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POINT & CLICK
ON BOLD LINKS



Equipment



Edited by
Rosemary 'Roz' E. Lunn

3D vest

The 3D Mesh inner lining that provided both insulation and pressure distribution in the revolutionary D1Hybrid drysuit, which Waterproof launched a few years ago, now comes in the form of a vest that can be used as a stand-alone undergarment. The two outer layers are kept apart by nylon springs, like in a bed mattress. The constant distance and unrestricted airflow provided by Waterproof's 3D Mesh inner lining also keep the moist air away from your body. The 3D Mesh has exceptional resistance to pressure. It provides real pressure distribution and keeps the distance constant to the outer shell. This virtually eliminates squeeze and cold spots.

www.waterproof.eu



AP CO₂ Sensor

The CO₂ Sensor from Ambient Pressure Diving is an 'active warning device' designed to alert the diver when the CO₂ content of the breathing loop is approaching a dangerous level.

This could be due to depletion of the CO₂ absorbent canister or incorrect assembly resulting in CO₂ bypass of the canister. The CO₂ Sensor has been specially developed for use with AP Diving's range of rebreathers equipped with Vision electronics. The sensor is intended as an option that can be used with or without the APD Scrubber monitor.

APDiving.com/rebreathers/



Pretty in pink

Smacking your skull on a stone during a high-speed scooter run does not make for a happy diver. Enter the Light Monkey high-density polyethylene (HDPE) helmet. Buoyancy has been considered because the helmet features nine ventilation holes on the top and sides (to release trapped air). The helmet is held in place by an adjustable soft nylon webbing chin strap, and fastened by a quick disconnect buckle. Light Monkey's helmet is already available in black, red, blue and yellow. The pink limited edition version is being launched at the 2013 DEMA Show, and proceeds from the sale of this helmet will be donated to Project Pink Tank: Rubicon-foundation.org



Darkfin Gloves

Webbed gloves need to have a decent increased surface area to move the water efficiently and effectively. They ought to be lightweight, yet strong, whilst retaining flexibility to allow for dexterity. Finally, a webbed glove should have decent grip. It seems Darkfin has achieved this.

Darkfingloves.com



500E

The Hollis DC7 500E first stage has been stripped down to reduce size and weight without compromising performance. We have been advised that this has superior gas delivery thanks to an over-balanced first stage, combined with a dynamic intermediate pressure, that increases with depth. The DC7 DIN first stage ports (2HP, 4LP) have been optimally angled to encourage advantageous hose routing for technical and sidemount diving.

Hollisgear.com



Review — Waterproof D9 Breathable Drysuit

When Björn Elhmé, Waterproof's CEO, flung me a little pouch with a big grin on his face, I initially wondered why he would toss me a child's sleeping bag. But that couldn't be—given the context. Sure enough, inside the bag was their new ultra lightweight D9 breathable drysuit, which has been created specifically with travel in mind where luggage weight is becoming still more of an issue.

After a two decade long tenure as an editor of a dive

more like putting on a windbreaker than a heavy winter coat when donning it. With its telescopic torso, it's got a baggy loose fit, which is less streamlined in the water, but I didn't ever feel it was an issue—who is doing speed trials anyway? But it actually gave me more freedom of movement. Even through the breathable fabric is only marginally stretchy, I never felt my mobility was hindered, as is so often the case. Following a dive off Italy from a RIB, I also got to appreciate the breathability of the suit. Down under, the usual amount of humidity from perspiration is trapped and accumulates inside like in a greenhouse, but once topside, it started drying. In one case, I was completely dry and comfy when I doffed the suit 20 minutes after a dive except, that is, having one leg soaked because I neglected to pull the zipper completely tight. The wear layer is made from tough and tear resistant Cordura Nylon over what Waterproof calls a 'Quad-Lam Breathable Material'. Even so, Waterproof cautions that this is not a suit for sustained heavy duty use such as advanced wreck diving. I will have to agree, albeit only reluctantly, as it was so comfortable. But it will come with me on a lot of warm water trips where I would otherwise have brought my wetsuit. Waterproof.eu

magazine, it takes something to grab my interest, but I felt immediately that the Swedes were onto something worthwhile, and I asked if I could take it for a spin. Less than two weeks later, I tried it both in a frigid mountain lake in the Austrian Alps and in the lukewarm Mediterranean Sea. The suit is indeed light, and it feels



RB Mouthpiece retainer headstrap

The military has been diving mouthpiece retaining head-straps for a number of years now. However, it is only recently that this piece of safety equipment has migrated into the technical market. Today, some rebreather manufacturers supply their units with a mouthpiece retaining strap as standard. Many divers have remarked that a mouthpiece retaining head-strap is comfortable to dive and makes for a more enjoyable experience. For divers seeking this piece of safety kit and looking for options will be pleased to hear that Ambient Pressure Diving manufactures an adjustable mouthpiece retaining head-strap. This can be attached to the inhale and exhale hoses either by the supplied loops or cable/zip ties. apdiving.com



CELEBRATE BRITISH DIVING AT SCUBAFEST 2014 - CORNWALL & ANGLESEY

Contour

Halcyon is based in High Springs, Florida, USA. Therefore, it is of little surprise that the Contour SM was designed as a cave rig by sidemount cave divers. The large bulky wing almost cradles the body and has huge amounts of lift (50lb).

Apparently, it is capable of supporting up to five cylinders, reflecting the Florida 'big steel cylinder' approach to sidemounting in caves. The Contour SM appears to be pretty much bombproof. It is very rugged and heavy duty and potential high-wear areas (behind the shoulders) are reinforced and protected with SuperFabrik. The Contour SM comes complete with four adjustable D-rings on the shoulder straps, and two D-rings on the waist strap that can be configured to an individual's requirements. Other adjustable items include the crotch strap, cylinder bungs and chest strap. There are also ten mounting holes and two rails. Halcyon.net



Text by Michael Menduno
Photos by Rosemary E Lunn, Mark Powell, Barb Roy, Peter Symes

A rebreather dive begins before you enter the water. You strap on the machine, put on your mask, or pinch your nose, and “pre-breathe” the unit for five minutes while monitoring the sensors and heads-up display (HUD) for any signs of trouble. It’s usually one of the last checklist items to complete before commencing the dive depending on the rebreather. Many divers find that pre-breathing is centering, like a moment of Zazen. You can feel your connection to the machine as your lungs rise and fall in counterpoint to your rebreather’s counterlungs. Resistance is futile: you and the machine are one. The quiet hiss of the solenoid valve firing focuses the mind and everything settles down.

It’s the silence that first catches the attention, as you descend in the water column. There are no noisy bubbles. You can hear the soft whisper and rhythm of your own breathing and almost detect the beat of your heart. You relax and slow down. Often divers don’t notice that they are breathing warm moist “air” (actually a dynamic mix of nitrox or heliox) until some time later in the dive. You feel warmer in comparison to scuba and not dehydrated.

“It’s like returning to womb of the mother,” said wildlife photographer and expedition leader Amos Nachum describing his early rebreather dives. To the wildlife around you, you’re no longer a noisy outside intruder but just another part of the food chain, so you can get up close and personal.

Many industry experts say that the paradigm for rebreathers is about to change making them more widely available for recreational divers.

Couple this enhanced communion with the “silent world” with greatly extended bottom times (a combination of gas efficiency and minimizing inert gas uptake), and you can see why rebreathers have so much appeal.

Want to spend three hours exploring a reef system on a “no-stop” multi-level dive from 60 to 100 feet? Make two 90-min plus boat dives without changing out your cylinders? Or spend an hour at 100 feet with minimal decompression. You can!

Unlike open circuit scuba, rebreather dives are limited by the capacity of the scrubber—a canister containing absorbent material that removes the CO₂—not gas volume, and typically provides up to 3-4 hours of dive time depending on your metabolism and the water

temperature, essentially independent of depth. As a result, the prospects of “running out of gas,” the number one factor in open circuit scuba fatalities, is no longer an issue. Nor is the stress of watching a dwindling SPG or buddying up with a heavy breather. For tech divers, the advantages of a rebreather are even more pronounced, enabling them to truly go where no open circuit diver has gone before.

A changing rebreather paradigm

Divers are hearing a lot more about the virtues of rebreather diving in the media. PADI Inc., the self-proclaimed “Way the World Learns to Dive,” is marketing a series of rebreather courses aimed specifically at recreational divers, and is supporting the effort with “Tec Xplorer Day” events and try-dives to promote rebreather div-

The Crystal Ball,
by John William
Waterhouse
(1849–1917)



Are Rebreathers the Future of Diving?

— *A Report on the State of the Rebreather Nation*

BARE 2013 participant test diving an Evolution rebreather by Silent Diving



It's the silence that first catches the attention as you descend in the water column. There are no noisy bubbles.

PETER SYMES

ing. They also announced a series of technical diving rebreather programs.

Though other training agencies have offered "recreational" rebreather courses for some time, none have PADI's sheer reach and marketing clout with more than 135,000 instructors and divemasters, and nearly 6,000 affiliated dive centres worldwide. It is expected that they will significantly expand the market for rebreathers. Call it a "Rec Revolution."

Since their introduction to sport divers more than a decade and a half ago, rebreathers have become an essential tool in the technical diver's arsenal. In many

Many industry experts say that paradigm for rebreathers is about to change making them more widely available for recreational divers.

respects, they represent the ultimate fulfilment of the "technical diving (or mix) revolution" that began in the late 1980s, enabling divers to go deeper and stay longer than they could with conventional air-based scuba.

Today, rebreather diving represents the fastest growing segment of the tech diving market, and in some place like the United Kingdom, you're likely to see more divers sporting rebreathers than sets of doubles.

Though a few well-healed recreational divers have purchased rebreathers, until recently, their cost, complexity, maintenance requirements and poor safety record have limited their use primarily to tech divers who needed their extended range capabilities.

But now, with the advent of more user-friendly next-generation machines, a decade and a half of industry training experience, and the rudiments of a global infrastructure in place to

support rebreather travel, many industry experts say that the paradigm for rebreathers is about to change making them more widely available for recreational divers.

PADI's recreational rebreather protocol is based on two important prerequisites. First, that the rebreather conform to their new "Type R" specification making them "suitable" for recreational diver use. For example, a Type R rebreather helps automate the required pre-dive checklist process, and will turn

itself on if the user forgets. They also won't operate without a scrubber canister present or the gas turned off and they have a built-in open circuit bailout valve in case of emergency. Second, that diving operations are limited to "no-stop" diving within the recreational envelope of 130 feet.

Advocates say that PADI's entry

into the rebreather market will help revitalize sport diving and increase the number of new divers while raising the bar on rebreather training. They compare recreational rebreathers to the introduction of snowboards in the then stagnant skiing industry in the late 70's. Though resisted at first, the technology attracted needed young people to the sport which then grew by a factor of 60 times over the next 25 years.

"You're too old if you think rebreathers won't work for recreational divers," said U.S. Navy Commander Joe Diture, who serves as the vice president of the International Association of Nitrox

and Technical Divers Inc. (IANTD) and trained his 15-year-old daughter to dive a rebreather. "Kids are smarter on electronics than we ever were, and they are goal oriented. I say get on board now or be left at the gate." [Diture's views don't necessarily reflect those of the U.S. Navy].

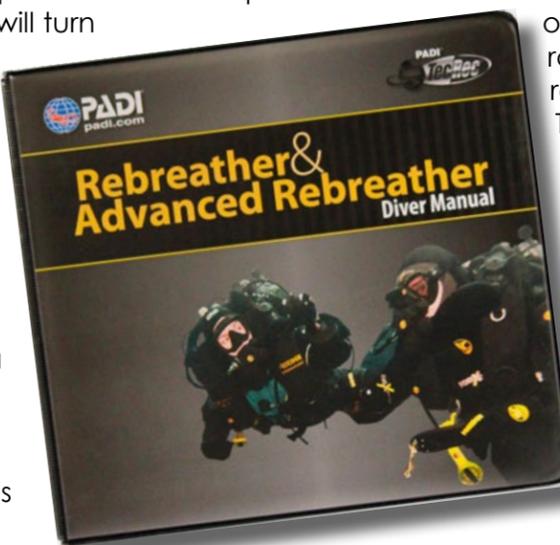
However, many industry watchers are concerned that with their operational complexity and poor safety reputation, the benefits of rebreathers may simply not justify the risks for recreational divers. Others like Technical Diving International (TDI) founder and former Uwaterc CEO, Bret Gilliam, whose company marketed the Dräger Atlantis semi-closed rebreather

to recreational divers in the late nineties before the machines were discontinued, says that rebreathers can meet the standard of "acceptable risk" if proper screening is put in place to weed out the unqualified participants.

Not so forgiving

"Just because you can afford one doesn't mean that you possess the background of experience and skills to use a rebreather," he said. "The overwhelming majority of sport divers are better off on open circuit, which is far more forgiving." But there is also trepidation.

As the CEO of one rebreather manufacturer explained, "I am worried that it [PADI program] will result in a plethora of



Advocates compare recreational rebreathers to the introduction of snowboards in the then stagnant skiing industry in the late 70's.

PETER SYMES



dead dentists, which will set the rebreather business back just like the Electrolung in late 60's." [Beckman Instruments pulled the \$2,500 Electrolung—the first electronically-controlled closed circuit rebreather—from the sport diving market in 1970 after a series of high profile deaths.]

The work of (re)breathing

For all their benefits, rebreathers require more work and discipline than open circuit scuba. The late Dr Ed Thalmann, for senior medical director for the U.S. Navy Experimental Diving Unit (NEDU) who wrote all the physiological specs for U.S. Navy breathing apparatuses, once described

a scuba regulator as the steam engine of diving. "They've been honed to a high degree and are incredibly reliable. By comparison," he said, "a rebreather is like a space shuttle." Though Thalmann's analogy might seem far-flung, many people compare rebreather diving to instrument flying a small plane; the diver is in essence depending on his or her electronics to maintain and manage an artificial life-supporting atmosphere.

Rebreathers require more work and discipline than open circuit scuba.

Subtle ways

Unlike open circuit, where failures like a free-flowing regulator, burst O-ring, or simply forgetting to crank open a tank valve all the way is immediately obvious; rebreathers often fail in subtle ways. In fact, the user might not even be aware of the problem, particularly if they're distracted, until it's a matter of survival.

Conversely, a rebreather gives divers many options to solve any problems that arise at depth and either continue or abort the dive.

Though today's rebreathers are

Rebreathers do not eliminate the need for open-circuit scuba. In fact, you and your team need to carry, or stage all the open circuit gas required to bail out at the worst possible point in the dive.

much more reliable than those of a decade ago, probabilistic analysis suggests that a rebreather, which is an electro-mechanical life support system, is still 20-times more likely to fail than a set of doubles due to their complexity.

However, incorporating redundant systems, e.g. adequate bail out, can mitigate this risk.

Then there is the on-going pre-dive and post-dive maintenance

requirements, i.e. completing the 20-50 items on a pre-dive checklist, which includes a series of pre-dive tests and somewhat fewer post-dive, which can add up to a total of an hour or more of work per dive day compared to 30-45 minutes or less for conventional scuba gear.

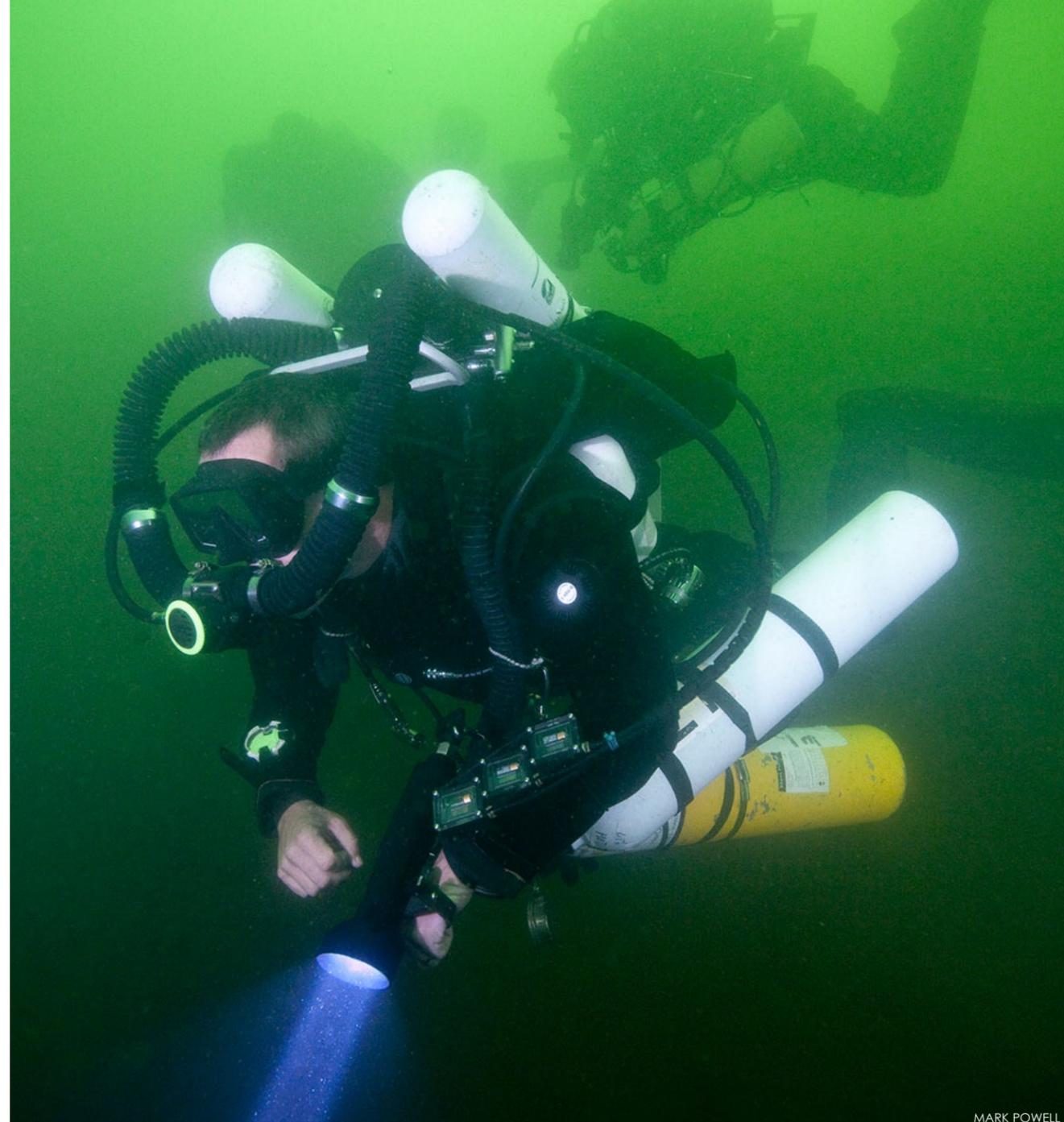
And guess what? If you don't complete the checklist each and every time you dive, when Murphy strikes, you could find your self in serious trouble or even die.

Still need tanks

Rebreathers do not eliminate the need for open-circuit scuba. In fact, you and your team need to carry, or stage all the open circuit gas required to bail out at the worst possible point in the dive. Rebreather veterans say that too many divers carry insufficient bail-out. Some rebreather veterans say that you should plan to carry as much as 2-3 times the bail out gas volume that you think you need. "People forget that bail

out gas is for themselves and their buddy," said TDI instructor trainer, Steve Lewis. "They also underestimate their bailout-breathing rate, particularly in the event of a CO₂ hit."

Finally, in terms of expense, rebreathers cost approximately 2-3 times their open circuit equivalent, though this differential is likely to decrease as manufacturers' volumes increase. Operations-wise, a dive day on the rebreather will likely cost you one and



MARK POWELL

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FILE PHOTO: DEEPSEA PRODUCTIONS



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Rebreather instructor assists a participant prepare to test dive a Hollis Explorer rebreather during the 2013 Bay Area Rebreather Experience

a half to two times as much as scuba.

For whom the bell tolls

At least one 181 divers died diving a rebreather between 1998 and 2010. Rebreather fatalities averaged approximately ten per year prior to 2005 and about 20 per year since, and it appears more than 20 rebreather divers have died since 2010 making the total number of deaths more than 200. Many of the deceased were diving's best and brightest, and the toll on the community and particularly those who lost friends has been particular heavy. No one has counted the near misses.

To put these numbers in perspective, there was a combined total of about 100-120 sport diving fatalities per year on average in the United States, Canada, United Kingdom and Europe over the same period, which represents a

large percentage of the worldwide sport diving market. (No one keeps worldwide diving fatality statistics.) On that basis, rebreather fatalities represent about 15 percent of the total each year.

But now consider that there are as many as 1-1.2 million active scuba divers in the United States alone, according to a 2007 analysis by Undercurrent (again there are no hard numbers) but likely no more than 10-15,000 rebreather divers worldwide. This would suggest that the fatality rate for rebreather diving is significantly higher than its open-circuit counterpart.

In 2011, Australian hyperbaric physician Dr Andrew Fock, an accomplished rebreather diver himself, set out to estimate the actual risk of rebreather diving

Divers are killing themselves because they made mistakes in their maintenance and pre-dive checks, or during the dive. Unfortunately, rebreathers require diligence to detail and are not very forgiving

by collecting and analysing data from the DAN, DAN-Asia Pacific, BSAC, Deep Life and Rebreather World databases. "They're really best guest numbers," explained Fock, who presented his findings last year at Rebreather Forum 3.0 in

Orlando, Florida. "There are errors and incomplete data. We know the number of fatalities but no one knows how many rebreathers are in the field, the number of rebreather divers or how many dives they made." In other words,

we know the number of incidents but not the relevant denominator.

Fock's conclusions? Rebreather diving may currently be as much as 8-10 times more risky than open circuit diving with a corresponding estimated incident rate of about 4 deaths/100,000 dives compared to a rate of .5 deaths/100,000 dives for scuba overall. Of course, some portion of this risk, is due to the fact that to date rebreathers have been primarily used to conduct deeper and longer "technical" dives. However, with scant data there is no way to quantify this extra risk.

Apples vs oranges?

It should also be considered, that historically fatality rates are often

disproportionately high in the early phases of many "civilian" adventure sports such as flying small aircraft and hang gliding until participants are able create suitable safety paradigms; early technical diving is a case in point. Using Fock's analysis to compare rebreather diving to other adventure sports, diving a rebreather is an order of magnitude less risky than base jumping at 43 deaths/100,000 jumps, but riskier than sky diving at .99, hang gliding at .86 and horseback riding at .57.

Exploding heads

Statistics like this make defence attorneys' heads explode. "Plaintiffs talk about safety sta-

tics and try to use them to argue their case," said David Concannon, who represents the Rebreather Education and Safety Association (RESA). "But they're based on faulty statistical assumptions because we don't know the denominator.

Concannon, a diver and ex-pilot who describes himself as "CCR Diver Zero" and consequently dives open circuit ("I'm 46, thick in the middle, only in the water 12-20 times a year, and I don't take care of my equipment), won three of the five lawsuits that have been filed to date against manufacturers and agencies, and settled a third for nuisance value [one other suit is pending].

"The more I see, the more I

Using Fock's analysis to compare rebreather diving to other adventure sports, diving a rebreather is an order of magnitude less risky than base jumping

believe that rebreather diving is similar to open circuit in that there are triggers that are the cause of death. The main difference is that there are more opportunities to get in trouble with a rebreather. It's like flying a multi-engine plane, or helicopter, compared to a single engine prop plane."

Tales of a non-compliant species

Over the last year, I spoke to more than a dozen manufacturers, engineers, instructors, hyperbaric doctors, defense attorneys

and explorers about the fundamental causes of rebreather fatalities and what needed to be done. Though I found differing opinions about the remedies, there was an overwhelming consensus of views as to causation. In a nutshell, though some problems can probably be addressed by human factors in engineering, the fundamental problem is operational i.e. the ability of divers to properly maintain and operate their rebreathers, and not necessarily a failing of the machines themselves.

"I've yet to do a forensic examination of a fatal accident and see where a unit failed. It's always "diver error," explained Gilliam, who has worked as an expert witness for more than two decades. "Divers are killing themselves because they made mistakes in their maintenance and pre-dive checks, or during the dive. Unfortunately, rebreathers require diligence to detail and are not very forgiving. If you, the operator, make a mistake there is very little room for error, and most divers don't recover. And that points directly to training and experience."

Leon Scamahorn, a former Special Forces diver and founder and CEO of Inner Space Systems Corp, which makes the Megalodon rebreather, or "Meg," compared diving a rebreather to packing your chute and jumping out of a plane. "If you fail to react, or react properly, the results are the same. Death by terminal velocity, or in the case of the rebreather, death by inappropriate gas mix." (Rebreather divers typically lose consciousness and drown as a result of having too little or too much oxygen or too much CO₂.) "I tell people, everything depends on your level of preparation and training," said Scamahorn.

Leon Scamahorn, Inner Space Systems Corp - maker of the Megalodon rebreathers,



Causes

Reading through available accident reports is reminiscent of the kind of problems that plagued the early days of tech diving. Divers failed to turn on their rebreather (lots of these), and went hypoxic and drowned. Divers failed to open their oxygen valve, analyse their gas, and/or used a diluent or bail out gas inappropriate for the depth. They packed their scrubber canister incorrectly, left out an O-ring, or reused spent scrubber material or forgot to install their canister at all. They went diving with only two of three oxygen sensors working, or used old sensors, or old batteries. They ignored visual and audio alarms. They carried insufficient bailout gas. They were diving alone. Most of these incidents could have been prevented if divers had worked through their checklist and followed protocol.

"The problem is that people take short cuts and don't follow the guidelines and best practices," explained Steve Lewis, author and current *X-Ray Mag* columnist "They get 40-50 hours and nothing happens because the units are so well made. So they stop using their checklists. They say to themselves, I know I should, but how

often does something go wrong? Of course, that's precisely when Murphy steps in."

Bruce Partridge, CEO of Shearwater Research, which builds rebreather electronics and dive computers, and is also a RESA member calls it the "normalization of deviation" because deviation from standards become normal. "It's a real problem," he said. "People go diving without having completed their checklist and nothing happens. They have significantly changed their risk, but they don't get any immediate feedback."

No longer scared

The reliability of today's rebreathers can give divers a false sense of confidence. "In the early days, the equipment broke all the

time, and so we expected problems," said filmmaker, explorer and instructor Jill Heinerth. "We were scared all the time and so tended to be prepared to make good decisions when we had a failure. Now the equipment is so incredibly reliable, there is nothing to scare people."

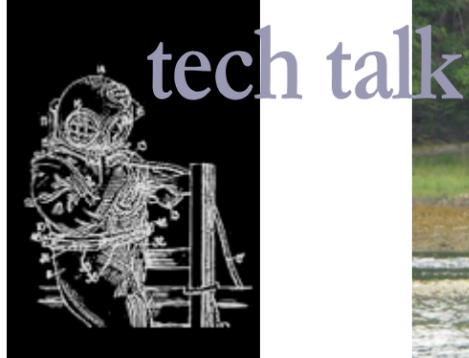


PETER SYMES



Jill Heinerth, filmmaker, explorer and instructor

BARB ROY



BARB ROY

The technology also enables people to dive beyond the limits of their training and experience level. "The rebreather enables people to make expeditionary dives without the necessary operational support, and they get into trouble," pointed out Fock, who identified the Human Machine Interface (i.e. maintenance, training and high risk behaviors) as the source of most problems in part of his safety analysis work. "We found that in two-thirds of fatalities, divers exercised what could be considered high-risk behaviours [such as ignoring checklists, solo diving, or pushing limits]."

This begs the question that if the technical diving community, which is presumably more experienced, better trained and able to deal with more complex diving situations has been unable to reduce rebreather fatality rates, how will recreational divers fare?

Checklist mistress

Finding solutions is easier said than done. "We are a non-compliant species," lamented Heinerth who has been called the 'Checklist Mistress.' "How do you change that?" She says that training is partly responsible, but more of the issue is a matter of culture.

"I know that some of my students have stopped doing their checklist. But I don't know the cure. We have to police each other. If we don't, we're liable to wind up with minefield of dead

divers and more lawsuits, and it will only be a matter of time before land-owners and boat captains will no longer allow rebreathers," she said.

It may all come down to changing the mind-set of the community. "We need to get to a place where it's cool to do checklists, and people aren't afraid to say to a buddy—don't get in the water with only 2 of 3 sensors working," commented Partridge. "I really believe it's a community problem. If you're flying an aircraft, we can make a rule. If your equipment isn't working properly, you can't fly. But we can't do that with divers."

The problem is compounded by the fact there is no adequate community reporting system in place at the present time and rebreather incident data, particularly regarding fatalities has become increasingly scarce as a result of an increasingly vitriolic media environment and the fear and expense of litigation. And if a lawsuit is filed, everything gets closeted in confidentiality agreements unless a

trial verdict is brought forward in the public record. This raises the conundrum, "How do you improve diver safety if no one will tell you what caused the fatalities?"

Engineering in safety

Manufacturers say that some of the problems that have triggered accidents, for example, failing to turn the unit on, or reassembling a unit incorrectly, can be engineered out of rebreathers thus improving diver safety and making the machines more accessible to a wider range of divers. Indeed, that is the focus of PADI's TYPE R specification, which requires that a "recreational" rebreather have certain features to be included in their program.

Though all of the manufacturers that I spoke with have incorporated unique features and innovations in their machines—there's no doubt that rebreathers represent a dynamic and innovative mar-

The problem is that people take short cuts and don't follow the guidelines and best practices.

Rosemary E. Lunn pre-breathing a Hollis Explorer at InnerSpace 2013 held at DiveTech, Grand Cayman



ROSEMARY E LUNN

The question is whether the sport diving community is willing and able to make the changes needed to accommodate this technology within acceptable levels of risk.

ket—I decided to focus on three areas of innovation that seem most promising in terms of diver safety.

Automating the checklist

The first major area of improvement is automating the checklist process. "The aviation and auto industries have long recognized that humans are fallible and susceptible to external influences and task loading, and have embraced automation," explained

Kevin Gurr, principal of VR Technology, which makes the Sentinel rebreather and is working with Hollis, which is manufacturing and distributing Gurr's latest creation, "The Explorer," an electronic semi-closed rebreather designed for recreational divers.

"When you turn on your car, you're actually turning on a computer, which then checks the brakes, the engine management system, fuel injection and other safety systems and tells you that

it's okay to go. You don't have to remember to turn on your brakes before you drive away. We concluded that rebreathers would benefit from the same type of automation," said Gurr.

Accordingly, the Explorer, and other units like the Poseidon Mark VI, not only walks the user through the checklist via their display but makes sure that he or she completes the steps like turning on the O₂ or pre-breathing the unit, and not let the user pass until checks

Rebreathers





are done properly.

The second innovation is in oxygen control. When cave explorer and engineer Dr Bill Stone and his colleagues were originally approached by Poseidon Inc. to develop a rebreather that could be safely used by recreational divers, they spent focused thinking about failure modes and concluded the most important thing was knowing exactly what the diver is breathing at any point in time, especially with respect to oxygen levels. With open circuit, a diver's breathing mix is fixed and known but with a rebreather the breathing mix is dynamic.

"One of the keys things a re-

breather diver must be able to do is read their oxygen sensors and know when to trust the results," said ichthyologist Dr Rich Pyle, who co-developed the Poseidon Mark VI rebreather with Stone. "It's easy to build a system that triggers an alarm when the oxygen values deviate by some amount. The hard part is knowing when the sensors are lying. That takes intuition and lots of experience."

Galvanic oxygen sensors, which measure the PO_2 in the breathing loop, are the most critical component of a rebreather, and are generally regarded as the weakest link of the system and can fail either high or low. Pyle said this led them to developing their "active sensor validation" technology: the software automatically validates the response of a pair of O_2 sensors, which are exposed to known on-board gas in one and five minute increments, and determines whether the sensors are accu-

rate or not.

As a result, said Pyle, the electronics are able to "think better" than a well-trained diver. "With the Mark V, there were a dozen incidences where my brain and the computer disagreed on what I was breathing. In each case, when I went back and analysed the log data, I was right and not the machine," he said. "Now with the Mark VI, I had six disagreements, and the electronics were right every time. So you could say that the Mark VI thinks better than me."

Pyle said that they are close to perfecting the technology, which he believes is superior to the three "voting" sensor system used by

virtually all other closed circuit rebreathers past and present: the logic being, if at least 2 of 3 sensors agree within a specified tolerance, they are regarded as correct. Jill Heinerth calls it an exciting advancement. "Without it," she said, "Divers are facing a bit of crapshoot as to what they are actually breathing."

Sensing CO_2

The third major innovation has been in CO_2 sensing. Experts now say that CO_2 build-up, or hypercapnia, a result of a spent or compromised scrubber for example, is much more of a hazard than originally thought and can result in disorientation, panic,

hyperventilation, convulsions, unconsciousness and eventually death. For that reason, PADI has included CO_2 sensing in its rebreather specs.

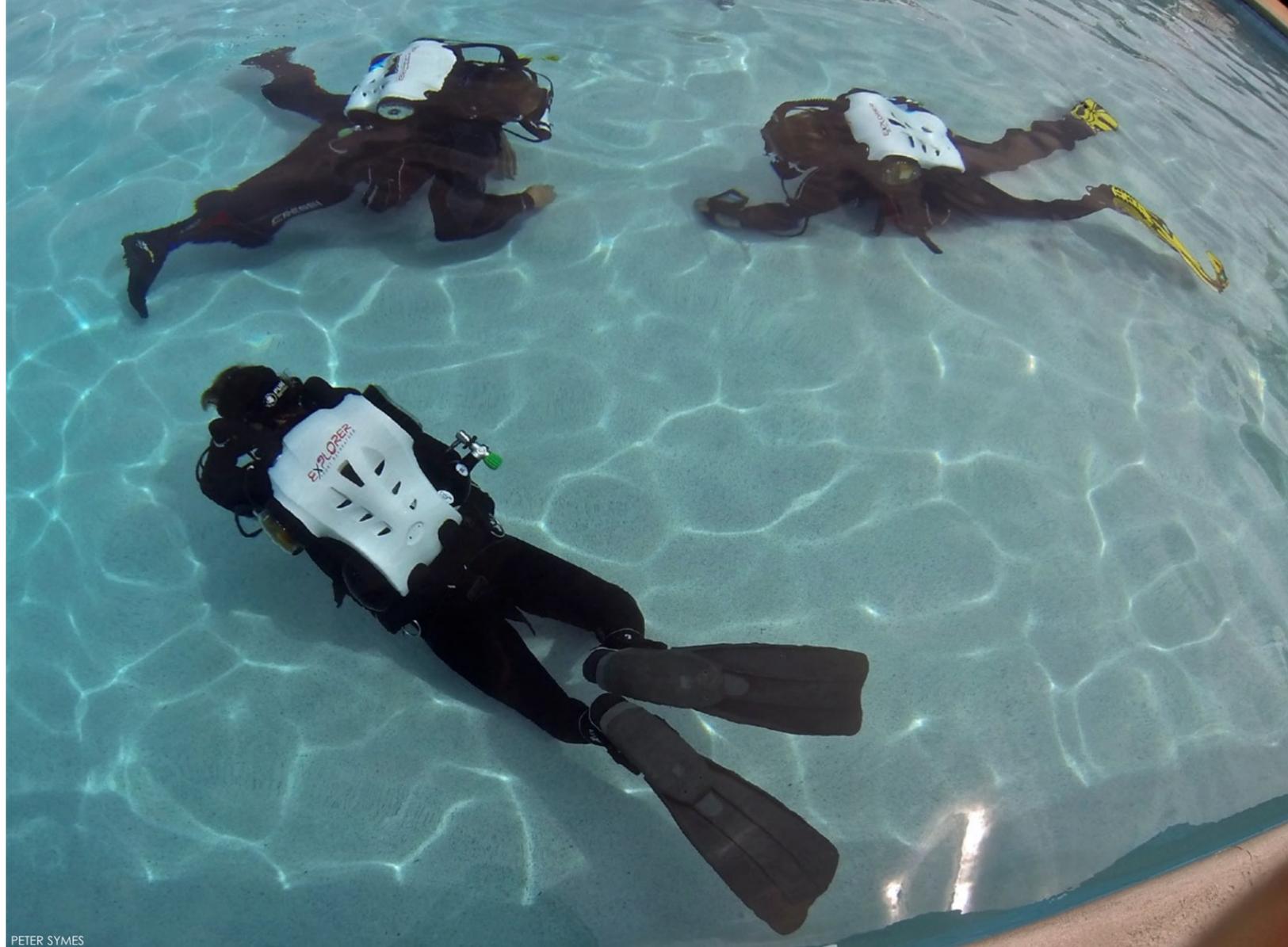
The first break through was the "temperature array," which was invented and patented by the U.S. Navy's NEDU and measures the exothermic reaction as it progresses through rebreather's scrubber canister. As such, arrays give a reasonable estimate of the life remaining during normal diving (e.g. no canister floods), but cannot respond to rapid changes in temperature, depth and workload.

As a result, some manufacturers say that they have already seen

Rebreathers

improvements in safety. Ambient Pressure Diving, the oldest and largest sport diving rebreather manufacturer, developed their "Temperature Stik" array in parallel to the NEDU. According to managing director, Martin Parker, "We've seen a dramatic reduction in incidents relating to overuse of the scrubber since we introduced the Stik. "There's something very comforting about being able to see your scrubber working properly, and we've developed it to give the diver warnings of high PCO_2 to give them plenty of time to ascend and bailout."

The second break through is due to Gurr at VR Technology who developed the first onboard gaseous CO_2 sensor, which measures the PCO_2 in the loop. VR uses the sensor in conjunction with a simple (scrubber) timer, a metabolism monitor (which measures canister loading based on O_2 consumption), and a temp array, which each measure slightly different variables. VR offers the CO_2 profile package as part of the sentinel. It will also be available on the Hollis Explorer. "Profiling the CO_2 removal system is complex



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Posedon MKVs lined up and ready for a class

Briefing on the MKVI at Poseidons facilities in Gothenburg, Sweden



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because there are several components including valves, the absorbent itself and the seals," Gurr explained. "As a result, the sensing method must be multi-faceted." The ultimate solution he says is a sensor that would measure end-

tidal CO₂ at the mouthpiece. "And yes, we are working on it." [Editor's note: As this issue goes to press, Ambient Pressure Diving has introduced a CO₂ monitor. It is described in the New Equipment section in this issue.]

Automation

With increased automation and improved O₂ and CO₂ sensing in a single machine, users will be able to know exactly what they are breathing with a high degree of certainty, which should help improve diver safety. However, insiders warn the responsibility still rests with the individual diver.

"I agree you can engineer out some problems, but the user can't get complacent," said Inner Space's Scamahorn, "They have to act appropriately when something goes wrong."

Training

Though insiders say that rebreather training has improved over the last decade, there continues to be some tension between manufacturers and training agencies. "Manufacturers can do quite a bit to make their machines require less training," acknowledged APD's Martin Parker, "but I do feel there will be a harsh learning curve until the instructors get on top of the important issues and emphasize the parts of the course that will keep the diver alive."

Gilliam said that agencies need to increase their prerequisites both for instructors and divers. "I think that an overall perspective should be a wake-up call to everyone that too many instructors and divers are being turned out that are not qualified," he said. "Their experience is too limited

"Manufacturers can do quite a bit to make their machines require less training, but I do feel there will be a harsh learning curve until the instructors get on top of the important issues and emphasize the parts of the course that will keep the diver alive."

as an initial qualifier, and that's one reason why things unravel so quickly when a problem manifests. Until the agencies wise up and put proper prerequisites back in place, we'll continue to see a disproportionate amount of deaths."

Others say that good training is available but there needs to be more consistency. "Some of the training has become a little too personal," observed Heinerth. "Everyone runs their own courses. That may be okay for someone like me with lots of experience but what about the new instructor?" Some of the instructors I spoke to also said there is a wide range of quality in training materials,

and some of it is not so good. Many people I spoke to are excited about PADI's entry into rebreather training and felt they would help raise the bar. "PADI has specific standards and very high quality learning materials," said Heinerth. "They will force other agencies to follow suit."

Others like Steve Lewis also give PADI high marks. "I just read through the PADI Tec 40 CCR Diver manual. It was enlightening for a PADI manual, and I was impressed. By the end of Chapter One, I must have read 'if you screw up, you're going die' numerous times. The quality of the material was extraordinary."

Echoing Gilliam's point, several people expressed concern about the challenge of growing the

pool of instructor trainers and instructors to serve a wider audience of divers while maintaining quality. "We'll have a problem if we, as an industry, allow the quality of instructors to dilute in order to build numbers," warned Lewis. "The instructors who fast-tracked their experience are the ones who are not prepared when Murphy comes calling."

The future of diving

From Walter Stark's first dive on the Electrolung in the late 60's, or Bill Stone's foray into the depths of Wakulla Springs sporting his first Cis-Lunar rebreather prototype 20 years later, it was inevitable that rebreather technology would find its way into the hands of so-called recreational divers i.e. diving consumers. It's a basic unstoppable paradigm of technology, whether its aircraft, trucks or computers.

Are we ready to change?

The question is whether the sport diving community is willing and able to make the changes needed to accommodate this technology within acceptable levels of risk.

Blueprint for survival

The situation is arguably parallel to the early days of cave diving where there were an unacceptably high number of fatalities. In response, the community came together to create a set of "best practices" based on accident analysis pioneered by the late great explorer Sheck Exley in his book, *Blueprint for Survival* (1979).

In essence, the community learned from diver deaths and was able to use that information to improve safety for other divers by encouraging, supporting and reinforcing best diving practices. The early technical diving community also faced significant safety challenges with open circuit mix diving and took a



tech talk

similar approach with *Blueprint for Survival 2.0* a decade later.

Recently, there has been some discussion among some rebreather veterans that a similar set of voluntary “best practices” for rebreather diving, call it *Blue Print for Survival 3.0* should be created and promulgated. Codifying a set of “best practices” for rebreather diving is the first step towards creating a standards-based model.

However, to date, no one has compiled a Blue Print 3.0.

Another approach might be to create “operational standards” for rebreather diving similar to what groups like the Global Underwater Explorers (GUE) and other DIR (Doing It Right) groups have done for open circuit diving.

That is the approach that explorer and educator Mathew Partridge, owner of Pro-Tech Dive

College, Phuket, Thailand, which provides factory training for the JJ-CCR, Sentinel/ Oroborous, Megalodon and Inspiration/ Evolution, has taken with his Association of Rebreather Training (ART). More than just a rebreather-training agency, Partridge has developed a set of operational diving standards for rebreathers akin to GUE’s standards for open circuit diving.

The standards include specifications for rebreather configuration, diluent and bailout selection, check lists and emergency protocols. ART also adheres to team diving. To date, ART has trained several hundred rebreather divers and conducted numerous workshops. Though the organization is still in its infancy, the work that Partridge has done shows promise for improving rebreather diving safety.

Unified team Diving (UTD) also offers a standards-based rebreather training program. GUE is currently in the process of developing a standards-based closed circuit program, which will likely be released in the next few years.

Some people argue that having operational diving standards create rigidity, and that having

standards makes it difficult to incorporate new information, for example, improvements to procedures on the basis of accident analysis. Though this is potentially one of the drawbacks of having standards, how can improvements based on new information be effectively disseminated and implemented when individual divers are left to their own devices to do whatever they believe is best? Another problem is that standards-based diving is likely

not applicable to all sport divers, the majority of which do not belong to a membership organization.

Nevertheless, standards-based rebreather groups may help to inform and raise the bar for others in the sport diving community to follow as they have, to some degree,

Nevertheless, standards-based rebreather groups may help to inform and raise the bar for others in the sport diving community to follow as they have, to some degree, with open circuit technical diving.

with open circuit technical diving. It’s not inconceivable that organizations like PADI, the BSAC or other training agencies, may eventually take a similar approach in creating their own set of operational rebreather standards to be used after the class is over.

Individuals may also form local user groups or rebreather clubs that agree to adhere to a set of rebreather diving standards. Historically, standard-based diving

Taking the first plunge. BARE 2013 participant is assisted into the pool with an Evolution rebreather by Silent Diving



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has proven to be effective way to improve diving safety in a variety of communities. ■

Writer and technologist Michael Menduno published and edited *aquaCorps: The Journal for Technical Diving (1990-1996)*, which helped usher tech diving

into the mainstream of sports diving, and coined the term “technical diving.” He also organized the first Tek, EuroTek and AsiaTek conferences, and Rebreather Forums 1.0 and 2.0. Menduno, who is based in Palm Springs, California, USA, remains an avid diver.



ROSEMARY E LUNN



Washington State's

San Juan Islands

Text and photos by Barb Roy



White plumose anemones cascade down the Wall at Whale Rocks underwater



Dive buddy Wayne Grant makes his way through the kelp forest (above); Alabaster nudibranch found in northern San Juans (right). PREVIOUS PAGE: Crimson anemones are often seen in the San Juan Islands

Every now and then I get an assignment close to home, which means my dive buddy and I can usually load up the car with dive and photography gear, and maybe a kayak or two, and head out for a full weekend of adventurous exploring. If the location is exceptional, like an assignment to dive in Washington State's San Juan Islands, we often allocate several days to experience all that's available.

When researching this unique area, I found there are over 170 different islands and reefs that have been named in the San Juan Archipelago. Of this spectacular array only four islands are serviced by the local ferry system—San Juan, Orcas, Lopez and Shaw—with daily departures from Anacortes. This would be great if we wanted to do some shore diving, since the ferries haul automobiles, but boat diving was on our agenda. To accommodate, we hooked up with a group of divers leaving from Anacortes on the dive charter boat, *Lu Jac's Quest*, run by Phil Jensen.

"Phil is an old sea dog, and I mean that in the best way," said Ron Akesson,



owner of the Bellingham dive store, Adventures Down Under (ADU). "On average, I book around 15 dive charters a year with Phil. He is thoroughly comfortable with being on the water and



San Juans

life is rich and thick wherever we happen to splash. There's always something to film—be it nudibranchs, lots of anemones, crabs, the occasional harbor seal or sea lion, octopus, or lingcod."

As we approached the lighthouse overlooking the dive site, my imagination ran wild, wondering how many shipwrecks might be hiding below. Or maybe this current affected site would be covered in life, similar to the sites around Victoria, British Columbia in Canada, only a few miles away. The flow of the current had not yet slacked, resembling a river of moving water full of overlapping kelp fronds.

Most divers wanting to venture underwater in this northwestern part of North America have come to

clear summer day in June complete with a few squawking gulls in the distance and two bald eagles flying overhead, as we motored past lounging harbor seals and black cormorants. San Juan Island is the largest of the islands, with the dive site located on the northern side. This gave me plenty of time to interview other divers onboard and see why they like the San Juans so much.

Mike Meager and his dive buddy, Jim Copher, are regular customers of ADU, joining them almost monthly on their excursions into the San Juans. As an avid diver and an underwater videographer, Mike explained:

"I like diving the San Juans for several reasons but mainly because I am susceptible to motion sickness and because it is so beautiful here! The inland waterways of the San Juans are very protected, and the norm is flat calm or close to it. There's rarely any swell. Also, the evergreen trees grow right down to the waterline, and during the summer, you can usually see Mt. Baker in the background, making it very scenic above and below the water.

"Once underwater, the invertebrate



Divers prepare for a dive in the San Juan Islands (above); Sea lions at Whale Rocks (top right); Burrowing sea cucumber can be found at most sites (top left)

Location of San Juan Islands on map of Washington State in northwestern United States

freighters and tankers to avoid our divers.

"He lets me choose where I want to take my groups and works with me to select a proper slack time of when to put the divers in, according to what the currents are doing. Since currents can be pretty tricky around here, the small groups of ten or so work well to keep track of everyone. His 42-foot (12.8-meter) vessel allows plenty of room to deal

with all the gear or move into the cabin if it is raining."

Lime Kiln Park. Our first destination was in front of the lighthouse at Lime Kiln Park on San Juan Island. It was a sunny

is very experienced. Phil is very low key, which has a calming effect on everyone around him. This is really nice if we are doing a tech dive out in the shipping lanes of the Strait of Juan de Fuca, and he is coordinating with captains of



NASA / WIKIMEDIA COMMONS

A collage of color beneath Deception Pass Bridge (right); Finger sponge cluster at Deception Pass below; Divers prepare for a shore dive at Deception Pass Bridge (lower right)

respect the power of these natural current flows, appreciating the rich nutrients that feed such an abundance of colorful marine life. Therefore, waiting for slack (when the flow of water stops to change direction) is a common practice as part of the dive's enjoyment. An experienced boat captain will know just when to put his divers in and for how long.

While we waited for slack, everyone donned their gear. The boat is set up so divers are positioned on the back deck where they can easily enter and exit the water. Once gear is on, you do a giant stride entry off the back between two ladders (which are pulled up and out of the way). Once in the water, you wait for your buddy to follow.

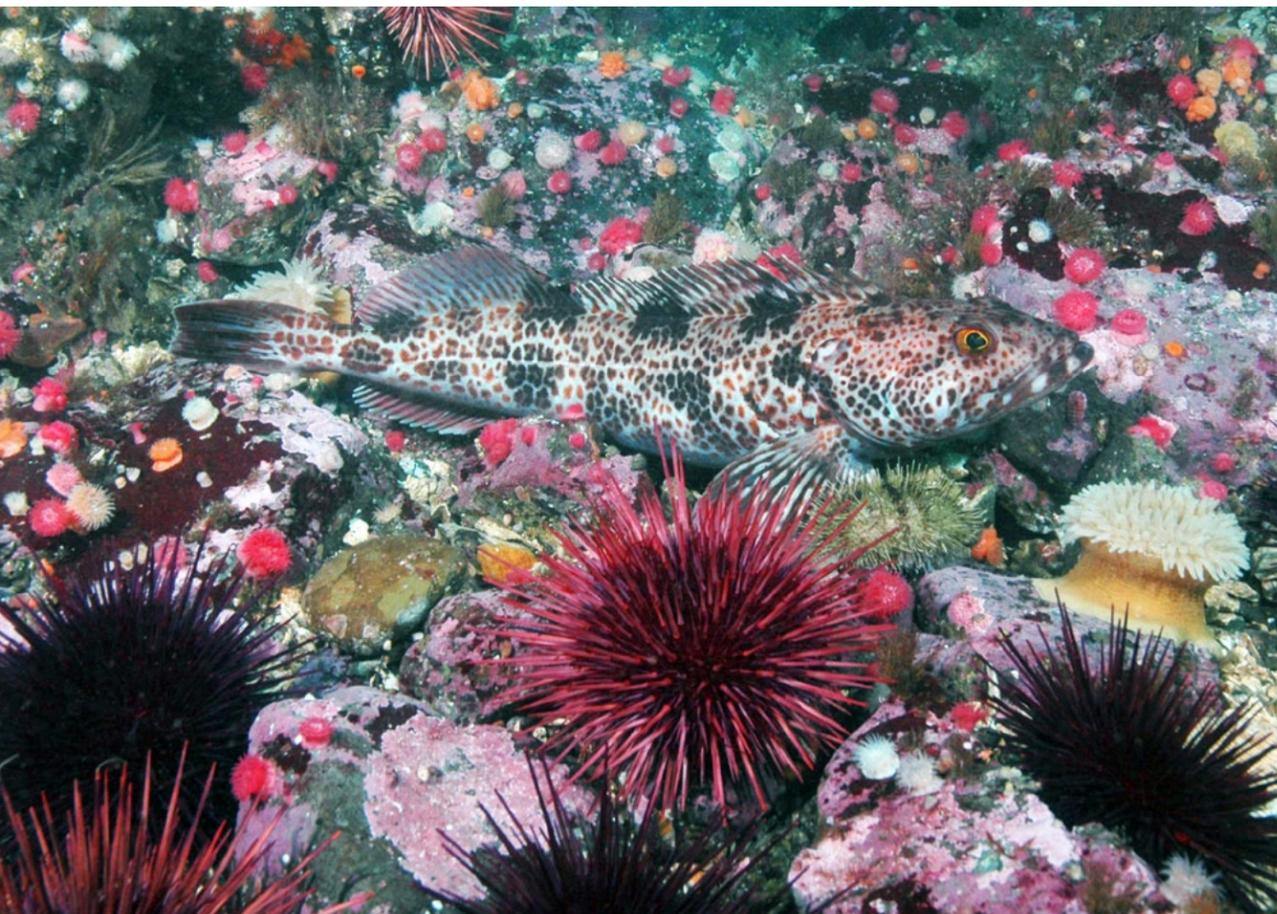
The water was clear and crisp at 48°F (8.8°C) as my dive buddy, Wayne, and I descended below the surface,



San Juans

making it easy to locate a pair of wolf-eels peeking out from a den of overlapping flat rocks. Before long, two other divers joined us. The wolf-eels appeared very curious of their bubble-blowing audience but didn't venture any farther from their shelter, perhaps because they may have been guarding a cluster of eggs or maybe just wary of the divers in general since this underwater site is rarely visited.

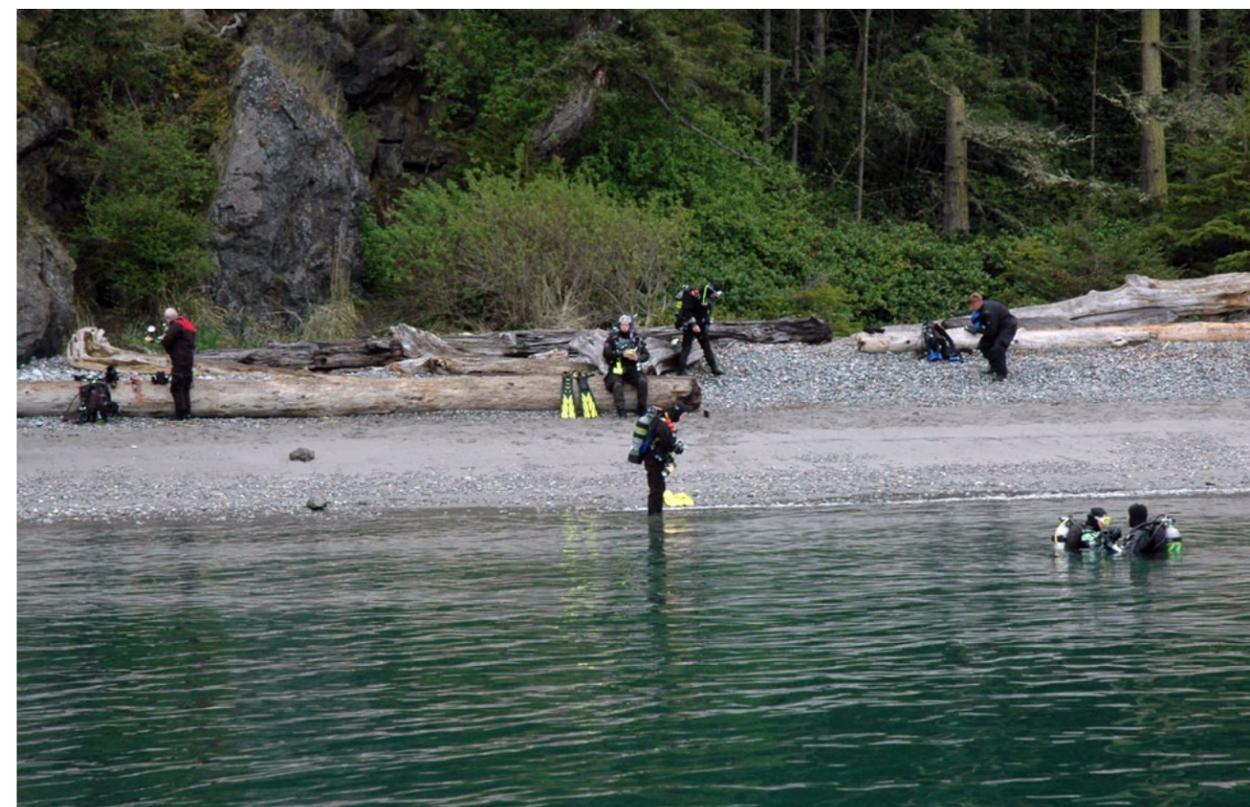
Staying at the same depth, we continued along a beautiful wall of large white plumose anemones that seemed to cascade down like a white waterfall. In the light of the video cameras, their long white columns and cotton-like plumes began to take on a regal appearance. Another section of the rock wall provided a foundation for clusters of yellow sponge, more crimson anemones, sea stars and deep red giant urchins within numerous cracks and jagged fractures. With the exceptional visibility, I could see



following golden brown fronds of kelp down to 40 feet (12 meters) where the terrain was covered in large boulders on a gently sloping decline. A closer look revealed each of the boulders supported a vibrant collection of invertebrate life like small orange tunicates, yellow zoanths and several different species of anemones. We were now within a forest of kelp along with a school of large rockfish that ignored us, as they hovered in mid-water.

Needless to say, I wasted no time with my Aquatica-housed Nikon collecting shots. Wayne had his Go-Pro camera and was already absorbed in watching a morning sunstar heading for the siphon of a buried clam. A pair of bright pink crimson anemones and a delicate white alabaster nudibranch caught my attention.

The kelp forest thinned out as we descending to 60 feet (18 meters),



Lingcod discovered on dive at Deception Pass Bridge



Large male orca from resident pod in the San Juans (left); A morning sunstar next to burried clam siphon (right)

San Juans

Juans he responded:

"Long Island West Wall is my favorite. I just love that wall on the west side and the blanket of strawberry anemones (*corynactis*) that carpet the bottom. For some reason, I love filming the little squishy critters, and you can see some of this beautiful scenery in my *Exploring the San Juans* video. Whenever I get to dive there, I stick to one spot and just concentrate on the anemones. The wall is full of other beautiful anemones also."

A collection of Mike's underwater videos can be found on his YouTube page: www.youtube.com/wolfeeldiver.

"I count nine specific San Juans videos," adds Mike. "I do have several specific videos on the San Juans posted on my YouTube channel. Just scroll down and



Wayne about 50 feet away.

As our dive time grew to an end, we slowly began our ascent back up the wall. Hidden within a mass of giant acorn barnacles was a cute tiny male scalyhead sculpin (fish) in an empty barnacle shell. Only its tiny head stuck out, possibly guarding a nest of eggs as well.

We ended our dive with a long safety stop back in the thicker part of the kelp forest next to shore. After getting situated with our buoyancy, we looked around at all of the hovering black rockfish, feeling like one of the crowd.

Before long, I could feel the tug of the current beginning to grow in strength. And as we waited at the surface for the boat to pick us up, a couple paddlers in kayaks paused to ask about our dive, curious of the critters we encountered. As usual, it was fun to watch their surprised expressions when we told them of the colorful variety residing just below their boats.

Whale watching

Time between dives can be equally as fun on a San Juan dive charter, especially if you have ever paid to be on a whale-watching boat, knowing how crowded they can be. Not so on Lu Jac's Quest during the months when the southern resident orca pod is cruising about the islands; divers are often treated to quite a show of activity.

In the past, Wayne and I have enjoyed photographing orcas passing so close Phil has had to turn off the engines. But orcas are not the only topside wildlife commonly seen; the occasional group of dolphins or pod of porpoises might also pass by. I don't think there has ever been a time on any of the trips when we have not seen huge

sea lions or harbor seals out on the exposed reefs enjoying some dry time.

"One of the best minke whale encounters was with Ron Akeson's group off Ice Berg Point," said Phil. "We watched a whale jump completely out of the water five or six times! 2013 is our tenth year of taking divers out, and you never know what you will see out here."

Long Island. When asked where Mike's favorite dive was in the San



It's not unusual to see a pair of wolf-eels in the San Juans (above) or moon snails (left)



CLOCKWISE FROM LEFT: Diver Ron Akeson adjusts video camera before descending; Male scalyhead sculpin likely guarding eggs in empty barnacle shell; Divers Nolan and David Grose enjoy diving the islands whenever they can

bridge is equally as full of life as Browning Wall.”

Deception Pass. This is another favorite dive destination Wayne and I like to visit, where we are able to dive beneath the huge Deception Pass Bridge. The 1,487-foot (453-meter) steel structure was completed in 1935, connecting Fidalgo Island to Whidbey Island. Today, over two million vehicles cross the bridge annually, and the bridge was declared a Natural Historic Monument in 1982.

Below extreme currents form impressive whirlpools and cause turbulent water to rush around Pass Island causing downdrafts and standing waves during low tide. For diving the area, good slack currents are limited to only a few days per year, making it a challenge for dive organizers like Ron to predict when the best dive time will be.

“Like any other location, when Phil and I put together a trip to Deception Pass, we give a thorough dive briefing and

only allow experienced divers to participate,” said Ron from ADU. “All the trouble we seem to go through to plan and organize the trip tends to pay off when we see what’s down there. The life is incredible!”

Incredible may not be the correct word to describe the dive—it’s more like spectacular!

I entered the cool clear water first, holding onto a strand of bull kelp in a protected part of the Pass, as I waited for Wayne to enter the water. Looking down, I thought I was in a huge tank at the Vancouver Aquarium. Multitudes of varying size fish freely swam about the kelp. Thirty feet below, swaths of lavender and pink covered much of the rocky terrain. Green and red sea urchins added texture while orange, purple and tan ochre sea stars seem to pile together on smooth rock faces.

Once Wayne was in, we followed Ron and the other divers underwater to the main part of the wall on the south side of Pass Island. Our time was limited to only 40 minutes, so everyone quickly moved to their favorite depths. The plan was to swim down the wall then turn around and head back, usually at a different depth because of the



look at the playlist for Washington State dives. Scroll that list to watch videos on: *Kellets Bluff*, *Exploring the San Juans*, *Strawberry Island*, *Invertebrates*, *Whale Rock* and *Deception Pass*. Also, *Colors of Cold* is a good sampling with some San Juan shots, as well as *Salish Sea Life on the Rocks* has lots of shots from the San Juans.”

“I don’t have just one favorite dive site in the San Juans,” said Ron Akeson. “But if I could only do one dive in Washington State, it would be Deception Pass. It reminds me so much of the Port Hardy area on Northern Vancouver Island, probably because the site we dive under the



Harbor seals are a common sight in the San Juan Islands



Divers emerge after a dive at Lime Kiln on San Juan Island

diverse variety of critters.

I was so enchanted with the colors; even the lingcod we came across were dappled in blue and orange spots. Heart crabs, painted anemones, orange burrowing sea cucumbers, pink brooding anemones, hydroids and giant barnacles were everywhere. Between the barnacles, tan finger-like sponge and assorted groups of feather-duster worms took up the remaining space.

Ron was busy shooting video of the wall when we came across him. Later he explained, "I am currently working on a film of under-

water life in Washington State, which will be followed by one portraying British Columbia diving. Third on the agenda is a film on diving high current sites of the northwest, not when the current is running, which commonly reach up to seven knots (8 mph)."

Afterthoughts

Overall, the diving we enjoyed throughout our San Juan adventure was delightful and so different at each location. At Whale Rocks, we had sea lions join us, as we checked out an excellent wall full of invertebrate life. Three wolf-

eels and seven different species of rockfish were counted at Bell Island.

Topside activities for us included a drive and hike at the top of Mount Constitution in Moran State Park on Orcas Island for a beautiful panoramic view of the islands and Mount Baker of the Cascade Range. It was also on Orcas Island where we met up with Tim Ferguson and his dive buddy, as they prepared for a shore dive.

"I like snorkeling here from my dive kayak so thought the diving might be good as well. We had to bring everything and no airfills are available. Boat diving is also a favorite too, but we felt like trying something different. We both like hiking, so when we're not diving, we have three great hikes to try: Mount Constitution, Turtleback Mountain and Obstruction Pass."

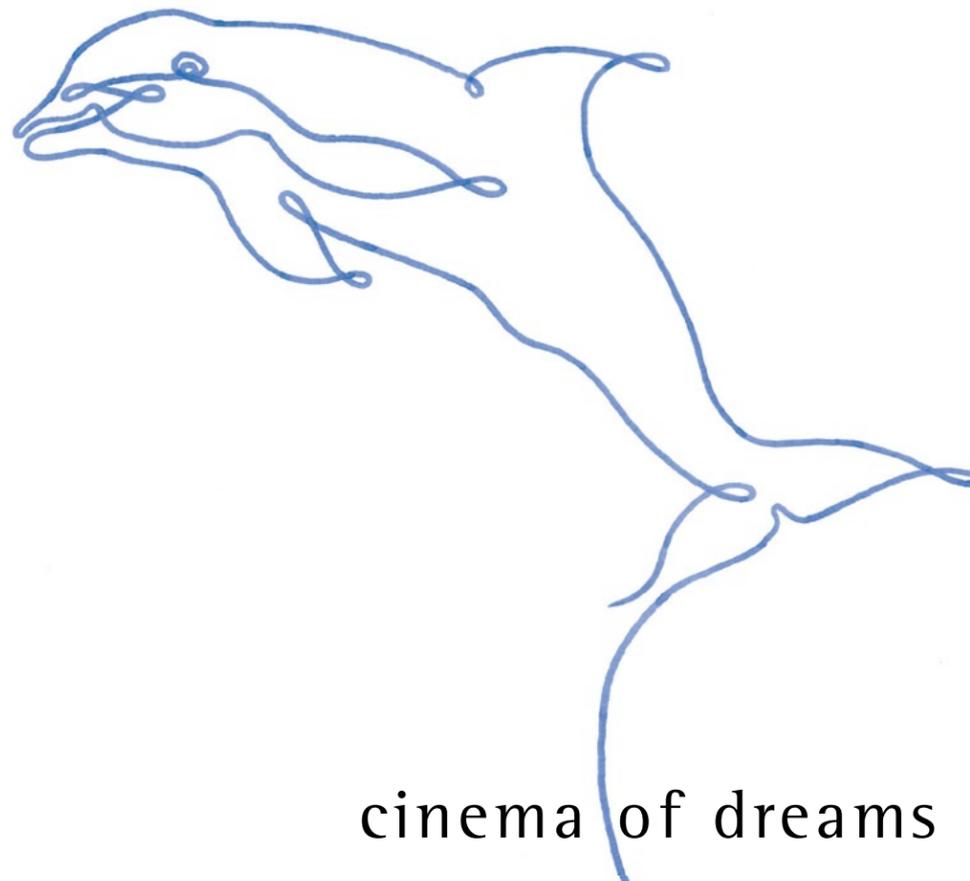
For those wishing to visit the San Juan Islands, they are located about 65 miles (105km) north of Seattle. They are conveniently in the rain shadow of the Olympic Mountains, yielding summer temperatures of around 70°F (21°C) and winter temperatures in the low 40's.

Group dive charters can be organized directly through Phil Jensen (Lujacsquest.com) or through Adventures Down Under in Bellingham (Adventuresdownunder.com). Expected pricing in 2014 will be US\$115 for two boat dives, which includes lunch—no dive gear included. Full rental (hire) packages are available on ADU charters for \$65 (wetsuit) or \$90 for a drysuit package (must already be trained in drysuit use).

Whether you are an underwater photographer, videographer, technical or recreational diver, the San Juans in Washington State offers a cornucopia of dive opportunities. ■



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Edited by Catherine GS Lim



Mid-Ocean Ridges

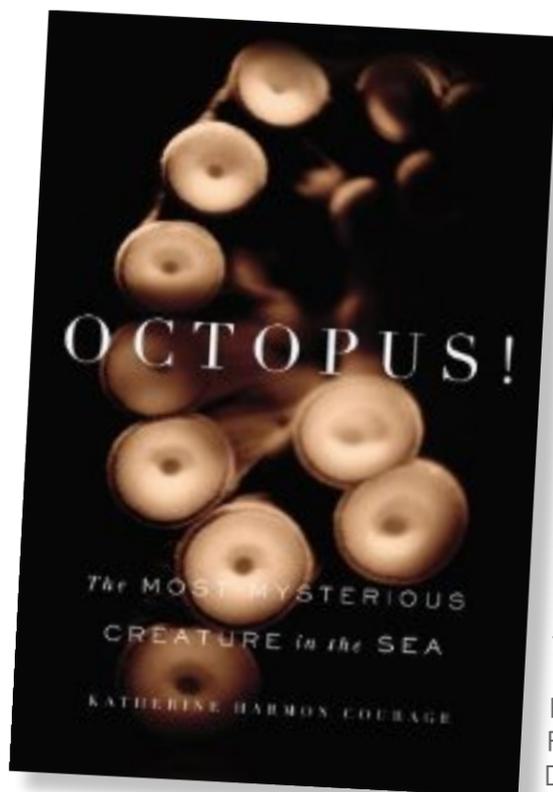
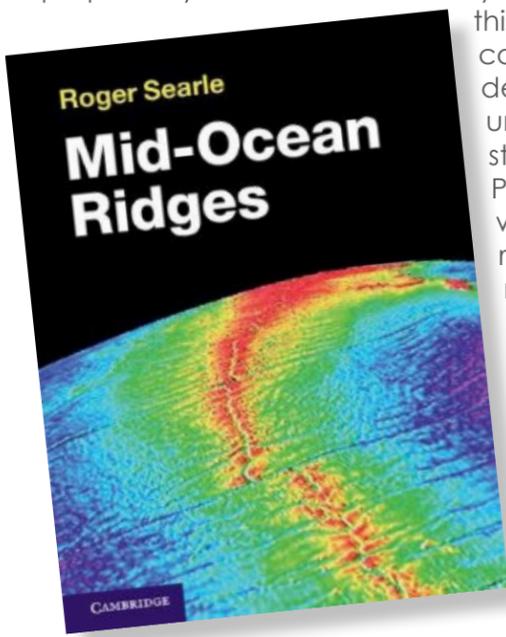
Mid-Ocean Ridge, by Roger Searle. Beneath the ocean surface runs a single, global ridge system that's the longest mountain range in the world. Constantly active, it is the site of tectonic movements that lead to seafloor spreading. This perpetually active

system is what this introductory coursebook, designed for undergraduate students, is about. Professionals working in related fields of marine geology, geophysics, volcanism and oceanography may also find the book to be a handy reference. Background chapters provide

an overview of research

techniques while succeeding chapters explore the structure of the lithosphere and crust, and the volcanic, tectonic and hydrothermal processes. A summary and synthesis chapter recap key concepts to aid new learning.

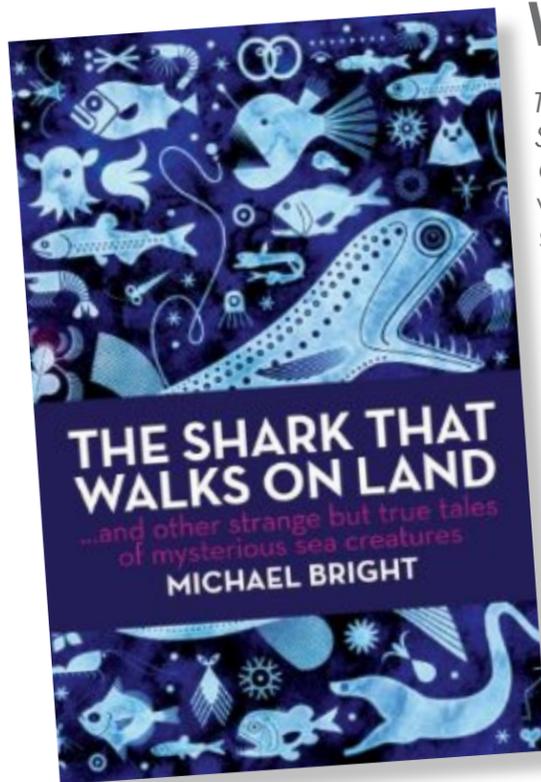
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 ISBN-13: 978-1107017528



Octopus!

Octopus! The Most Mysterious Creature in the Sea, by Katherine Harmon Courage. The octopus is quite the peculiar creature. It can change colour at will. It has three hearts and eight long tentacles. The earliest fossilised remains date back 296 million years ago, and that's even earlier than the age of the dinosaurs. And also, it does look kind of ... weird. Find out more about this underwater wonder and hear from leading octopus experts in this 272-page book. Chances are it may cause you to think twice about ordering that octopus dish from the menu this weekend.

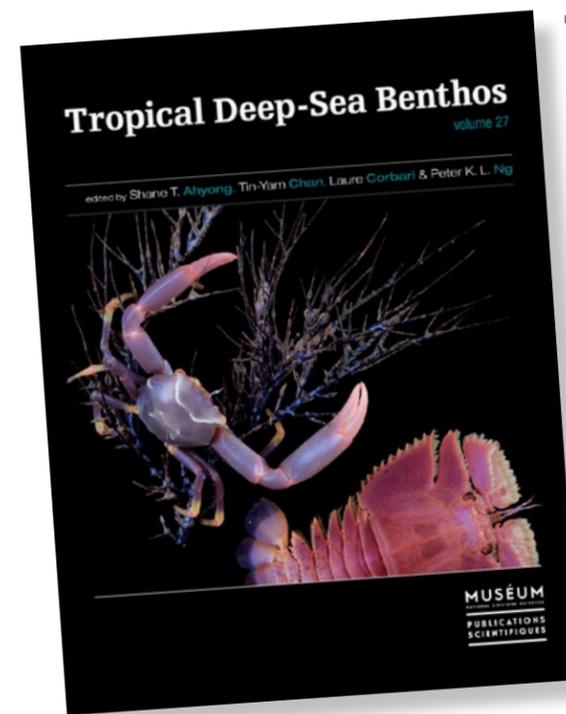
Hardcover: 272 pages
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Walking Sharks?

The Shark That Walks on Land: And Other Strange But True Tales Of Mysterious Sea Creatures, by Michael Bright. Behind its whimsical front cover lies tales of sea serpents, mermaids (and mermen!), sea dragons and even the legendary kraken. However, this is more than just a collection of seafaring myths and legends. This book blends the unknown with the familiar, mixing together facts, figures and anecdotes about the vast range of mysterious creatures that swim within the ocean depths. Be prepared to come face-to-face with the giants, the oddballs and the record breakers of the underwater world.

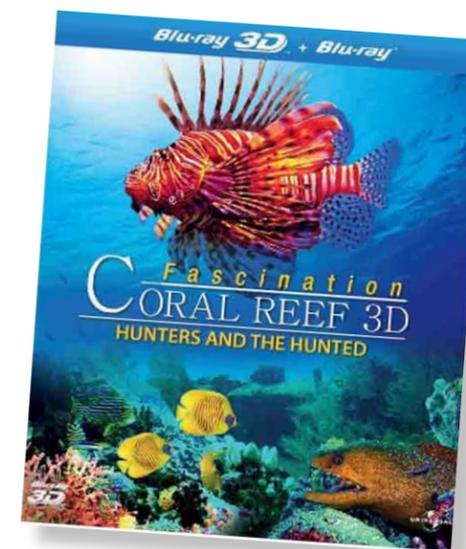
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 ISBN-13: 978-1849545983



Tropical Deep-Sea

Tropical Deep-Sea Benthos 27, edited by Tin-Yam Chan, Laure Corbari, Shane Aiyong, Peter Ng. This is the 27th volume in this series dedicated to the world's deep-sea fauna, particularly those found in the Indo-West Pacific. This illustrated book provides an inventory of more than 200 species, including 27 new species of crabs, shrimp, lobsters, etc. It also contains essays by renowned researchers and scientists in the field of crustacean biodiversity research.

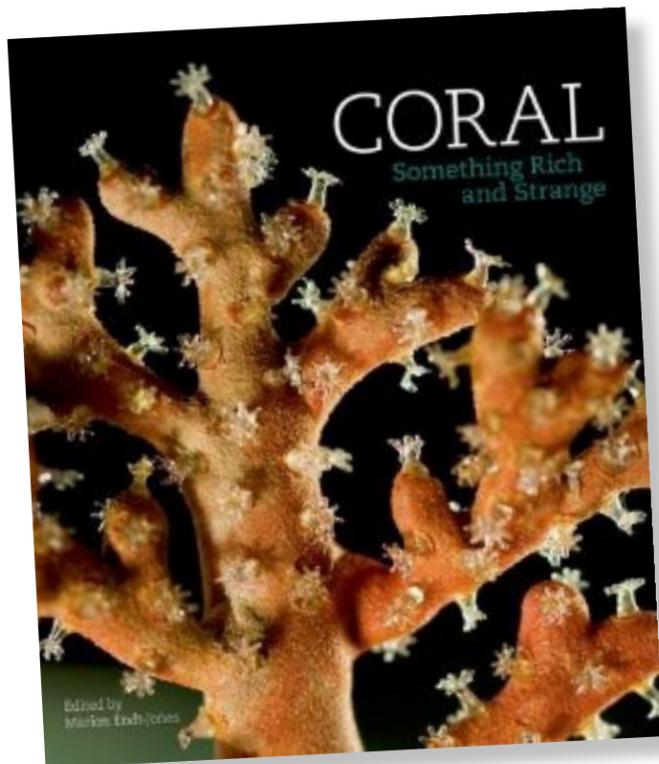
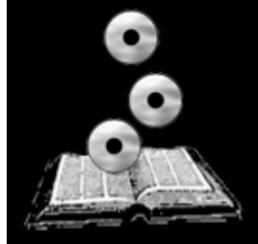
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 ISBN-13: 978-2856536926



Coral Reef in 3D

Fascination Coral Reef: Hunters and the Hunted, directed by Rene Schoepfer. The title says it all. This documentary shows, in exciting 3-dimensional format—the eternal chase between the hunter and the hunted in the underwater world. Observe both the hunting and stalking methods of the hunters, and the defence and camouflage strategies of the hunted. Be prepared to be fascinated and amazed—all from the safety and dry comforts of your home.

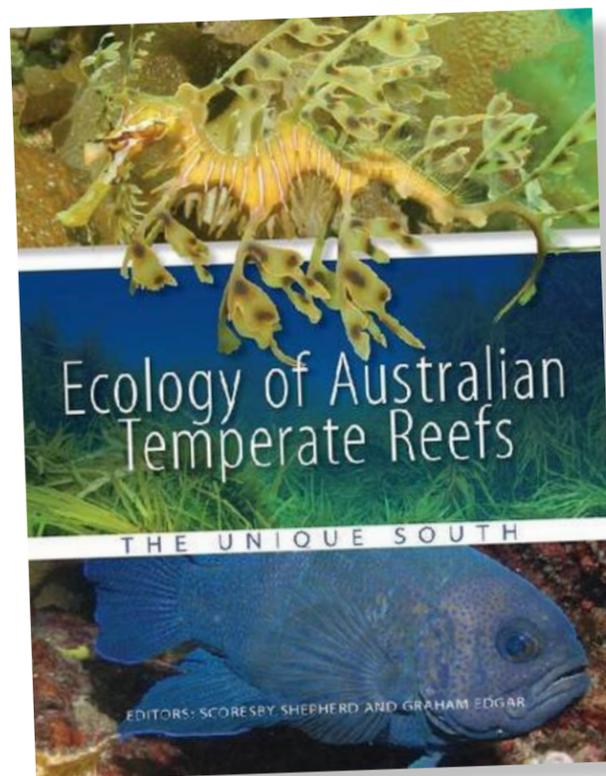
Directors: Rene Schoepfer
 Producers: Benjamin Krause
 Format: Blu-ray, 3D, Widescreen
 Languages: Hungarian, Portuguese, Turkish, Czech, English, Italian, French, Japanese, Spanish, Spanish
 Region: All Regions
 Rated: NR (Not Rated)
 Studio: Universal Studios
 DVD Release Date: 12 November 2013
 Run Time: 106 minutes



Coral

Coral: Something Rich and Strange, edited by Marion Endt-Jones. Although the coral species depicted on the front cover isn't exactly eye candy, this comprehensive book explores the coral in art and nature throughout the centuries. In addition to an interview with artist Gemma Anderson, there are essays and concrete objective stories covering the coral's mythical and metamorphic qualities, its resistance to classification, geological and architectural significance, religious iconography, etc. This illustrated publication launch has been scheduled to coincide with an exhibition at Manchester Museum from November 2013 to March 2014.

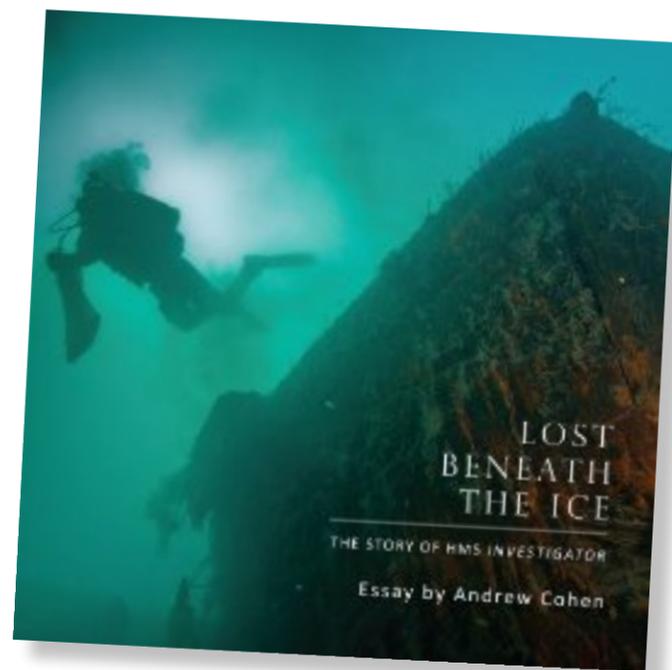
Paperback: 128 pages
 Publisher: Liverpool University Press
 Date: 31 October 2013
 ISBN-10: 1846319595
 ISBN-13: 978-1846319594



Australia

Ecology of Australian Temperate Reefs: The Unique South, edited by Scoresby Shepherd and Graham Edgar. This book starts by exploring the geological origin, oceanography and biogeography of southern Australia. Then, it elaborates on the origin and evolution of the flora and fauna as Australia separated from Antarctica, the region's oceanography, as well as the ecology of particular species at the various trophic levels. The concluding chapters cover conservation and management issues. Generously illustrated with line drawings, figures and colour photos, this book promises to be a useful reference for students and field researchers—in fact, anyone interested in the ecology and health of coastal waters.

Hardcover: 520 pages
 Publisher: CSIRO Publishing
 Date: 15 Oct 2013
 ISBN-10: 148630009X
 ISBN-13: 978-1486300099

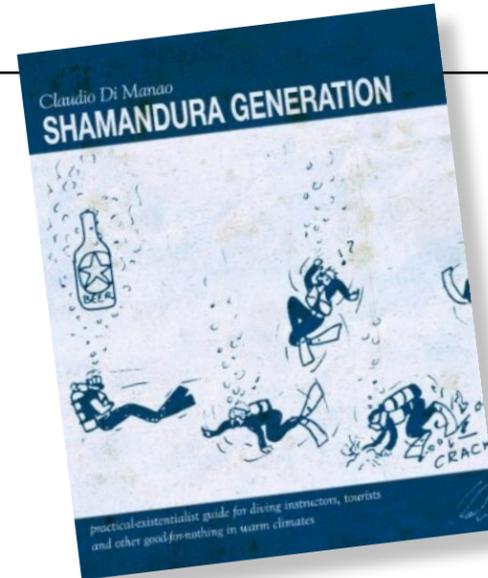


Arctic Shipwreck

Lost Beneath the Ice: The Story of HMS Investigator, by Andrew Cohen. When Sir John Franklin and his crew went missing in the Arctic in the 1840s, a rescue mission was dispatched. Among the ships that made their way was the *HMS Investigator*. Although the vessel failed to locate the men, the crew discovered the fabled Northwest Passage instead. Then, the ship itself became trapped in the ice of Mercy Bay. Some of the crew survived and were rescued three years later, and the *HMS Investigator* abandoned. In 2010, the ill-fated vessel made the news again, as archaeologists sought to uncover its fate. Alongside underwater photos, this book tells the story of endurance, daring, deceit and courage of the individuals—its crew, surgeon, missionary and captain—aboard the *HMS Investigator*.

Hardcover: 128 pages
 Publisher: Dundurn
 Date: 10 December 2013
 ISBN-10: 1459719492
 ISBN-13: 978-1459719491

REVIEW



Shamandura Generation

By Claudio Di Manao

This book is a fun read. Many times have I lamented that dive-speak is often so dreary, serious or technical. In contrast, Claudio Di Manao's anecdotes from working as a dive guide in Sharm el Sheikh provides entertaining insights into the often bizarre workings of the Egyptian dive industry. Having visited Sharm many times, I could certainly relate—I have witnessed their perplexingly weird ways in full bloom—but divers without the same frame of reference should also get quite a chuckle out of these tales. Sharm is a melting pot where innumerable cultures, mostly in the form of dive bums from all over the world, meet—and some times clash—with certainly colourful personalities pursuing often incompatible agendas. Not all is smooth sailing (pun intended) between the Egyptian crews, the European dive professionals and the often anal-retentive dive operation managers. But like a classic Woody Allen movie, the absurdities have high entertainment value. From a different perspective, Di Manao's accounts, which come with the quite appropriate subtitle 'practical-existentialist guide for diving instructors, tourists and other good-for-nothing in warm climates' would probably be the best 101 introduction for wanna-be dive professionals, if there ever was a class for such a subject in a business school. — Peter Symes. ■

Shamandura Generation e-book is available at Amazon.com for US\$3.00 or EU€2.68.