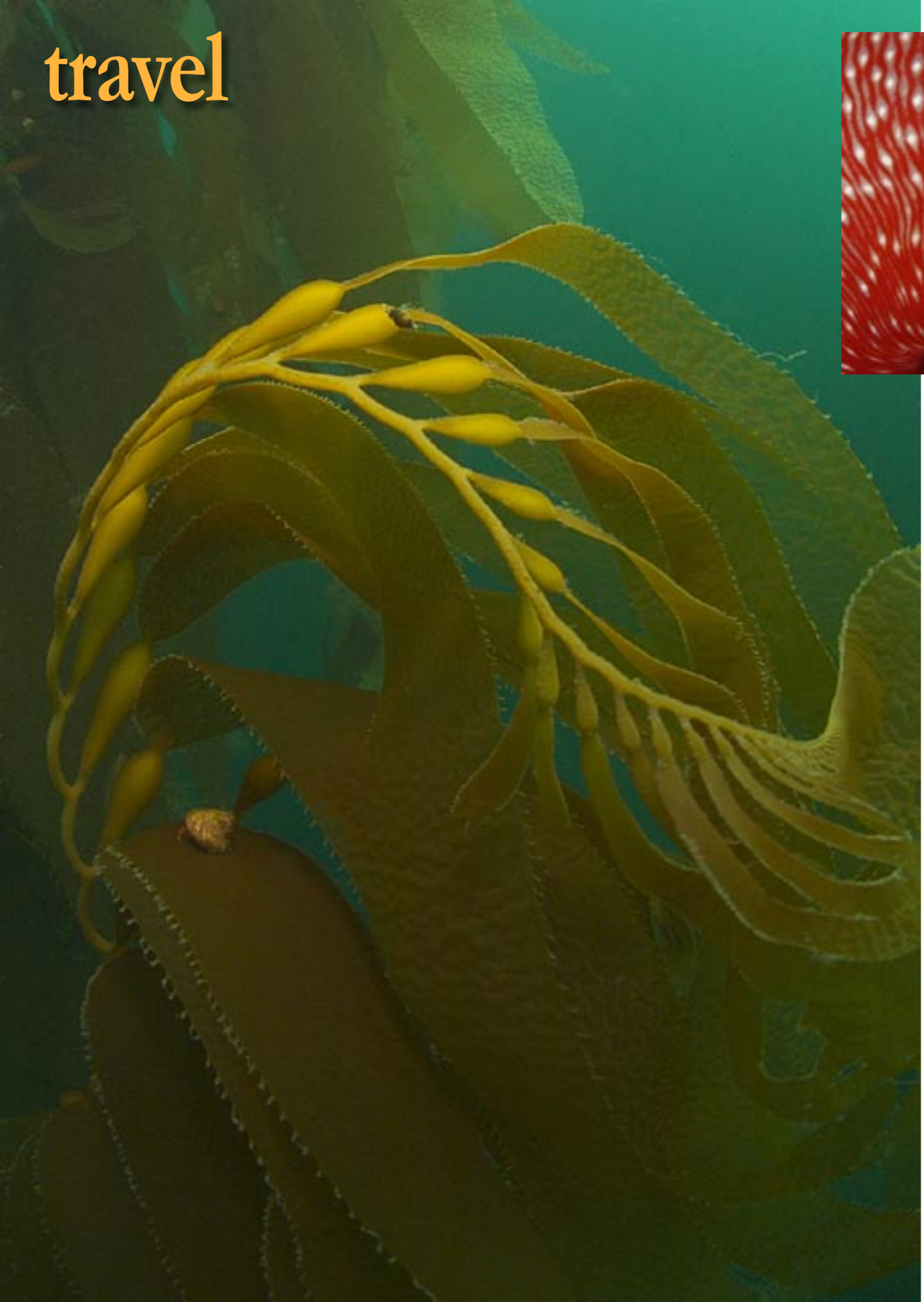
The First Nations

The name 'raincoast' is apt. The native peoples here enjoyed the bounty of the sea in summer, but wisely moved inland for winter. The First Nations heritage in this area is fascinating.

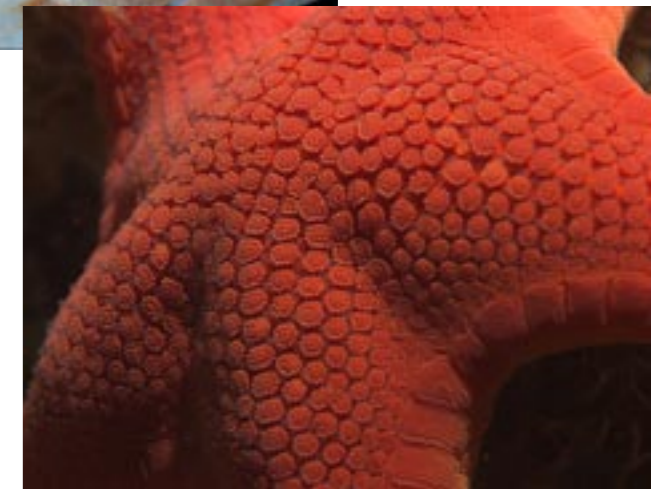
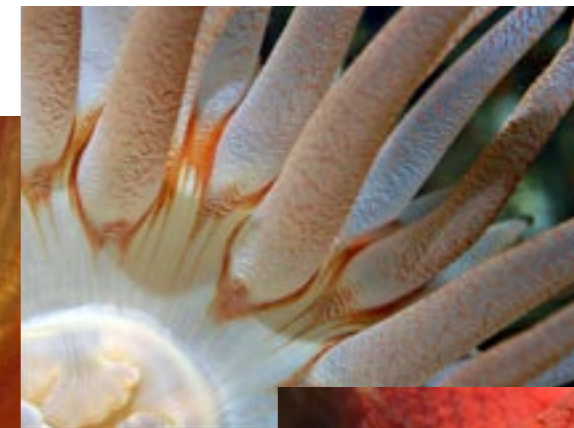
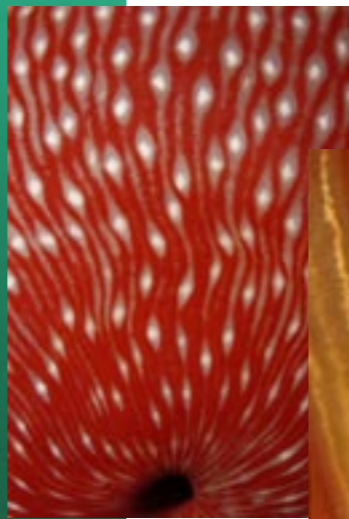


▲ Aerial view of the coast of Vancouver Island
▶ View from the plane as it banks over the sound of Vancouver
▶ The live-aboard ship, *Nautilus Explorer*





Vancouver Island



In Nootka Sound, the now quiet village of Yuquot, named Friendly Cove by Captain Cook, was the scene of first contact with Europeans. The Spanish had made previous trips to the area but did not go ashore. So it was not until Cook landed in 1778 that the land was claimed under England's flag. At this time Captain Cook and Chief Maquinna had the famous first encounter between the Europeans and the First Nations people. The Spanish Government still considers Friendly Cove part of their history, and in 1957, Spain donated two stained glass windows for the church on Nootka Island in Nootka Sound.

Kelp Forests

Underwater, the seaward sides of the rocks and cliffs are bare. The constant Pacific surge gives fledgling kelp little chance. Only in the shelter of bays does it get a chance to flourish into the famous kelp forests seen along this Pacific coast. An early morning dive in

Kuyquot sound is a delightful submersion into this mesmerizing world. These forests of giant kelp seen on California's offshore islands are familiar from television documentaries. Here in Vancouver, the kelp is shallower – in 10-20 m depth. The fronds sway gently, caressed by the soft morning light. The gas-filled floats form endless patterns in the clear water. It is one of the most peaceful and endearing diving experiences I have enjoyed.

Wrecks and sea-lions

As we move further south towards Victoria, the weather is warmer and the sea bright and clear. The diving continues to be diverse and fresh every time – from the 1972 wreck of the Vanlene in Barkley

- CLOCKWISE FROM LEFT:
- ◀ LEFT: Sea Kelp and hermit crab
 - ▲ TOP THREE IMAGES: Close-up details of a variety of anemones
 - ▶ FAR RIGHT: Vermillion seastar, *Mediaster aequalis*
 - ▼ BELOW: Giant barnacle, *Balanus nubilus*





PHOTO BY BOB WILSON, NATIONAL MARINE SANCTUARIES, NOAA

▲ Stellar sea-lions nuzzle one another on the rocks



▲ The vibrant city of Vancouver
▲ INSET: Underwater photographer and dive writer, John Collins

Sound to the aptly-named Race Rocks in the Strait of Juan de Fuca. Like the sites of Port Hardy in the north, these sites must be dived on a slack tide. Approaching in the dive skiff, the loud barks of Stellar sea-lions protest our arrival. Once in the water, however, the younger, curious sea-lions cannot resist checking out the divers. I find myself shooting some beautiful red-bodied sea anemones, only to feel a tug at my fin. Large black eyes plead to me for play instead of photography, but we humans are a poor match for these agile masters of the aquatic world.

Vancouver Island

Entering Victoria harbor signals the end of our circumnavigation, as this is the final stop before our return to Vancouver city. It has been a superb trip, carefully planned and organized by Captain Mike Lever and the crew of the *Nautilus Explorer* (www.nautilusexplorer.com). The only question in my mind on this final day is, when can I get back here and go north to Alaska? ■

To order prints of images from this story directly from the photographer, contact: info@johncollinsale.com



▲ An underwater photographer passes through an archway of sea kelp
◀ Close-up portrait of a Kelp Greenling



fact file



Vancouver Island British Columbia 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 southern 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 Arctic 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, hydro-power; 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 (July 2004 est.) 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 18%



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

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

Web sites

- Vancouver Island Tourism www.islands.bc.ca
- Vancouver Island & Victoria BC Tourism Travel Guide www.vancouverisland.com
- Diving Vancouver Island www.bcdiving.com

Dive Operators

- British Columbia Dive Guide www.bcdiveguide.com
- Dive charter operators and dive re Columbia dive.bc.ca/links/charters.html

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Wrecks of Vancouver Island



Sixgill sharks

Why is swimming next to these large sharks like swimming back in time?

Given its large size, broad, flat face and slow, deliberate motion, the bluntnosed sixgill shark may look like a throwback to Jurassic Times. But these deep-sea sharks aren't very primitive at all. The shark's sixth gill, a unique feature of its family the *Hexanchiformes*, and other parts of its well-adapted anatomy, are recent, specialized innovations. They're simply different from the majority of today's modern sharks.

According to the most accepted version of the shark family tree, they belong to a whole other branch: the squalomorph sharks which living representatives are limited to dogfish, the Greenland shark, and the six and seven-gilled sharks, which probably split from a common ancestry around 200 million years ago, the age in which the oldest Hexanchiform fossils are found. "There is nothing remarkable in the separation of the lineage," says sixgill researcher Dr. Robert Dunbrack. "Lineages split continually. Since most lineages go extinct, the only surprising thing is that there are still Hexanchiform species around today, 200 million years later."

Scientists may know more about the sixgill shark's past than they do about its current biology. Like other northern water sharks, and especially the deep water ones, basic information about the sixgill's lifecycle isn't known. Scientists aren't sure how long it lives, how fast it grows, how often it reproduces, or even why it migrates from its usual depths of around 2500 metres to the shallower British Columbia waters each year.

Flora Islet is world famous as one of the only two places where a diver can count on seeing the giant sixgill shark. Some of the smaller sixgills are about 8 feet long and much larger ones have been spotted. These sharks swim slowly along the bottom and can easily be matched by divers. Swimming along side one of these docile giants is one of the most amazing thrills any diver can experience. ■

Every rugged coastline close to major economic centers is densely dotted with shipwrecks. Vancouver Island and Juan de Fuca Strait being the entrance the US Pacific North West and western Canada is certainly no exception.

A coastline that has been dubbed the Graveyard of the Pacific and The Unforgiving Coast, a clear testimony to the many human trag-

edies that have taken place here. A popular saying goes that there is a wrecked ship for every mile of coast. In reality this is most likely an underestimate because of all the many shipwrecks that went down unnoticed. In the days of sailing ships, before they had engines, not to speak of radars, radios and GPS, a severe storm would often spell the end for several ships at the same time. Sometimes there is a record of these tragedies, sometimes not. In those days, more often than not, you only learnt that a ship was probably lost at sea because it failed to show up at its destination.

Ignorance of the local geography, a tired and overworked crew, a vessel unfit to sail, surprise winds and greedy shipping agents who overload on cargo, have all contributed to the shipwrecks and many tragic losses of lives off the Vancouver Island coast.

In many cases, all the available information was the name of the vessel and where it probably sank, sometimes extracted from insurance records, or newspaper notices. Later in history, information obviously became more accurate but generally it is mostly the fate of larger vessels which is known. But the wrecks come in all sizes and varieties. There are Canadian and foreign vessels, war ships, freighters and passenger ferries as well as working tugs, lumber barges and small craft lost on the rocks and breakers. The ocean did not distinguish between them.

Wreckdiving As in many other parts of the world, there are laws in place to protect historic wrecks in British Columbia but also a plethora of wrecks to explore. Sometimes wrecks are found by random searches, which have recently been greatly facilitated by the advent of affordable sidescan sonars, which build a very precise picture of what lies on the bottom. It

is also possible to begin the search by researching in libraries and archives to find information about the type, construction and special features of the wreck, and hopefully also about its location, and the conditions under which it sank. ■



SOURCE: MARITIME MUSEUM OF BRITISH COLUMBIA



SOURCE: MARITIME MUSEUM OF BRITISH COLUMBIA

Other useful and interesting links:

Underwater Archaeological Society of British Columbia

Dive.bc.ca



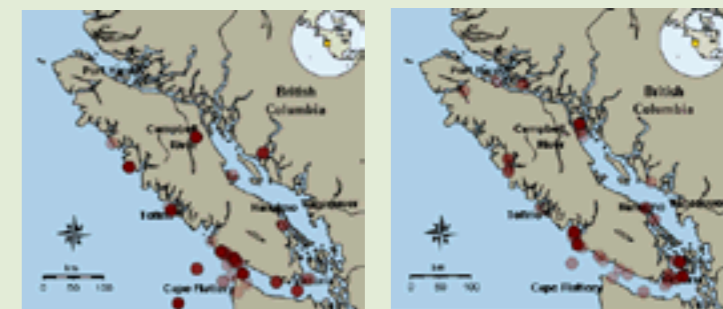
Graveyard of the Pacific! www.pacificshipwrecks.ca

This is an excellent website about the shipwrecks off Vancouver Island. It is made and operated by the Maritime Museum of British Columbia, and is one of those rare pleasant surprises where design, database, message and usability actually works together in a sensible whole.

A section called "Shipwreck Times" features ten stories of shipwrecks along the Vancouver Island coast, gives a series of good examples of how different the shipwrecks are, and that

reflect a long historical era. From Boston, Tonquin and Lord Western which date back to the early years of trade, and exploration by Americans and Europeans around Vancouver Island, to examples of how even modern freighters are not safe from the rough coast.

Most interesting is the interactive wreckmap. Under the map is a slider that one can pull along a time axis that goes from 1750 to present day 2005.



To screenshots of the interactive wreckmap. LEFT: the shipwrecks in the year 1908. RIGHT: the year 1928

The interactive map only seems to work properly in Internet Explorer. There seems to be a problem displaying it in NetScape Mozilla/Firefox. ■

Make reefs - not war

Text edited by Peter Symes
Photos courtesy of the ARSBC
and Divers Choice

Artificial reefs are created when vessels are sunk in a special area. This is where ARSBC comes into the picture. The Artificial Reef Society of British Columbia is the Canadian non-profit organisation behind a series of spectacular and highly publicised sinkings of predominantly decommissioned warships during the past decade.

Since 1990, the ARSBC has created six dive sites in British Columbia. The Coastal Freighter and former WW2 supplyship GB Church was the first project of the ARSBC and Vancouver Island's first artificial reef, sunk in Princess Margaret Marine Park in 1991. It served an important role as a proving ground for the larger and more complex naval artificial reef projects that were to follow.

Preparation of the ships meant cleaning them down completely, including cleaning all fuel and oil lines and removing all environmental hazards, often gutting them all the way

down to the bare steel. As diver safety is, obviously, an important consideration it also means cutting holes for diver access, removing any hazardous obstacles and either sealing off confined spaces or opening them up for easy entry and exit.

The sinking sites were often chosen for close proximity to local dive shop operators to enable positive economic

spin-offs from the new diving attraction, and for a flat sandy bottom on which to land the ship. All coast guard and navigation requirements also had to be met when choosing locations.

The sunken ships have quickly since become overcome with rich marine life including octopus and wolf-eels, and today they are testimonials to the positive environmental impact that



PHOTO COURTESY OF DIVERS CHOICE CHARTERS. WWW.DIVINGBRITISHCOLUMBIA.COM

Sinking of
HMCS Cape
Breton



PHOTO: JAY STRAITH

The HMCS The Saskatchewan was sunk in two steps. On the day prior to the sinking, the engine room was flooded in an attempt to lower the ship's center of gravity ▶



PHOTO: ARBSC'S WEBSITE

artificial reefs have on the marine ecosystem. Not only do artificial reefs promote marine life, they also reduce diver impact on surrounding natural and historical shipwreck dive sites by diverting diver traffic from those sites.

The 111m destroyer escort Chaudiere was sunk in Sechart Inlet in 1992, and aided by these experiences a second naval ship soon followed. On a beautiful September day in 1995 surrounded by more than 1,200 boats, aircraft and thousands of spectators, the former antisubmarine destroyer Mackenzie was sent to the bottom too. She now rests on the sea-floor off Sidney in about

33m of water. The site is just north of the USA - Canadian border and marker buoys are attached to the bow, bridge and stern of the ship for direct access to the ship from the surface.

Columbia, located near Campbell River, was the third naval destroyer sunk by the ARSBC as an artificial reef, just nine months after Mackenzie. Again, knowledge gained from two prior destroyer projects further improved the preparation efficiency, diver access and safety features incorporated into the ship. In addition to the explosives used to sink the ship, the crowd was treated to a spectacular display of pyrotechnics that lit the guns of Columbia as

a final salute to her tour of duty. She sank to the bottom in three minutes and forty-five seconds, bow first.

Then followed the destroyer Saskatchewan which was sunk in 1997 off Snake Island, a few miles east of Nanaimo. The site has mooring buoys adjacent to the ship and marker buoys attached at the bow, bridge, and stern of Saskatchewan. This fourth sinking of a destroyer was also the subject of an International contest to "push the button" and sink the ship. Cousteau Society sponsored the contest as a fund-raiser to replace its former ship Calypso which sank two years earlier following a collision in Singapore.

The ARSBC writes on its website that it went through a great deal of trouble to make this wreck diveable for all skill levels by cutting many large holes at close proximity



PHOTO: ARBSC'S WEBSITE

▲ The HMCS Cape Breton before ARBSC took good care of her.

to each other the length of the ship. Although an exit is visible from any entry point along the ship, it is still highly recommended that divers receive proper wreck training before penetrating the vessel.

2001 then saw the creation of the world's largest artificial reef sinking when the 111m former WW2 Victory ship HMCS Cape Breton was also sent to the ocean floor near Snake Island where she now rests at 40 metres below the surface.

The ARS-540 is a decommissioned Boeing 737-200 airframe that was donated to the Artificial Reef Society by Qwest Airparts Ltd. of Memphis, Tennessee. Why the number 540? Why the cryptic name ARS-540? Well, the Air Canada internal designation of the plane was FIN-540, and ARS stands for Artificial Reef Society. The new reef project has been quite a while in the making, but the plane is still waiting for the sinking permit to be issued by Environment Canada. The plane is still in Comox, but is being stored on a lot, which the owner wants to develop, so he wants the plane out of there asap. The Comox Valley Dive Association has begun an impressive fund-



LESTER LICHSTONE, ARSBC



▲ ABOVE: The 737 is the ARBSC's next project. However as this magazine goes to press, the former jet is still waiting for the sinking permit to be issued by Environment Canada
▲ TOP LEFT: Diving the Saskatchewan

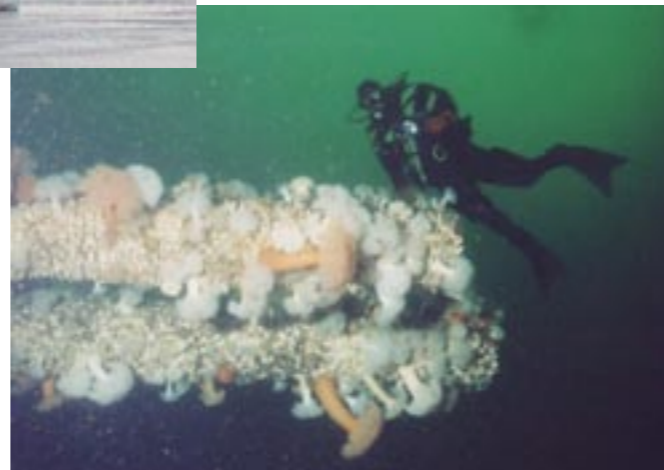


PHOTO: JAY STRAITH

Diving the Saskatchewan ▶

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Become an ARSBC Member!

Would you like to dive on the most interesting un-natural sites in B.C.? Would you like to help out to maintain and monitor - or just dive for fun - the 6 (and soon to be 7) wreck sites which the ARSBC has created? Would you like to meet other divers with similar interests? Then we'd like to invite you to become a member. Visit ARSBCs Members' Page for more details and an application form.

Click here: www.artificialreef.bc.ca



▲ The sinking of the HMCS Mackenzie in 1995. She went under in 3 mins, 45 secs. Photos: ARSBC's website

raising and promotional effort for the 737 artificial reef. The CVDA has a limited number of advertising and sponsorship opportunities available, and would be happy to discuss the possibilities with you further. All gold level sponsors will receive a limited edition bronze statue by Simon Morris (morrissculpture.com) of Salt Spring Island. Additionally, all donations can have tax receipts issued. Until the sinking date, the 737 is being stored beside a marina in Courtney, in full view of the public. Then, after it's sunk, every diver to the new artificial reef will see your company's logo for years to come. **Click here for more information.**

Underwater Treasure Hunting

Along the east coast of Vancouver Island is the city of Nanaimo, one of North America's premier dive destinations, but did you know that there are treasures to be found in the emerald waters that surround the harbour city? We are not just talking about the amazingly abundant sea life and healthy marine environment, we mean actual treasures. Well! Tokens for treasures — Citizen Watches to be exact.

As a part of the promotion of the wrecks, a long-time locally-owned jewelry store, Grassicks, donated women's and men's Citizen Watches. Tokens were created and hidden amongst the wrecks by members of the Nanaimo Dive Association. To date, none of the three tokens have been found. For those planning to search for them, the only tip we can offer is that there are two tokens to be found within the Cape Breton wreck—one at recreational level and the second at technical level. The third token is somewhere amidst the wreck of the Saskatchewan. ■

For information on dive charters in Nanaimo, call 1-250-756-0106 or visit [Tourism Nanaimo's website: www.tourismnanaimo.com](http://TourismNanaimo.com)

Tourism Vancouver Island's website: www.islands.bc.ca



ARSBC

Rivtow Lion was successfully sunk on February 6th, 2005. The Rivtow Lion is a 157-foot (47 metre) long North Sea Rescue Tug. Built in 1940 in Selby England, she was originally named the HMRT (His Majesty's Rescue Tug) *Prudent*, later named HMRT *Cautious* in 1947 and finally becoming *Rivtow Lion* in 1966. This 561-ton vessel was first stationed in Iceland and the Shetland Islands. Built to tow convoy ships damaged by German U-boats in WWII, these tugs accompanied convoys

across the North Atlantic on a three week voyage through winter gales and U-boat attacks, towing damaged ships in all kinds of weather. She was part of a rescue fleet that saved 140 American, 245 allied and neutral ships, 750 British and Commonwealth ships along with 245 allied warships and millions of tons of supplies during the war. ■

Source and photocredit: www.oceanexplorersdiving.com

Advertisements

West Coast Dive Package

Port Alberni's Coast Hospitality Inn is offering a year-round West Coast Dive Package from CAD155 per person based on double occupancy. Package includes two dives with Six Gill Adventures, breakfast, boxed lunch, dinner, and one night accommodation in a Coast Comfort Guest Room. Guests will be whisked via the Alberni Inlet on a short ride to the dive sites. Experience the wonder of Barkley Sound...reefs covered in stunning sponges and hard corals, sea lions, and possibly a glimpse of the elusive Six Gill Sharks. Rental equipment available for additional charge. For more information, call 250-723-8111 or visit portalberni.coasthotels.com

Snorkelling with Seals

Get up close and personal with harbour seals during a snorkelling experience unique to Nanaimo. Guided excursions allow snorkellers to spend up to two hours in the water with the playful and curious critters that make their home at Snake Island, a short boat trip outside of Nanaimo's harbour. Dive operators offer snorkelling tours from CAD 75 per person which includes all necessary equipment.

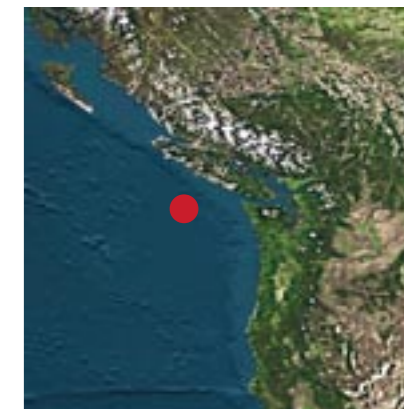
Stay and play in Nanaimo with a Seal Adventure Package starting at CAD189.95 per person based on double occupancy. Package includes two nights accommodation, two snorkelling adventures, and a number of extras. One night packages available.

For more information or to book your snorkeling and accommodation package, call 1-250-753-1246 or visit www.buccaneerinn.com

Seafloor earthquakes signal eruption off Vancouver Island

Seismic activity on the Endeavour Ridge

An underwater eruption some 200 miles off the coast of Vancouver Island may be under way. Recently the area has been rocked by thousands tremors, most tiny, but some exceeding magnitude 4. "It has been going on long enough that we're pretty sure lava is moving," said Edward Baker, an oceanographer at the Pacific Marine Environmental Laboratory, which is part of the National Oceanic and Atmospheric Administration (NOAA).



THE LIVING EARTH® INC./EARTH IMAGING

Researchers keep scientific instruments packed and ready to go so they can act quickly when an underwater eruption starts. The Juan de Fuca plate, is a tectonic time bomb capable of producing earthquakes and tsunamis on par with the disaster that struck the Indian Ocean in December. "An eruption along the ridge doesn't directly raise the risk of an earthquake on the subduction zone. But the regions are closely linked, like pieces in a puzzle. We really don't know what to expect," Baker said.

Among the researchers tools is a network of Navy hydrophones originally used to monitor enemy submarines. The sensitive instruments can detect underwater earthquakes that are too faint and far away to be picked up by land-based seismographs. "It's left over from the Cold War, and it's become very useful," Baker said. "But even I'm not allowed to know where the microphones are. The sensors located the shaking on the Juan de Fuca Ridge, where fresh oceanic crust forms as tectonic plates pull apart and magma wells up from deep within the earth. This seafloor spreading is slowly forcing the Juan de Fuca plate under the North American plate, creating a subduction zone that has unleashed massive earthquakes in the past. ■

*Diving the Land
of the Midnight Sun...*

Eureka Alaska!

Text by Barb Roy

Colorful Northern Lights danced across a late evening sky in Whittier, Alaska. As my husband, Wayne Grant, and I donned our scuba gear for our first night dive in this mysterious Land of the Midnight Sun, I wondered if the native legends were actually true, and that the dancing lights were actually happy spirits enjoying a night of play. At the same moment this beautiful and unusual phenomenon took place above us, we saw the water bubbling in the boat's wake sparkle with phosphorescence below us. The lights of the sea and sky glimmered as if waiting to illustrate a magical story. Wayne handed me my camera, and we submerged into the glassy, calm realm of the aquatic world.

Within seconds, I spotted several Dungeness crabs, causing them to flee from our approaching path of light. Although the water was 49 degrees, visibility was particle-free and excellent. As the depth gradually increased, we noticed an abundance of red rock and hermit crabs, huge sea stars, shrimp, and an odd-looking juvenile Alaskan king crab. To walk, the baby king crab stood tall on its prickly pink spiky-thin legs and moved with uncanny speed. Just a few meters ahead, Wayne had a flounder in his sights and encouraged me to follow. In an undulating motion, the flat fish slowly moved forward trying to keep up with Wayne's light. Little did we know we were following the small flounder along a pre-marked trail to the remains of an old 'bush' plane. Careful not to stir up the sediment, we surveyed the site



◀ LEFT: Mountains surround Resurrection Bay
◀ CENTER: Snakelock Anemone
▲ RIGHT: Nudibranch, White-lined Dirona

Text by Barb Roy
Photos by Barb Roy, NOAA
Photo Library, Alaska Tourism

PHOTOS ON THIS PAGE BY BARB ROY





▲ Anemone, Fish-eating Urticina

with our torches. I noticed two big eyes peeking over a portion of debris. In the process of approaching the site, we must have attracted the attention of a curious medium-sized giant Pacific octopus. Instantly a game of hide-and-seek developed. Needless to say, this quirky, almost comical, octopus held our

attention for the rest of the dive. We took the opportunity to take some close-up and macro shots.

Alaska

The state of Alaska encompasses 587,878 square miles (1,522,596 square km). Past explorers were drawn to this vast terri-

tory known in search of gold and fame. Today, visitors are held in awe of Alaska's extremely long summer days—hence the reference, land of the midnight sun—and the seemingly endless supply of majestic scenic beauty. Among these adventurers, are often a number of curious divers yearning for a chance to explore a por-

tion of Alaska's extensive underwater terrain. For the truly daring, this cold water haven can offer a seemingly endless supply of exploratory possibilities.

For our excursion, Wayne and I chose the month of September to explore the Alaskan coast. By doing this, we avoided large crowds of tourists and took advan-

Did you get the previous issues of X-RAY MAG? They are also free



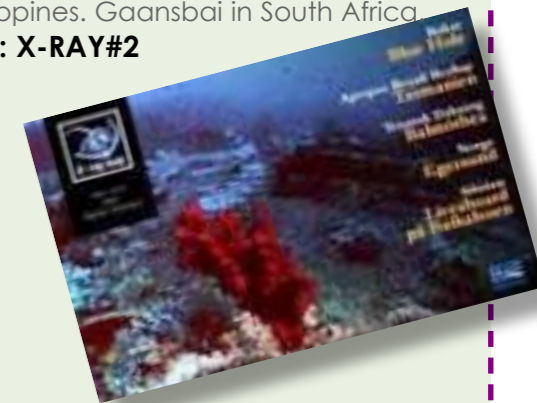
MALAYSIA. Coralreefs after the Tsunami. Whalebeachings. Tragedy in South Africa. Nemos Nose The Science of Fish Fashion, Ice Diving in Russia. Tod Essick.

Link: X-RAY #3



Diving in the Himalayas, Swimming with Orcas in Norway, El Dorado in the Philippines. Gaansbai in South Africa.

Link: X-RAY#2



Featuring Belize's Blue Hole; Tasmania; Balmorea, Texas; Norways Egersund, Liveaboard on Lake Baikal, Siberia

Link: X-RAY#1



- ▲ Denali National Park
- ◀ Prince William Sound
- ▼ Alaskan Railroad

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PHOTO BY BARB ROY

tage of the water's clear visibility. Since Alaska is so big, our main focus would be the South Central portion of the state, beginning in Anchorage, the largest city and home to an international airport.

For two hours, we mulled over maps and possible dive sites at a popular java joint called Café Del Mundo. Our plan was to squeeze in the sight-seeing, wildlife photography, gold panning and souvenir shopping around the diving. Faced with a possible mutiny, I reluctantly agreed.

Diving

Several dive facilities are available in Anchorage for rentals, air and overall site information. They informed us,

that due to the melting glaciers, spring and summer water run-off carries fine silt to the ocean sometimes producing an underwater 'cloud layer.' Therefore, visibility is usually best during late fall, winter and early spring months ranging from 35 to 90 feet depending on the location. With water temperatures of 30 to 45 degrees F, winter snowfall can pose a problem with regard to access to some shore locations. Summer months, however, tend to yield 20 to 60 feet, with water temperatures of 50 to 60 degrees F. With this in mind, I'm glad we brought drysuits! After obtaining a map of our first underwater destination, Smitty's Cove, we were on our way to catch an auto shuttle train, or rail-ferry, to the secluded

community of Whittier.

The Seward Highway

From Anchorage we headed south past the Potter Point State Game Refuge for about 46 miles (75.2 km) down the Seward Highway. I could not believe the scenery! Shades of lavender Lupine flowers bordered the winding curves around Turnagain Arm, a shallow stretch of water extending from Cook Inlet. This is where bore-tides, up to five feet high, are often seen as walls of water race across the

mud flats with incoming tides. Beluga whales can also be seen contently feeding offshore during the summer. I had to keep telling myself this was all REAL and not a show on the Discovery channel!

Although visitors can now drive to Whittier, through two consecutive tunnels, the Alaskan Railroad also offers a passenger/vehicle train, which travels along the same path. If time permits, Portage Glacier is a great side trip, only a few extra miles beyond the train depot.

Opting for the rail transport, it didn't take long for the gentle rocking to put Wayne to sleep. We passed beautiful wildflower fields, tinted with colours of autumn and scenic waterfalls rolling off the mountainside. As we exited the last tunnel, the train entered into a valley nestled between more mountains. Continuing past a magnificent display of water falling from the base of blue-green mountaintop glacier, and past a colony of nesting shorebirds, we pulled to a stop in the middle of town.

Whittier

The U.S. Army established Whittier during World War II for its secluded strategic location in Prince William Sound. To this



COUNTER-CLOCKWISE FROM TOP RIGHT:
 Portage Glacier ►
 Grunt Sculpin fish ▲
 Curious Lingcod ▲
 Diver encounters wolf-eel ►

ALL PHOTOS THIS PAGE BY BARB ROY

day, Whittier still possesses a quaint remote-location charm, attracting thousands each year for fishing and whale-watching charters, kayaking and wildlife tours and scuba diving.

We headed for Smitty's Cove (where we later did our night dive) down a gravel road along the waters edge. Parking is readily available, for a nominal fee, but public washrooms are scarce on site. A wide concrete path leads into the water making entries and exits easy. Other divers, already finishing their first dive, were warming up pots of water for some tea. Visitors might want to add a portable stove and a pot to the packing list.

Smitty's Cove

Wayne and I geared up and entered the cool refreshing cove. Once underwater, we gradually descended with the sloping

bottom to 90 feet (27 meters), at the outer perimeters of the cove. There, we found a field of white, thin, five to six-foot tall Sea Whips. A few tiny Basket Stars clung to several whips, gently swaying in a slight current. Heading back to shallower depths, we paused at 50 feet (15 meters), to watch an adult wolf eel out in the open. It paid us little attention as it foraged through an overgrowth of ground-covering kelp in search of a tasty snack of green urchins, crabs or perhaps a bed of swimming scallops. Shrimp, lingcod and painted greenlings were among the cove's other many residents. Tiny decorator crabs busied themselves, gathering new décor for their shells near a bunch of old pipes and other debris. At 30 feet (9 meters) we came across the skeletal remains of an old barge. This was my favorite attraction, as the area teemed with juvenile green-

ish brown tubesnouts and a variety of colourful nudibranchs. Reddish-orange California sea cucumbers, multi-coloured sunflower stars and small white metridium anemones added even more to the collage. Both wide angle and close-up photography worked well at this location.

Glacier gazing

With an ample supply of accommodations, restaurants and campgrounds, Whittier also offered some excellent hiking trails. After a short hike and our night dive, Wayne and I opted to stay overnight and take in a bit of sightseeing on Phillips' 26 Glacier Cruise the following day.

During our cruise we passed glacier after magnificent glacier. Bird rookeries, breaching whales and furry sea otters filled our view. As divers though, we really wanted to have them stop their high-speed

Trawling to be banned near Aleutian Islands



WWW.NOAA.GOV

Trawling, in which boats drag mammoth nets along the sea bottom for miles, can easily crush the long-lived, brittle creatures on the Aleutian sea floor, which scientists believe may be the most diverse and abundant cold-water coral and sponge habitat on Earth. Scientists believe the coral may help incubate a fertile fishing area that helps supply a significant portion of U.S. seafood.

Therefore, in a plan to protect the deep-water corals and sponges that help nurse Alaska's fishing grounds, commercial trawling nets will be

banned from more than a million square kilometers of ocean near the Aleutian Islands. This is the largest area ever closed to fishing solely for conservation.

A whole new approach to protecting the rocky, colourful seafloor habitat has thus been initiated. Coming shortly after two scientific panels proclaimed the world's seas were in ecological trouble, the decision signals a shift in thinking about how to manage oceans, and puts new pressure on the bodies that oversee fishing in Atlantic, Pacific and Gulf Coast waters to follow suit.

Typically, entire oceans are open to fishing except in areas that have been specifically set aside to protect sea lions or rare birds, or to rebuild fallen crab stocks, for example. In this case, the opposite approach was taken. It recommended outlawing bottom-trawling everywhere in the Aleutians, except in the some 65,000 square kilometers of seas where boats fish today, minus a few

coral-rich areas that already are off limits. It will prevent the industry from spreading out into the Aleutians and further destroying coral, which ultimately could prove to be essential to the ecosystem.

The action was mainly fueled by an explosion in coral exploration, and the quest to understand its role in the ecosystem. In recent years, scientists have been taking deep-sea submersibles 350 meters or more deep along the volcanic flanks of the Aleutians. Here they found acres of coral gardens: red corals shaped like a Joshua tree; sponges shaped like spatulas, barrels or crooked human fingers; and a 1½ meter sponge that looked like a little girl's pigtailed. They were a brilliant green, violent shades of orange and bright yellow. Scientists even saw a lone predatory sponge that captured crustaceans for food. More than two dozen were coral species found nowhere else on earth. ■



WWW.NOAA.GOV. ALASKA FISHERIES SCIENCE CENTER, MARINE OBSERVER PROGRAM

Bringing a huge trawl aboard a commercial fishing vessel. (Filephoto NOAA)

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After more than thirty years, we thought it was time that the other 72% of the planet got some attention. Which is why we're asking people to Dive In To Earth Day the week of April 18 to 24. So grab some friends and install a mooring, do a reef survey, or organize an underwater cleanup. Everybody into the water. For more information, visit www.coral.org or call (415) 834-0900.





PHOTO BY BARB ROY

Alaska

catamaran, so we could jump in and check out all these critters below all the breathtaking scenery! Yes, another day in Alaska's paradise, I thought to myself as we boarded the train.

Seward

Seward, our next destination was another 80 miles (129 km) south over Turnagain Pass (elev. 988 feet / 301 m) and through Chugach National Forest. Coming into Seward, we detoured long enough to visit Exit Glacier. Although they do not permit this now, I had never touched a real glacier before today! It wasn't as cold as I thought it would be... The Alaska SeaLife Center is another attraction worthy of investigation, located on the water downtown. A diver can see firsthand the various species of marine fish and invertebrates they may encounter, before they even get wet.

While shore diving in Seward is limited to a handful of sites, most requiring a climb over large boulders, there are several seasonal dive charters available. We came across two, one based in Anchorage, Dive Alaska, and another based in Sterling, The Dive Shop.



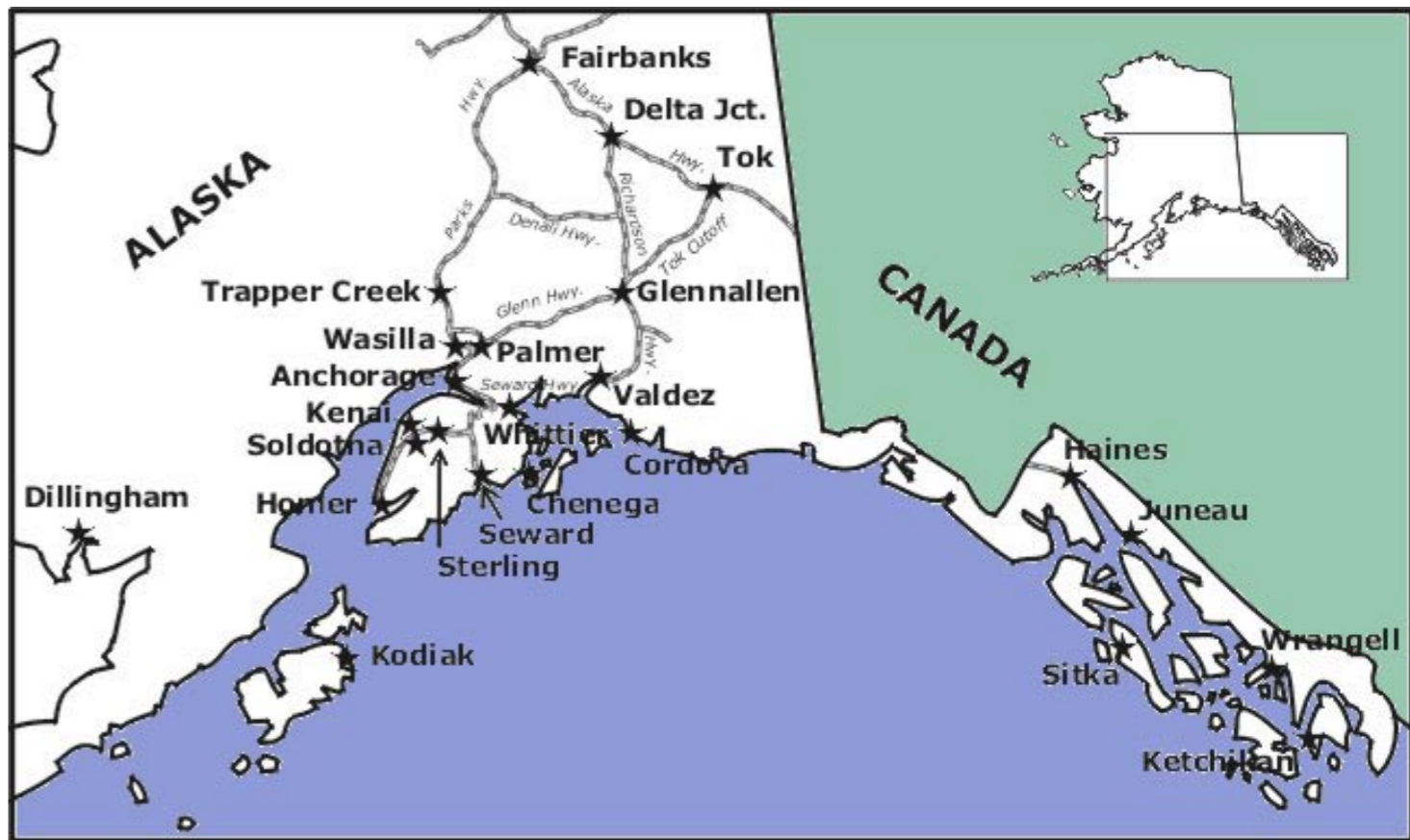
PHOTO BY BARB ROY

Barwell Island

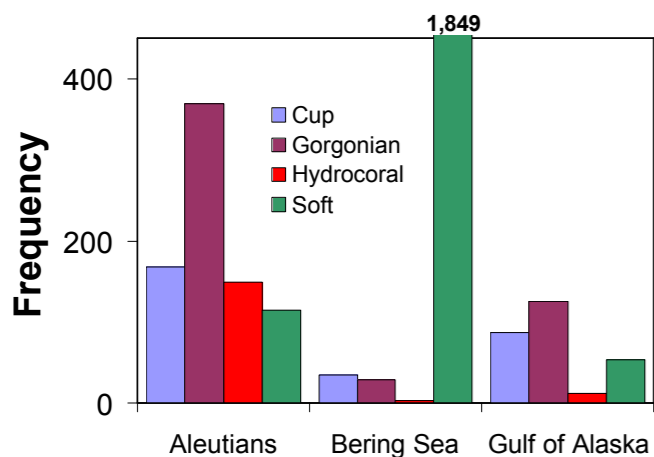
It was great to have an opportunity to explore Resurrection Bay, so we arranged a dive to Barwell Island the next morning with Ed Lindquist, owner of The Dive Shop. Ed met us at the boat harbor with his 22-foot (6.6 meters) Seasport boat. In no time at all we are heading down the long narrow passage of Resurrection Bay. The water was as smooth as satin sheets, making it easy to spot a small group of sea otters lounging in the sun. Sea Lions, Bald Eagles, and shore birds were all around. I was really impressed with the rugged mountain coastline running parallel on one side of the bay and the weather-beaten islands on the other.

Barwell Island turned out to be a very remote chunk of rock, open to the fury of the Gulf of Alaska. It was surrounded by clean blue ocean water. Looking at the island up close, I could see

- ◀ TOP LEFT: Barwell Island reef wall
- ◀ BOTTOM LEFT: Chart of coral growth in Alaska regions
- ▶ TOP RIGHT: View of The Sleeping Lady from Anchorage, Alaska
- ▶ BOTTOM RIGHT: Map of marine parks in south eastern Alaska



ALASKA TOURSIM



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Alaska

years of erosion caused from enormous pounding ocean swells and surf. Today however, it was calm and weather permitted an exploratory dive on the open ocean-side, which was normally unreachable.

We descended to a carpet of tan and yellow encrusting northern staghorn bryozoan covering the ocean's floor. Macro size brittle stars stretched tiny red arms out from their tangled shelter to filter the water. Clusters

of red and pink sea strawberries (soft coral) dotted the terrain as we continued to the 60-foot (18 meters) range. The various porifera (sponge) included; yellow breadcrumb sponge, orange finger sponge and brown chimney sponge housing juvenile rockfish. Stripped prawns, orange and red anemones and an assortment of invertebrates filled my macro framer, causing me to fly through my film way to fast!

A similar environment was discovered on the inside of the island during our second dive. Thankfully I had switched to a 50mm lens, because a friendly wolf eel peeked out from its den of invertebrate-covered boulders. With huge round eyes on a flabby gray mottled face, the eel stared out at us with curiosity. Realizing that some adults can attain a length of up to eight-feet, we guessed this one to be pretty close to that. With a diet of giant red sea urchins, no wonder they are so unusual critters.

As we continued on, we came across huge rock faces, also blanketed in invertebrate life. In some areas it appeared

that nature had painted a canvas of orange tunicates, yellow cup corals, tan feather stars and white sea squirts. In some areas I found pink mouth hydroids and multi-coloured painted anemones. Huge Snakelock (or Crimson) anemones sat high on rocks, with their long delicate tentacles gathering food in the surge. White-spotted (Tealia) anemones, yellow and white coloured swimming anemones and lacy orange peel nudibranchs were everywhere. Both dives proved to be superb for wide angle, close-up or macro photography.

Before heading back Ed took us around the island to get some shots. An old wartime shelter could be seen from the highest point. It must have been some kind of a lookout where soldiers would watch for approaching enemy ships during times of war. Now, the only fighting that goes on is from squabbling nesting seabirds.

As we passed by Fox Island, Ed pointed out the location of a sunken barge. Covered in a growth of kelp, the wreck is home to a countless number of fish, nudibranchs, a pair of wolf eels and several giant Pacific octopuses.

Afterwords

During our journey back to Seward, Wayne and I were already planning our return journey. Homer, Seldovia, Kodiak Island and hiking through Denali National Park were added to the next adventure's agenda and I'm sure time won't pass by quickly enough! ■



- ▲ TOP LEFT: Orange Peel Nudibranch
- ▲ BOTTOM LEFT: Year-round diving at Whittier
- ▶ TOP RIGHT: Weathered Island, Resurrection Bay
- ▶ BOTTOM RIGHT: Sculpin at Barwell Island

ALL PHOTOS THIS PAGE BY BARB ROY





fact file

Alaska, USA



History The 13 American colonies broke with Britain in 1776. They were recognized as a new nation called the United States of America after the 1783 Treaty of Paris. Thirty-seven new states and overseas possessions were added during the 19th and 20th centuries as the nation expanded westward over the North American continent. The Civil War (1861-65) and the Great Depression of the 1930s were the two most traumatic experiences in the nation's history. Victories in World Wars I and II as well as the end of the Cold War in 1991, has boosted the US into a seat as the world's most powerful nation state. Rapid advances in technology encourage a steadily growing economy marked by low unemployment and inflation.

Geography Located in North America, the U.S. borders both the North Atlantic Ocean and the North Pacific Ocean, between Canada and Mexico; Total area: 9,631,418 sq km, land: 9,161,923 sq km, water: 469,495 sq km; Coastline: 19,924 km; Terrain: vast central plains, mountains in the West, hills and low mountains in the East; broad river valleys and rugged mountains in Alaska; rugged, volcanic topography in Hawaii; Lowest point: Death Valley -86 m; Highest point: Mount McKinley 6,194 m; Natural resources: coal, copper, lead, molybdenum, phosphates, uranium, bauxite, gold, iron, mercury, nickel, potash, silver, tungsten, zinc, petroleum, natural gas, timber; Natural hazards: tsunamis, volcanoes, and earthquake activity around Pacific Basin; hurricanes along the Atlantic and Gulf of Mexico

coasts; tornadoes in the midwest and southeast; mud slides in California; forest fires in the west; flooding; permafrost in northern Alaska, a major obstacle to development; Note: The U.S. is the third-largest country in the world by size after Russia and Canada, and by population after China and India.

Climate is mostly temperate, but arctic in Alaska, semiarid in the great plains west of the Mississippi River, arid in the Great Basin of the southwest, and tropical in Hawaii and Florida; low winter temperatures in the northwest are relieved occasionally in January and February by warm chinook winds from the eastern slopes of the Rocky Mountains.

Population 293,027,571 (2004) white 77.1%, black 12.9%, Asian 4.2%, Amerindian and Alaska native 1.5%, native Hawaiian and other Pacific islander 0.3%, other 4% (2000); Note: Census bureau Hispanic numbers are included in the percentages of white, black and Asian groups. Religions: Protestant 52%, Roman Catholic 24%, Mormon 2%, Jewish 1%, Muslim 1%, other 10%, none 10% (2002 est.); Below poverty: 12%

Currency US Dollar (USD\$); Exchange rate: USD 1 = EUR .77
Language English, Spanish

Economy With a per capita GDP of \$37,800, the U.S. has the largest and most technologically powerful economy in the world. It is market-oriented and driven by private individuals and business firms who make most

of the decisions. The federal and state governments buy most of the needed goods and services in the private marketplace.

Travel:

The Alaska Marine Highway
1-800-526-6731

www.akferry.com

Alaska Travel Industry Association

www.travelalaska.com

Alaska Railroad Corporation
1-800-544-0552 or 907-265-2494

www.akrr.com

Denali National Park and Preserve
907-683-2294 (winter phone)
907-683-1266 (summer phone)

www.nps.gov/dena

Diving:

The Dive Shop
Ed Linguist, 907-252-9017

www.scubaalaska.com

Dive Alaska
Scott Anderson, 907-770-1778

www.divealaska.net

Last Frontier Diving
Loic Thomas, 907-222-6706

www.lastfrontierdiving.com

Reference Books:

Under Alaskan Seas, by Lou and Nancy Barr

Alaska Wildlife Viewing Guide, by Michelle Sydeman, Annabel Lund
Natural Wonders of Alaska – A Guide to Parks, Preserves & Wild Places, by Kent Sturgis

The Milepost, An annual publication of Morris Communications Corporation ■



Map of the United States of America including Alaska and Hawaii

National Park Service

National Park Service
U.S. Department of the Interior

Glacier National Park www.nps.gov

<p style="font-weight: bold; color: #006600; margin: 0;">Parks & Recreation</p> <p style="margin: 5px 0 0 0;">find a park to visit. Learn more about your National Parks</p>	<p style="font-weight: bold; color: #990000; margin: 0;">History & Culture</p> <p style="margin: 5px 0 0 0;">preserving America's history in parks and communities</p>	<p style="font-weight: bold; color: #990000; margin: 0;">Nature & Science</p> <p style="margin: 5px 0 0 0;">discover the natural wonders in parks and how we use science to conserve them</p>	<p style="font-weight: bold; color: #000066; margin: 0;">Interpretation & Education</p> <p style="margin: 5px 0 0 0;">the place for teachers and learners of all ages, park fun for kids</p>
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**POINT & CLICK
ON BOLD LINKS**



Edited by
Andrey Bizuykin
& Peter Symes

Equipment

New & Interesting

Back to the Future



FD-70 housing

The Fantasea FD-70 for the Nikon D-70 is a compact and lightweight polycarbonate housing with ergonomically designed handles, making it easy to hold and use. The FD-70 also protects against damage from rain, snow, dust, sand and dirt. It is a valuable tool for many commercial, industrial, and medical applications, because it is resistant to most liquids and sprays. The FD-70 housing is rated to a depth of

200 feet (60m). Suggested retail price: USD 999
www.fantasea.com



The new Mistral is a modern version of the original double hose regulator invented by Jacques Cousteau and Emille Gagnan in 1943, combined with the refinements of modern regulator technology. Incorporating a timeproven dry sealed first stage, a unique completely sealed second stage, the unique double hose design will appeal to underwater photographers, videographers and ice divers. Compatible with EAN 40 right out of the box.

www.aqualung.com

Let there be Light!

Nocturnal Lights are now introducing a whole new series of dive lamps for the discerning user. The mid-range SL50, uses rechargeable NiMH batteries which have been overcharged to 14.4v, which increase light output to 30 – 40% more than standard 12v systems. The lamp comes with 20w, 35w, and 50w bulbs that are interchangeable. Burntimes are: 120min at 20w, 80min at 35w, and 45min at 50w respectively. The lantern style handle also doubles as a video arm or camera arm mount, which includes mounting hole. Priced at USD 330.
www.nocturnallights.com

Interesting inventions

Thermocline Explorer

THERMAL PROTECTION HAS EVOLVED

The new Thermocline Explorer exposure suit for warm water diving from Fourth

Element has been heralded as a revolution in scuba diving thermal protection. As it is neutrally buoyant and very lightweight, there is no, or very little, need for lead. Obviously, this means less strain on the lower back, and fluctuations in the buoyancy of the suit with depth are no longer a factor. The increased comfort and freedom of a neutrally buoyant suit is clear.

With the equivalent thermal protection to 2.5mm neoprene, the breathable, fleecelined material developed by Polartec, is perfect as a high performance successor to neoprene. Fast drying, lightweight and machine washable,

(cont'd next page)



ScubaDoRag

Unlike cotton products, the original ScubaDoRag material dries fast, stretches to fit, and will maintain its color and shape. The ScubaDoRag is designed for divers to tame the hair, identify them underwater and provide sun protection on the surface. For longer hair, the Ragtails can be tied over and under the ponytail and stuffed into the Secret Compartment in the Stingray Pouch™ or use for storing cash, credit card/ID, key or a lucky charm. The limited edition prints, solids, and textures are highly visible above and below the sea.

www.scubadorag.com

Poseidon: To BeSea or not to...

We make the best regulators in the world, says Yaniv Bertele, responsible for R&D at Poseidon. "Now we are hoping to take the same leading position on BC's as well." The Harness is available in two different models, *Advanced* and *Sport*, developed to fit everyone from the smallest woman to the biggest guy. The ergonomic of the harness makes you carry the heavy tanks with your hips instead of around shoulders. The HybroBack™ has a soft upper back and a hard lower back is hard connected via a size adjustment sys-

tem. The length can be altered to fit from XXS to XXL. Lumbar Support placed where back meets the seat, without needing any tools. It distributes all weight absorbed by the lumbar support, spread around the waist instead of around the shoulders. Together with the ergonomically shaped shoulder straps, the lumbar support system and the anatomically correct HybroBack™, anyone from the smallest woman to the biggest guy can make BeSea fit perfectly.

besea.poseidon.se





Dry Delta 4

"One hot new regulator ready to take on all challengers with improved performance," states Oceanics website. New features, improved styling, and the new FDX-10 First Stage, featuring the exclusive Dry Reg Technology, which prevents moisture and contaminants from entering your first stage, even if the dust cap is left off. No more corrosion of critical internal components, bacteria, hose deterioration, and damaged gauges and computers. When your dive is finished, before the regulator is even removed from the tank valve, the Dry Reg Technology system is already closed, sealing out moisture and any other contamination.

www.oceanicworldwide.com



Kinesis

The new Kinesis fins from Sherwood Scuba utilizes its patented Optimal Pivot Blade (OPB) technology to increase kick efficiency, minimize fatigue and maximize acceleration. Effortless propulsion with optimum thrust. Offered in two models, the Kinesis, and the Kinesis EX, which is designed for advanced divers seeking higher performance. The KINESIS comes in blue and yellow colors with black accents, the EX model only in black in black. Suggested retail prices are USD129.95 and for the EX, USD149.95.

www.sherwoodscuba.com

(from previous page)

the fabric is perfect for an exposure suit designed with travel in mind.

The Thermocline Explorer is a zipless suit giving exposure protection to the legs and body. When worn with a long or short-sleeved top, this combination ensures a double layer on the body core, maximising thermal protection and performance.

The Thermocline range also includes a short sleeved top, men's and women's vests and shorts and even a bikini. The garments can also be used to add comfort add warmth, worn underneath a wetsuit for extra protection without the associated buoyancy increases.

For more details visit

www.fourthelement.com

Also see the test review in this issue

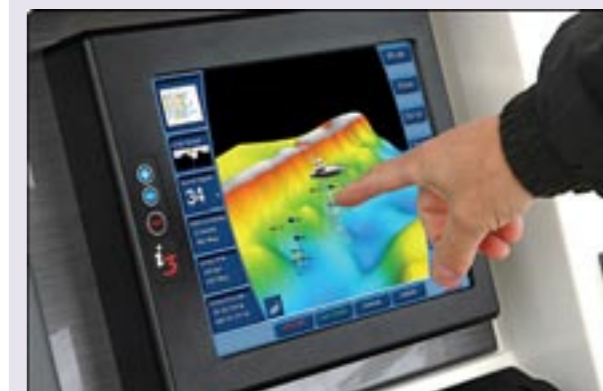
Seaspy

This underwater housing from Equinox Underwater Products, designed to fit a majority of today's popular cameras, provides an affordable solution to photographers wanting to expand to digital underwater photography. The SEASPY housing can also be custom-manufactured to individual needs and cameras at no additional cost on request. Priced at USD 325. Depth Rating: 50 meters. www.diveequinox.com



Full-featured from Amphibico

Amphibico has launched its all-new, full-featured Phenom FXZ1 HDV marine housing for the Sony® HDR-FX1 & HVR-Z1U HDV camcorders. With its ergonomic functionality and high quality construction, the phenom fxz1 will once again afford its users the best possible underwater "images.....even better than the real thing", as Amphibico puts it. This full-featured housing provides access to all key camcorder functions to depths of 330 feet or 100 meters and, in addition to a long list of features, Amphibico's usual high quality, full zoom-through 94 degree optics will complement the package. www.amphibico.com



A fine touch!

Radar, echo-sounder, chart, GPS and what not - all in one. More than just another sophisticated chart plotter, Maptech i3 is an extraordinary, integrated nautical information system. All operated effortlessly by Touch Screen you can send and receive emails or send messages via fax or voice. You can even send a message showing your boat's location on a real chart. Request and receive weather reports based on your actual GPS position. And you can even automatically monitor vital onboard systems when you're away from your boat.

www.maptech.com

Have a Blast!

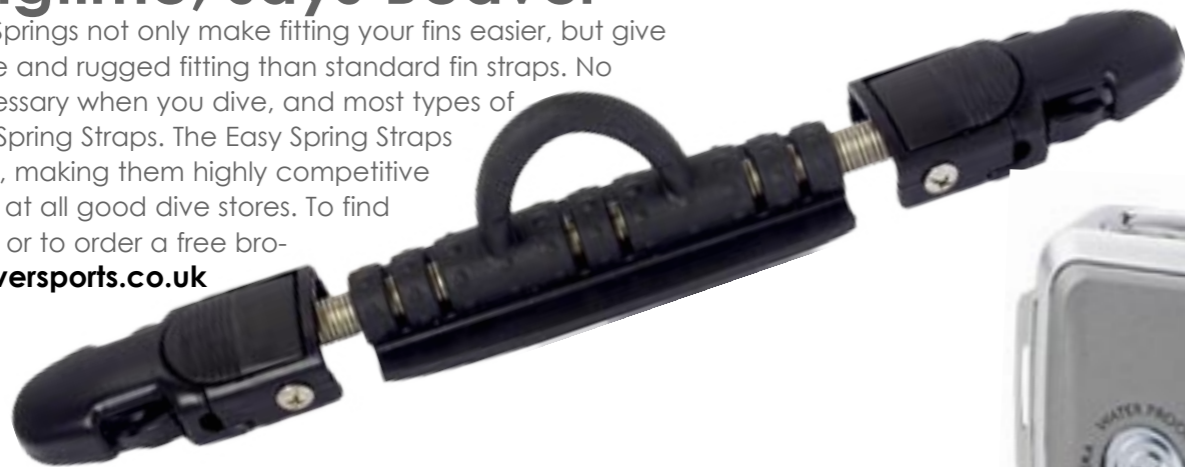
The new Blast is designed so that divers can operate it easily with cold hands or gloves in an emergency. There are no tiny buttons to locate - you just grip the body of the unit and squeeze the spring-loaded halves together to activate. The Blast operates from a medium pressure hose and comes in three versions, each with a swivel connection so that the unit can be rotated to the ideal position. The new Blast is also useful as an air-gun for filling SMBs or liftbags underwater.

www.apvalves.com



It's springtime, says Beaver

Beaver's Easy Fin Springs not only make fitting your fins easier, but give you a more secure and rugged fitting than standard fin straps. No adjustment is necessary when you dive, and most types of fin will fit the Easy Spring Straps. The Easy Spring Straps retail at GBP 16.95, making them highly competitive and are available at all good dive stores. To find your local supplier or to order a free brochure: www.beaversports.co.uk



Elegant Everywhere

Snorkel, ski, or a stunning wedding, This latest digital delivers both on land and in the sea with a faster .6 second start up, a quick .05 second shutter release, movie mode and a generous 2.0 inch monitor. A beautiful, petite JIS Class 8 waterproof-rated exterior promises you'll capture images proudly just under the water's surface or in the most formal settings. Finally, your wait is over for petite, durable, go everywhere digital. Priced at under USD 400.



www.pentaximaging.com

How about a Great White Wine and a good Book?

Great White Wine

Do you like good white wine and are you passionate about sharks? Well, if that is the case then you probably have a lot in common with the founders of Great White Wines, Melanie Marks, 33, and her husband, Mark Horton, 37, who founded their company partly out of interest for great wines and in an effort to protect the great white sharks.

These fascinating, widely mis-

understood and threatened species have declined worldwide by 80 percent over the past 15 years. Great White Wines have pledged to work towards changing the image of the shark from a feared and hunted species to a respected and valued one. The two have pledged to donate 10 percent of Great White Wines' profits to shark research and educational institutions, such as the Monterey Bay Aquarium.

Marks came up with the idea of combining a wine-tasting hobby with marine conservation some years ago after returning

from a scuba diving vacation to South Africa, where she dove with white sharks in what proved to

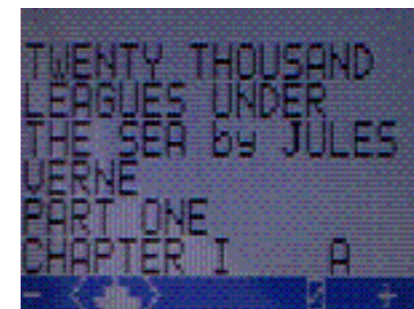
be an life-altering experience.

After some initial research into the wine industry, the couple hired small-business consultants to help them launch their new label. Marks and Horton put their custom label on bottles and import the wine from the Zidela winery in South Africa, whose government was the first to protect white sharks.

True to their label, they carry only varieties made from white grapes. They refuse to bottle red wine because it might evoke the kind of blood-thirsty image about sharks they want to erase.

www.greatwhitewines.com

Don't drink and dive



Read a book on your Dive Computer!!

Delta P Technology UK have released a new optional feature for the VR2 and VR3. Deco Books allows a diver to download an electronic book or any text file from a PC into his dive computer to read during long shallow decompression stops or even on deck during surface intervals. 20,000 characters (around 40 pages in a paperback) can be stored at a time. The Deco Books feature is only accessible by a diver at a depth of 6 metres or shallower, just like the famous Octopus Game. And talking of Games, Deco Books comes bundled with two brand new games, Wreck Finder and Buddies, that divers can play on their VRs as they hang around. Full details at: www.vr3.co.uk

Sarawak - Malaysian Borneo

Miri Reef Map

Sarawak's ecological heritage is among the most distinctive in the world. Being part of the Indo-Australian Archipelago, the epicentre of marine biodiversity, the region comprises nearly 1000,000 square kilometer of coral reefs or 34 percent of the world's total, housing 600-800 reef-building coral species in the world. It is home to more than 3,000 species of fishes and the richest concentration of invertebrate species.

Underwater Jungle
www.sarawaktourism.com

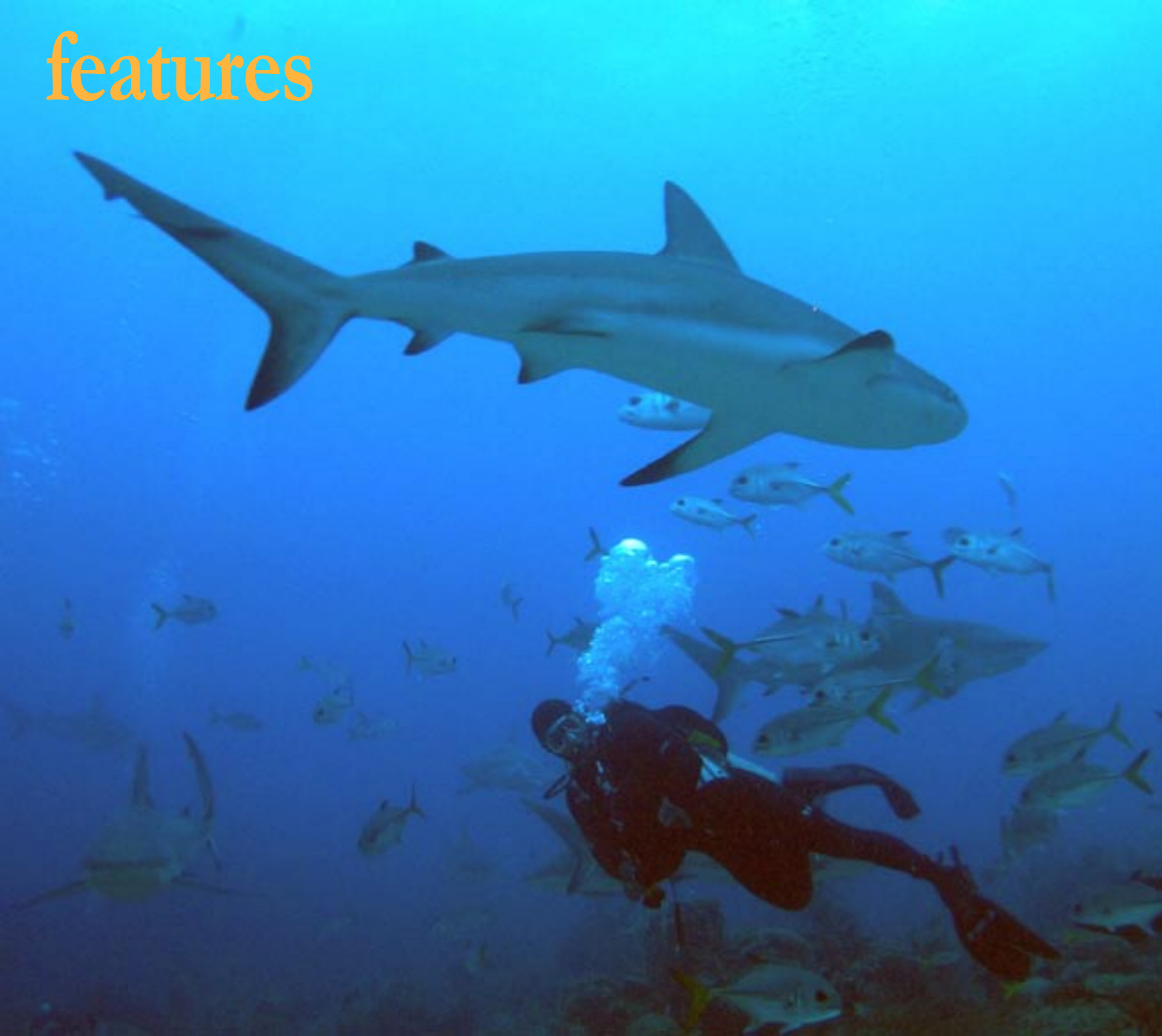
SARAWAK TOURISM BOARD
Level 6 & 7, Bangunan Yayasan Sarawak
93400 Kuching, Sarawak, Malaysia
Tel: +60 82 423000 Fax: +60 82 416700

Divers get an up close and personal encounter with sharks at Anthony's Key Resort

Sharks of Honduras

Text and photos
by Bill Becher

ROATAN ISLAND, Honduras --- The attorney strokes the white belly of an eight-foot-long reef shark. This is not a lawyer joke. I'm 70 feet (23 m) deep in the clear blue Caribbean water off Roatan Island with a half dozen scuba divers from Anthony's Key Resort. We're at a dive site called "Cara a cara," which in Spanish means "face-to-face."



A diver swims with the sharks of Roatan

We're cara a cara with 20 gray reef sharks. The biggest are nine feet long. The sharks glide by silently, swimming slowly past schools of smaller fish that seem unafraid.

Remoras attach and reattach themselves to the sharks. They're not parasites — the remoras count on the

sharks' sloppy eating habits and dine on scraps of fish the sharks miss.

Sergio Tritto, our dive master and a former lawyer from Italy, is the one petting the animals. It's a case of "Do as I say, not as I do," as he warned us before the dive not to touch the sharks. He also said, "Don't wave your

hands." The sharks might mistake a hand for a fish and bite it.

Shark to Shark Guide

Tritto said he had been unhappy in his job as a legale in Naples and was searching for a new career. A friend told him about the sharks that con-

Roatan Sharks

gregated at a spot off the windward coast of Roatan, an island in the western Caribbean popular with scuba divers. Tritto decided to make a business out of leading shark dives.

In the pre-dive briefing he told us to descend the anchor line and form up on at a sandy patch with our backs against a coral wall so the sharks can't sneak up on us. Like Spitfire pilots in a school of Messerschmitts we protect our six o'clock. If everything is right we will get to swim with the sharks before the feeding frenzy said Tritto.

Tritto has brought a white plastic pail full of fish to feed the sharks. He's wearing a pair of chain mail gloves as a shark did bite his hand once. So much for professional courtesy.

Tritto signals us that we can swim freely with the sharks. Seeing the reef sharks slowly circling around us is something none of us will soon forget.

Feeding Frenzy

We line up again in front of the coral wall. Tritto opens the fish bucket and the feeding frenzy is on. The sharks are especially aroused by the sound of jaws snapping on fish and there is a lot of snapping going on.

One shark gets his head stuck in the bucket.

Tritto grabs the shark and tries to turn it on it's back to calm it, but the shark just shakes his head, bucket attached. The bucket comes off and the shark swims away.

We head back up the anchor line. On the boat everyone is talking at once about their amazing experience with the sharks.

Controversy

Feeding sharks is somewhat controversial. Opponents say it can be dangerous and that it alters wild creature behavior. Those who defend it say that

Maybe worth knowing

Tidbits

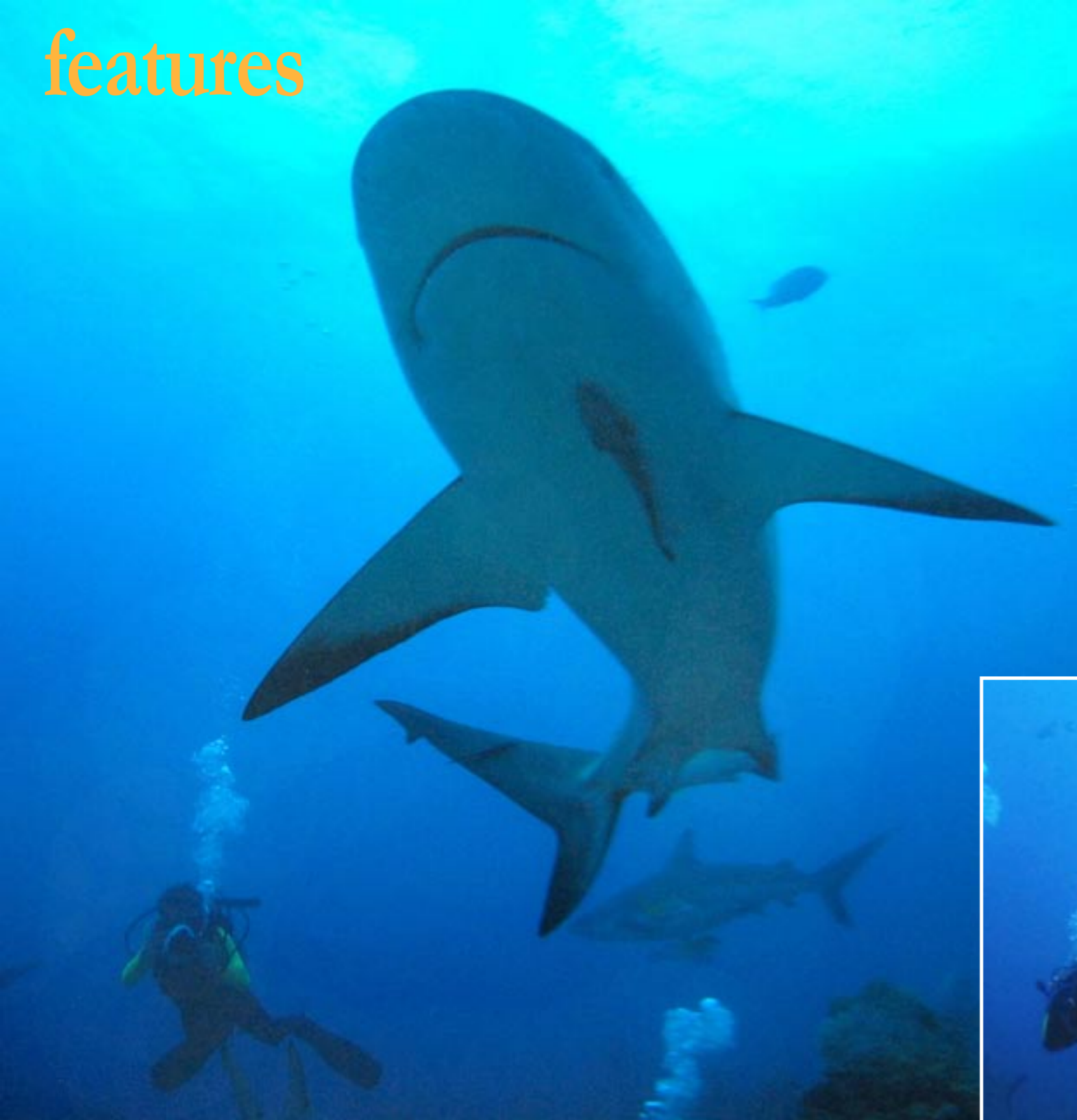


Cannon balls retrieved from ancient shipwrecks should be handled with care, they may explode even centuries later. Marine archaeologists have recorded several occurrences of the rusted iron balls spontaneously heating up and exploding after exposure to the air. In one case, at the National Museums and Galleries of Wales in Cardiff, a cannonball retrieved from a 1691 wreck heated up to a few hundred degrees after several minutes in the open air, began to glow a dull red and started burning its way through a pine table top.

Others have split open by themselves many weeks after they were pulled from the sea.

It has been suggested that the iron develops a lattice-like porous structure over the hundreds of years spent underwater that reacts exothermically with the oxygen in the air to produce massive amounts of heat. The combination of oxygen and sea salt caused rapid oxidation resulting in the balls "exploding" open and crumbling into bits.





Roatan Sharks

the shark encounters help educate people about sharks and create support for conservation programs.

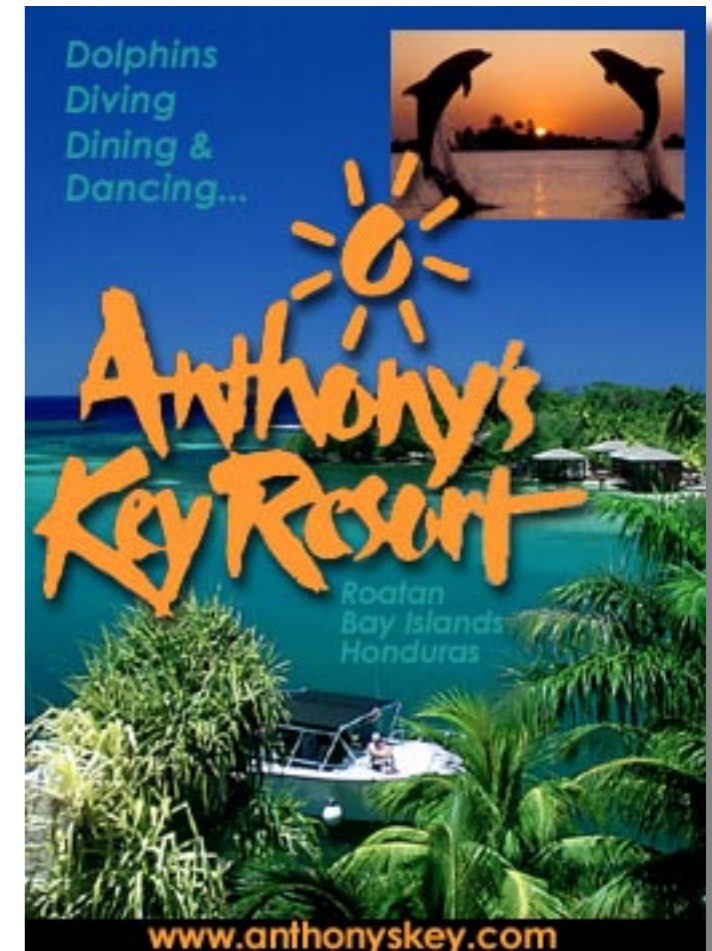
Tritto says he's careful and only feeds the sharks a small amount of food so they won't become dependent on the handouts. His feeding spot is far from any beaches where swimmers might congregate.

Anthony's Key Resort

The shark dive is one of the optional activities at Anthony's Key Resort.

There is also a Monday night beach party with crab races and a limbo contest. I divide my time between eating, diving, riding, paddling and thinking about sharks while swaying in a hammock watching the sunset.

Bill Becher can be reached at billbecher@yahoo.com



Remoras attach and reattach themselves to sharks so they can scavenge on scraps left over by their hosts ▲

An adult gray reef shark can be about 3 meters in length ►



fact file



Honduras



Map of Honduras

History: Honduras became independent of Spain's vast empire in 1821. A freely elected civilian government came to power in 1982, after 25 years of military rule. However, Honduras became a haven for anti-Sandinista contras fighting the Marxist Nicaraguan Government and an ally to Salvadoran Government forces fighting against leftist guerrillas during the 1980s. In 1998, the country was devastated by Hurricane Mitch, which killed 5,600 people and caused \$2 billion in damage.

Government: democratic constitutional republic
Capital: Tegucigalpa
Currency: lempira (HNL) Exchange rates: lempiras per US dollar - 17.3453

Languages: Spanish, Amerindian dialects
Climate: subtropical in lowlands, temperate in mountains

Geography: Central America, bordering the Caribbean Sea, between Guatemala and Nicaragua and bordering the Gulf of Fonseca (North Pacific Ocean), between El Salvador and Nicaragua; Terrain: mountains in the interior, narrow coastal plains, has a short Pacific coast but a long Caribbean shoreline, including the uninhabited eastern Mosquito Coast, Elevation extremes: lowest point: Caribbean Sea 0 m; highest point: Cerro Las Minas 2,870 m; Coastline: 820 km, Natural hazards: frequent but mild earthquakes; hur-

ricanes and floods along the Caribbean coast; Agriculture: bananas, coffee, citrus; beef; timber; shrimp; Industries: sugar, coffee, textiles, clothing, wood products

Environment issues: urban sprawl; deforestation from logging and clearing; land degradation, soil erosion, farming of marginal lands; mining activities cause heavy metal polluting of fresh water sources.

Population: 6,823,568
High mortality due to AIDS cause lower life expectancy, higher infant mortality, higher death rates, lower population and growth rates; Below poverty line: 53%; Ethnic groups: Mestizo

90%, Amerindian 7%, Black 2%, White 1%; Religions: Roman Catholic 97%, Protestant minority

Medical/Deco chambers: Cornerstone Decompression Chambers and Clinic at Anthony's Key Resort in Sandy Bay tel. 455 1049 / 445 1003. Fantasy Island at French Key. Woods Medical Center 24 hour service Tel. (504) 445-1080.

Dive Travel: Anthony's Key Resort
www.anthonyskey.com
Bahia Tours
Email: akr@anthonyskey.com
800-227-3483 or 954-929-0090 ■

Organiser and Management:
OceanNEnvironment Ltd ACN No: 873 67085
P.O. Box 2138, Carlingford, NSW 2118, Australia
Tel : 61 (02) 9 686 3688 Fax: 61 (02) 9 686 8438
cts@oneocean.com, www.celebratethesea.com



Participate in the Biggest Event of the Sea in 2005

Celebrate the Sea is now in its fourth year, after a successful beginning in 2002, the festival has grown to the largest of its kind in the Asia Pacific. After two great festivals in Kuala Lumpur in 2003 and 2004, we return to Singapore and the Suntec City Convention Centre in 2005. Continuing from our previous years we have as special guests some of the world's greatest underwater luminaries. Already confirmed for Celebrate the Sea 2005 are National Geographic Explorer in Residence, Dr. Sylvia Earle, National Geographic Photographer David Doubilet and Australia's own marine adventurer Neville Coleman. We will hold a series of workshops and lectures on underwater photography, exploration, marine science and the latest digital techniques. Celebrate the Sea exhibitors will include resorts and dive operators in the Asia Pacific, photographic equipment manufacturers, environmental groups and more. Award winning underwater documentaries from Antibes and previous winners of Celebrate the Sea will be shown during the festival. Our international photographic and video competitions attract entries from all over the world, finalists will be on display at Celebrate the Sea in our galleries.

Organised by:

ASIAN GEOGRAPHIC
MUSTANG ASIA
SCUBADIVER

In Association with:

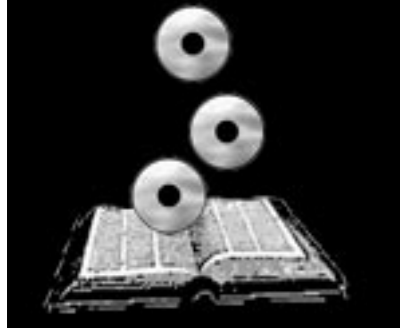
www.underwater-festival.com

Supported and Endorsed by:



Venue: Suntec City Convention Centre Level 3, Gallery.
Date: Friday June 3 to Sunday June 5 2005
Opening times: 10:00-20:00 (Friday); 10:00-18:00 (Saturday & Sunday)
Visitors: 10,000 expected over three days; 250 masterpass holders in our workshop track.
Exhibitors: Dive resorts, Liveaboard operators, dive equipment manufacturers, environmental NGO's, photographic equipment and more.

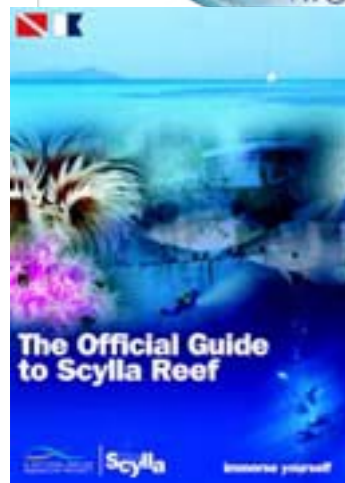
media



Books Film DVDs CDs

Edited by Peter Symes & Michael Symes

POINT & CLICK ON BOLD LINKS



For the wreckies

Boom!

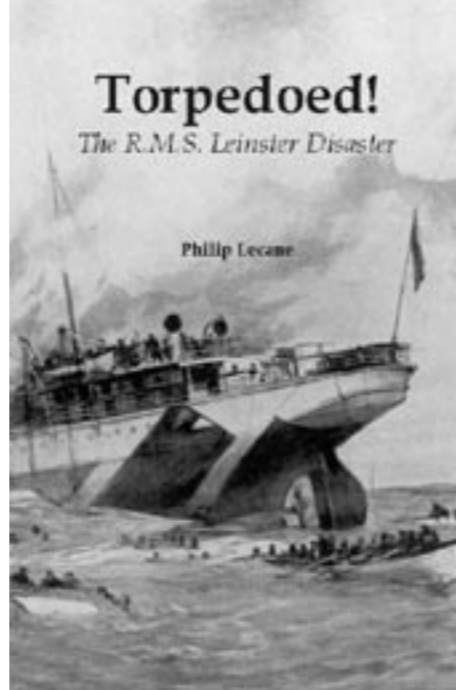
A New Focus for Divers and Scientists, writes the National Marine Aquarium in Plymouth, England. Scylla Reef is a tremendous local outreach project that provides a venue for leisure diving and a centre for education and research as the vessel becomes a reef.

Like all reefs, Scylla is a fragile environment. As she is colonised the anemones, sea squirts and other marine life will settle, and fish and other mobile animals will be attracted to the developing reef.

The Reef Guide includes an extensive plan of the superstructure and the decks of Scylla, dive and harbour information and a

marine species guide. It is printed in full colour on waterproof paper and is not only a useful planning tool but also a great memento of this brilliant dive.

www.national-aquarium.co.uk

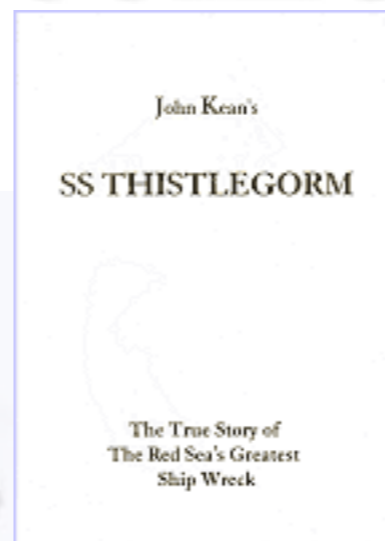


Torpedoed!

The long forgotten story of the sinking of the R.M.S. Leinster in the dying days of the First World War is brought back to life in this intriguing tale of the disaster. Torpedoed by the German submarine UB-123, 501 of the 771 people on board were killed, marking the event as the worst maritime tragedy ever witnessed in the Irish Sea. The Leinster carried civilian passengers, postal workers and military personnel from Ireland, Britain, the United States, Canada, New Zealand and Australia, and as such its

loss had an impact around the globe. This remarkable book tells the stories of those on board the Leinster and UB-123 and sympathetically examines not only the sinking but also its ramifications for those left behind. This well-researched work will appeal to any with an interest in the sea, as well as military and maritime historians and genealogists. Price: GBP 15.99

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SS Thistlegorm

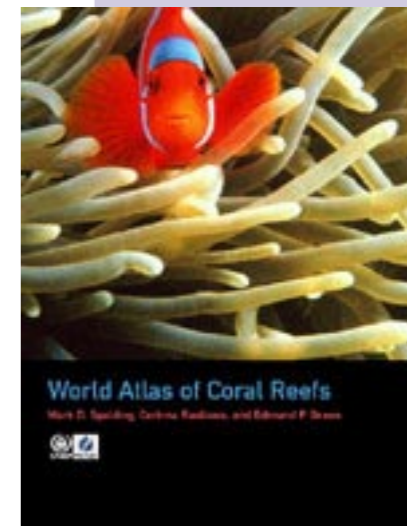
Here for the first time the true story of the Red Sea's greatest ship wreck is now revealed in spectacular detail in John Kean's SS Thistlegorm. Spanning a period of over one hundred years, from the origins of Thistle Ships to present day diving on the wreck, this explosive new book silences, once and for all, the rumours and speculation surrounding this famous and mysterious dive site that has attracted nearly a quarter of a million visitors from all over the world.

Packed full of never-seen-before photography, including the only two pictures known to exist of the Thistlegorm on the surface, the book gives living eye-witness accounts of the ship's final hours through a series of exclusive interviews.

GBP 21.95 plus P&P at BSAC's webshop

www.bsac.org/shop/bookshop.html

Scientific stuff



WORLD ATLAS OF CORAL REEFS

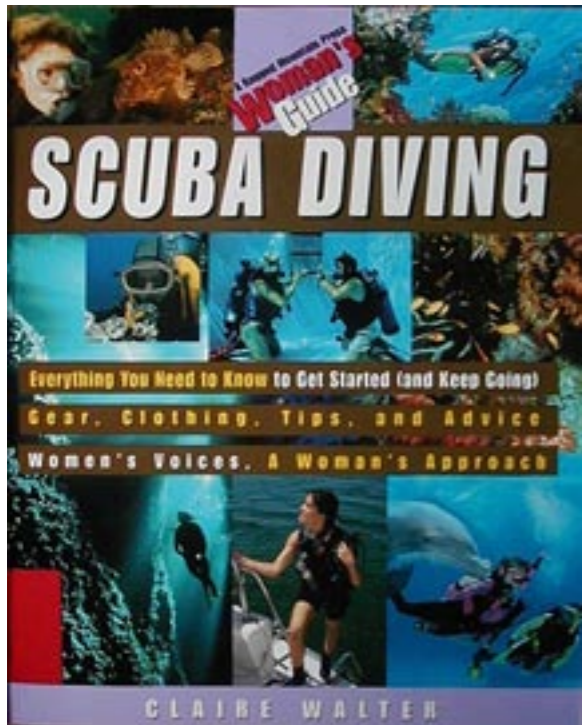
This guide is an invaluable resource that can be appreciated and enjoyed by a broad audience — from scientists to world travellers, including individuals with an interest in the natural history of

coral reefs, travel organisations, resource managers and college students. The book will also aid divers and boat owners with key information on reefs worldwide. ISBN 0 520 23255 0. Price: USD 55.00 or GBP 35.95. Buy the atlas from University of California Press, IUCN World Conservation Bookstore or Earthprint. www.unep-wcmc.org

FIELD GUIDE TO ALASKAN CORALS

Two marine scientists, Dr. Bruce Wing of NOAA Fisheries in Juneau and Dr. David Barnard of the Alaska Department of Fish and Game in Kodiak, have released a photographic field guide to deep sea Alaskan corals. Wing and Barnard relied on their own observations, fisheries observer data, and specimens from as far back as 1905 in their five-year writing effort. The book's photos depict the corals after they've been pulled up on deck, the way fishermen and fisheries observers see them. www.sitnews.us





Women's Guide to Scuba Diving

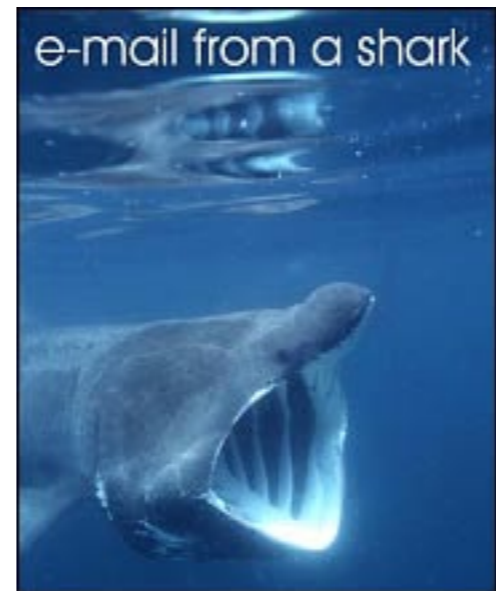
Snipped from Amazon's review: This edition to the successful Ragged Mountain Press Woman's Guides will introduce the rapidly-growing sport of scuba diving, the fastest growing segment of which is women. Claire Walter addresses women's issues in everything from getting started and diving basics to advanced diving. As with other titles in the series, she weaves women's voices into the narrative to provide a range of assuring experiences. Among topics covered are overcoming one's fears, choosing the right instructor, equipment, your first dive, and expanding your horizons. Price from USD 25.74

www.amazon.com

Extraordinary Fish

Frances Dipper
Paperback: 99 pages
BBC Books
ISBN: 0563534095
Amazon price: GBP 6.39
www.amazon.co.uk

With some 25,000 species, there are many more kinds of fish than mammals alive today. To scan the whole of their world is a tall order but this book provides a beautifully illustrated overview of these remarkable creatures, who were around over 350 million years ago. Since they have been around for so long it is not surprising that they are so diverse and successful. Fish have occupied virtually all the corners of the aquatic world from the wonderful variety of cichlids which live far inland in the lakes of the East African Rift Valley to the rat-tails which haunt the wreck of the Titanic and the monstrous-looking angler fish of ocean depths. Packed with information, and with an illustration on practically every page, Extraordinary Fish shows how life, survival and reproduction are as difficult for a fish as for any other animal.



Email from a shark

It's the second biggest shark in the world, yet very little is known about it - where it comes from, where it goes - until now. This is a story of the discovery of the secrets of one of the most ancient fish on the planet by a combination of modern technology and scientific detective work. One of wildlife's greatest mysteries unravelled... with a few surprises.

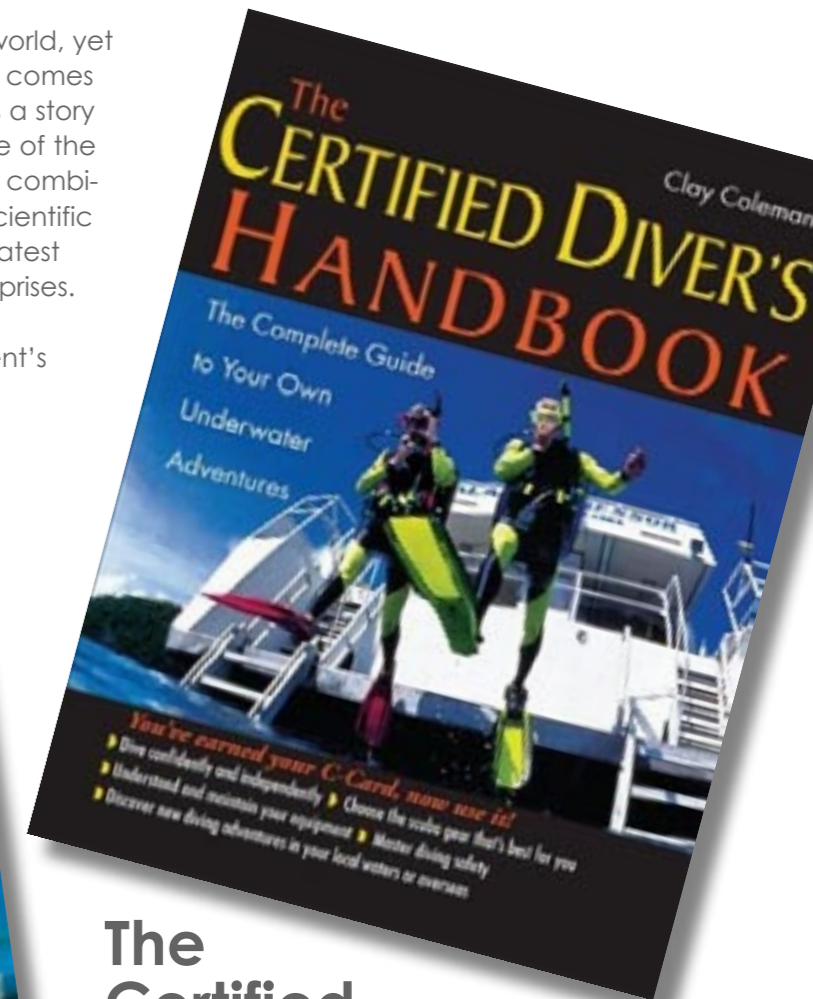
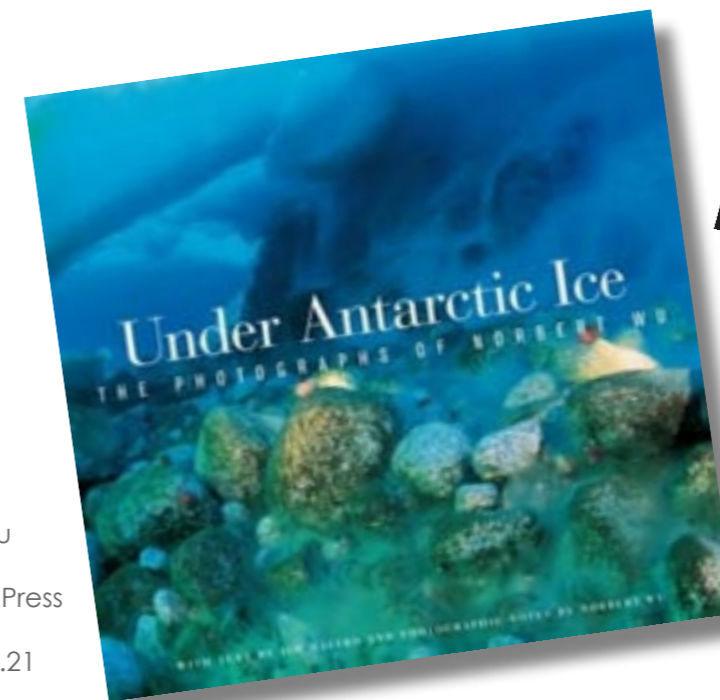
Format: Video. Seen at Fourth Element's webshop for GBP 15.00

www.fourthelement.com

Under Antarctic Ice

The Photographs of Norbert Wu
Jim Mastro, Norbert Wu
Hardcover: 198 pages
University of California Press
ISBN: 0520235045
Amazon price: GBP 19.21
www.amazon.co.uk

This is a collection of the finest photographs ever taken underwater in deep Antarctica, illuminating a world of strange and beautiful life forms. Internationally renowned photographer Norbert Wu was given access to the icy waters off Antarctica by the U.S. National Science Foundation to obtain these photographs. In the extreme conditions that prevail in these seas, invertebrates can grow to enormous sizes: sponges are as big as bears, jellyfish tentacles extend thirty feet, and giant sea spiders crawl through beds of soft coral. Wu has also focused his lens on the birds and mammals living at the edge of water and ice. Jim Mastro's introductory text condenses forty years of scientific research into a clear and concise natural history of this unique place.



The Certified Diver's Handbook

Clay Coleman
Paperback: 384 pages
International Marine/Ragged Mountain Press
ISBN: 0071414606
Amazon price: USD 15.61
www.amazon.co.uk

Want to enjoy scuba diving to the fullest? This guide will help you create your own diving adventures on any budget, schedule, local destination or distant travel, without the restrictions of group travel. Author, Clay Coleman, offers insider's tips and advice for divers about how to organize dive travel plans, equipment and expeditions. Readers will learn how to buy or rent the best SCUBA equipment at the best prices; plan dives for their maximum enjoyment and safety; find great diving sites near home; learn underwater rescue procedures and shore- and night-diving techniques; explore wrecks, reefs and underwater caves.

Edited by
Michael Arvedlund

Coral reef fish larvae & Blooper Science

Marathon Fish larvae

Coral reef fish ecology is a new research area, probably just about 40 years old, compared, for example, to research in temperate fish ecology, which has been studied extensively for more than 100 years. Therefore, coral reef fish ecologists often have to “borrow” knowledge from what we know about temperate fishes, simply in order to establish the first research in coral reef fish ecology.

However, this sometimes causes some big “bloopers”. Such a blooper is the case regarding the swimming abilities of coral reef fish larvae.

The life cycle of most coral reef fishes includes a larval planktonic stage, lasting from a few days up to several weeks, before settling to a benthic habitat. This phase has been considered the ‘black box’ by coral reef ecologists, because

the coral reef fish larvae field is very difficult to examine. For example, they are quite difficult to sample in large numbers, because of the



many more species in much lower numbers on a coral reef than in a temperate ecosystem, where there are a few species in very high numbers. Therefore, to establish important coral reef fish dispersal models for predicting the size of reef fish populations, ecologists assumed that coral reef fish larvae behave exactly as temperate fish larvae out there in the blue water. However, when finally the first swimming results with reef fish larvae turned up it caused a shock among coral reef fish ecologists. They swim fast and very long distances.

Surprising results

The results of swimming tests with coral reef fish larvae showed that larvae of coral reef fishes are strong, effective swimmers, capable of sustained speeds higher than ambient ocean currents, and of swimming non-stop for tens of kilometers over tens of hours. Further, they are much faster than larvae of temperate species of similar size, particularly the well-studied herrings and cods. This surprising information on settlement-stage larvae is the result of laboratory swimming-chamber (or flume) measurements of swimming endurance in 51 species of 9 families, and speed measurements on the

When the first swimming results with reef fish larvae turned up it caused a shock among coral reef fish ecologists. They swim fast and very long distances.

coral reef of free-swimming larvae for over 50 species of 15 families. Both sets of research were conducted by Australian researchers. Temperate fish larvae of 1–2 cm apparently swim at 1–5 body lengths per second, whereas similarly sized larvae of coral reef fishes swim at a mean speed of 13.7 body lengths per second, with some as fast as 34 body lengths per second. Put into perspective, a freestyle human swimmer capable of 13.7 body lengths per second would swim the 100-m race in 3.6 seconds; the Olympic record for 100-m freestyle is 48 seconds.

The actual speeds

of reef fish larvae average 20.6 cm per second with some as fast as 65 cm per second. This is faster than the average ambient ocean current speed in the studied areas, so the average reef fish larva near the end of its pelagic stage is indeed

an effective swimmer. Just as remarkable as their swimming speeds, these larvae have great endurance, being able to swim

an average of 40.7 km (some up to 140 km) in laboratory experiments, unfed and without rest before exhaustion. The mean time to exhaustion was 83.7 hours (maximum 288.5 hours). On a per-size basis, this is equivalent to a human swimming roughly 4000 km!

Swimming far and fast may simply increase the possibility of encountering a reef by chance alone, but pelagic reef fish larvae in blue water may be able to detect and orient to reefs. Orientation, combined with effective swimming abilities, would greatly increase the capacity of larvae to find a reef. In either case, this capacity would vary among species because swimming abilities vary among species.

Comparison and contrast

Why are temperate fish larvae so different from reef fish larvae?

Coral reef fishes are overwhelmingly of the order Perciformes, or perch-like fishes. In contrast, most research on temperate marine fish larvae has been on herrings, sardines, and anchovies, cods, flatfishes. These latter five types of fish are so-called non-perciform fishes. Most of the literature on fish larvae from temperate waters concerns species that are pelagic or live on soft bottoms (sand or mud) as adults rather than species from (rocky) reefs. This alone may confound temperate/coral reef comparisons. Adult pelagic fishes usually have habitat requirements that differ from those of their larvae, but





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Hi, call me Jenny! I have been diving and selling inbound dive travel since 1990 and yet, just by talking about all the exciting diving Borneo has to offer, it gets my adrenalin going!

Marathon Fish Larvae

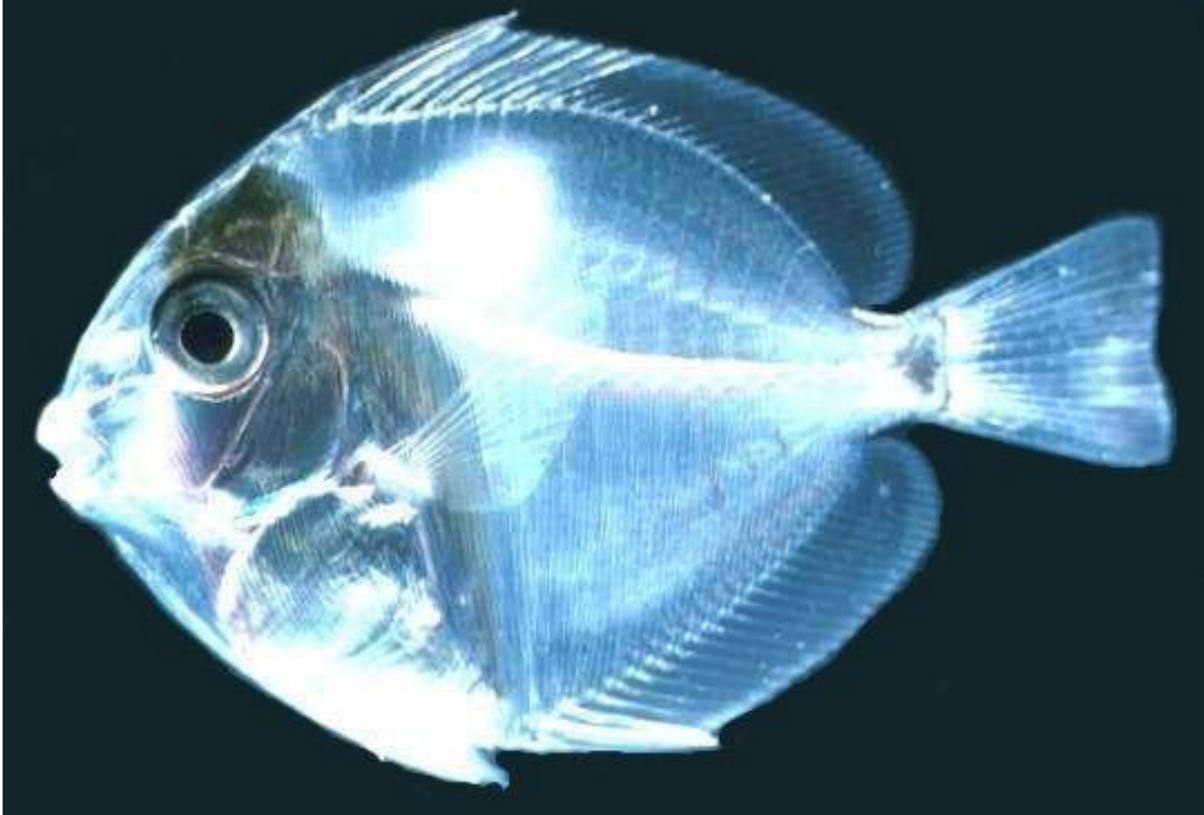


they never make the abrupt changes entailed by settlement out of the pelagic environment and into the benthos. Except on oceanic islands, soft-bottom habitats are usually far more extensive and less discrete than reef habitats, so larvae of reef fishes have a much smaller target to find at the end of the pelagic phase than do fishes of soft bottoms. Further, it is thought that most reef fishes are relatively sedentary as adults, whereas adults of many pelagic and soft-bottom species undertake extensive migrations. A major difference between coral reef fishes and temperate marine fishes is the incubation period of their eggs. Pelagic eggs of most coral reef fish species hatch within 1 day, far more rapidly than pelagic eggs of temperate fishes, which commonly have incubation periods of 3–20 days. A second major difference between coral reef fish and most temperate fish larvae is that, at any given size, the reef fish larvae are more developed. This is particularly apparent if one compares the state of development of well-studied tem-

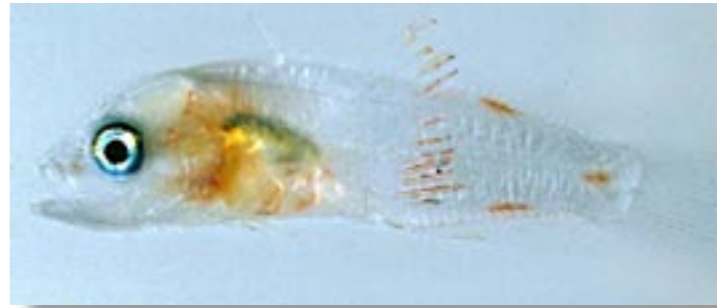
perate larvae such as herring and cod at the sizes at which reef fish larvae commonly settle (1–2 cm). At all sizes, the reef fish larvae have more complete fins. They develop scales at a smaller size, seemingly have better developed sensory apparatus at any size, and are morphologically equipped for effective feeding within a few days of hatching, and at a smaller size than the herring and cod.

Looking ahead
So what of the future in research of coral reef fish larvae?

Recent research on the pelagic stage of reef fishes has given coral reef fish ecologist an excellent look into the black box of larval biology. This look reveals that these pelagic stages are real fishes with capabilities in excess of the larvae of well-studied temperate fishes. This has changed thinking about the behavior and ecology of reef fish larvae. We now know that reef fish larvae and their



behaviour have a major influence on the dynamics of reef fish populations in the foreseeable future, we should have a firm and defensible basis for design of marine reserves and of the geographical size of reef fish population units for management purposes, based on this increased understanding of reef fish larval biology.



Literature

This text has mainly been based on: Leis, J.M. & McCormick, M.I. 2002. The biology, behaviour, and ecology of the pelagic larval stage of coral reef fishes, *Coral reef fishes: Dynamics and diversity in a complex ecosystem* (P.F. Sale, ed.) Academic Press: San Diego & London, pp. 171–199. ■



Pictures of Fish Larvae, courtesy of Northwest Fisheries Science Center, National Atmospheric and Oceanographic Administration



Leigh Cunningham

Redundancy ethic? Don't be dead – be a double bagger!

Double Bagging for Divers



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.

Redundancy Ethic

In the world of technical diving, a direct ascent to the surface is not an option if you run into a problem or emergency. For this reason, technical divers are required to carry back-up systems to resolve problems associated with equipment malfunction during a dive.

But what about the rest of us?

Text by Leigh Cunningham
Photos: Craig Nelson

Better be safe than sorry. This old adage certainly applies to diving too, and in this case redundancy pretty much translates into having a back-up for all important systems. After all, diving is supposed to be fun and a means of having adventures that enrich our lives, not something that will make us lose it.

Fortunately, there are a lot of good lessons and readily applicable techniques to be learned from the world of technical diving, that can make diving much safer, without being a real bother or overshadowing the experience. Using a seat-belt when driving a car has become second nature, as is carrying a spare tyre in the trunk. We will probably never, or rarely, actually have need of them, but when needed we surely appreciate these simple measures.

But here the similarities between driving and diving stops. Running out of gas when driving a car is mostly just an embarrassment and inconvenience, but for a diver it can obviously have dire consequences.

The meaning of redundancy In dive-speak, redundancy usually translates into having double tanks, double regulators, double this and double that. But what does redundancy really mean? The dictionary give us the following definition.

Redundancy, in general terms, refers to the quality or state of being redundant, that is: exceeding what is necessary or normal, containing an excess. This can have a negative connotation, superfluous, but also positive, serving as a duplicate for preventing failure of an entire system.

The last sentence in the above definition is interesting, because it raises a very important question, also in terms of diving: When is something superfluous, and when is it an important safety measure 'preventing failure of an entire system'? Most of us will probably agree that using a heavy double tank rig for a shallow water dive is overkill, and we wouldn't be bothered. But as we go gradually deeper and longer, we will also approach a point where a double rig becomes a very useful piece of equipment and a safety measure



So where is this point?

Turning once more towards the above definition, *the entire system* refers not just to the mechanical equipment but also to the diver, along with his or her training and

ability to cope with critical situations. For this reason, when to use then becomes a somewhat subjective and individual question. It is not, however, just a matter of what the diver can safely handle but also a question of mental comfort during a dive. Diving, we should not forget, is also about having a good time. Simply bringing the extra equipment - even on dives that do not venture into those depth zones where conventional wisdom would deem it absolutely necessary - means more than just additional safety. Just as importantly, the feeling of having that extra safety also translates directly into making the dives far more enjoyable. Because, while it doesn't lower any alertness, it does remove the latent stress-loading of *what if...?*. And this is certainly worth taking into consideration.

Being more concrete So, are there no absolute criteria as to when one should wear back-ups? Absolutely! For starters, with any kind of diving that carries a decompression obligation, and diving in overhead environment obviously qualifies, as set forth by various training agencies. But before it comes to that, why not make it a policy always to have a sensible margin of safety, and always use redundant systems for any diving close to the NDL limits or beyond, say, 30 meters?

What is needed? Regarding deeper dives, or dives with long bottom times, redundancy means diving with twin tanks and two sets of regulators. These tanks may either be independent or, which is more common, connected by a manifold. In either case, if there is a regulator malfunction on the bottom, there is a back-up system which can be switched to.

Size matters The tanks should also be big enough, not only to carry enough gas to complete the planned dive, but also to give an ample reserve supply to



Technical Matters

handle any unexpected problems. How big this gas supply should be depends not only on the depth and the length of the bottom time, but also on the diver and a previously determined breathing rate. The gas used at the deepest parts of the dive may be either air, Nitrox (aka EANx, Enriched Air Nitrox), Heliox, or Trimix. For shorter or shallower deco dives, divers might opt for a single tank, with a redundant valve (Y or H valve), allowing the diver to use two regulators on a single tank.

If there is a problem at the bottom, the dive would be cut short, and the diver would make a controlled ascent, complete his decompression obligation, and finish the dive safely.

Buoyancy: For divers using wet suits, a redundant wing system should be used as the buoyancy device. This means two independent bladders, usually in one outer shell, and with independent inflators. In the event of a buoyancy problem, i.e. the regulator supplying gas to the primary bladder, malfunction, or a problem with the bladder itself, or ruptured inflator hose, etc, the diver would switch to his back-up bladder, make a safe ascent, complete the decompression obligation, and finish the dive.

Twin tanks, manifold and two regulators with hoses routed so that both lift and breathing gases are always available - even with one first stage closed. Hose routing is the subject of next article in the series



Divers using dry suits might consider their dry suit a form of back-up buoyancy. In this case, divers should consider the weight of the diving system (rig), compared to the comfortable lift capacity of the dry suit. Swimming up to assist the ascent could be considered appropriate in this type of emergency, but if the diver is too negatively buoyant, and have to fin too hard or for too long, it could lead to excessive CO₂ loading. As the breathing rate goes up, any narcosis would intensify, plus an increased risk of CNS O₂ toxicity.

When relying on a drysuit as a back-up buoyancy device, one should take the worst case scenario into consideration. For example, a split bladder where all the gas is abruptly lost from the wing. Would the dry suit support the diver sufficiently to make a safe and controlled ascent from depth, through a series of decompression stops, accurately and without over exertion? If not, the diver should consider using a redundant wing system. Another important question is, whether a well worn dry suit with weak seals will be able to retain a sufficient volume of gas for a safe controlled ascent. If the dry suit has sufficient lift, then having a redundant wing system seems pointless.

Try to avoid carrying equipment, which would not be used.

If necessary, simulate the problem in shallow water with



Spare mask can easily be carried in a pocket

schedule outside the primary plan, in order to handle any emergency causing a digression from the primary plan. Even those divers who use multi-gas computers, might opt for the additional security of back up tables and plans.

The down side of multi-gas computers is, they may encourage technical divers to rely on the ability to make new plans on the fly (during the dive), instead of making a structured depth and time plan before the dive. In spite of the risk of being considered old fashioned, I think it is safer to make a structured plan and do the required calculations using an appropriate decompression software before the dive, and consider the deco schedule, as generated by the multi-gas computer, as a bail out option.



Men in Black?

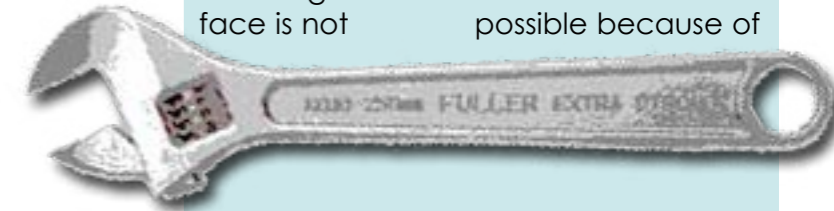
near full tanks. Dump wing gas, and see if you can establish neutral buoyancy using the dry suit alone

Depth and time monitors

(Depth-timers): In this day and age of multi-gas Air/Nitrox, and mixed gas computers, divers have the luxury of having a continuously re-adjusted schedule with them on the dive, based on exactly what they are breathing. When using Depth-timers, or computers in gauge mode, divers should carry back-up tables to have a

What is technical diving?

Some people define technical diving as diving in "overhead environments" meaning that direct ascent to the surface is not possible because of



a decompression obligation requiring decompression stops and/or a being inside a cave or a wreck.

The late Robert Palmer, once one of the gurus of technical diving, defined it as "the use of advanced and specialised equipment and techniques to enable the diver to gain access to depth, dive time, and specific underwater environments more safely than might otherwise be possible"

Whichever system you chose, multi-gas computer, Depth-timer or computer in gauge mode, you need at least two to accurately finish the dive in the event one malfunctions.

Mask: This is probably the most unlikely item of equipment you will have a problem with. But for any kind of dive that takes you into deep waters or a decompression schedule, you should certainly bring two. I can talk from own experience, as I once lost a lens during a dive. This was due to a hairline crack in the frame of the mask, which went unnoticed at the surface before the dive. The back up mask came in most useful, enabling me to read gauges, whereby I could ascend at the correct rate, perform accurate stops and finish the dive safely.



These artistic expressions might seem funny to some people but it gets to the point when required. The boat crew know who the diver is below it, and the face's and colors are descriptive.

Technical Matters



Reel and SMB (Surface Marker Bouy). These are very useful tools in all environments but let's talk open water. For open ocean drift decompression diving, deploying the SMB during the ascent, the diver creates a form of reference along which specific ascent rates and a complicated deco schedules are much easier to carry out accurately. The divers simply hangs under the SMB by being slightly negatively buoyant, and reeling up at the right time. The SMB also allows the boat and support team to track divers doing a decompression drifting under the buoy.

In an emergency, an SMB could also act as an emergency signalling device. For example, a red SMB could be a signal to the surface support team that everything is OK. If the diver suddenly has little or no gas, a differently coloured emergency SMB could be sent up as a signal for a support diver to bring additional gas in the water, or to see what the problem is.

The reel is also very useful on the bottom to ensure a safe return to a specific ascent point in low visibility. The diver simply ties the end of the line to the anchorline or downline.

Minimum. A minimum requirement would be at least one reel, and

Double bagging

There are several explanations for where the expression *double bagger* comes from, but it is actually a piece of British Army slang. The idea is, that if a lady is hard on the eye, you need to put a paper bag over her head before you can get intimate with her. If she is really hard on the eye, you will want to have a second bag close at hand, in case the first one breaks. So, a double bagger will always have two bags ready – just in case. Not very PC, but it's history.

two SMBs. One SMB to let the support team know the dive is running according to plan, and one as an emergency signalling device. When doing drift decompression in the open ocean, it would be wise to take a back-up reel too.

Lights: In overhead environments, where dive-lights are necessary, back-up lights would fall under the redundancy ethic.

In short, any item of equipment used to conduct the dive safely, and which could possibly malfunction, should be duplicated with a appropriate back-up system

Summing it all up For the recreational community, where divers are staying within no-deco limits (NDL), the redundancy ethic does not apply with the same degree of necessity as it does for the technical or decompression diver. The non-deco diver can always, at any point during the dive, make a controlled ascent directly to the surface without stopping. However, while there are no clear-cut criteria as to when a diver should start to carry redundant systems, it is certainly something the advanced recreational scuba diver should look into as means of improving both safety and technique. In the event that a diver runs low, or out of gas, while his dive buddy is outside comfortable swimming range, an intermediary form of

redundancy might be used in the form of a pony bottle, i.e. clamped to the side of the main tank, or a small spare air cylinder clipped to the BCD. However, a word of caution seems to be appropriate here. Divers are often seen to be putting more and more distance between buddy teams during a dive, or pushing past the accepted depth limit of 40 meters set forth by most recreational scuba agencies. They are, perhaps, relying on these stop-gap measures, which are of questionable value, if not outright inadequate, should any real emergency occur. In such situations, nothing can substitute the mental readiness stemming from having undergone some sort of advanced training and using redundant systems.

Think about it! ■

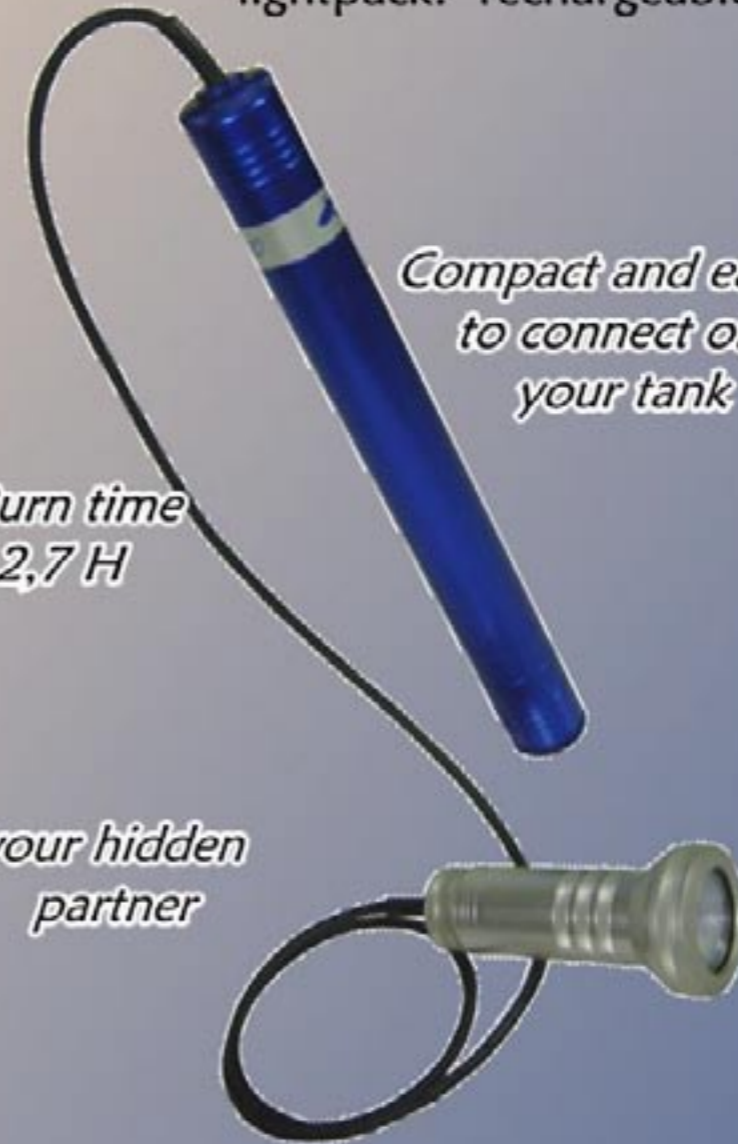
Next issue: Kit configuration, streamlining and hose routing



Compact DX6 Advance



Aluminium Compact tech diving lightpack: rechargeable



Compact and easy to connect on your tank

Burn time 2,7 H

your hidden partner



Charging in end of lamp plug



Compact Long burn time Option: Extra bulb head easy maintenance



Turn on/off on lamp head

Technical data:

Tension (volts): 6 Volt
Current (Amp/h): 9 Amp
Power (Watt): 20 W
Burn Time: 2,70 H

Reflector Dia: 51 mm
Bulb (Degrees): 12
Color Temp.(Kelvin) 3200

Weight in air: 2300 gr
Weight in water: 1900 gr

Lamp dimensions:
Pack dim: ø42 x 320 mm
Light on/off in light head
Batteri type: NIMH

Charging time(min) 10H

Description:

Lamp head made of aluminium machined in high precision, and double coated, oring sealed in front of lamp, and double sealed in back on the plug, light turn on /off just turn plug, charging of batteripack, on end of lamphead plug.

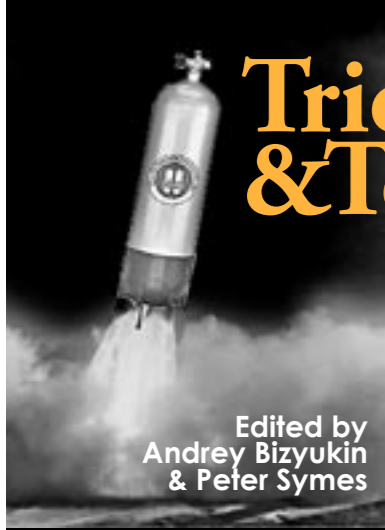
Batteri pack, made of aluminium double coated, and all plug ends are double sealed.

Light system are waterproove to 220 meter.

Charger and plastic box included.

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& Tested**

Edited by
Andrey Bizyukin
& Peter Symes

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By Kevin Gurr

New undergarment from Fourth Element has been heralded as not less than a revolution. Well, is it?

Productshots are supplied by Fourth Element

Fourth Element launched itself into the diving industry in 2001 with the intention of developing an innovative range of technical clothing designed to combat the problems of thermal regulation in scuba diving. After lengthy research and development, their first product was the Xerotherm, a drysuit base layer undergarment that was extremely well received by technical and sport divers alike.

I have been using the Xerotherm for the past few months and took to it instantly. It is well designed and very warm and uses high performance fabrics to keep the wearer's skin dry from perspiration and any suit leaks. It's four way stretch gives complete freedom of movement and it is an excellent next to the skin layer whose warmth belies its weight. I also used it under a wetsuit on a recent expedition; even in a situation where it was completely wet, it performed very well, keeping me significantly warmer and more comfortable. So, when I was asked to review Fourth Element's products designed specifically for use underneath wetsuits, I

was really interested to see how they would have modified their approach and keen to test them as part of my cave diving equipment.

On initial inspection, the Thermocline garments have a more glamorous look to them than the black Xerotherm. Shiny or rubbery, they look like something from a Bond movie. The designers at Fourth Element have obviously put some time into the design of these garments so that they look good, but it is in their use of the fabric that the innovation shows.

Polartec fabric

Fourth Element has used another high performance fabric from Polartec, specially developed for water sports. Weight for weight, the fabric has the equivalent Thermal performance of 2.5mm neoprene, yet it is neutrally buoyant. This is significant for all divers looking to add some extra thermal protection without the need for additional lead. It has a fleece lining against the skin which has similar wicking properties to the Xerotherm fabric but this is bonded to a

waterproof yet breathable membrane. This membrane makes the Thermocline fabric windproof and warm.

Antimicrobial

The fabric has an antimicrobial treatment to resist the build up of odours, but the garments are machine washable, making them easy to keep clean and smelling fresh. The Thermocline garments

have two different outer finishes on top of the membrane. The shell finish has a woven nylon outer face similar to that of double lined neoprene and the skin finish has a smooth surface rather like rubber, which Fourth Element says is ideal underneath a wetsuit or semidry as it gives a very good seal against the inside of a suit.

There are several garments in the Thermocline range including short sleeved tops, vests, shorts and even a ladies' bikini. I tested the short sleeved raglan top and the men's shorts.

The Thermocline garments were extremely comfortable and gave excellent freedom of movement. Most sig-

nificantly, they were warm and I could imagine many tropical applications where diving in just the Thermocline would not only be possible, but also desirable from the point of view of comfort and neutral buoyancy. It would also make a very good pool suit for training situations, being breathable above the surface and warm in the water.

I tried the Thermocline in two caving situations. The first was in the Red Sea on fairly long dives of up to ninety minutes. I wore the Thermocline underneath a knackered old Cressi semi-dry which has more holes than it should. Much of the insulation work was being done by Fourth Element's undergarments and I was extremely comfortable and warm. The neutral buoyancy of the fabric meant that I needed no extra lead and had no changes in buoyancy with changing depth due to changes in the fabric.



Who's testing?

Kevin Gurr has been a leading figure in the technical diving community for more than a decade. He was the first technical and cave instructor to be qualified in Europe and headed the IANTD in UK 1992-2004. Authored the acclaimed Technical Diver Student Workbook with Tom Mount as well as two workbooks for the Technical Diver and the Normoxic Trimix programs. Leader of numerous successful diving expeditions that include the Britannic and the Pilar Project, Kevin Gurr also heads up Delta P Technology, manufacturer of the successful VR3 and VR2 air and mixed gas dive computers. www.vr3.co.uk



Tried & Tested

After the dive, the speed at which the undergarments dried was fantastic. By the time I had got out of my wetsuit, the inside of the Thermocline had dried. The fleece is made using a hydrophobic polymer which does not hold water, which runs out under gravity. With so much less water next to the skin there was much less wind chill and the garments had dried within 15 minutes or so of wandering around the boat.

The breathability of the fabric should not be underestimated when out of the water – it is much less sweaty wearing a Thermocline top than a neoprene vest or shorty wetsuit so you can keep it on between dives. It is also easier to keep clean. Simply rinsing in fresh water and hanging it up for a few minutes is all that is required during a dive trip and afterwards the Thermocline garments can be washed in the washing machine. The second test was a little more demanding of the thermal performance of the Thermocline

garments. Caving in Swildons Hole in the Mendips, I used the same arrangement of the Fourth Element undergarments under my Cressi semi-dry. In air temperatures of 15°C and water temperatures of about 5°C, I was much warmer than I had anticipated, I did not feel the cold of the water and I have to put that down to the Thermocline as I know all too well that my old semi dry has lost its integrity.

Criticism

My only criticism of the Thermocline range is perhaps in the sizing which is a little on the tight side particularly around the shoulders – anyone thinking about buying it would do well to get some good advice about sizing from the manufacturers or retailers before purchasing. I raised this with Jim Standing at Fourth Element and he said that they would be working on making the sizing more consistent for future products.

At the same time I also sug-

gested to him developing a long sleeved and long legged product to give more protection to the arms and legs. A long sleeved top will be available soon, he assures me and full length legs will follow.

Until then, the Thermocline Raglan top and shorts are an excellent way to increase the thermal protection of the body core and the vest and shorts combinations would also provide core warmth with just a little more freedom of movement in the arms. I believe this would be an excellent addition to most divers thermal protection systems, from technical cave divers to those who prefer more tropical conditions and just want the best in comfort and performance.

Sample prices

- M Thermocline long sleeve top £65.00
- M Thermocline shorts £45.00
- W Skin Thermocline vest £48.00
- W Shell Thermocline short £35.00

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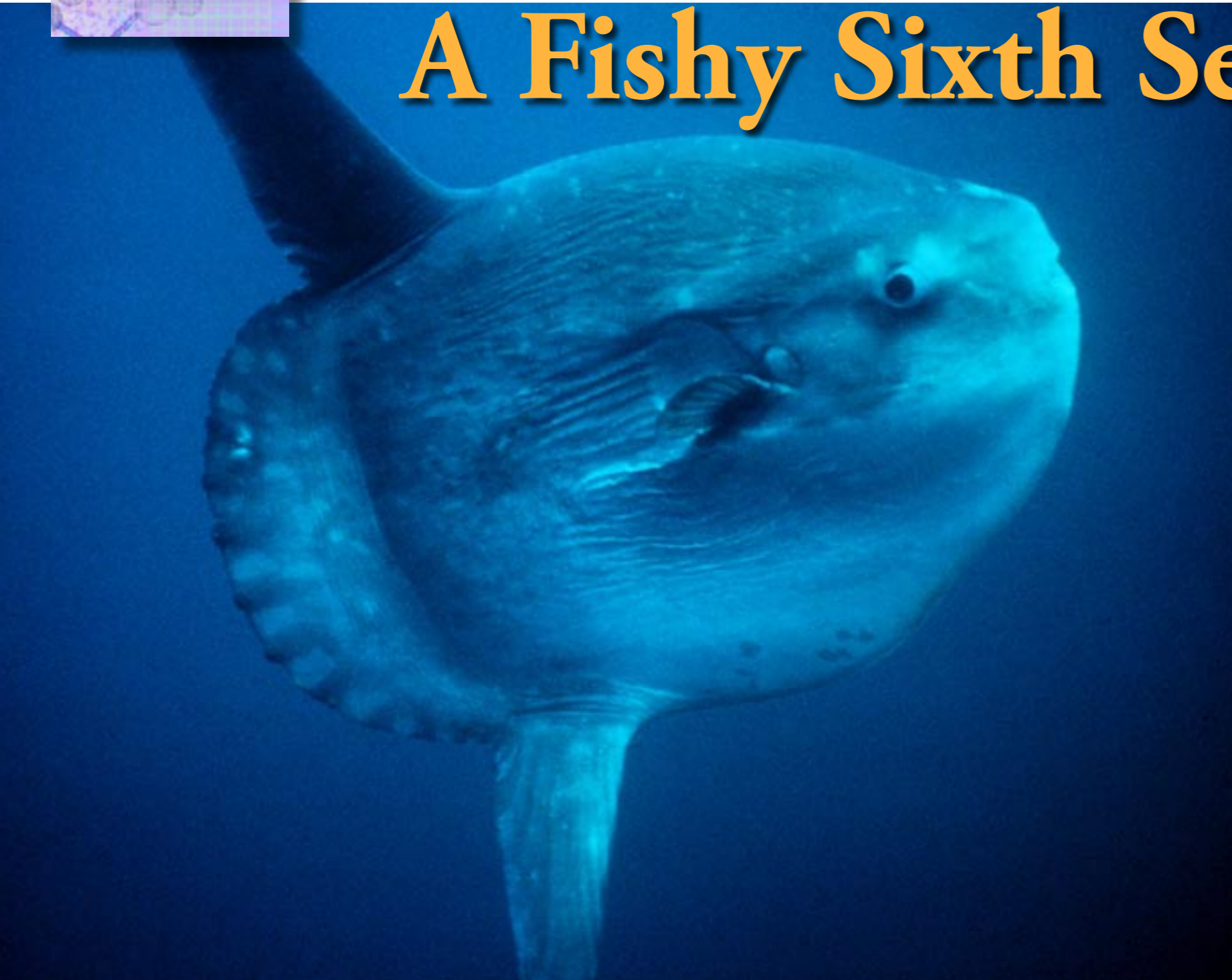
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After a year of intense research the Royal Danish Navy decided what suits them best

DYKKERCENTRET

Text by Michael Symes
 Photos by Peter Symes, NOAA Photo Library, USDA Forest Service,
 Hawaii Biological Survey, Freshwater and Marine Image Bank

A Fishy Sixth Sense



NOAA PHOTO LIBRARY

The ocean sunfish, or mola mola, is a deep sea fish found in the Gulf of the Farallones National Marine Sanctuary



USDA FOREST SERVICE

A rainbow trout in the shallows of a freshwater stream

The environments in which the many fish species have evolved are very diverse, ranging from the shoreline to the deep-sea depths, from fresh-water streams to tropical lakes. Because of the great variety of these habitats, the senses of these different species have consequently evolved quite differently, exhibiting a great diversity, with many senses not yet understood or even identified. There are thus still many mysteries regarding the behaviour of aquatic creatures. For example, how do eels find their way across the Atlantic ocean? Why is it so very difficult to swim up to a fish from behind without being detected? And even bank-side freshwater fish-

ermen, for example, know that the vibrations from footsteps can be detected by fish. But what sense or senses are being used by the fish in such cases?

The senses of fish

Fish have been shown to have the five, commonly accepted, human senses. In fish, however, their relative importance is different from that of human beings.

Vision

As the amount of light available below the surface generally is small, this is not the primary sense for fish. Some aspects of fish-sight were discussed in Xray Mag #3.

Smell

Generally, the sense of smell in fishes is very developed. Eels, for example, may detect a substance when only three or four molecules of it have entered its nose. It is probably that sense most used by fish in finding food.



- ▲ The Needle Fish has a lateral line that runs very low on the sides
- ▶ The neon wrasse has a lateral line that has gaps along its length

PHOTO BY PETER SYMES



HAWAII BIOLOGICAL SURVEY

Hearing

Hearing in fish is not very well understood, but seems mostly to be used for simple distance perception and sound source location.

Taste

Taste buds in fish are mainly located in the mouth, but also in the skin covering the head, body fins, barbels and lips. No response is obtained when a barbel is touched with an inert glass tip, for exam-

Hearing

ple, but an immediate response is obtained when it is touched with a morsel of food.

Touch

Fish have a fine tactile sense, as is shown, for example, by certain catfish who can use their barbels almost as humans feel with their fingers.

However, good as some of these senses might be, none of them can account for even simple phenomena such as the detection of the vibrations from footsteps. Fish must therefore have at least one other sense which enables them to detect low frequency vibrations. Such a sense is located in their lateral line.

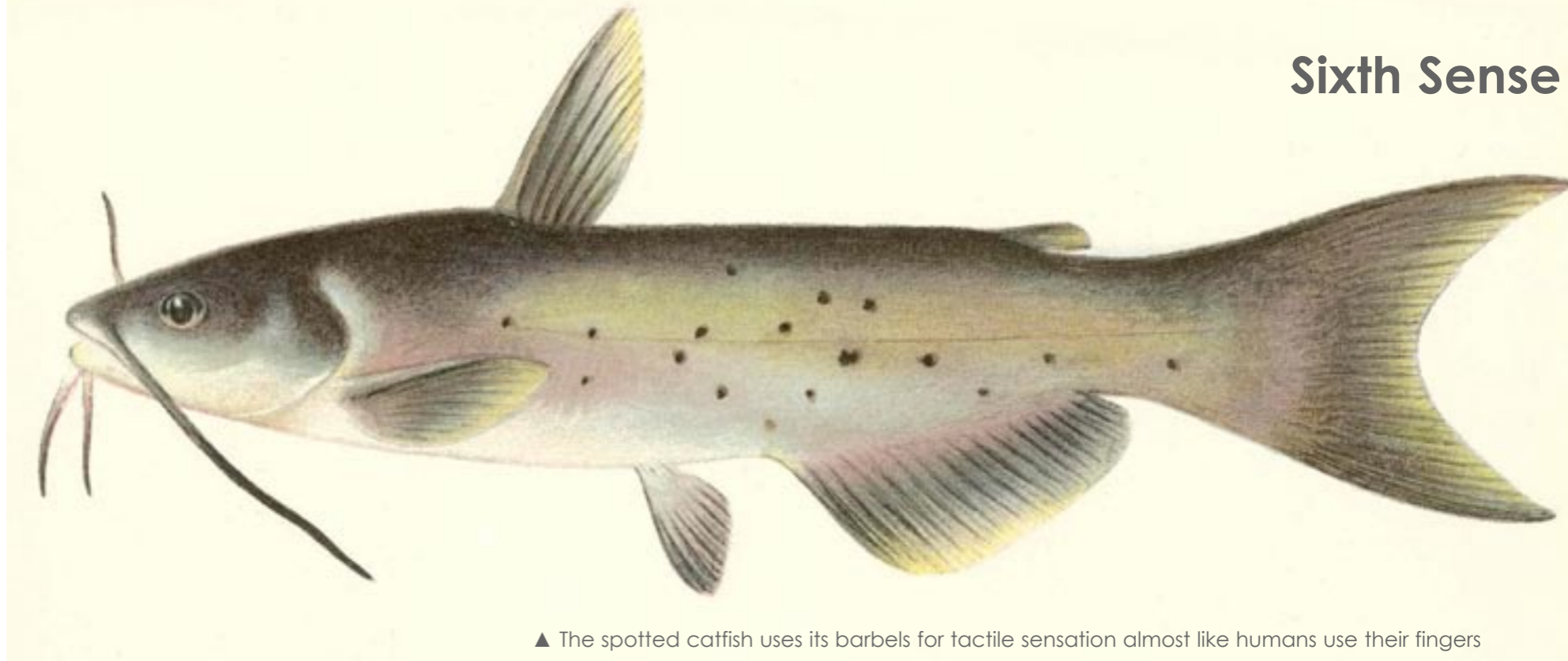
The lateral line

The lateral-line system is easy to observe in most fishes. There is usually only a single lateral line on each side of the body, but many variants of the typical lateral line may occur. For example, on the sides of the Belontiidae (Needle Fish), the lateral line runs very low on the sides. On some species the lateral line may be incomplete, or it may also be interrupted, meaning that it ends

and then recommences after a gap, as in some of the Labridae (Wrasse) species. And in a number of families the lateral line may be absent altogether.

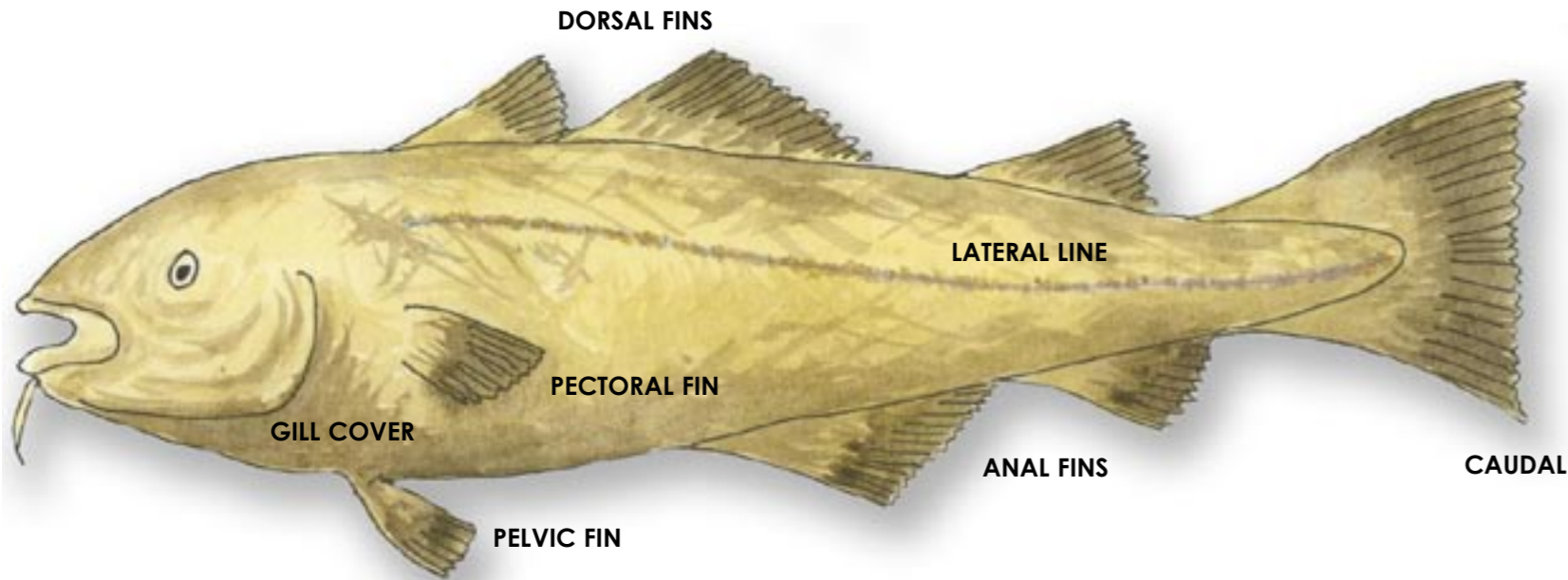
The lateral line consists of a linear series of sensory cells or neuromasts. In many fishes, the neuromasts can also extend along the fish's head as well as sides, although these are not always as obvious. These neuromasts are situated in a mucus-filled canal, situated just under the skin, which is in direct contact with the surrounding water through pores in the skin or scales. The incoming stimuli from the neuromasts are fed into a nerve parallel to the canal which then feed the stimuli to the fish's central nervous system.

The neuromasts can be thought of as very sensitive hydrodynamic transducers that can detect water disturbances. They consist of a base of sense cells with sensory hairs (cilia) that project into the canal. These hairs are capped with a gel-like cupula. Movement of the mucus in the canal, caused by flow of water, makes the cupula bend. This in turn causes bending of the hairs, which stimulate the sense cells, thus generating minute electrical signals which

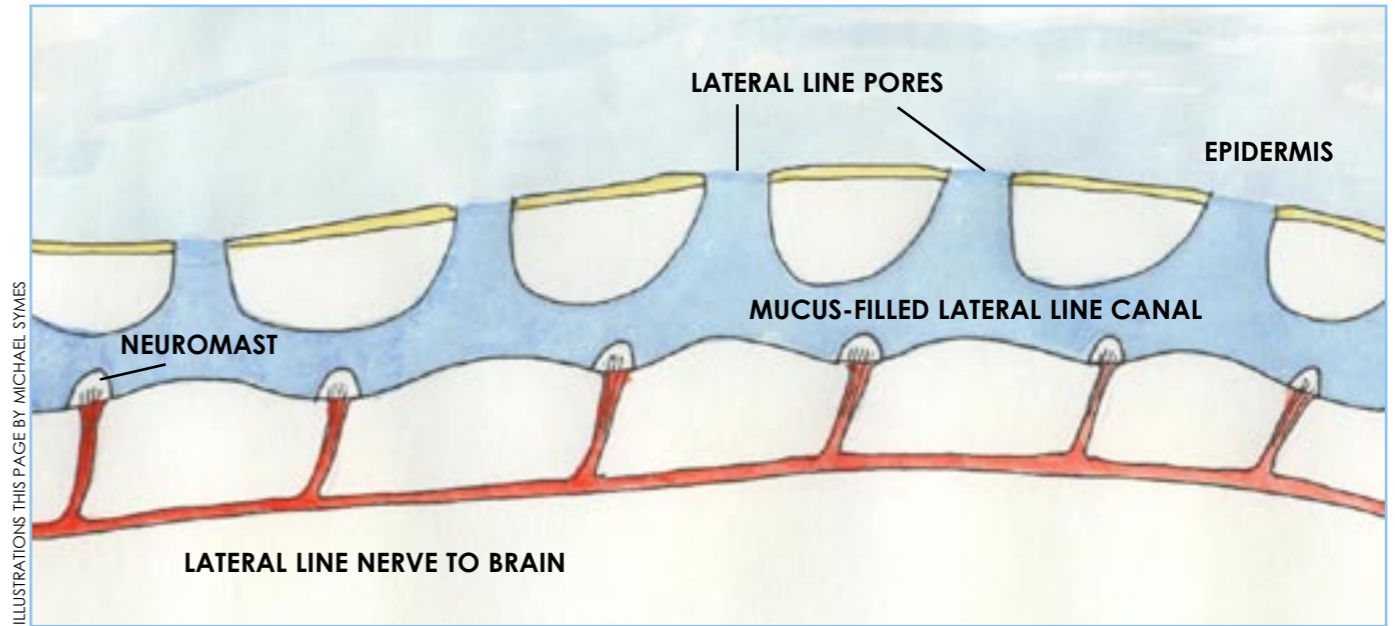


▲ The spotted catfish uses its barbels for tactile sensation almost like humans use their fingers

FRESHWATER AND MARINE IMAGE BANK



▲ Diagram showing lateral line on cod fish



▲ Schematic diagram of lateral line

pass along nerve fibres to the brain.

There are actually two main types of neuromast: *canal neuromasts*, where the water displacements are transferred to the canal fluid via pore openings, and *superficial neuromasts*, which are directly exposed to the flowing water. In either case, when the neuromasts are at rest,

they send a continuous series of nerve impulses to the central nervous system.

In the case of the canal neuromasts, variations in water pressure between different pores along the canal cause a directional movement of the mucus through the canal. When pressure either increases or decreases due to a disturbance near a fish, the nerve impulse pattern changes, the fish registers the change, and takes appropriate action. In the case of the superficial neuromasts it is the drag of the water past the cupola that causes them to bend. The degree of this bending is directly related to the water velocity, i.e. to the velocity of the fish relative to the velocity of the water.

Similar to the human inner ear. For those with some knowledge of human anatomy, it will be clear that the structure of the cupola is homologous to the crista ampullaris of the human inner ear. Bending of the cupola by water currents and that of the crista ampullaris by dis-

turbance of the endolymph of the semi-circular canals causes excitation of sensory cells of both organs. Gerard (1936) inferred that the inner ear of vertebrates has phylogenically derived from a primitive lateral line system.

So, the lateral line can be considered as a sort of higher hearing sense, reacting to certain types of pressure changes in the surrounding water, just as the human ear reacts to pressure changes in the surrounding air. However, while the lateral line is a linear system of receivers, the ear functions just as a single receiver, although covering a range of frequencies. It does improve matters, though, that we do have two of them, giving stereo-directional hearing.

What can this sense be used for?

The lateral line system obviously greatly expands the area of tactile perception by making it possible for the fish to interpret its environment without actually touching an object. The lateral-line thus helps the fish in a number of ways.

Rheotaxis

Rheotaxis is a behavioural orientation

to water currents and is one of the most important functions of the lateral-line system.

The term, rheotaxis, comes from the Greek root *rheos*, meaning stream, flow or current; and *taxis*, meaning the movement of a cell or microorganism in a particular direction in response to an external stimulus, from the Greek via the New Latin *tassein*, to place in order.

Scientists at the University of Auckland, New Zealand, have demonstrated that some of the receptive cells in the lateral line are particularly well suited to provide information on water currents. It was found that the canal neuromasts are most sensitive to water acceleration whereas the superficial neuromasts are most sensitive to water velocity. Fish thus have one set of receptors designed to detect water acceleration and a second set to detect water velocity.

Rheotaxis is mostly mediated, however, by one specific receptor class of cells in the lateral line, the superficial neuromasts. These velocity-sensitive receptors seem to enable a fish to sense its orientation in relation to stream flow, even in the absence of other clues. Facing upstream

is highly advantageous, for not only does it present the most streamlined shape to the flow, but it also makes it easier for the fish to intercept food items drifting downstream.

Detection of food or enemies

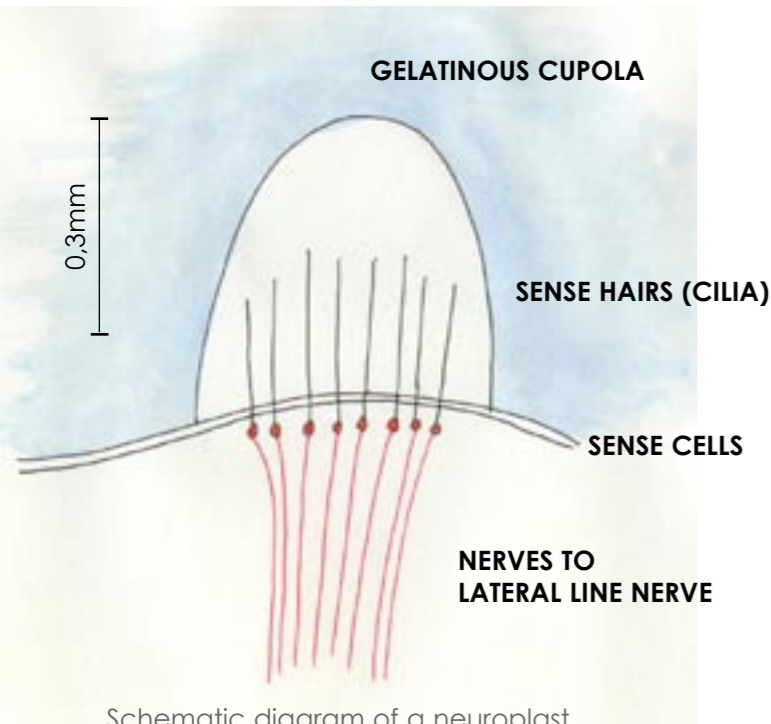
Sound passing through water creates variations in pressure. The lateral line system can thus detect sound, though only at a low frequency, such as that arising from footsteps, for example. Pressure waves are also caused by unseen prey such as a struggling insect, or the movements of an injured fish, so they can be located – and eaten!

Distances from stationary objects

The lateral line can serve as a sonar system with which distances from stationary objects may be determined. A bow wave precedes a swimming fish. This wave is reflected from the object back to the fish where it is detected by the lateral line system, thus enabling the fish to determine the distance to the object.

Communication

Typically the lateral line system can



Schematic diagram of a neuromast



PHOTOS THIS PAGE BY PETER SYMES

Sixth Sense

*Why are fish smart?
Because they are often in schools*

▼ Bigeye Jacks
Sipadan Island
Malaysia



The lateral line makes it possible for schooling fish to coordinate their movements and stay together. Some species of fish like the Blue Banded Snapper found in the Red Sea have a very strong sense of schooling

detect sound lower than 160 to 200 Hz. (The human ear can detect sounds down to about 10 Hz.) Many fish vocalisations are very low frequency crunches, grunts, and popping sounds. The lateral line system may thus play an important role in communication in some species of fish.

Schooling with other fish

The lateral line system makes it possible for schooling fish to coordinate their movements and stay together. The lateral line system is particularly good at detecting large disturbances in the water. Schooling fish often have a well developed lateral line. Sensing the movement of its schoolmates through water pressure variation, each fish can

synchronize its movements with the school.

Wake detection

Modern submarines can estimate the current position of an enemy submarine by detecting its wake. Like many other 'new technologies' evolution has preceded them. Recent research at the University of Konstanz, Germany, has shown that predatory catfishes use their lateral line for tracking the wake caused by prey as they swim after dark, and use past locations to predict the present position of their prey. Although the sense of taste is also used to detect chemical signatures produced by the prey fish, it was shown that stimulus of the lateral line was by far the most important factor.

All in all, then, it is clear that the lateral line system is a very complex and sensitive sense-organ. Or perhaps we should consider the lateral line as several different sense organs, for sensing motion, pressure, distance, etc.

In any event, it can therefore truly be said that fish do have, at the very least, a sixth sense, and a very complex one at that.

Do humans have an extra sense?

Although we must be careful to distinguish between sense and perception, it is obvious that we must more than five senses. For example, we can sense, and react to, pain, heat, pressure and movement. Even our sense of vision can be subdivided into one for light and one

for colour. But do we have as yet any undetected senses? Perhaps an amusing experiment, described in the *Electronic Naturalist*, may be of interest regarding this question.

Blindfold a person and let them move within a room, making sure there is some open space along one wall. The aim is for the blindfolded person to try and determine when he/she is really close to a wall by using senses other than the commonly accepted five.

Move the person around a bit so they lose track of exactly how far they are from the selected wall, then face the person towards the wall and let them

Are fish ticklish?

Probably not! But there is an ancient way of catching trout, called tickling that's even described in Shakespeare's twelfth-night, written 1599-1601, where Maria says ".... for here comes the trout that must be caught by tickling", the trout in question here being Malvolio.

Trout can be found in most fast running streams, but they hide very well. You will occasionally see one near the edge of a river but it is important to be very quiet and move slowly. Slowly move closer and bring a hand underneath the trout from behind and to the side. If you prod crudely the fish will take flight and dash to another hiding place; and do not touch its tail or it will be off in a flash. But if you are careful enough you will feel something swaying in the current and stroking your fingers like the soft touch of a feather. It is the fish's tail but do not try to grab it, for it will twist from your grip before you can get it out of water. Instead, the fish is rubbed gently so that it moves slowly backwards into your hand. Your palm slides gingerly over the dorsal fin and goes on till you feel the gentle waving of the pectorals. Then suddenly you grip a thumb and finger into the gills, and with one strong heave lift your fish from beneath its rock and throw it to the bank.

Well! That's what they say, but it does seem to be a very difficult skill. So you probably shouldn't count on getting your supper using it. ■

walk very slowly towards it. If the subject moves cautiously and carefully, just before arriving at the wall, they should be able to "feel" its presence just beyond their body. Not everyone is good at this but with a few trials many will be able to do this activity surprisingly well. Although people will be able to do this exercise, they will have trouble explaining just how they are able to do it.

So, perhaps we, too, have some vestigial extra sense, over and above those normally accepted. ■



Shark Tales



By Edwin Marcow

ILLUSTRATION COURTESY OF FIONA'S SHARK MANIA
WWW.OCEANSTAR.COM

Cove's Questions

When leading Hollywood directors want to simulate a realistic shark attack they most often go to Stuart Cove – the master of shark wrangling.



WB ONLINE

Stuart Cove is one of the most famous shark wranglers in the world. He is the owner of Stuart Cove's Aqua Adventures in the Bahamas. His portfolio of work includes three James Bond movies, one Jaws sequel, and recently, a commercial for a Japanese tooth paste company where he managed to hold a shark still while he brushed its teeth!

Stuart's journey to where he is now, started modestly at the

age of 19, working for \$150 dollars a day, a small fortune back in 1979, to his status in the industry today where he will charge USD 10,000 for two to three days shooting with a Tiger Shark.

What made Stuart famous was the film 'Open Water', which was produced on shop-bought digital camera equipment. But what made this film stand out from so many before it, were the very real shark encounters—made possible only with Stuart's deep understanding and knowledge of sharks—with only recently certified divers who had little time and experience in the water.

Stuart's experience with many species of sharks—from Caribbean Reef Sharks, Tigers, and so on—is that they are very discerning eaters, and will spit out anything that is either foreign to them or that, in the case of fish, is well beyond its 'sell date' and not healthy to eat.

Items Stuart has tried to feed sharks include leg of lamb, chicken, lobster—quite a banquet—and even once, a dead rat, but he could never induce a shark to partake of any of these food items.

Love Bites

Cove's generosity has not stopped him from being bitten three times by the sharks. On one such occasion, he was bitten on the hand through the knuckles—a very painful injury. Two other bites happened while snorkelling and baiting the water for a photo shoot. A shark approached

Cove who was wearing little protection. All he could do was 'roll away' as the shark chewed (racked) his back. He was lucky to sustain only minor injuries.

The most serious attack occurred while in the making of Ocean Men, an Imax film. While Stuart broke up bait in the water, a piece of fish landed on his head.

A shark swam in and raked the top of his head, almost scalping him in the process. A massive body of 20 or more sharks descended and filled the water around him. Almost immediately, Stuart was engulfed by this mass. The water turned red, and everyone assumed that this was Stuart's last dive — that he was being eaten alive. Against all odds, he survived.

Stuart insist that anytime he has been bitten, it was because he was doing something for the camera. 'Hamming it up', you should not, while diving with sharks (e.g. arms failing about, waiving hands etc.)

Seeing green?

Although Stuart has successfully proved that sharks are discerning



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eaters, do they have colour vision? This is a question that has never been successfully answered.

A recent shark attack off Cottes Beach Australia, has once again

triggered research into this question.

The US Navy, more than 40 years ago, funded many studies into shark visual systems. They found that their downed pilots were more likely to be attacked if they wore an orange jump suit, as apposed to those who wore a green jump suit. Those in green were never attacked.

Dr. Nathan Hart of the University of Western Australia was recently awarded \$500,000 over a five-year period by the Australian Research Council's prestigious QEII fellowship

Scheme to research this very question.

Intelligent life

After many years of research, time in the water, the US Navy's findings into shark visual responses to different jump suit colours, work being undertaken by Dr. Nathan Hart, and the lifetime wealth of experience built by people like Stuart Cove feeding and interacting with different species of sharks in the open ocean, one can plainly see that a shark is just another intelligent being—living, breathing and hunting as nature intended it to, capable of making 'reasoned' decisions on what to eat, and more importantly, what not to eat.

With the work of the US Navy and Dr Hart, we can gain tantalizing insights into whether sharks can see

colour. This may help to explain why some swimmers may get bitten and others do not. Was the colour of the swim suit the deciding factor?

For many lucky divers around the world who have dived and interacted with any species of shark, under the supervision of a reputable shark

diving company that respects the shark and the environment that the creature inhabits, it can be one of the most rewarding experiences of a lifetime.

It is these very divers who should act as ambassadors for the sharks. They can educate the rest of

the world about how intelligent and discerning these animals really are. The shark is not some mindless killer, but an intelligent animal that can appear to differentiate between colours and food that is within its natural diet and food that is alien to it. ■

Although Stuart has successfully proved that sharks are discerning eaters, do they have colour vision?

manufacturer

The British Legend

Apeks

Edited by
Andrey Bizuykin

The Apeks Marine Equipment Company was founded more than 30 years ago with but one purpose – to make the best scuba diving equipment in the world.

Building on original design ideas and its own technological innovations, and constantly striving to excel in both design, manufacture and skill, Apeks' production by far now exceeds the requirements set forth in existing international standards. Their quality standard became the yardstick against which many other manufacturers measured themselves. They obtained the very stringent and coveted European ISO 9001 certification.

Absolutely full quality assurance of all manufacture, in combination with the highest standard of manufacture, that of the European Quality Assurance System BS EN ISO 9001, guarantees the top quality of all products which others today can only envy.

It was in the middle of the 1960s, that the magazine Practical Mechanics fell into the hands of Kenneth Smith Ainscough and Eric Partington, two young men from Bolton, in northern England. They

were very interested in an article about aviation cylinders and propane gas reducers. Ainscough had trained at a technical college, and had worked on the railway, in a printing house, repairing trucks, had been employed by one of aerospace companies, and had even been a steward for the British airlines. But he was also a keen diver, being an active member of a scuba diver club. He enjoyed repairing all the club's equipment, everything from valves for cylinders, reducers and even compressors. His partner's speciality was engineering. They then started to design and make

suggested that they sell their homemade products through his shop. The trade was very successful, and the partners quickly realised that there was a good opportunity for the manufacture of equipment for scuba diving.

Apeks Marine Equipment Ltd started vigorous activity in 1971-1972, when Ainscough and

Partington used the first letters of their names for drawing up the trade mark

Apeks.
Apeks comes from:
Ainscough, **P**artington,
Eric, **K**enneth, **S**mith.

A look behind the scenes at Apeks Marine Equipment Company where engineers and technicians strive to design and build the best scuba diving equipment in the world





Apeks

Apeks headquarters in Lancashire, England

In the beginning, the partners organized the small business in Partington's garage. At that time, diving was not the fashionable sport it is today, and was at a more or less embryonic stage. The first project of the company was the manufacture of lobster hooks which divers used for pulling them out from nooks and crannies. This small business became the bread and butter work of the new company. The company then specialized in manufacturing hoops for cylinders and snap fasteners for weight belts.

At that time, the regulators on the market were only very simple in design, such as the Mistral. The Mistral was very far from perfect, it was unsafe and, because of long corrugated hoses, it was inconvenient in use. It was obvious, even then,

that the future was in regulators. Therefore Ainscough, with the support of Partington, started to develop a new type of regulator.

This project, however, had to be put on the back burner

when the company were offered the chance of producing new valves for cylinders. The partners decided to make a jump into the unknown. They raised a bank credit, bought a small lathe and a pressing machine, and made one thousand valves. All these valves were sold immediately. It allowed the partners to pay off all the credit with interest, plus the purchase of the machine tools, and to make a small profit. The renown of the quality of their production quickly spread, and they received a new order. Manufacture of this second lot of valves proved to be even easier, as one of the partners left his former job to concentrate on the production of the valves. From then on, Apeks became an independent business unit with its own tools, lathes and press. The trade mark "Typhoon" valves for cylinders are well known, and still exist in the UK today. The small profit enabled the company to employ three people, two of whom are still working in the company today.

In 1976, Ainscough finally created the first regulator, and named it Manta. The real progress of the company really only began with the advent of the Manta. The Manta design has been altered and improved, and has achieved a stable position in the world market for regulators for scuba diving.

The Apeks TX50 regulator appeared in 1978. It was the first-ever regulator which could pass the EN 250 international test, and has been awarded the CE mark. It was a real success. The prestigious British magazine Diver published the results of testing it, and informed their readers that the TX50 is most clearly the best regulator in the world. After this publication, the sales volume started to grow continuously. The first regulator, the APEKS TX50, was strikingly different from the current modern model. The first TX50 did not have an antifreeze system in the second stage, and it had a completely different first stage. Ainscough had to make many experiments before he achieved a reliable, non-failure operation of the first stage. Furthermore, he devised the dry chamber system.

There was a crisis in 1979-80. The company had to dismiss all employees, with only the directors remaining and business went from bad to worse. A decision was therefore made to organise a business trip to Australia. Some of the partners worked in Adelaide, Victoria and Melbourne, where they received an order for the development of a new type of regulator. The company business began to improve once more. The crisis had passed, and the partners returned to the UK to continue the business. Even in the most difficult



Apeks became an independent business unit with its own tools, lathes and press in the 70s



Employees at work at Apeks



Apeks

By 1983, the company had expanded rapidly, and was manufacturing six different products. A strong advertising company had been developed, and a new trade mark created. Among the range of products was valve for dry suits. In 1995, when the number of employees had exceeded 50, the company moved to the new, specially constructed building in Blackburn.

During its existence the company has created nine types of Apeks regulator. Each of the regulators that Apeks makes today is suitable for pure oxygen.

A confirmation that Apeks makes high quality equipment is that it produces equipment for several navies, including the British Navy. Fifteen percent of the total amount of manufacture is for military orders: these are respiratory equipment for helicopters, respiratory saving devices, devices for emergency escape from submarines, and equipment for hyperbaric chambers, non-magnetic valves, manifolds, valves for dry suits, and as well full-face

masks and accessories for the naval rebreather MK-16. Apeks works for rescue services, coast guard, police and firemen over the world.

Today, Apeks production is exported to all corners of the world, and there are distributors in the USA, Japan, Germany, Australia, South Africa, Spain, Poland, Russia and other countries.

Apeks' mission does not end with the sale of equipment. Apeks' quality is also based on a professional after-servicing of all equipment. Apeks organizes and runs service courses for their own dealers and other professional organizations everywhere. Each Apeks dealer can help with advice and guarantees non-failure operation of its equipment worldwide.

Apeks is now one of the basic divisions of the Agualung corporation. All manufacture at Apeks, from planning, prototypes, manufacture, to quality assurance and marketing, is

computer controlled. Except for its own production, the role of Apeks in the corporation is the manufacture of all metal accessories, and also parts of plastic elements for all Agualung regulators.

The 120 employees work the whole day round in three shifts. The company gives a lifetime guarantee on all its equipment. The company gives a lifetime guarantee on all its equipment. Today the turnover is about £4.5 million annually. It is a real British legend. Scuba diving is always an adventure. And if you are a keen diver, amateur or serious professional, Apeks should be the equipment for you. Apeks equipment is reliable and trouble-free, and works in practically all extreme conditions. It is thus the ideal choice for serious divers, who want to feel confident and free from anxiety under water. ■

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CHRIS HUF OF HUF.ORG

Poseidon Underwater hotel

Soon you might get a chance to sleep underwater face to face with sharks while enjoying the full comfort of a modern hotel.

An undersea hotel is under way in the Bahamas. "People who are interested in experiencing something they can't find anywhere else in the world will find it a real bargain," says Bruce Jones who heads the 40-million-dollar project.

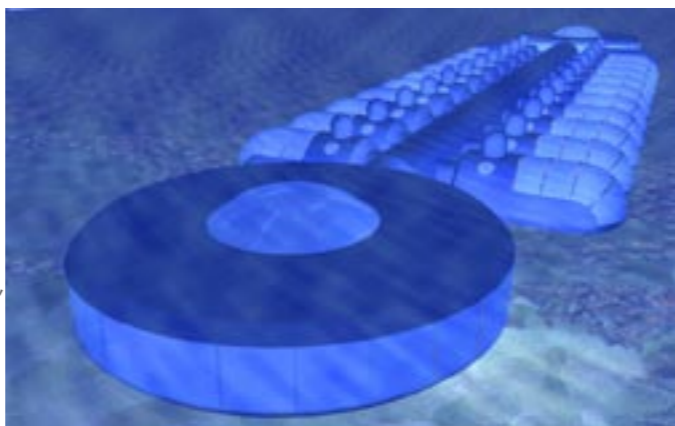
To date, there is only one other underwater hotel, and this is in a small refitted marine

lab located off the coast of Key Largo, Florida. But Jones says his Poseidon resort will be one of a kind, as guests will not need to don scuba gear to reach their luxury suites.

The hotel, located off the Bahamian island of Eleuthera at a depth of 15 meters (50 feet), will be connected to the mainland through two tunnels and an escalator, and pressure will be the same as at the surface. The hotel will have its own restaurant, a bar and 20 large suites with transparent acrylic walls facing coral gardens that can be lit up at night. Guests can expect to see a large variety of tropical fish, tuna and turtles, and with a bit of luck, sharks, from the

comfort of their rooms, or even from their private jacuzzis, says Jones. "They will enjoy five-star luxury accommodation, all with stunning views of the underwater world." Jones, who has spent 17 years designing, refitting and selling submarines, is confident the planned resort will become reality, probably sometime in 2006, even though a number of similar projects have foundered in the past.

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Wet & Weird NEWS

Robotic sharks in new giant aquarium

New amusing opportunity for trainee scuba divers

An artificial shark, called the Roboshark, was invented by Andrew Sneath to swim with wild sharks while carrying a movie camera in its head. In this way, animals could be filmed behaving in a natural way. Mr Sneath has now designed a 40 m diameter aquarium to house a number of

these robotic fish in a seven-metre-deep tank.

The new aquarium will also include a shoal of robotic tuna, called Tintuna, and a collection of robotic sting rays. The fish will be programmed to behave in as natural a way as possible.

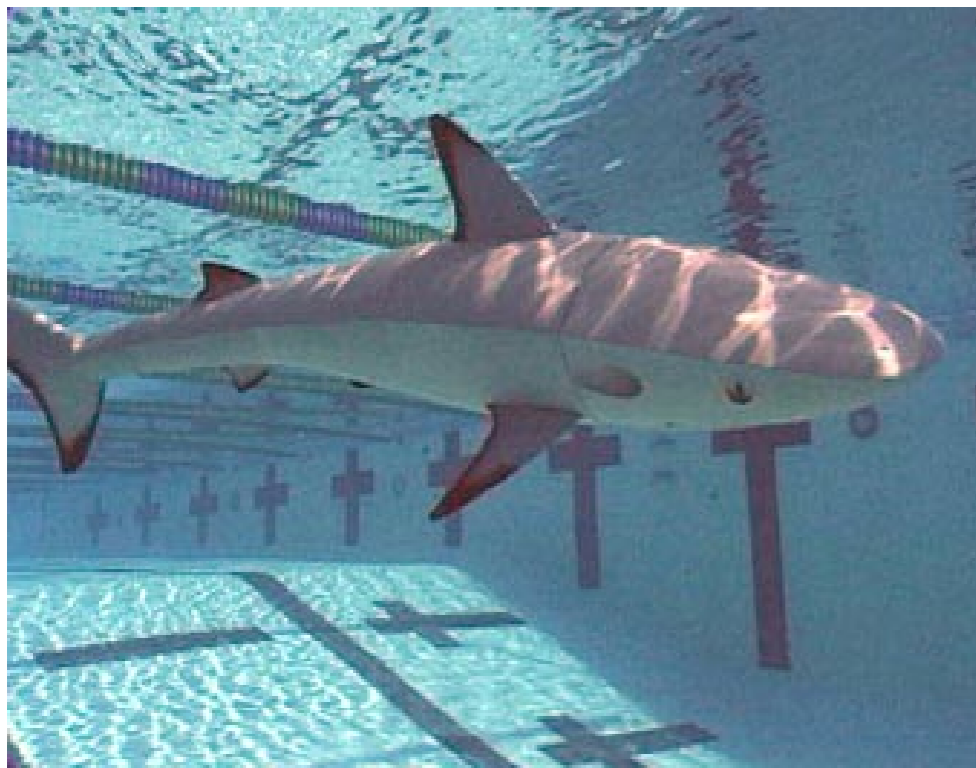
It was said that the tintuna school look like real tuna, and behave like real tuna. They have cameras

in their eyes and, in a simulated protective measure, will group together when they see a shark. On the other hand, the roboshark will also be programmed to chase the tuna, but only if it sees a lone fish moving on its own.

Diver training

As well as tourists, the Hydrodome will also welcome trainee scuba divers. Having robotic fish swimming about will give new divers familiarity because trainees are not used to having fish around them.

The aquarium will be housed in the new Hydrodome leisure centre situated near Birmingham, UK, and is expected to open in 2006. ■



Lost underwater robot still functioning after a year at sea

A little over a year ago, a VideoRay underwater robot was lost off Tasmania. After drifting over 30 km in rough seas, it was found by at Bruny Island. The VideoRay was lost during an inspection by Huon Aquaculture Company P/L, an Atlantic Salmon farming organization. Huon Aquaculture had been using the VideoRay for environmental monitoring surveys below and around fish farms, and for checking video systems and the deployment of underwater video systems in pens.

When found the unit was a bit knocked about, with a smashed up float block and scratches on thruster and camera and light



domes. However, on being returned to its owners, it was plugged in and everything was found to be fully operational. The VideoRay

will be put back into operation at Huon Aquaculture after being providing with a new control box, tethers, and side thrusters.

Weighing just 3½ kg, VideoRay ROVs are the smallest, most portable, and most responsive remotely operated vehicles available for use in underwater environments. VideoRays are used for underwater

surveys, offshore inspections, search and rescue, homeland defence, science, fish farming, and other applications. ■

Deep-sea fish found after tsunami is an e-mail hoax

Many stories have been circulating regarding the recent South Asian tsunami, including rumours of improbable scientific discoveries. An example of such is a widely distributed e-mail showing pictures of deep-sea creatures that were supposedly washed ashore when the tsunami hit Phuket, Thailand. Although the animals in the photos are real deep-sea animals, the e-mail claiming they were tsunami victims is a hoax.

The photos originate from a scientific expedition, the NORFANZ voyage, that explored life in the deep seas, and around

the seamounts, between Australia and New Zealand in May and June 2003.

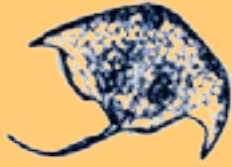
Seamounts are underwater mountain ranges and peaks. Deep ocean currents can concentrate nutrients around seamounts, promoting abundant marine life. There are giant squid here, and sea spiders can grow to half a metre across. Many of the creatures on these seamounts are slow growing, and some can live for more than 100 years.

Researchers on the NORFANZ voyage collected animal specimens and photographed and video-taped seamounts over a kilometre



down, and surveyed free-swimming animals that live in the waters around the seamounts.

Information about the expedition, including the circulated photos of alleged tsunami fishes, is available on the NORFANZ website. ■



News edited by
Micahel Symes

Dangerous underwater dive attraction could have returned

Wastwater, in the Lake District, UK, is three miles long, half a mile wide and about 80m deep. It is the deepest in the Lake District, and is quite clear at the bottom, although there is nothing to see. However, towards the bottom of Wastwater, there used to be a "gnome garden", which was well known among the diving community. Divers had taken gnomes down to about 48 meters, and placed them with a picket fence around.

But several years ago there were a number of fatalities and the Lake District National Park Authority asked the police to get rid of them, which they did. It is thought that the dead divers had spent too much time at too great a depth while searching for

the site of the ornaments.

However, there is now a rumour about a new gnome garden placed deeper than 50 meters. And as police divers can't legally dive any deeper than this, the new garden, if it exists, could have been purposefully put out of their reach.

The Sub-Aqua Association states that different associations had different depth limits but theirs was 50 meters for air divers, and that was only for very experienced divers. However, technical divers, who used a mixture of gases, could go below that depth. ■



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Wushu goes underwater

Lunar New Year ushered in at Sentosa's Underwater World

Wushu exponents have taken the ancient martial arts to a whole new level - underwater. It is not easy to balance underwater, and the perfectly executed punches and kicks of the wushu performers astonish viewers

As all three award-winning wushu exponents had no diving experience, they had to take a crash course in diving. Non-certified divers have to dive with the sharks, and for all these dive programmes there is a set of regulations and requirements for them to meet in order to go in the

water. And, of course, they must be in good health and able to swim.

As wushu performances are usually performed on land, little was known of the challenges presented by the aquatic environment. The buoyancy had to be dealt with because, unlike in the air where it is easy to jump and kick, it is more or less slow motion in the water. When floating, it is hard to control one's centre of gravity.

The group practiced at least three times a week, one hour each time for the past three months to come up with a unique routine and stunts that work underwater. ■

Giant squids to be plastinated

Gunther von Hagens, the anatomist behind the Body Worlds exhibition, where plastinated human bodies, as well as those of animals, were displayed, is to do the same for giant squids. Giant squid have never been successfully put on display before because their bodies collapse under their own weight out of water. He will therefore use

the same plastination technique on two huge giant squid specimens, which are being prepared to go on display as part of the Body Worlds exhibition.

Von Hagens invented plastination in the 1970s. The process involves replacing water and fat with a polymer, and it has allowed him to exhibit human bodies in life-like poses. But a



giant squid, with its lack of a rigid internal skeleton for support, and relatively poorly understood circulatory system, poses some novel challenges.

The plastination process could take up to a year, and the squid will need a rigid framework for support. ■

Photos of Crash Damage to Nuclear Submarine released

Photographs have been released of the shredded bow of a nuclear submarine, the San Francisco, that ran into an undersea mountain. The submarine limped back to Guam after smashing into the mountain, which was not on its navigational charts. The crash occurred 500 feet below the surface about 360 miles southeast of Guam. It was said that the San Francisco was traveling at more than 30 knots when the crash occurred.

The submarine's stronger inner hull, which protects the crew's living and working spaces, held firm, preventing a disaster. However, the sonar dome, made of fiberglass, shattered in the crash. The dome, which carries sonar gear, is normally flooded with water, so that the water there, along with water in the vessel's forward ballast tanks, probably helped

cushion the blow and keep the inner hull intact.

The submarine's main chart was apparently prepared in 1989 and did not show any potential hazards within three miles of the crash site. Satellite images taken since then show the wedge-shaped outline of the undersea mountain.

East View Cartographic Inc., a map company based in Minneapolis, said that Russian Navy charts, which have been available for five years, indicate more hazards in that part of the ocean than were on the American charts, though they also fail to show the undersea mountain. It was stated that one of the Russian charts noted that the area where the crash occurred had been "insufficiently surveyed." It also warned:



"Cautionary measures should be taken when sailing." ■



Contrary to popular belief rebreathers are actually a much older scuba diving technology than open circuit regulators

focus

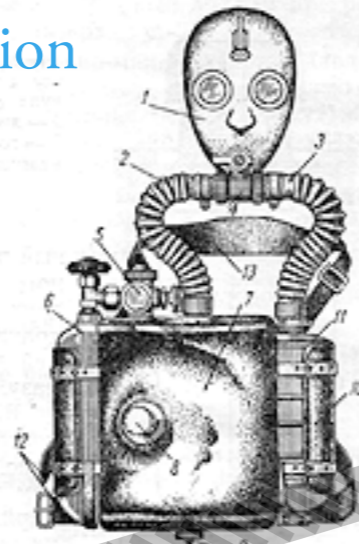
Scrubbers & Sensors

The Long (his)Story About

From Fleuss to Evolution

There is more and more talk of rebreathers, stated as being the future of diving. However, not many people have tried them. So what is all the fuss about?

Text: Michel Tagliati
Additional reporting by Peter Symes



The greatest majority of the readers of this magazine will have learned to dive with a regulator originating from the Aqualung, which the renowned Jacques Cousteau and Emile Gagnan invented in 1940. The regulator was the first

commercial, generally available dive-system, and this promoted the later great expansion of sports diving everywhere. And it must be said that the regulator is a fine

piece of equipment. It is reliable, more or less foolproof, and its simple construction is very robust. These are good properties to have when one's underwater breathing depends on them. However, as we will see, there are also a number of disadvantages. And it is these that make rebreathers an interesting alternative system.

When diving with a regulator, it is said that one is diving with an *open*

circuit, because the exhaled air passes straight out into the surrounding water, and is thereby lost. As only about a quarter of the available oxygen has been taken up by the body, and the rest expelled, it is a rather ineffective utilisation of a scanty resource. (See table next page.)

In addition, as the amount of air used increases proportionally with depth, open systems become more and more inefficient, and there are therefore major limitations to how long a diver can remain underwater. It seems obvious, then, to try

to re-use the air that has been exhaled, by using a closed system.

Closed circuit systems

Closed circuit systems are a far from new idea. It was Giovanni Borelli in the 1700's who first thought of re-using the exhaled air. His idea was to recirculate the air through a copper tube which was cooled by the sea water, and thereby "cleaned" the air before re-use. Luckily, it was never made. The mining industry and its problems with gas in the mine shafts also stimulated the relevant technical developments during the 1700's.

Henry Fleuss, an English naval officer from Germany, worked out the principles for a re-breathing apparatus, and produced a prototype at the end of the 1870's. He stayed down in a water tank for nearly an hour, and later went down to 5 meters in a lake using his system. Fleuss was the first "diver" in history with a re-breathing apparatus. At the beginning of the 1900's the military were quick to take up this idea. Oxygen-rebreathing equipment consisted of an oxygen tank together with a bag of potassium hydroxide and a breathing loop, and was used to rescue submarine crews and attack divers (there were no revealing bubbles on the surface). The German manufacturer Dräger released several models for military use in connection with World Wars I and II.



Ambient Pressure Diving's Closed Circuit Rebreather *Evolution* is the latest step in CCR...erh... evolution.

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Respiration

In a modern medical textbook on physiology, one of the several chapters on aspects of respiration is entitled "Physical principles of gaseous exchange; diffusion of oxygen and carbon dioxide through the respiratory membrane". And it is these very important principles that are of great interest to divers. How we take in and utilise oxygen, and how we get rid of the carbon dioxide produced by metabolism.

Cellular metabolism is independent of pressure

The amount of air which is needed to take a normal breath at a depth of 20 meters is three times greater than at the surface, and therefore the consumption of air with open systems increases with depth. **However, more importantly, cellular metabolism does not depend on the pressure.**

Oxygen is required to make adenosin trifostat, ATP, the fuel of the human cell. And a molecule of oxygen is a molecule of oxygen, wherever it is to be found, at the beach, or 100 meters deep, with the

corresponding increase in pressure. Therefore, when using a closed circuit there is the same consumption of air, whatever the depth. At rest, 0.3 to 0.5 liters of oxygen are used per minute (l/min), and with maximum work up to 3.0 l/min are used. Of course, there are differences between individuals, depending on the size of the diver and his or her physical condition.

The carbon dioxide problem

As we have seen, cellular metabolism depends on oxygen, which is inhaled from the atmosphere. The following table gives the composition, in volume percent, of inhaled atmospheric air (on an average cool, clear day), and also the corresponding composition of exhaled air. (There is also a minor content of the non-reactive noble gases such as argon, helium, etc., but this has been ignored here.) It will be seen that the uptake of oxygen in the lungs has caused the oxygen content of the inhaled air to be reduced from its original 20.84% to 15.7% in the exhaled air. It will also be seen that the concentration of carbon dioxide, a biproduct of metabolism, has gone up by about ninety times, to 3.6%.

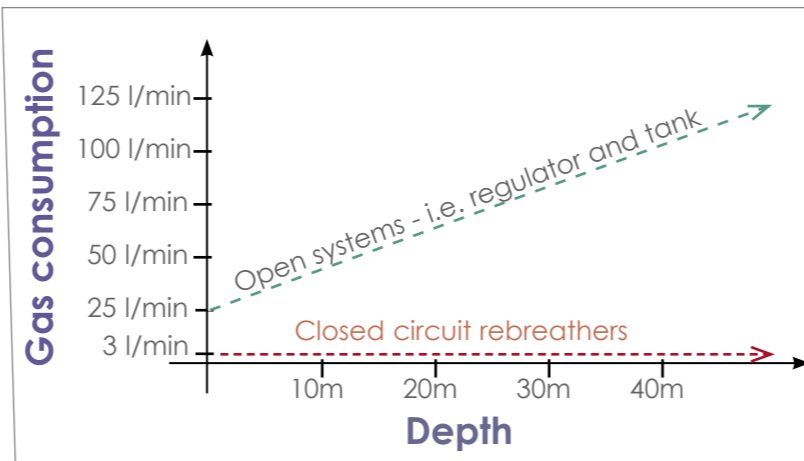
COMPONENT	INHALED AIR %	EXHALED AIR %
N ₂	78.62	74.5
O ₂	20.84	15.7
CO ₂	0.04	3.6
H ₂ O	0.50	6.2
Total	100.0	100.0

So, it is not so much the reduction in amount of oxygen that is the problem, for there is still some 16% available in each expelled breath, which should be available for re-use. It is the increase in carbon dioxide, CO₂, that is the real problem. A

diver can tolerate a build up to a CO₂ concentration of about 10%, increasing respiratory volume to compensate for the increased CO₂. However, beyond the 10% level the respiratory center in the brain stem begins to be depressed rather than stimulated, and the diver's respiration then actually begins to fall rather than to compensate. As a result of this, varying degrees of lethargy, narcosis, and, finally, anesthesia will occur. The CO₂ in the exhaled air must therefore be removed before the remaining oxygen can be re-used. Luckily, this is quite easy to do, using calcium hydroxide, Ca(OH)₂, which reacts with, and therefore fixes, the carbon dioxide. It is called CO₂-scrubbing and the filtering material, in this case calcium hydroxide, which comes as a granulate, is referred to as the scrubber.

In a rebreather, CO₂-scrubbing therefore takes place by circulating the breathing gas through a canister with the scrubber granulate in it.

Scrubber, in this case Sofnolime, comes in small granules,



Comparison of gas consumption in open and closed systems. In closed circuit rebreathers the gas consumption doesn't vary with depth.



A REBREATHER TIMELINE

1500's In England and France, full diving suits made of leather with metal helmets. The diving helmets were already some sort of rebreather, but needed surface supply and were without scrubber

1680 Giovanni Borelli designed a closed breathing circuit. The idea was to recirculate air through a copper tube which was cooled by sea water. The assumption was that all the impurities would then condense out of the air inside the tube.

1726 Stephen Hale designed the first scrubber: a flannel liner, soaked in salt and tarter, used in a helmet for mine disasters.

1772-4 Oxygen independently discovered by Swedish chemist, Carl Wilhelm Scheele, in 1772, and the English chemist Joseph Priestly, in 1774. Soon followed the first known ideas to use Oxygen for diving and first functional ideas to build autonomous rebreathers.

1876 Henry Fleuss began to develop an oxygen rebreather. He used a rubber face mask and a breathing bag connected to a copper oxygen tank. The carbon dioxide, scrubber was a rope yarn soaked in a solution of caustic potash. Enabling Fleuss to walk along a river, this was the first SCUBA Dive.

1879 Fleuss builds a Mining-Rescue Rebreather for Siebe/Gorman

1881 A special rebreather scrubber using a barium hydroxide is patented by Khotinsky and Lake.

1904 Siebe and Gorman patent Oxylite, a potassium- and sodium-peroxide mixture that produces oxygen on contact with water.

1907 A Dräger rebreather is used as submarine rescue equipment

1912 Dräger helmet-diving-rebreathers are available

1913 Dräger performs a successful simulated 40 minute dive to 80m in chamber.

1914 Dräger introduce a selfmixing Nitrox-Rebreather for max. 40m.

1926 Dräger presents the first early recreational rebreather, the 'Bade-taucher'.
1941 Dräger "Kleintauchgerät 138"

1941 Dräger "Kleintauchgerät 138"

1953 Dräger Leutnant Lund II and Barakuda Delphin I

1967 Russians experiments with predecessor to AKA-60



No, rebreathers are not new. In this 1912-footage we see Dräger's helmet diving rebreather in use. Photo: Dräger's archive.

Expression: Breathing loop

The whole volume of circulating gas in a rebreather, mainly the hoses, one or two counterlungs and also the diver's lungs.



PETER SYMES

Lt.Lund rebreather, 1953

Scrubbers

Although easy to do in principle, getting a CO₂-scrubber to function in a safe and reliable way is not completely without its complications - which many divers have found out to their cost. As with walking or running, it takes work to breath underwater. If the resistance to breathing is too high, there will be physiological problems which will limit the use of this system.

Also, *hypercapnea*, the condition where there is too much CO₂ in the body can become an issue. The material used to remove the carbon dioxide in the system, the scrubber, has a limited life, and can only fix a certain maximum amount of carbon dioxide.

As these filters cost money, people are disinclined to change them often enough. The maximum limit for how long these filters should be used is thus some times transgressed, which increases the risk of accidents.



The matter with oxygen

And while we are at it, why not increase the oxygen level in the inhaled air, even perhaps right up to 100% pure oxygen? This way we could also avoid breathing in nitrogen, which is the cause behind depth narcosis and decompression illness and give away with all concerns about decompression limits. If it only was so easy! The apparently paradoxical answer is that pure oxygen quickly becomes poisonous under pressure.

Partial pressure of oxygen

Assume that we have a mixture of gases. Then the total pressure of the mixture is equal to the sum of the pressures exerted separately by each of the individual components in the mixture. So, if the mixture we are considering is atmospheric air, we have:

$$P_{atmos} = P_N + P_O + P_{CO_2}$$

Where

P_{atmos} is the atmospheric pressure
 P_N is the partial pressure of nitrogen
 P_{CO_2} is the partial pressure of carbon dioxide
 P_O is the partial pressure of oxygen

Now, according to the ideal gas laws, as the components are all at the same temperature, the partial pressures must be proportional to the volumes of each gas present in the mixture. In the table given above, oxygen has an volume % of approximately 21 of atmospheric air. This means that its partial pressure is 0.21 of an atmosphere, or 0.21 bar. This is oxygen's contribution to the total atmospheric pressure.

So, at the beach, oxygen in the air has a partial pressure of ca 0.21 bar. And if the diver is using compressed air at a depth of 10 meters, then the corresponding oxygen partial pressure is 0.42 bar (0.21 x 2 bar), at 20 meters it is 0.63 bar, at 30m its 0.84 and so forth. In the literature the partial pressure of oxygen is written as ppO₂.

The importance of ppO₂

When discussing respiration this is probably the most important parameter to be considered. Not only must the excess carbon dioxide be removed from the air, but the partial pressure of the oxygen must also be maintained at a reasonably constant level to ensure correct cellular metabolism.

Gaseous diffusion from the alveoli of the lungs to the pulmonary blood is determined by the partial pressure of the oxygen. The partial pressure determines the force exerted in diffusion through the pulmonary membrane.

In other and more plain words, it is the ppO₂ and not the O₂ % that determines whether we live or die.

Consequently, ppO₂ should be maintained within a certain range to sustain life.

Normal ppO₂ (at sealevel) is, obviously, 0.21 as air contains 21% oxygen. If the partial pressure falls below 0.12 (12% oxygen at sealevel) most individuals will lose their ability to function. Below 0.10 bar ppO₂ they will lose consciousness and below that die from asphyxiation.

On the other hand, a prologued exposure to high ppO₂ leads to oxygen toxicity and the condition hyperoxia which manifests itself in sudden convulsions, which under water inevitably will lead to drowning. Therefore a ppO₂ of 1.6bar is usually considered the upper limit in recreational diving, and only for a limited time. And 1.3 bar the level not to exceed in general.

For these reasons it should be clear that maintaining the ppO₂ of the breathing gas within specific bounds is of utmost importance. It becomes, quite literally, a matter of life and death.

Diving conventionally with compressed air on open systems, as most regular holiday makers do, controlling ppO₂ is usually not an issue as normal air only reaches a ppO₂ of 1.3 bar at a depth of 54m - far beyond where they should venture.

But as soon as we start tinkering and raising the O₂-content of our breathing gas, these matters change, as we are taught already at entry level Nitrox courses —such as PADI's Enriched Air Specialty, or the various Basic Nitrox courses offered elsewhere.

1968	First electronically controlled rebreather, the Electrolung, is marketed
1970	BioMarine CCR-1000
1972	BioMarine Mark 15
1975	Dräger LAR V
1977	BioMarine NM-6
1978	Interspiro ACSC
1982	Interspiro Oxydive
1984	Dräger Tieftauchsystem CCBS for operating depths of max. 600m
1985	AKA-60 (Russian)
1991	Dräger Newtsuit
1992	Interspiro DCSC
1995	Dräger SCR Atlantis (1998 renamed in Dräger-Dolphin)
1998	Buddy Inspiration
1999	Dräger-Ray
2001	Halcyon RB80, Cochran CCR and Mares SCR Azimuth
2004	Ambient Pressure Diving's Evolution

PETER SYMES



Oxygen rebreathers

In water pure oxygen rebreathers are restricted to use in shallow water of less than 6 meters - to keep ppO₂ below the 1.6 bar limit. For this reason the pure oxygen rebreathers are of limited and mainly military use. Oxygen rebreathers however also have a use on land with firefighters, rescue crew and miners.



Whether we dive on open systems or semi-closed rebreathers (see explanation below) we chose, prior to the dive, our breathing gas with a predetermined oxygen-content. This may be air or we may opt for another specific gas suitable for the depths we are aiming at. In most cases this will be Nitrox—which is now becoming quite a household word among divers.

Nitrox with 32 or 36% oxygen is now quite routinely being offered at dive centres, resorts and liveboards worldwide as these two “standard-blends” will cover most needs in the typical recreational range with near optimum benefits.

However, choosing the right oxygen-% will always be a compromise between longer no-decompression times versus maximum depth. For example, diving on Nitrox with 36% oxygen gives a generous no-deco time of 50 mins at 26m - rather than the usual 20 min when diving on air. That is nice, but Nitrox 36 can't take you any deeper, as ppO₂ is already 1.3 bar around that depth.

And if you dive any shallower you don't get the full benefits of Nitrox at that particular oxygen content. So, for each depth there seem to be an optimum oxygen % in the breathing gas. With the

current general limits, this optimum oxygen content corresponds to a constant oxygen partial pressure of 1.3 bar oxygen regardless of depth.

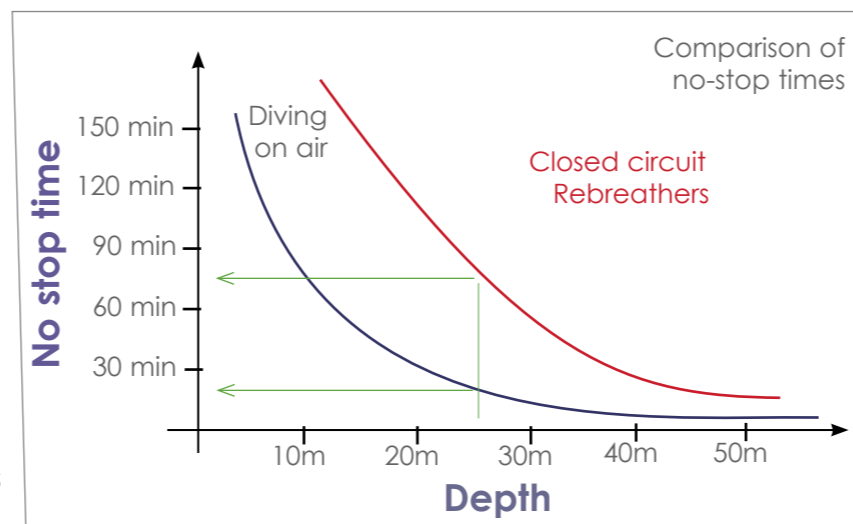
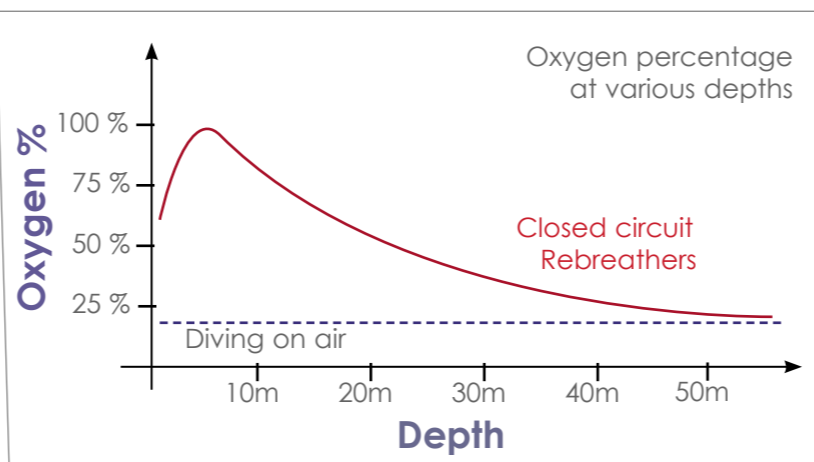
Controlling the ppO₂

To ensure that the correct oxygen level is obtained, i.e. its partial pressure, it is necessary to measure its concentration. For this purpose a special transducer is needed, an oxygen sensor. (see box below)

Modern closed breathing systems

With the advent of oxygen sensors and microprocessors, it is now possible to reduce the amount of gas taken down by a diver to a mere bagfull of atmospheric air and a few liters of compressed oxygen. These closed circuit rebreathers, CCR, use oxygen sensors to control the partial pressure of oxygen in the inhaled gas. This means that the diver can continually control and maintain oxygen partial pressure at certain levels during a dive. And this is where the fully closed rebreathers excel.

Say, for example, that a fully closed breathing system has been set to maintain a given oxygen partial pressure at depth, typically 1.3 bar. If the diver then descends to another depth, the ambient pressure increases, and with it the oxygen partial pressure in the breathing



loop. The rebreather then compensates to keep the oxygen partial pressure constant. Likewise, if the diver ascends, the pressure decreases, and the oxygen partial pressure will decrease. The apparatus

will then compensate in a controlled way by injecting some more oxygen into the loop.

As the graphs above clearly demonstrate, the potential extension of no-deco times are huge.

Open, semi-closed and fully closed circuits

By *Open Circuit* one usually refers to the omni-present regulator - a second and a first stage connected to on a tank of compressed air. The expression is partially misleading because the air doesn't go in a circuit. It travels from the tank and via the regulator, through the diver before getting exhaled into the water in a one-way process.

A *semi-closed circuit* is a type of rebreather in which (most commonly) the breathing gas is being continuously injected from the tank into the breathing loop where it circulates a number of times. On average the gas is re-circulated 4-5 times before being vented to the outside through an over-pressure valve. It is because gas is continuously being vented that these circuits are referred to as being semi-closed (or rather semi-open). The breathing gases used in these semi-closed (circuit) rebreathers or 'SCR' are various pre-set Nitrox-blends. The popular Dräger rebreathers (Dolphin, Ray...) are SCRs.

In a *fully closed (circuit) rebreather* or 'CCR' all the gas is continuously being recirculated and no gas is vented. The CCR is generally being considered the thoroughbred of rebreathers. In CCR's the only gas being consumed is the oxygen metabolised by the diver (not considering gas used for inflating suits, wings etc and gas lost during ascent and decent).

Another important distinction between the popular Dräger SCRs and a CCR such as the Inspiration, is that the SCRs have a present oxygen-% and a variable ppO₂, whereas in the Inspiration it is the ppO₂ that is fixed and the oxygen-% which varies with depth.



Dräger Dolphin SCR



APD Inspiration CCR



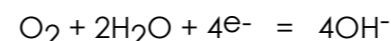
Oxygen sensors

An oxygen sensor can be considered as a small fuel-cell in which the chemical energy of oxygen is transformed into electrical energy.

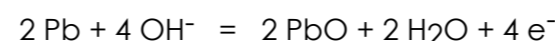
A very thin, plastic membrane, placed over the top of the sensor, operates as a solid barrier in which the oxygen molecules must dis-

solve in order to reach the sensing electrode. The flux of oxygen to the working anode is dependent on the partial pressure gradient of oxygen across the barrier. This means that the output signal from the cell is proportional to the partial pressure of the oxygen in the gas mixture.

When oxygen reaches the working electrode, it is immediately catalytically reduced to hydroxyl ions.



These hydroxyl ions migrate through a conductive electrolyte (typically potassium hydroxide) to the metallic lead anode, where they are involved in the oxidation of the lead to its oxide.



So, as the two processes take place, a current is generated (represented here by the four electrons 4e⁻). This current can be measured externally by passing it through a known resistance and measuring the potential drop across it. Since the current produced is proportional to the rate at which these reactions occur, its measurement allows accurate determination of the oxygen concentra-

tion. The current produced can then be used, via a computer, to control an oxygen inlet valve.

As the electrochemical reaction results in the oxidation of the lead anode, these sensors have a limited life. Once all the available lead has been oxidised they no longer work. Typically, oxygen sensors have 1 - 2 year life times.

Taking it further

Nitrogen is the usual diluent for oxygen in our normal atmosphere. However, as all divers know, nitrogen dissolves in the blood under high pressure, and can cause narcosis or decompression sickness. To reduce or eliminate this problem divers would like to use as little nitrogen as possible in the inhaled air.

Remove the biologically inactive nitrogen from the inhaled air and the risk of being hit by rapture of the deep disappears. And rebreathers can solve this problem, too, with the non-narcotic gas helium replacing nitrogen in the inhaled air being used at greater depths.

In CCRs like the Inspiration there are two tanks (see picture on previous page). One contains the oxygen which is being injected into to breathing loop to maintain the correct ppO_2 .

The other tank contains the *diluent gas*, which usually is just air, but it can be anything breathable such as trimix. This gas is, basi-

cally, the 'base substance' of what you breathe and what the oxygen gets injected into, it is what inflates the breathing loop and what is used for buoyancy in the wing or drysuit. So with an octopus attached this tank also can double as a normal open circuit and as backup system should there be a problem with the rebreather. (Switching to open system by closing the rebreather's mouthpiece and breathing from the octopus instead is referred to as *bail-out*).

The diluent gas is normally not consumed except for what is used to inflate the breathing loop and maybe the suit and wing (some carry separate tanks for this, i.e. when argon is used for suit inflation).

For trimix divers this is very good news as Helium is a very expensive gas so using a rebreather also come a significant economic incentive. Also it means a significant reduction in weight and the

number of tanks a diver who need to explore some extreme environments like deep wrecks and caves need to carry and for this reason the rebreather has become a preferred tool among many underwater explorers and scientists alike.

Next issue:

Diving the thing - what is it like and what the difference in skills?

US/Canada Distributor of Inspiration and Evolution Rebreathers



"Now, where did that contact lens go?"



When experience comes in the way

ing of safety. This can lead to a failure to carry out the vital control checks of the equipment before and after each dive.

Oxygen sensors degrade (oxidise) and must be changed every year, or more often, according to how much the system has been used. The reliability of the sensors and their output is also a matter of some controversy. It happens that

technical divers use fully closed systems at depths of more than 100 meters, in spite of the fact that neither the equipment nor the sensors are approved for these depths because of the doubts regarding the reduced reliability of their performance. (see, for example, the story about David Shaws fatal dive to 271m in X-RAY #3)

But, today, it is technically possible to dive to a depth of 100 meters with a couple

of 3-liter tanks containing 200 bars of compressed oxygen. However, the technique is so advanced that the necessary knowledge, training and maintenance of this equipment is not yet fully integrated into the training courses offered today.

To dive safely with fully closed systems requires a thorough theoretical and practical knowledge plus frequent use in order to maintain the routines and reflexes learned during training.

Sarawak's ecological heritage is among the most distinctive in the world. Being part of the Indo-Australian Archipelago, the epicentre of marine biodiversity, the region comprises nearly 1000,000 square kilometer of coral reefs or 34 percent of the world's total, housing 600-800 reef-building coral species in the world. It is home to more than 3,000 species of fishes and the richest concentration of invertebrate species.

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Disclaimer:

Diving with rebreathers requires special training.

Diving with a fully closed system is, in many ways, significantly different from diving with an open system. Several things have to be re-learned, and re-learning is much more difficult if one has long been used to diving with an open system. Many experienced divers think that they are quite competent at diving, and often find it difficult to accept that they are beginners again when diving with a completely closed

breathing system.

For example, they may not realise that the oxygen partial pressure can vary considerably. Also, there is a risk that a very experienced diver will make serious elementary mistakes, due to a false feel-

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The Uniqueness of Water

Water, obviously, is essential to our very existence, without it we rapidly die. In spite of this, everybody perceives water to be a rather ordinary sort of stuff, as it is transparent, odourless, and tasteless.

Many divers feel almost just at home in water as they do in air, and rarely, if ever, think about its more unusual physical properties. Water appears to be a very simple molecule, consisting of just two hydrogen atoms attached to an oxygen atom. There are, in fact, very few molecules that are smaller or lighter. In spite of this, it is a most remarkable substance, with many anomalous properties.

For a start, water is unique in that it is the only natural substance that is found in all three states – liquid, solid (ice) and vapour – at the temperatures normally found on Earth. And the fact that ice and liquid water can coexist at the not abnormal temperature of 0°C, is extremely important for all life on Earth.

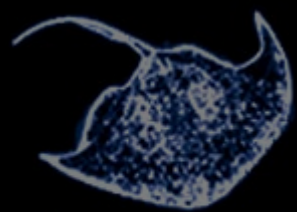
Water has an unusually high density, and this density is further anomalous in that, unlike other liquids, it increases on cooling down to 3.984°C and then decreases until the freezing point temperature of 0°C is reached. The density of water is thus a maximum at about 4°C, meaning that it expands both on heating and cooling from this temperature. This density maximum, together with the low ice

density, ensures that all of a body of water (not just its surface) must be close to 0°C before any freezing can occur. The freezing of rivers, lakes and oceans is therefore from the top down, so insulating the water from further freezing. The oceans do not, therefore, freeze from the bottom upwards until they result in just a thin layer of liquid water on solid ice. If they did then life as we know it today could not have been possible.

The unusually high density of water is mainly due to the cohesive nature of the hydrogen-bonded network. This reduces the free volume and ensures a relatively high-density, compensating for the partial open nature of the hydrogen-bonded network. Why the density of water actually has a maximum at 4°C requires a much more detailed thermodynamic explanation than can be given here. ■

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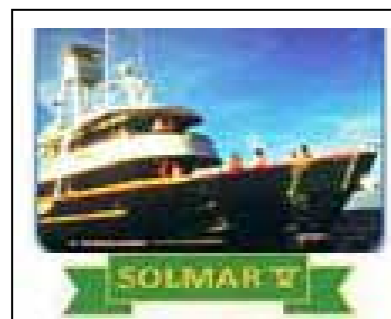
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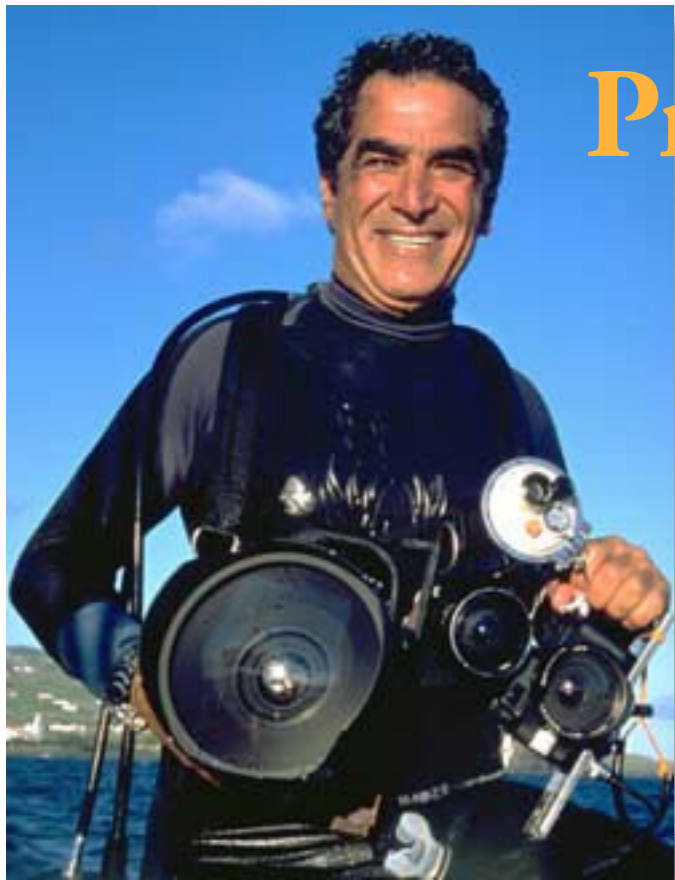
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Amos Nachoum

Interview by Edwin Marcow
Photographs by Amos Nachoum

Amos Nachoum, world acclaimed wildlife photographer is the recipient of numerous photographic awards and acknowledgements for his ground breaking work in free diving with Great White Sharks and Orcas in the open ocean, speaks to underwater photographer, Edwin Marcow, about his life, work and vision.

Amos was born in Israel in 1954. Today, he is based in San Francisco, California, USA.

EM: Amos how did you get started in photography?

AN: I was aged 12 and I knew that is what I wanted to do. For me, it was more evolutionary — I did not know what format of photography I wanted to do, but my desire and love for this art form started here.

EM: When you were a youngster growing up, were there any particular photographers that you admired or tried to emulate?

AN: For me it was not a question of any particular photographer. It was the concept of holding the camera adjusting and 'pushing' the camera's f-stop's shutter speed, and so on, to create the desired image that I had in my mind. This was a tool to communicate with others. I could not communicate very well when it came to writing and speaking in order to get across what I was trying to say.

While I was growing up, I had a difficult time within the family, and there were times when I did not always see eye to eye with my father. My mom would inadvertently take his side, so the medium and art form of photography became my escape — a way to express my self.

EM: Amos when did you get your first break in photography?

AN: As a youngster, I was fascinated by photography. I ran around the streets in Israel, camera in hand, photographing the people that I came across. My pictures were being sold and published by newspapers in Israel.

EM: When was your first break in marine and wildlife photography?

AN: I settled in the States in 1990-91. At that time, I was exchanging advertising

for stories, so naturally the magazines would use my images for the story. But this was a business arrangement to raise awareness for my Adventure Travel Company Big Animals. When I became a full time photographer, and not just a tour operator, I had to rethink everything that I had done previously.

So, I took a loan from the bank of \$4000 dollars, and I gave myself assignments to complete. I imagined that I had received a commission to shoot for National Geographic and to do a story.

I went to the island of Serbine in the Netherland Antilles, because I was very familiar with the Island and it's geography. I had good connections there. I shot the Island from the air, land and water.

This project took three weeks to complete. I chose only 15 images to portray the Island with the supporting article. I made several photocopies, and then sent this package to 55 different magazines around the US.

I sent this package to diverse and broad magazines in the travel and leisure market and to National Geographic.

The Condor Naste Traveller magazine gave me my first break. At this time, I was driving a taxi in New York to cover my costs. Then, I received a request from them to cover a story on Bonaire,



▲ TOP: Amos Nachoum
▲ Tail of a Humpback whale, Niue, South Pacific

Profiles



army often working whilst under fire. The discipline that I acquired from being under fire, having to cope with being put into strange situations, and understanding how to prepare for it, makes me feel a lot more comfortable underwater with any subject. Of course, no encounter is the same as another.

This has helped me when it comes to shooting underwater with large predators such as Great White

sharks. which included both topside images and marine life, though only from the perspective of snorkelling. This was 1991. From then on, things just took off.

EM: Amos, What would you say is your greatest achievement to date?

AN: Well, for me that would have to be that I am still doing what I love to do — rather than one individual experience or achievement.

EM: What is the scariest or most dangerous situation you have been in?

AN: In general, I have had a good grounding [in risky situations] from the many years I worked as a war correspondent and photographer in the Israeli



the boat manoeuvred between myself and the polar bear to allow me safe passage onto the boat.

Other than the incident with the polar bear, all encounters with wildlife have been peaceful, as long as my mindset is on the right plane and the circumstances fall into

sharks.

Underwater, I have had only one scary moment — when I encountered a polar bear. This was the most memorable moment of my life. Indeed, it was scary. In fact, I had to move the camera out of a shooting position and concentrate on saving myself.

I dived as deep as I could, to keep myself out of the reach of the polar bear. This took place about three years ago. But it is still on my agenda. I want to get a picture of a polar bear underwater in the wild—fully body in frame—precisely because all polar bear pictures have been taken in zoos where the bears are in captivity. The feet have been cut off or you only have an image with part of the

bear's body in the frame.

There have been only three photographers in the world who have been in the water with polar bears. One was an Italian filmmaker, now in his late 70's, whom I interviewed prior to my trip to the High Arctic. He advised me that a polar bear cannot dive deeper than 9 meters, or 30 feet. Armed with this information, I thought that I could dive to 40 feet and still achieve what I was looking for while working with the right lens. Well! No one told the polar bear this! For low and behold, the polar bear surprised me, defied all the rules and followed me down to about 24 meters (80 feet). But as I am usually ready for surprises and the unexpected, I took the necessary steps to prevent getting hurt. Upon my ascent,

place.

EM: Amos have you ever been bitten?

AN: [laughs] Well, these Great White sharks are very large fish! I have been bitten by a Clown fish. [He laughs]. At the time of the polar bear shoot, I was nearly bitten by a walrus, but due to a malfunction on the boat, the boat could not come to my aid. And there I was—in the water with this walrus mid-channel between the boat and the flow ice—without cover from the boat, as this large female closed the ground between us. I kicked out with

Amos Nachoum

- ◀ LEFT: An underwater photographer takes photos of a Humpback whale and its calf, Niue, South Pacific
- ◀ CENTER: A diver swims with the infant Humpback whale, Niue, South Pacific
- ▼ Spectacular shot of a killer whale diving to deeper depths, Norway

my fins to fend off her attack. About to get bitten or gored, I turned to my side, and then she sank her tusks into my dry suit where she tore two large holes into the side of the suit, thankfully missing my groin. I got quite wet from that but no real injury.

She could have done a lot more damage. [He laughs]. She just wanted to push me out of the way.



EM: How do you plan to push the envelope further, and how do you plan to cap your already amazing achievements?

AN: Pushing the envelope is a mindset that I apply even in everyday life. It is not something that I plan to do in advance.

When I am in the field, I weigh up the situation from what is going on around me, and then knowing what other people have done, what pictures have already been taken, bearing all this in mind and blessed with a quick memory, and based on emulating not copying what other people have achieved – I bring this with me to the field, with camera in hand. I see what I want to shoot but with the knowledge of what has been done before. I

see what can I do differently without endangering myself or others around me.

For me, it does not make a difference if I am taking a picture, of a Clown fish or a crocodile, or if I am on location in the North Pole. I do not push the envelope for the sake of “pushing the envelope”. It is a total understanding of personal and group safety, what has been done before and what I can do. While knowing what is going on in the field at the

time, I take new pictures with new results.

EM: What cameras and lenses do you use?

AN: I shoot with two Nikon RS,



and now I am shooting with a Hasselblad X Pan—an old concept brought back into fashion.

For the first time, a dedicated housing has been made for this camera by Aquatica in Canada, especially for me, and I am testing it here in Gansbaai on the Great White, and next, in the Cayman Islands to do some reef diving with this set up and test it further.

I am one of the first in the world to take this camera underwater,

and to shoot with it. Although, what is more important to me is to bring new images to the world.

EM: What is your favourite lens?

AN: There is only one, and that is

the fish eye, because water is 800 times denser than air, and anything we photograph, from more than one metre, loses its impact, power, and beauty, which Mother Nature provided, other than calibration, textures and shape.

The fish eye does the job. It is so sharp, it allows you to get closer to the subject. It can bring you very close to your subject and still fit everything in the frame.

EM: What is your preferred film

choice and speed?

AN: Kodachrome 64. It's a hard film to use. You have to be absolutely spot on with it. What is also very difficult is that it is almost impossible to have it developed anywhere in the world today. It's an excellent film, especially underwater, because it is so neutral, and with all that filtration of colours underwater already happening, you do not want to be “pushing” it further with a film that is already pushing the RGB spectrum through its chemical make up.

E6 processed films are already filtered, with blues, reds, and yellows, and Kodachrome brings that all alive when used underwater.

EM: Film versus Digital?

AN: Digital is here. It is the future. It will be better than film one day—no question. I still prefer to use film, because I know it so well. I enjoy working with it. In my opinion, film still has a higher quality. There is more depth in film. It has more texture than digital.

Sooner or later, digital will be able to achieve these results as well, which film gives you now.

I know that Fuji has come up with new chips. I think they are 11 or 12 MB files—6 MB are for highlights and 6 MB are for shadows or low light. I have not tested this myself. I have just heard about it.

So, in a year or so, digital will be as good or better than film. Personally, I will be waiting for the



◀ INSET: Napping polar bear, High Arctic, Canada

▲ TOP: A hunting wild dolphin breaches the surface, Sardine Run, South Africa

▲ BOTTOM: A leaping wild dolphin is captured on film in mid-air, Sardine Run, South Africa



◀ A dramatic moment when a leaping shark nabs its fleeing prey, a seal, for dinner, South Africa

mother and calf Humpback whale vertical in the water. I called it, *The Renaissances*.

Then, there was the Nikon 1993 award for a Great White lunging out of the water.

Nature's Best, the most prestigious wildlife and photography magazine in the world, gave my work an award in 2003.

I also got recognized by The Editorial Communication Arts magazine, which is the leading magazine in the US for general photography, and a cover for Rodale's Scuba Diving magazine, which was a half in-half out picture taken in the water of a diver with his fins in the air and his body in water, head facing towards the sea floor.

I felt that this image was my best work, because I was shooting with a fish eye lens that cannot use any filters. I balanced the exposure between the diver in and out of the water. This image really was for me, 'thinking out of the box'. I like this image the most due to the fact of how hard it was to balance the different exposures—from being underwater to topside and having to think out of the box to get it right.

On a last note about my photography and my continued pursuit in this field... It is not only a love for shooting in the water with large marine subjects, it is mostly my love and appreciation of photography, and what I can say with an image that I cannot with words. What I think most

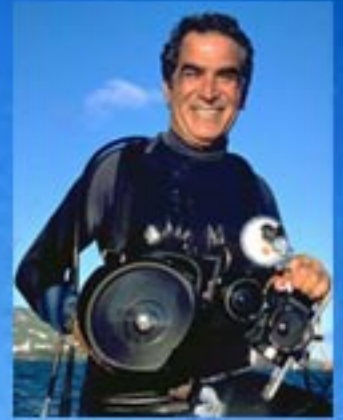
Amos Nachoum

underwater photographers miss, and what we are missing, is that people are not realising that they need to bring all the understanding and discipline of topside photography, which is so evolved, to the underwater realm.

Many of us have too narrow a point of view when it comes to underwater photography. One should have an understanding and love of all the great artists and emulate them, such as Monet, Rembrandt and Van Gogh. Look at paintings that have come out of these spectacular minds. Understand the rules of leading lines, beauty, light, drama, fear, power, and bring this into your work.

Painters and photographers are very similar, even though painters work with a blank canvas and have to add colours, shape and texture. Whereas, we go underwater, and we have the help of the greatest artist of them all, Mother Nature, who has painted everything for us. The only problem is that nature hides this element and colour from us, because number one, there is a lot happening down there (e.g. predation), and two, there is loss of light. We only need to learn how to understand white light and ambient light and how to read it.

In summary, I do not believe that marine photography is a genre in its own right. Marine photography is just another form of photography, and if one learns more from what has been done before—on land or by the great artists—one can bring this with oneself underwater and create better images. ■



AMOS NACHOUM'S
BIG ANIMALS
PHOTOGRAPHY EXPEDITIONS



Jon Gross

Text by Gunild Pak Symes

Jon Gross specializes in underwater and marine related photography from the west coast of North America, primarily Washington State, USA, and British Columbia, Canada. According to Jon, the marine life found in this part of the Pacific rivals anything found in the hottest tropical destinations in almost all aspects. He said that the challenges of this region, however, are cooler water temperatures and fickle water visibility. The diversity and abundance of marine life in these cold dark waters is relatively unexplored, and one of Jon's goals is to make this marine life more widely recognized.

► The Market, or Opalescent squid, is common in Puget Sound, and can be seen catching fish during night dives. Three Tree Point (north side), Washington State, USA.





▲ Egg Yolk Jellys often have crabs living on them that drift with them. They are usually found in the mantle, but this one was sitting on top of the bell, and is probably a Graceful Crab (*Cancer gracilis*) in the final larval stage. That identification is tentative though.

► This China Rockfish is defending its territory against me. Note the flared pectoral fins, and the upright dorsal fin. Waadah Island Fingers, Washington State, USA



▲ Very common on sandy or muddy bottoms in Puget Sound, the C-O sole buries itself on the bottom, and ambushes its prey. Mukilteo T-dock, Washington State, USA

◀ This Bering Hermit crab brought to mind (depressing as it may be) a suicidal person getting ready to jump from a bridge. I've seen Hermit Crabs jumping from their perches if you get too close, and falling up to 50 feet down a wall to land somewhere else. It's a handy escape response, but boy, climbing back up the wall must take awhile.

▲ PREVIOUS PAGE: Basket stars are ubiquitous with high current waters. They capture food from the water rushing by in their uplifted tentacles. Seven Tree Island, British Columbia, Canada





◀ Some of the largest anemones in the world are the Fish Eating Urticinas. The mouth on this particular specimen is almost 2 inches wide, and the oral disc can measure up to 18 inches. Waadah Island Fingers (Blades), Washington State, USA

▼ This octopus was sitting quietly on the top of an old engine block, which provided a beautiful rusty red backdrop. He (I think it was male) was living in one of the cylinders.

▼ NEXT PAGE: As I've mentioned in other images, these anemones grow to enormous size. This particular specimen is at least 18 inches in diameter.



► The Red Irish Lord is one of the most photographed fish in this area because of its arresting color patterns, and reluctance to move when approached with a camera. Browning Wall, British Columbia, Canada

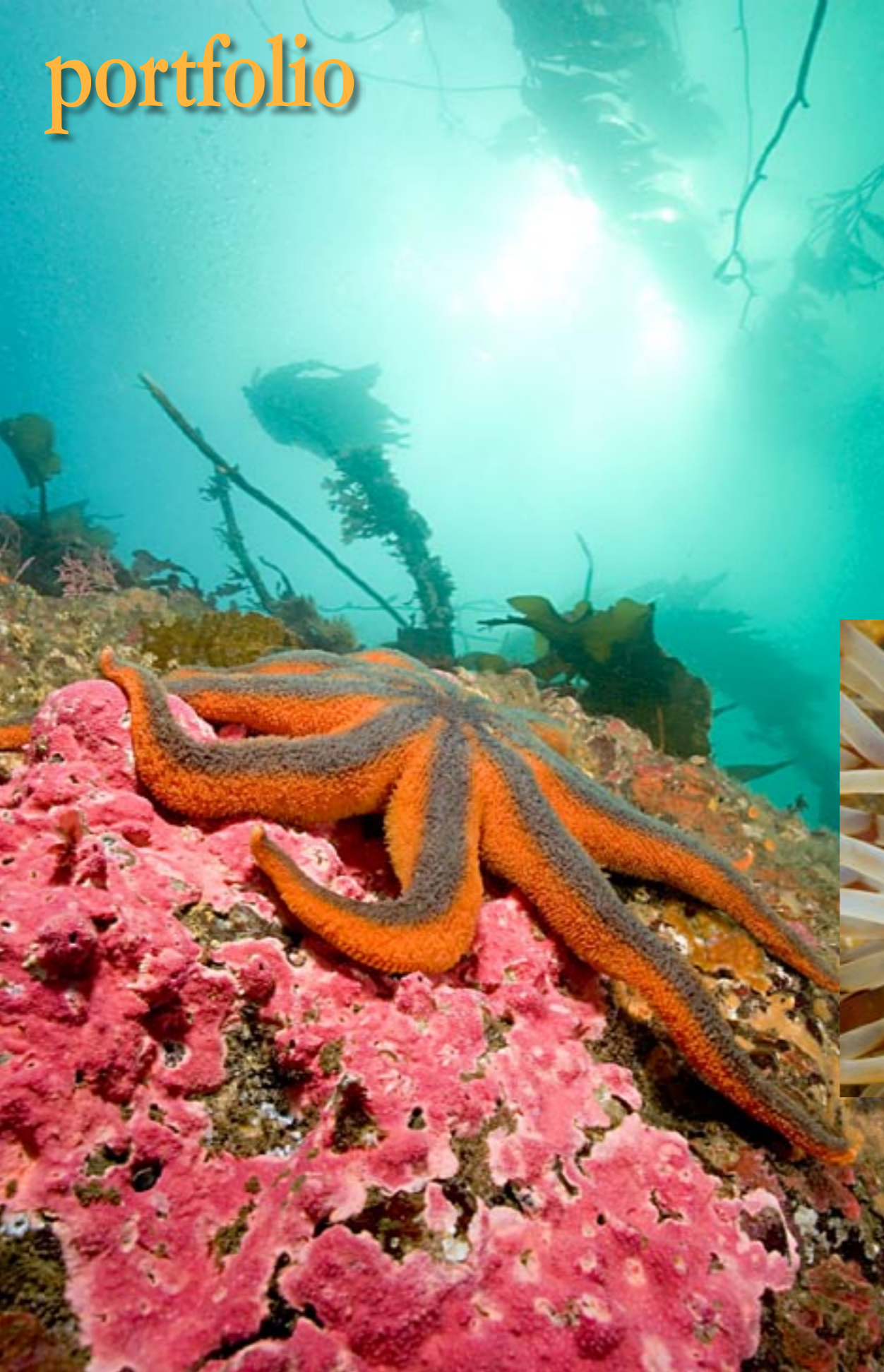




Jon Gross

◀ Stimpson's Sun Stars are a common sight on the Strait of Juan de Fuca, and the outer coast, underwater boulder fields covered with a kelp canopy make for beautiful diving. Sekiu Bay, Washington State, USA

▶ Nudibranch on Coralline Algae. These summer peak aeolids are very common nudibranchs both in Puget Sound in points north. They can be found on muddy bottoms, this rocky coralline algae substrate, broadleaf kelps, and other types of bottoms. Seven Tree Island, British Columbia, Canada



▲ This anemone lives in a tube, usually buried in the substrate. It is most famous for being eaten in a dramatic fast moving attack by various Dendronotid nudibranchs.





▲ These Surf Anemones can be found growing in cracks in the rocks in Port Hardy, and in enormous carpets down near Nanaimo, BC. They are gorgeous in the shallows, where the natural sunlight can reach them and set off their bright colors. The green in their bodies is from zooxanthella that live in the anemones tissue.

These zooxanthella, as a byproduct of photosynthesis, produce oxygen, which the anemone can metabolize. The anemone, in turn, produces molecules that the zooxanthella can metabolize. The green algae in the foreground is *Ulva fenestrata*, or Sea Lettuce, a common mid-shallow water green algae.

To order images directly from Jon Gross, visit his web sites at:
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