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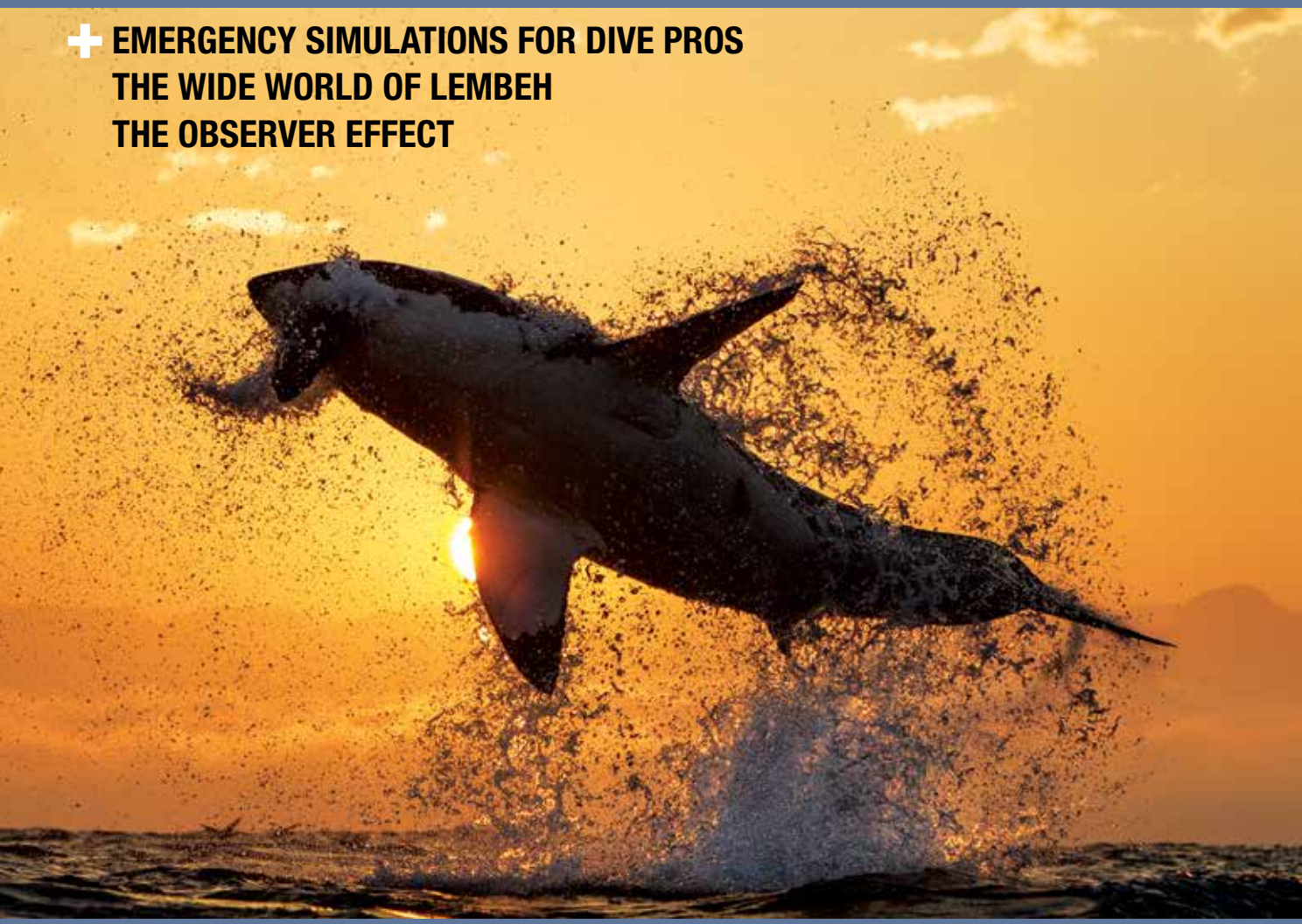

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FALL 2013

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VISION

Striving to make every dive accident- and injury-free. DAN's vision is to be the most recognized and trusted organization worldwide in the fields of diver safety and emergency services, health, research and education by its members, instructors, supporters and the recreational diving community at large.

DAN

MISSION

DAN helps divers in need of medical emergency assistance and promotes dive safety through research, education, products and services.

Divers Alert Network® (DAN®), a nonprofit organization, exists to provide expert medical information for the benefit of the diving public.

DAN's historical and primary function is to provide timely information and assistance for underwater diving injuries, to work to prevent injuries and to promote dive safety.

Second, DAN promotes and supports underwater dive research and education, particularly as it relates to the improvement of dive safety, medical treatment and first aid.

Third, DAN strives to provide the most accurate, up-to-date and unbiased information on issues of common concern to the diving public, primarily — but not exclusively — for dive safety.

ALERT DIVER'S PHILOSOPHY

Alert Diver® is a forum for ideas and information relative to dive safety, education and practice. Any material relating to dive safety or dive medicine is considered for publication. Ideas, comments and support are encouraged and appreciated.

The views expressed by contributors are not necessarily those advocated by Divers Alert Network. DAN is a neutral public service organization that attempts to interact with all diving-related organizations or persons with equal deference.

Alert Diver is published for the use of the diving public, and it is not a medical journal. The use and dosage of any medication by a diver should be under the supervision of his or her physician.

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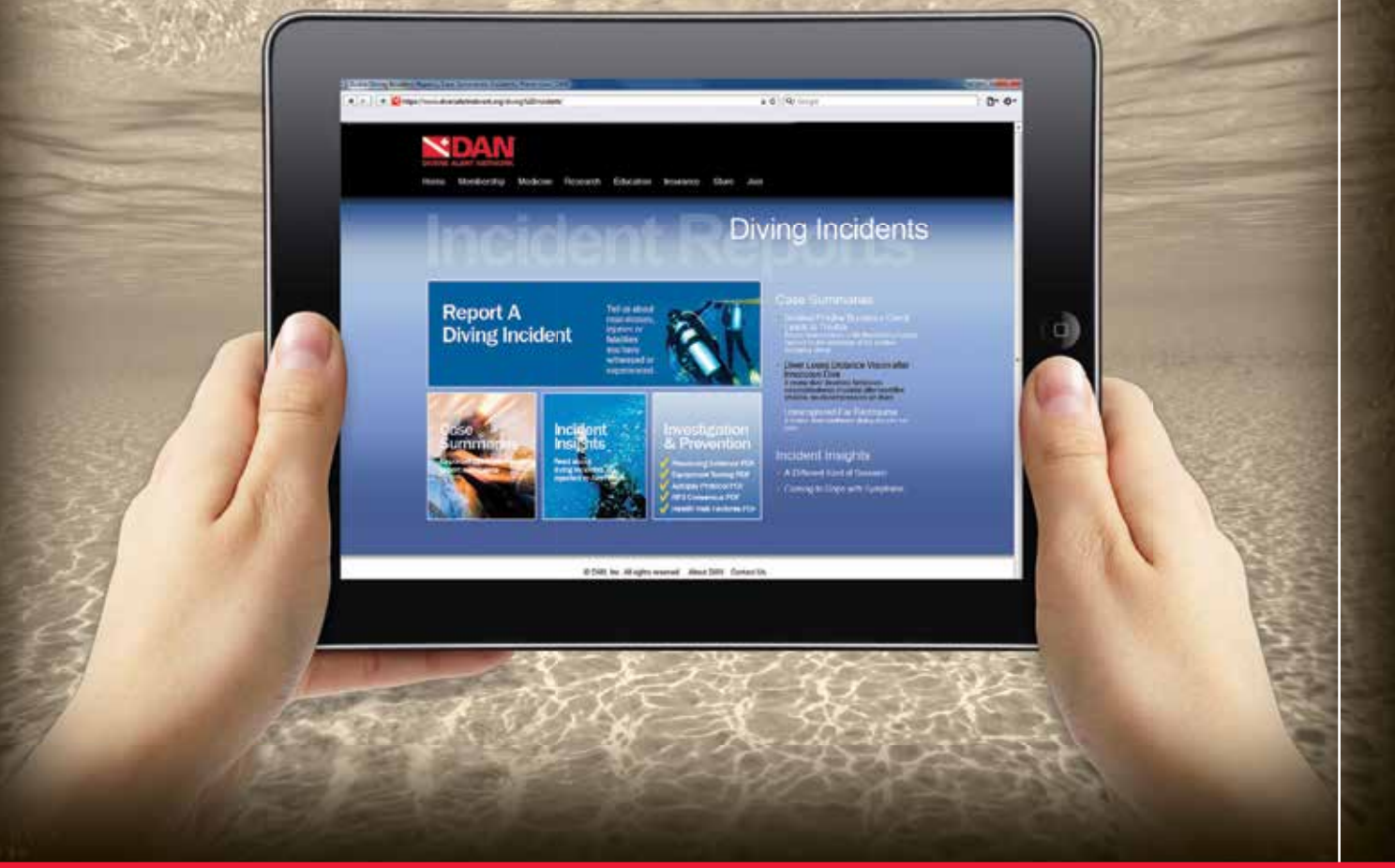

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FALL 2013

ON THE COVER:
One of Seal Island's legendary great white sharks (*Carcharodon carcharias*) blasts into the air as the sun rises over False Bay, Cape Town, South Africa. Chris Fallows took the photo with a Canon EOS-1D Mark IV and 70-200mm f/2.8 IS lens, 1/4000 sec @ f/5.6.

features

Caribbean reef shark (*Carcharhinus perezii*) and diver on the *Ray of Hope*, New Providence, Bahamas. Photo by Stephen Frink

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departments

Spotted dolphins (*Stenella frontalis*), Bimini, Bahamas. Photo by Stephen Frink

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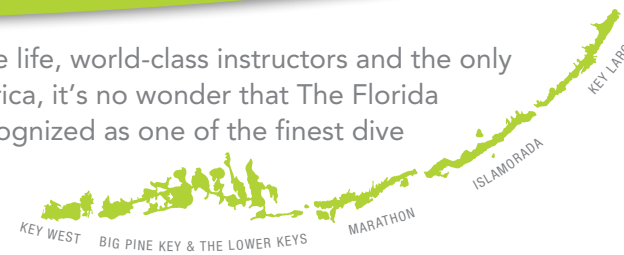

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DAN's Recompression Chamber Network

BY BILL ZIEFLE

DAN® faces many challenges when trying to help an injured diver deal with a suspected case of decompression illness, not the least of which is access to a suitable hyperbaric facility. In many of the more remote locations where divers travel, access to hyperbaric care is often limited. This may lead to expensive medical evacuations, delayed treatment and, in some cases, suboptimal outcomes for divers in need.

Even in places where chambers exist, injured divers may not receive the level of care they require because of factors such as the absence of ancillary medical support, limited diagnostic capabilities and physicians' lack of access to consultation with medical colleagues. Furthermore, remote facilities often have limited opportunities for continuing medical education for physicians and chamber support personnel. Challenges that some chambers face include a lack of financial support, language barriers and no backup personnel to treat patients when the regular staff is away for training or on holiday. Inadequate care often is not the fault of the chamber owner or operator but a consequence of the lack of access to the resources needed to provide a higher level of medical care.

Over the years, DAN has worked with numerous chambers to address these problems. Through initiatives such as DAN's Recompression Chamber Assistance Program (RCAP), various forms of assistance have been provided to hyperbaric facilities around the world. This assistance includes on-site and off-site training of chamber personnel, sponsored educational opportunities for physicians, periodic technical and operational risk assessments and donation of replacement parts. This support has allowed many chambers to remain open that might otherwise have closed.

But DAN can do more. Starting this month, chambers can apply to be part of DAN's new Recompression Chamber Network (RCN). This unique program serves multiple purposes and offers several significant benefits to divers, including:

- expanded availability of treatment facilities
- better operational readiness and higher quality medical care at remote facilities
- support for facilities that offer affordable and reasonable treatment options

The RCN is a comprehensive support platform that includes technical, safety, medical and operational assistance to chambers within the network. Participating chambers will enjoy significant benefits from DAN, including:

STEVE EXUM

- 24/7 real-time consultations with DAN physicians and other doctors who provide support for DAN's emergency hotline
- chamber assistance, including risk assessment, financial support (where needed) and on-site and off-site training such as courses for chamber attendants and operators and chamber maintenance
- expert consultation using the "Ask the Experts" program offered through National Baromedical Services
- access to the latest scientific papers in diving and dive-medical research
- access to DAN's Medical Services Call Center, a state-of-the-art electronic medical record and the tool DAN Medical Services uses to document and manage dive injuries
- designation as a "DAN Preferred Provider Partner," with expedited payment protocols and a new e-claims process that is currently in development
- priority access to the DAN RCAP

The RCN program became operational Nov. 1, 2013, with 35 charter members. Divers will find RCN chambers in such diverse locations as the Galapagos, Cozumel, Vanuatu, the Solomon Islands, Papua New Guinea, Vietnam, Palau, Yap, Fiji and Chuuk at present, and more partner chambers are joining the network all the time.

DAN is working diligently to ensure your favorite dive destination is served by a member of the RCN. A sign that reads "DAN Preferred Provider Partner" indicates quality care and represents our guarantee that your donations and membership dollars are being used to support that facility. AD

DAN®

DIVERS ALERT NETWORK

Over the years, we've worked hard to make scuba diving a much safer sport through improved training, education and research. However, dive accidents still occasionally happen and may require costly treatments and emergency transportation. DAN's dive accident insurance protects you against out-of-pocket expenses and is an irreplaceable resource should a dive injury occur. It's the smart way to enjoy the sport you love.

DAN.org/Insurance

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R-E-S-P-E-C-T

BY STEPHEN FRINK


TYRA ADAMSON

I find it hard to even write the word "respect" without hearing the Aretha Franklin tune in my head ("sock it to me, sock it to me"). As divers, one significant association we should have with that word is our relationship with the sea and the coral reef.

This occurred to me recently as I read a long and active thread on an email list hosted by the National Oceanic and Atmospheric Administration (NOAA). Most people who add their voices to the discussions held there are extraordinarily knowledgeable scientists speaking about their particular marine biological passions. I learn a lot just by lurking, hoping that by osmosis I can become a better-informed citizen of this blue planet.

The director of Alacranes Reef National Park in Yucatan, Mexico, initiated this particular thread. The park administration is writing a new management plan, and the director sought comments on an idea to obligate divers to stay five feet away from the coral reef to prevent damage.

As an underwater photographer, I find this recommendation troubling. Besides the obvious consideration that quality underwater photography can't be done at a distance of five feet away, and macro photography can't be done at all, a larger issue evolved in the ensuing conversations. Is the degradation we see in our coral reefs brought about by scuba divers?

The following are a few of the scores of fascinating insights proffered by those who are in a position to speculate with authority:

"I regard the proposed 'keep your distance' rule as not only misguided but counterproductive, sure to derail important observations and documentation of reef life. In the 21st century, divers who value 'looking, not taking' are among the ocean's best friends and most effective ambassadors. They are direct witnesses to the swift changes that have taken place in recent years and often document behavior and make observations and discoveries of great scientific value. They also provide knowledgeable, caring voices for corals, fish and other forms of ocean life that cannot vote or speak for themselves. Damages in the form of an occasional snapped branch or nudged sponge are small compared with the impact of an improperly placed anchor or the removal of fish, lobsters, conchs or other living elements that make coral reefs prosper." — *Sylvia Earle, marine conservationist and National Geographic Explorer in Residence*

"In most parts of the world, especially the Caribbean, diver damage is an undetectable signal compared with other human-induced impacts or natural disturbances (storms, bleaching, ocean acidification, overfishing and others). Yes, it's easy to point a finger at a diver touching the bottom or a wayward gauge, but look at what happens in one winter blow — not even a hurricane — or from turtles grazing on sponges and you'll see more damage than divers cause in a year. I'm not saying we shouldn't encourage good behavior, proper buoyancy control and a better understanding of the marine ecosystem, but realistically, putting significant time and effort into diver regulation is not going to solve any problems." — *Lad Akins, Director of Special Projects, Reef Environmental Education Foundation*

"Some divers and dive operators find reducing diver impact appealing, because it is something they can do to help. I'm all for that. The problem is that diver impact, while significant for some small areas of reef, is one of the most minor impacts on the world's coral reefs. … If we want to save reefs, we must stop global warming and acidification. We must also reduce local impacts — primarily overfishing, nutrification, chemical pollution, coral disease and introduced species such as lionfish. … Climate change is the 800-pound gorilla in the room. If we don't do anything about that, we could stop

all diver damage, and it would be like rearranging the deck chairs on the Titanic. If you look at any ranking of the causes of coral reef decline around the world, diver damage is always near the bottom of the list. … Reefs at Risk lists overfishing and destructive fishing as the number-one local threat to coral reefs, with pollution (including sedimentation, nutrient runoff and chemical pollution) as the other big local threat. The top global and future threats to coral reefs are climate change and acidification." — *Douglas Fenner, Department of Marine and Wildlife Resources, American Samoa*

This was the springboard for some lively conversations I had with Earle at a recent meeting of the DAN® board of directors. She is of the opinion that overfishing is a huge and largely controllable challenge to our oceans. She believes each fish extracted leaves a substantial hole in the ecosystem, as a fish that can no longer procreate costs far more than just that one fish. That's why she is such an ardent proponent of marine protected areas, nurseries where fish are allowed to congregate, achieve critical mass and reproduce.

In light of her experience, her personal choice is to not eat fish. All divers will develop their personal ethic in this regard. There are things I used to do that I can't in good conscience continue to do. For years I thought it was clever to order yellowtail snapper from the menu when out to dinner, as retribution for all the times they got in my way while I was trying to photograph a queen angelfish or some other more glamorous reef denizen. Now yellowtail are rare on our local Florida Keys reefs, except in no-take sanctuary zones that are closed to both hook-and-line fishing and spearfishing. Even conch, a gastropod of little charisma, were so plentiful in my early local-diving days that the boats would stop on the way home, and we'd snorkel up a half-dozen for conch salad on the way back to the dock. Those days are done. Now it's illegal to do that here in the Keys, and, more significantly, the global conch fishery is in real danger of collapse.

We divers see the coral reef with an intimacy landlubbers never will, and as citizen scientists we should know by observation what is right and what is wrong with our oceans. We owe the sea a large measure of respect and must each consider what our personal choices for sustainable consumption might be. Earle observed with some sense of urgency that we should care for the sea as if our lives depend on it, for in more ways than we can now fathom, they do. AD

WHAT'S NEW ON ALERTDIVER.COM

JENNAH CASTER

Inspiring Passion

Read about Waterlust (Page 19), a vibrant online film series that highlights water-related science, sport and art to inspire interest in and communication about our aquatic resources. Then watch *Coast Guards*, a Waterlust film in which marine biologist Austin Gallagher shares his fears and fascinations about sharks.

Surf and Turf

South Africa is a predator's paradise both above and below the surface. After you've read Chris Fallows' feature article (Page 64) about a dive destination brimming with thrilling predatory creatures, check out Alexa Frink's gallery of that country's iconic topside species.

JUAN VENTER

ETHAN DANIELS

Acoustic Insights

Take a look at "The Symphony of the Reef" (Page 38), and learn about the ways marine life use sound to communicate. Don't miss Ethan Daniels' bonus gallery, which captures glimpses of some of these unique behaviors.

Jack of All Trades, Extraordinaire

Meet Nathan Myhrvold, a DAN member and dynamic innovator with a staggering array of interests and achievements. Read about him on Page 24, then listen to him discuss some of his ideas in one of his TED talks, *Nathan Myhrvold: archeology, animal photography, BBQ ….*

CAMERON MYHRVOLD

ALL THIS AND MUCH MORE AWAIT AT *WWW.ALERTDIVER.COM.*

Letters

GENEROUS OR LAX?

I was happy to read that DAN was there for Krista Holbrook when she needed you for medical assistance with her spearfishing accident in the Sea of Cortez (DAN Was There for Me, Summer 2013).

I have no problem with sustainable spearfishing for food, but I was a bit taken aback to read her opinion of Mexico's "reasonable and generous fishing regulations" compared to southeastern U.S. regulations that require "a degree in marine biology to adhere to."

Mexican fishing regulations and their lax enforcement have been responsible for a catastrophic decline in fisheries in the Sea of Cortez. When my wife and I dive there we see very few large fish outside the tiny marine reserve at Cabo Pulmo. Perhaps a little more marine biology is in order.

— Mike Boom, Oakland, Calif.

STEPHEN FRINK

A FOND FAREWELL

I wish Dan Orr well in his retirement. I've met him on several occasions, and he was certainly a wonderful representative of DAN. His contributions can never be measured.

— Pam Lyles, RN, via email

NOTES ON PORIFERA

This may be a little nit-picky, but the answer to a question on irritation from handling sponges by Drs. Nochetto and Bird (From the Medical Line, Summer 2013) gives the impression that sponges are echinoderms. Not so; sponges have their own phylum, Porifera. The phylum Echinodermata includes sea stars, brittle stars, sea cucumbers, sea urchins and crinoids (feather stars). Of these, the only ones that commonly inhabit sponges are brittle stars. As stated in the article, sponges are often colonized by cnidarians, mostly zooanthids.

— Jay Burreson, Corvallis, Ore.

A BRISK PARADISE

I wanted to say how much I enjoyed Brandon Cole's article, "Nanaimo: Shipwrecks and swift waters in an emerald sea" (Local Diving, Summer 2013). Well done! It's nice to see our little slice of diving paradise in your magazine.

— Don Ravensbergen, Nanaimo, British Columbia

DIVE MEDICAL RESEARCH

I enthusiastically support DAN and its mission, and I appreciate the vitally important services DAN provides. However, I would like to express that I do not support DAN-funded medical research that involves animal subjects. I understand the benefits animal-subject research can provide and has provided in the past. However, the vast majority of diving done by DAN members is recreational; to me, small improvements in the margins of safety for a fun activity don't support the suffering of animal subjects. I'm sure my opinion is the minority, but after reading about DAN-sponsored animal research in *Alert Diver* ("DAN Research: Safer Diving through Science," Winter 2013), I felt the need to express it.

— Michael Cole, via email

DAN's response:

Dear Michael,

We appreciate your concerns. To be clear, DAN does not conduct any research studies with animals. However, a number of reputable institutions with whom we interact are, under strict ethical supervision, involved in animal studies. Some basic physiology questions could not be answered without this research. In the case of the study of Sudafed and oxygen toxicity, this was an established line of research that is addressing issues important for understanding some basic biological processes involved in many diseases. Because this research contributes to knowledge applicable to commercial divers, tunnel diggers, astronauts, patients treated in hyperbaric chambers and firefighters as well as recreational scuba divers, we thought it meaningful and worthy of our support.

— Petar J. Denoble, M.D., D.Sc., Vice President, DAN Research

WRITE US

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ONLINE

Send email to:
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All letters included in this column are subject to editing for length and content.

IN OVER THEIR HEADS?

One of the letters to the editor in the last issue (Letters, Summer 2013) highlighted a common problem in diving today: complacency among much of the diving public and failure to remember some of the basic skills taught in open-water classes. Each diver must be responsible for his own equipment and should know that his breathing gas is on and sufficient for the dive. Divers should never rely on the divemaster or boat crew to check their tank or open their tank valve.

The letter also highlighted another problem I often see on dive trips: divemasters leading divers through swim-through features, which are overhead environments. Most of the divers (including the divemaster) are probably not trained or equipped to dive in an overhead feature. In my opinion, leading a group of inadequately trained and equipped divers through an overhead environment is irresponsible and dangerous.

Each diver should know better than to engage in a dive for which he is not properly trained and equipped; but many divers defer to the experience of the divemaster and assume that if it weren't safe, the divemaster wouldn't offer to lead them through the overhead feature. Divers should always take responsibility for their own safety, and divemasters, regardless of their own training, should not lead untrained divers into overhead environments.

— Dave Potter, Shelburne, Vt.

A DOSE OF OPTIMISM

In the introduction to "Ocean Views 2013: A Time Capsule of Excellence," (*Alert Diver*, Spring 2013), I was disappointed by the author's pessimism when he stated: "Unfortunately, no one will ever get to experience those oceans again...."

Human interference was already a factor when the first divers experienced the ocean's magnificence. With perseverance, dedication and education, I believe an even more abundant ocean than what they enjoyed is possible.

Thanks for always being a great source of information.

— Mary Alice Miller, via email

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All Is Lost

A tale of ocean survival

BY STEPHEN FRINK

When I last spoke to J.C. Chandor, the writer and director of *All is Lost*, he had just returned from the film's premiere at Cannes and was basking in the afterglow of an enthusiastic reception there.

"This is a film that needs to be seen on the big screen," Chandor said. "The audience needs to be able to get their minds in the place of the main character. At Cannes we had a theater with 2,500 people all leaning forward in their seats. Sound — as well as visuals — is a huge part of this film, and the audience definitely got it. We had incredible cinematography — so good that things we shot in reality were assumed to be computer-generated special effects. But in the end it was the talent and dedication of Robert Redford that dominated. While this is an experiential action movie, it is also quite existential."

The premise is one that anyone who has ever lived aboard a boat at sea can relate to: Sound asleep in the dead of night on a passage in the Indian Ocean, a massive thud reverberates through the hull. The sailor is Robert Redford, and he is alone on his fairly modest 39-foot sailboat. The early light of dawn reveals that the fateful bump in the night was a partially submerged shipping container knocking a gaping hole into the side of the boat. The sailor's calls for help on the VHF radio are about the only dialogue in the whole movie, and the response to them is only static. Despite his heroic efforts to patch the hull, the sailor is drawn inexorably into the path of a violent storm. Soon he succumbs to the inevitability that his boat will sink, and his new reality is life adrift in a raft.

Making a film entirely in and around the water was a huge challenge for Chandor, whose debut feature film, the Oscar-nominated *Margin Call*, featured an ensemble cast and extensive dialogue. This time it was just Redford and the harsh realities of survival at sea.

"It's a very big challenge being alone, with no crutch, no dialogue, no words," Redford said. "It's a challenge that attracted me a lot as an actor. I believe in the role of silence in film, and in life, because we often talk far too much. Silence allows you to really live your role and forces you to totally trust the director."

Chandor characterized the film as a realistic portrayal of "Our Man" — the only name Redford's character has in the script — coming to grips with his own mortality. He didn't want this to be a superhero film, but rather one about the particular things the man experiences in his days at sea that define whether he lives or dies. "Average people in extraordinary circumstances" is how Chandor described


DANIEL DAZA


STEPHEN FRINK

STEPHEN FRINK

STEPHEN FRINK

Clockwise from top right: **Director of Underwater Photography Pete Zuccarini prepares to shoot a scene with his housed Arri Alexa. Writer/director J.C. Chandor checks the underwater video footage being fed to him live via optical cable. Much of the open-ocean filming of the life raft was done at Stuart Cove's Dive Bahamas. *Opposite:* Robert Redford takes the helm in the new film *All Is Lost*.**

it. There is a scene in which the man stands in chest-deep water in his sinking ship and shaves his face before a mirror. The scene is both mundane and extraordinary in that the opportunity may never again exist for Our Man. Such sublime moments are the hallmarks of this film, which *Entertainment Weekly* called "scarier than anything in *The Perfect Storm*."

Chandor was never a Wall Street trader before making *Margin Call*, but he was a sailor before he made *All is Lost*. He had experienced ocean-induced fear, too. He was once caught in a wicked storm during a yacht delivery to Bermuda — a psychological shadow that came out of hiding for this script. "Script" might be too grand a description of the project's origin though; the spare, 32-page treatment was more like a narrative or an essay. I asked Chandor how he managed to bring such a major talent on board for that kind of project. In the past 15 years Robert Redford hadn't acted in a single picture he hadn't directed. Why was Chandor's film so special?

"I was at a seminar for filmmakers at Sundance, and Robert Redford was speaking," Chandor said. "*Margin Call* had done very well at the festival, but I hadn't actually met Redford yet. I was sitting in the back of the room listening to this really iconic voice — one we'd all grown up with from so many movies. He was describing his 1972 film, *Jeremiah Johnson*, in the context of a man who had the choice to give up or continue in the face of daunting odds. He goes on because that's all he can do. Some might have given up, but he never does. That's the spirit I envisioned for Our Man." So he sent Redford the treatment.

It is perhaps surprising that Redford isn't inundated with movie pitches from aspiring filmmakers. "There's something ironic in that; all these years after starting Sundance and starting the film festival, none of the filmmakers I supported ever hired me," Redford said with the smile we've all seen so often. "They never offered me a part until J.C." Four days after receiving the script, Redford invited Chandor to a meeting at his office in Los Angeles. Ten minutes into the meeting Redford slapped his knee and said, "I just wanted to make sure you aren't totally crazy. Let's do it!"

At that point, the daunting task of making this film set in. Sinking a boat repeatedly is not a project for the open ocean, so a water set had to be found. The perfect set was at Baja Studios in Rosarito, Mexico. It was built by James Cameron to shoot the marine effects for *Titanic*, but the studio had gone largely unused for years because of security concerns in an area rife with drug warfare. The Mexican government eventually intervened, security was provided, and the *All Is Lost* crew got access to three giant water tanks. Among them

Director J.C. Chandor discusses a scene with *All is Lost* star Robert Redford.

ANDREW ILLSON

was the world's largest infinity-edge tank, which sits right on the ocean shore and is the size of three football fields.

Pete Zuccarini, the film's director of underwater cinematography, said it was a blessing that Redford had such terrific water skills: "He could be in the water eight hours a day and then go swimming for fun when he went home at night." This from a man who was 75 years old at the time the film was made, which wouldn't necessarily be relevant except that Our Man's survival depended on his ability to overcome the hazards of nature as well as his own frailties.

Special effects supervisor Brendon O'Dell used a massive dump tank to simulate the violent movements of a sinking ship. Rigging and hydraulic cylinders were employed to suck the boat downward and move it side to side. Much of the movie was filmed in tanks, but some scenes were shot in the open ocean, including scenes of the sailboat at sea in the Sea of Cortez and shots with sharks in the Bahamas.

Zuccarini recalled conversations with Chandor about the shark segment, and they briefly considered going to Guadalupe Island to shoot great whites for the scenes where sharks surround the raft and disrupt the survival fishing done by Our Man. But Chandor made the call that this was not supposed to be a monster movie — the sharks were meant to be a nuisance and somewhat of a hazard; too much shark would overpower the subtleties of the performance.

Redford performed most of the stunts himself, a fact the producers found both inspiring and unnerving. After all, he is the only actor in the whole movie, and if he were to get hurt doing take after take of jumping from the sailboat into the life raft or being pulled laterally for 50 feet in a breath-hold stunt, the production would be in serious jeopardy. Regarding Redford, Zuccarini said, "He was the consummate professional, swimming an hour a day just to stay fit. To be honest, he's an inspiration for any working man. He's a movie star digging in with physical labor, giving a really convincing physical performance. He was dragged, rolled over and took more than a few bumps and bruises. The man was all in for this project."

— Stephen Frink

See the film's official trailer at *www.allislostfilm.com.*

KYLE WRIGHT

WATERLUST

Spreading the lust for our blue world

Water surrounds and is part of us all. It covers the majority of our planet and makes up a significant portion of our bodies. Humans and water share many connections — biological, physiological, economic, emotional and professional. This is the idea behind Waterlust, a dynamic online film series launched in 2011 that blends water-related science, sport and art.

Given the imperiled state of many aquatic systems worldwide, platforms such as Waterlust are an important means of communicating and inspiring an increasingly active online population. "It's all about impact," said Waterlust founder and creative director Patrick Rynne, a Ph.D. candidate in applied marine physics at the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS). "We're trying to inspire many people all over the world to take a moment out of their day to consider the importance of water in their life."

Sourcing content from scientists and adventurers around the world, the program is run by Rynne along with fellow marine-science graduate student Fiona Graham and RSMAS alumna Jennah Caster. The current lineup of 22 short films was produced by eight self-taught filmmakers, and every sequence of the one- to five-minute-long videos was captured with GoPro cameras, the seemingly ubiquitous and magnificently useful adventure cameras.

"We always joke about how we don't identify ourselves as filmmakers in the classical sense," Rynne said. "We're scientists and adventurers who bring cameras along for the ride. That's the beauty of GoPro cameras — you can get out and do your thing without the equipment getting in the way. The result is a very genuine and intimate perspective of whatever is being captured."

The films, however, are anything but amateur, and they tell an astonishing variety of stories. Some highlight the appreciation that ocean athletes such as surfers and kiteboarders have for their medium, while others reveal the perspective of marine scientists and reflect their personal connection to their subject, whether it's sharks or ocean currents. What unites the Waterlust videos is a fresh and epic style that plays out as a rapid yet memorable audiovisual adventure served with a dash of adrenaline and grandeur.

JENNAH CASTER

So far, Rynne and company's recipe at Waterlust has been working, garnering hundreds of thousands of views worldwide, grabbing the attention of GoPro and earning screenings at some of the world's top film festivals. Perhaps most important, the series has the potential to engage people who may not already be part of the movement to preserve the marine environment.

"That's really the challenge we're trying to make headway on," Rynne said. "If you're standing in a room giving a lecture or a talk about environmental issues, there is a good chance that the people in your audience already care about it. The fact that they are even there tells you that, so we're trying to chase down the people who aren't in the room and get them thinking."

Environmental and ocean literacy are desperately needed, and promoting them can be exciting and fun. That's a central tenet of the Waterlust mission, and it's a formula that's gaining attention as more scientists realize the need to broaden their impact and communicate to the public. There are amazing stories happening in our oceans every day, and Waterlust is capturing and sharing them with the world.

— Austin J. Gallagher

Learn more at *www.waterlust.org.*
See the films at *www.youtube.com/waterlust.*


ANDY SALLMON

Southern California Strandings

California sea lions face a mysterious crisis


ANDY SALLMON

While it's not clear why there has been a recent spike in malnourished sea lion strandings, residents and veterinary professionals are rallying to the animals' aid in the hopes of seeing more happy and healthy sea lions frolicking in the surf.

Kneeling on the floor of the animal-care center surrounded by barking patients, I was reminded of veterinary school — with one major difference. The pens here were filled not with dogs but with pinnipeds. Dr. Richard Evans, the veterinarian for the Pacific Marine Mammal Center (PMMC) in Laguna Beach, Calif., knelt beside me and examined a 28-pound California sea lion nicknamed O'Brien. A local resident had discovered the exhausted and shivering young sea lion near the shoreline and had contacted the PMMC rescue team. The little pup was critically malnourished; extreme nutritional problems are difficult to overcome in such a young animal. It was unlikely O'Brien would survive.

A glance at the PMMC's busy staff and full pens revealed the extent of the well-publicized crisis. Early in 2013, marine mammal rescue operations throughout Southern California began reporting record numbers of California sea lion strandings. The California Marine Mammal Stranding Network, for example, reported 293 strandings in Orange County between January 1 and March 31, 2013, compared with a total of 20 during the same period in 2012. Affected animals were almost exclusively pups born in 2012, and they were nearly always emaciated and dehydrated, many fatally so.

This was not news to avid Southern California divers, many of whom had witnessed exhausted pups hauling themselves onto dive-boat decks at sites miles from shore or watched lifeguards sadly remove dead pups from beaches. Nor was it surprising to coastal residents from San Diego to Santa Barbara; they had been inundated with broadcasts about homeowners discovering starving pups on their property.

Marine mammal organizations in the area were quickly overwhelmed. At the peak of the crisis, the PMMC housed an overwhelming 167 patients and had reached their absolute limit. The staff was regularly working 16-hour shifts, and volunteers from the U.S. Navy Marine Mammal Program were donating their time to help feed the recovering pups.

While it was clear to conservationists, government officials and residents that something abnormal was happening, the reasons for the situation were unclear. According to the website for the National Oceanic and Atmospheric Administration (NOAA) at the time of this writing, the reasons remain uncertain. No infectious or toxicologic (including radiologic) causes have been publicly identified, and no other marine mammal species appear to be affected.

Population increases in California sea lions (NOAA estimates a steady year-to-year increase of 5.4 percent) don't seem to account for such a massive single-year increase in strandings. Although sea lion populations have experienced abrupt, precipitous declines in El Niño years, the 2013 incident did not correspond with a declared El Niño weather phenomenon. Still, the most obvious scapegoat is environmental factors. Food shortage seems likely to be a major component: A 39-year investigation by the Scripps

Institute of Oceanography recently determined that there has been a substantial decrease in Southern California coastal fish numbers among both fished and nonfished species; the study concluded that an oceanographic climate alteration may be to blame.

A combination of factors could also be at play. Recent research examining Galapagos sea lions suggests that compared with pinnipeds in the wild, pinnipeds affected by human populations can exhibit a greater decline in body condition when they need to mount an immune response, a relationship that could quickly become extreme when fish are hard to come by.

Adding to the issue's complexity is some residents' view that simply investing time, money and effort into determining the cause of the stranding crisis can oppose natural selection. Others argue that human interference could have a negative impact on the food supply of sharks and other predators.

No matter the reason for the crisis or the "right" thing to do, the veterinarian in me felt a rush of joy when four months after my initial visit the PMMC invited me to witness a special event: O'Brien, the skinny pup who faced such a bleak outlook at his rescue, was ready to be released. Now weighing 86 pounds, he was not only eating well on his own, but also adroitly competing for fish. I watched in elated, hopeful silence as a volunteer raised the cage door and O'Brien headed for the surf — a fat, brown blur racing across the sand to dive into the Pacific.

— Allison Vitsky Sallmon, DVM

A barracuda cruises past the wheelhouse of the USS *Spiegel Grove*.

TIM GROLLMUND

The Evolution of a Shipwreck

What happens when 9,000 tons of steel hit a sandy bottom less than a mile from a coral reef in the nation's preeminent marine sanctuary? There's a high probability of a world-class dive site, which will enhance tourism. But what about all the fish and invertebrates that make the wreck their home? Where do they come from? Does the wreck alter the concentration of native marine life on nearby natural reefs? Are the fish on a wreck congregated and therefore easier to catch? Important questions such as these are central to any discussion of the liabilities and benefits of artificial reefs.

In 2002 the USS *Spiegel Grove* was placed on the seafloor of the Florida Keys National Marine Sanctuary about 6 miles east of Key Largo, becoming (at the time) the world's largest intentionally sunk artificial reef. Sitting in 130 feet of water, the 510-foot-long ship is now a mecca for wreck divers the world over. The wreck rested on its starboard side for three years before it was fully righted by storm surge during Hurricane Dennis. This was the blank slate that Reef Environmental Education Foundation (REEF) had to work with when it was commissioned to survey the recruitment of life onto the wreck. REEF's surveys began prior to the sinking to establish a baseline of life on the sandy seafloor and along nearby reefs. REEF continued monitoring the *Spiegel Grove* for five years after it was sunk.

Unsurprisingly to wreck-diving enthusiasts the *Spiegel Grove* now hosts an incredible diversity of marine life. More than 144 species

of fish have been documented on the wreck including commonly seen bluehead wrasses, bar jacks and great barracudas, as well as more rarely spotted longlure frogfish and unicorn filefish. Federally protected goliath grouper and large cubera snapper are becoming ever more common.

REEF was also tasked with determining how native fish assemblages on nearby natural reefs respond to such a massive structure being situated just a few hundred yards away. Previous studies on smaller artificial structures demonstrated that such structures may aggregate fish from surrounding areas. This is significant in terms of marine-life management, for if fish are spread out in low densities over a large area they may be harder to catch. Consolidated on a wreck, however, they may be easier to catch and thus be lost in greater numbers. While marine life in the Upper Keys has been protected from spearing for decades, hook-and-line angling is permitted on this wreck, and therefore fish are vulnerable. Yet REEF data suggests that the *Spiegel Grove* actually provides a net increase in fish abundance without significant migration away from nearby natural reefs.

One reason for the increase may be the sheer size and complexity of the wreck, which provides habitat that may be more hospitable for some species than the surrounding natural reef. Another unintended consequence working in favor of abundant marine life may be the fact that so many divers use the wreck that it's difficult for fishermen to find an open space to drop a line. With eight mooring buoys running the length of the wreck and estimates of tens of thousands of divers visiting the site each year, its sheer popularity may be establishing it as a de facto marine protected area.

Key Largo is no stranger to ships as artificial reefs. Since the time of the Spanish exploration, countless ships have grounded and sunk in the Florida Keys. More recently, in 1987 the U.S. Coast Guard cutters *Bibb* and *Duane* were intentionally placed as dive sites. The *Duane*, which sits upright like the *Spiegel Grove*, has been down for nearly 30 years, and the World War II casualty *Benwood* has been down since 1942. Each hosts large schools of fish, diverse macro life and colorful sponges. The assemblages of marine life at these wrecks are much more complex and mature than the 11-year-old assemblage on the *Spiegel Grove*. But the currents sweeping the *Spiegel Grove* have brought about rapid colonization of algae, sponges, corals and gorgonians. The chain of life is already well established on this reef of steel.

— Lad Akins


TIM GROLLIMUND

The French angelfish is one of many species of reef tropicals that makes its home on the massive shipwreck.

For more information on the fish found on the *Spiegel Grove*, visit *www.reef.org/db/reports/geo/TWA/34030038/* or view the five-year report at *www.reef.org/reef_files/monitoring/SpiegelGrove_5year_report.pdf*.

DAN® MEMBER PROFILE

NATHAN MYHRVOLD

HOMETOWN: Born in Seattle; grew up in Santa Monica, Calif.; now resides on Lake Washington, Bellevue, Wash.
YEARS DIVING: 16
FAVORITE DESTINATION: "Raja Ampat so far, but I'm having fun looking for more."
WHY I'M A DAN MEMBER: "I like *Alert Diver*. I like being informed. I like the insurance and emergency services I hope never to use"

Nathan Myhrvold prepares to take a series of underwater photos.

CAMERON MYHRVOLD

Ace of All Trades

There is a hazard to reading the curriculum vitae of Nathan Myhrvold: It may make one feel like a comparative slacker. First there are the degrees — a bachelor's degree in mathematics from the University of California, Los Angeles; a master's degree in geophysics and space physics from the University of Southern California; master's degree in mathematical economics and a doctorate in theoretical and mathematical physics from Princeton. Then there is the post-doctoral fellowship at the University of Cambridge working with Stephen Hawking on quantum-field theory in curved spacetime and theories of gravitation.

Myhrvold also is the author of *Modernist Cuisine: The Art and Science of Cooking*, which was recently hailed by *Forbes* magazine as "the world's most influential — and profitable — cookbook." This 2,438-page, six-volume set is lavishly illustrated with Myhrvold's own photographs; it weighs 43.5 pounds and costs $625. Self-published, using the best paper Myhrvold could find and at the highest production value possible, his relatively modest initial pressrun of 6,000 copies has now grown by tens of thousands in additional reprints and grossed $30 million. Plus it's the first book of a trilogy — the comparatively slender, 456-page *Modernist Cuisine at Home* has now printed in the range of 100,000 copies, and the coffee-table book *The Photography of Modernist Cuisine* is coming soon. Despite his achievements as an author and chef (he has been a celebrity judge on *Top Chef* and won the World Championship of Barbecue in 1991), it his primary career track that is most inspiring.

Following graduation Myhrvold founded Dynamical Systems, which Microsoft acquired in 1986. That was the springboard for a 14-year career with Microsoft as chief technology officer, during which time he founded Microsoft Research. Today he is the founder and chief executive officer of Intellectual Ventures, a company that creates, funds and commercializes inventions. He personally holds 328 patents on topics ranging from digital displays and 3-D graphics to surgical staples and genomic selection and has another 859 patents pending (at the moment). Much of Intellectual Ventures' work is aimed altruistically at the developing world and includes technology that uses lasers to zap malaria-carrying mosquitos, advances to keep vaccines cold and viable in sub-Saharan heat and work to mitigate health hazards from HIV and influenza. Intellectual Ventures was among the top-10 patent generators in the United Sates last year, and it maintains the world's largest patent portfolio.

It was a love of diving and photography that brought Myhrvold to the DAN® community. He has been interested in photography his whole life. He bought his first camera, a $2 Contax rangefinder he stumbled across at a Salvation Army store, when he was only 9 years old. He had his own darkroom growing up and was a passionate advocate of Ansel Adams' zone system for black-and-white photography — a means to

Shrimp on soft coral, Raja Ampat

NATHAN MYHRVOLD

extract the ultimate in contrast and tonal scale from a negative by means of selective processing and printing to control highlights and shadow detail. He experimented with large-format cameras, including a Deardorff 5x7 field/view camera, but as you might expect from a mind nimble in both technology and creativity, he was an early and eager convert to digital photography.

Instead of underexposing and overdeveloping, or employing any of the other myriad tricks of the analog age, Myhrvold embraces what modern cameras and computers can do with an image. He speaks to the challenges of dynamic range in his typical analytical way: "Dynamic range is the term for the difference between the lightest part of the picture and the darkest. A typical outdoor scene may have a ratio of light to dark of 4,000:1 — the bright parts are 4,000 times brighter than the dark parts, but scenes can easily go higher than that, up to 1,000,000: 1 if you have a dark shadow in one corner and the sun itself in another. Human eyes have an automatic system that compensates for this, allowing us to see both bright highlights and dark shadows simultaneously. Not so with cameras. Analog color film typically has a dynamic range of 32:1, or five f-stops (one f-stop difference is a factor of two in illumination). Digital cameras are a little bit better at about six to maybe seven f-stops, or 64:1 to 128:1, or maybe a little more. A lot of the problem of picture taking is how to stuff 4,000:1 dynamic range into the much smaller range of the sensor." That is the kind of background noise that passes through his amazingly active mind with every click of the shutter.

His immersion in scuba diving came a bit later. The inspiration was that of so


NATHAN MYHRVOLD

many of us: the televised 10-year run (1966-1976) of *The Undersea World of Jacques Cousteau*. Myhrvold was only 11 when the series began and was a college student by the time he was 14, so it might seem unlikely that this would provide lifelong inspiration. Yet so active was his imagination the fantasy of underwater exploration never left him. These documentaries provided the spark that finally ignited decades later when he convinced some of his friends at Microsoft to go to Hawaii and get certified. He already had a housed Nikon camera at that time, which he had used while snorkeling in the Galapagos and elsewhere. But finally being certified allowed him the luxury of time — unhurried access to marine life and an opportunity to perfect his underwater photo techniques.

Myhrvold contends the two most compelling reasons for underwater photographers to shoot digital are being able to acquire more than 36 images per dive and the fact that immediate review is such a powerful educational tool. He considers the prompt feedback cycle of digital photography instrumental in accelerating the learning curve for so many people so quickly — to the extent that there are a plethora of extraordinary marine images floating in cyberspace these days. The opportunity to create is now much greater than in the film era, when one had to be consciously committed to underwater photography as a function of expense and degree of difficulty.

Enhanced technology and pervasive access to imaging tools (with even smartphones being adapted to underwater use) coupled with the ease of transmitting and sharing images, underwater photography now is in a period of renaissance. That's not to say Myhrvold has been willing to compromise in quality just because easy imaging solutions are out there. He still travels the world with several bulky Canon DSLR camera bodies and a variety of underwater housings, ports, accessory viewfinders and strobes that further encumber his dive trips.


NATHAN MYHRVOLD

The six-volume set of *Modernist Cuisine* is one of the most successful cookbooks ever published.

Right: **Myhrvold as chef.**

Opposite, from top: **Gobies on gorgonian, Raja Ampat; manta ray in silhouette**

CHRIS HOOVER

COURTESY NATHAN MYHRVOLD

Myhrvold has been profiled in a variety of media for a variety of reasons. Early in our acquaintanceship I recall passing through an airport and seeing his name in a cover line of *Men's Journal*, "How a Geek Grills a Burger." I purchased the magazine to read on the plane and discovered beyond our shared love of underwater photography his interests are astonishingly eclectic. Trying to drill down past the patents, paleontology (he is a *Tyrannosaurus rex* aficionado), diving and countless other pursuits to cooking, the authors were challenged by his diversity of interests. "But we're not here for the dinosaurs — or to review what Myhrvold learned studying astrophysics with Stephen Hawking or to discuss his Formula One race-car period or the bungee jumping or nature photography or scuba diving or spelunking or fly-fishing. We're in his vast and brightly lit laboratory, surrounded by glass beakers and humming machines, to talk about food. And not just food but, in fact, molecular gastronomy, the avant-garde approach to cooking that uses chemistry and technology to invent novel, even ludicrous, edible creations."

As they discovered, there is no single dimension or descriptive to contain the essence of Nathan Myhrvold, and we can expect this renaissance man to further evolve.

— Stephen Frink

ONLINE VIDEO SERIES

REMOTE MANAGEMENT OF DCS: AN OVERVIEW

Sometimes decompression sickness (DCS) occurs in remote areas, where treatment options and local expertise may be lacking. Could you recognize the signs and symptoms of DCS and determine an appropriate course of action? Nick Bird, M.D., MMM, presents a usable description of DCS, diagnostic criteria and treatment options for remote settings in his presentation "Remote Management of DCS." He also addresses important factors that may help guide decisions about treatment versus evacuation. Watch the video at *DAN.org/onlineseminars*.

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As an exclusive benefit of your DAN membership, you have access to iJET's Worldcue® Planner, an online global-intelligence resource that provides comprehensive safety and security information for more than 180 countries and 200 cities around the world.

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CALENDAR OF EVENTS

DIVE SHOWS AND EVENTS

OUR WORLD-UNDERWATER

Feb. 14-16, 2014; Rosemont, Ill.

Join DAN for seminars, safety discussions and first-aid training programs at the Midwest's largest dive expo. Stop by the DAN booth to try your hand at the CPR Challenge, a hands-on scenario that will test your skills. Top challengers will take home a special safety prize.

OUTDOOR ADVENTURE SHOW

Feb. 21-24, 2014; Toronto, Ontario

Join fellow outdoor-adventure enthusiasts at Canada's 8th-annual showcase of gear and adventure travel opportunities. If, like many divers, you also enjoy hiking, biking, climbing or paddling, you won't want to miss this show. Discover new destinations and the gear to get you there.

RESEARCH/MEDICAL EVENTS

DIVE SAFETY SEMINARS

Dec. 4, 2013, 7 p.m.; Durham, N.C.

Niles Clarke will present "Practical Strategies to Manage Decompression Risk" in a special evening safety seminar at DAN headquarters. This session will consider practical factors that affect decompression risk and the science behind each of them. It will also provide tips to help divers proactively manage decompression risk.

For a full listing of events or to register for a DAN Education program, visit *www.DAN.org/events*.

EDUCATION SPOTLIGHT

DIVING EMERGENCY MANAGEMENT PROVIDER

It's uncommon for emergencies to be single events; more often they're outcomes of several small problems compounded. The DAN Diving Emergency Management Provider (DEMP) course is perfect for people interested in learning to provide first aid for a variety of scenarios. DEMP integrates the core content of the four essential DAN first-aid training programs into a single course, maximizing learning opportunities while minimizing time commitment.

The DEMP course combines the following DAN courses:

- Basic Life Support: CPR and First Aid
- Emergency Oxygen for Scuba Diving Injuries
- Neurological Assessment
- First Aid for Hazardous Marine Life Injuries

After completing the skill- and knowledge-development portions throughout this program, you will bring together what you learned using mock scenarios. You will leave feeling prepared and empowered to respond to a crisis. Contact a DAN Instructor near you for a course schedule.

ENCOUNTERS

Tough Neighborhood

TEXT AND PHOTOS BY NED AND ANNA DELOACH

Squinting, I can just make out individual skeleton shrimp clinging to a hydroid bush. They are part of a colony of hundreds, with the largest measuring no more than a half-inch long. Knowing that Anna shares my appreciation for such weird creatures, I motion her over, and we settle in for a stay.

There's little wonder we are so captivated. Skeleton shrimp are oddities with attitudes, appearing both primitive and futuristic, toylike and menacing at the same time. Think of a thousand praying mantises in miniature or, better yet, straw-thin robots on speed armed with claws that would make a lobster envious.

The first to catch our eye are the larger males stampeding through the colony like motorized inchworms looking for someone to wallop. But underlings don't cower from such bullying; they strike back with a whirlwind of blows. Without question, if skeleton shrimp were quadruple their size they would rank among the most popular attractions in the sea.

Everything about skeleton shrimp is unconventional. For starters, they are not shrimp at all. They belong to an entirely different order of crustaceans, amphipods, but they don't really resemble others of that lineage either. In fact, their peculiar morphology doesn't fit comfortably anywhere. You have to burrow deep into their classification, passing through suborder, infraorder and something called the parvorder before you finally arrive at family Caprellidae, into which a head-scratching taxonomist back in the 1800s stuck them along with whale lice, which bear little resemblance to their supposed next of kin.

Although skeleton shrimp are tiny and inconspicuous, divers willing to make the effort can usually track them down. They inhabit most inshore waters around the world. During the summer, they can be prolific in seagrass and on dock pilings and mooring lines along both coasts of the United States and into Canada. In Indonesia we typically find them on hydroids, sponges, gorgonians and algae, but they occasionally gather in unexpected places. In the Gulf of California we found them living on the heads of scorpionfish, and we have heard tales of them taking up residence on frogfishes, sea stars and nudibranchs.

Above: **Skeleton shrimp portrait.**

Right: **Skeleton shrimp mothers carry their young until they are ready to fend for themselves.**

Wherever there are colonies, there are big males controlling the high ground, where the hunting is best. The shrimps' primary prey is a tiny crustacean they pluck from the currents with their claws, but if given the opportunity they won't hesitate to tackle bigger game. One night Anna's video lights attracted a whirlwind of planktonic worms to a colony she was photographing. In the blaze of her beam, a male skeleton shrimp snagged a worm several times its

size and wrestled with it for more than a minute before the monster finally broke free.

Small, short-lived animals such as skeleton shrimp are particularly susceptible to boom and bust cycles. From the look of things, the colony we are investigating is approaching its population zenith and heading for an inevitable crash. Such trying times bring out the worst in any animal, and skeleton shrimp have a lot of worst to bring out. Predictably, much of the animals' bad behavior revolves around sex.

Like other crustaceans, females become reproductively active immediately following a molt. The process produces pheromones that drive the males wild. There is no courtship for these bad boys; the right to pass on genes is settled by a winner-take-all round of fisticuffs. The stakes are high — a well-placed claw can slice an opponent in half — and to add to the peril, each claw is tipped with a poisonous spine capable of inflicting a fatal wound. The last male standing moves fast, helping strip away the female's old exoskeleton in its haste to spawn.

Contrary to the majority of marine creatures, which release thousands of immature larvae into the open sea during a single spawn, skeleton shrimp — ever iconoclasts — take the less-traveled path, producing a small number of offspring that require extended care. Among the mass of bodies on the hydroid we can make out what appear to be balls of fuzz. As we lean closer, the fuzz becomes the limbs, claws and antennae of several dozen babies clinging to their mother — each an exact replica of its parent.

From the moment hatchlings emerge from the brooding pouch and clamber onto their mothers' backs they are under siege. And from what we can see, the tykes need protecting. Baby-toting females, far from pushovers, fight like banshees to safeguard their offspring. Surviving juveniles grow rapidly, passing through several molts before they are ready to fend for themselves. It seemed fitting that toward the end of our dive Anna noticed a mother flinging her mature babies off her back with the coldhearted demeanor one would expect of a skeleton shrimp. AD

DIVE FITNESS

The DAN Guide to Healthier Diving

Natural Movement

TEXT BY JESSICA B. ADAMS, PH.D.
PHOTOS BY STEPHEN FRINK

A variety of natural-movement exercises have recently entered mainstream fitness. In the fitness industry the exact definition of *natural movement* ranges from activities and movements that occur between the body and the natural world to multijoint exercises that can be accomplished using traditional weights.

Most natural-movement professionals agree on a scientifically sound premise: The exercises require that several large muscle groups work together to perform a task through a full range of motion. Most exercises are completed at various levels in three-dimensional space (in contrast to the single-plane movements of traditional weight machines). Large muscle groups working together performing movements in multiple planes is inherently life-specific training. This sort of training prepares your body for the activities of daily living — in addition to the joys of the dynamic underwater world.

Many of these movements may feel anything but natural at first. The exercises are natural only in the sense that your body once had — perhaps many years ago — the aptitude to develop these skills. The unfortunate truth is that in modern society few of us have the opportunity to physically reach our full potential unless we take the initiative to prioritize our fitness.

Train smarter, not harder. The images shown in this article illustrate a substantial range of motion for each exercise. Do not try or expect to reach this range during the first day, week or even month of doing the exercise. Full range of motion is a long-term goal. The key is to be patient, pay attention to your body and gradually increase mobility. Your muscles work together to develop strength through an increasing range of motion, which amounts to improved flexibility. It is not smart to "push through the pain"; gradual progression is a fitness principle that yields long-term results with minimal risk. If at any point you feel pain, take a break, reassess and adjust your form, or move on to a different exercise.

Attempt to complete the stated number of repetitions for three or four rounds, depending on your training state and the amount of time you have available. Remember, every repetition counts, so if you have time only for a single round, that's better than nothing. Initially you may need breaks between rounds, but as your training progresses, you will complete the exercises through a greater range of motion at a faster (yet still controlled) pace with less rest in between.

The exercises purposely alternate between low and high levels to make you get up and down between exercises. You may feel slightly light headed when you transition from low to high, so transition slowly until you feel comfortable. Focus on how you feel, and always listen to your body.

DEEP AIR SQUATS (20 REPETITIONS)

These are traditional body-weight squats. A full-range deep squat is shown, but your full-range squat may be just a quarter of that range of motion. Descend as low as you feel comfortable. If you pay attention to your body, each time you do the routine your comfortable range of motion will slowly but surely increase.

1. Start in an athletic stance with your feet shoulder-width apart (or slightly wider) and your toes pointing slightly outward.
2. Flex (bend) your knees and hips simultaneously while consciously pushing your rear end back and down.
3. Keep your eyes toward the horizon, and push through your heels to minimize stress on your knees while maintaining the natural curve of your spine.
4. Fully extend your hips through their full range of motion in a controlled manner at the end of each repetition.

Tips:

- *Squats should not put pressure on your knees. If you feel any stress on your knees, you probably need to lift your chest higher.*
- *Squats should not put pressure on your lower back. If you feel any stress on your lower back, you are probably focusing your eyes too high in the sky.*
- *Adjust until each repetition feels right.*

BEAR CRAWL (10 FORWARD THEN 10 BACKWARD; REPEAT TWICE)

The bear crawl is not just for kids. It is a total body exercise that improves balance, flexibility and muscular strength throughout the body.

1. Begin in a quadruped (crawling) position with your hands and knees about shoulder-width apart.
2. Raise both knees slightly off the floor.
3. Move one hand and the opposite foot, keeping your hips and shoulders square with one another.

Tips:

- *Gradually increase the speed of the movement within your zone of comfort and control.*
- *Try not to raise your hips too high.*

TRAVELLING SQUAT (FOUR STEPS FORWARD THEN FOUR STEPS BACK; REPEAT FIVE TIMES)

1. Start in a low but comfortable squat position. Low is a relative term; listen to your body.
2. While holding this position, take four steps forward and then four steps backward.

Tips:

- *You may not be able to go as low as is shown in the photo. A low squat is a position in which your body feels comfortable. It's OK if your thigh muscles are uncomfortable, but any stress on your knees or lower back is unacceptable.*
- *Keep your weight on your heels. (You should be able to wiggle your toes.)*

CRABWALK (10 BACKWARD; 10 FORWARD; REPEAT TWICE)

The crabwalk is not just for kids. This is a total body exercise.

1. Start in a seated position on the ground with your hands slightly behind you.
2. Lift your rear end off the ground.
3. Travel backward for 10 steps and then forward for 10 steps.
4. Challenge: Add a kick with each foot prior to each change of direction.

Tips:

- *Try to keep your hips up — this will make the movement more challenging.*
- *Start slowly, and gradually increase speed as you become more comfortable with the movement.* AD

DAN NOTE

To avoid an increased risk of decompression sickness, DAN® recommends that divers avoid strenuous exercise for 24 hours after making a dive. During your annual physical exam or following any changes in your health status, consult your physician to ensure you have medical clearance to dive.

WHY NEWFOUNDLAND?

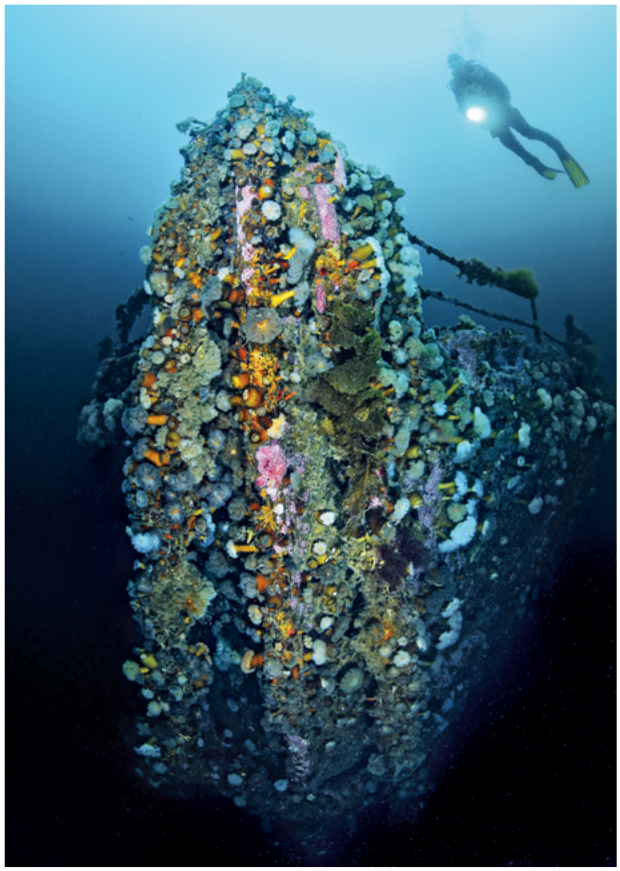
DIVING CANADA'S MOST EASTERN POINT

TEXT AND PHOTOS BY JOSEPH C. DOVALA

Night doesn't get much blacker than this, Korvettenkapitän Ruggeberg thought. He and his crew of the U-513 had just crossed the North Atlantic for their first war patrol. Conditions were now textbook perfect to use the steamer they were following to slip into the bay and sit out the dark night on the seabed.

Lying in the mud at 80 feet made for a restful night, but at 1045 hours the next morning, general quarters sounded, and Torpedoman Second Class Hans Grubber scrambled to his duty station. He felt like he did on his first date, complete with sweaty palms. He and his torpedo crew loaded both "fish" in record time, and he drummed his fingers nervously on the air-pressure lever. At 1107 hours Korvettenkapitän Rolf Rüggeberg gave the order to fire, and the ship-killing torpedoes were away.

An exploding torpedo sent one of the S.S. *Saganaga*'s anchors up onto its deck.



Clockwise from above: **Janine McMurdie explores the S.S. *Saganaga*'s encrusted bow; Joe Tezak at the engine-room telegraph on the S.S. *Rose Castle*; the propeller of scuttled ex-whaler S.S. *Southern Foam***

Twenty-four atmospheres of air pushed the 3,500-pound torpedoes out of their tubes — and they promptly sank to the bottom. In all the excitement of his first live combat action, Grubber forgot to switch the torpedo batteries from "charge" to "fire." The green crew of the U-513 *recovered quickly, however, and proceeded to sink the S.S.* Saganaga *and the S.S.* Lord Strathcona *on that day, Sept. 5, 1942. Two months later the* U-518 *under Friedrich Wissmann sent the S.S.* Rose Castle *and the* PLM-27 *to join their comrades at the bottom of Conception Bay.*

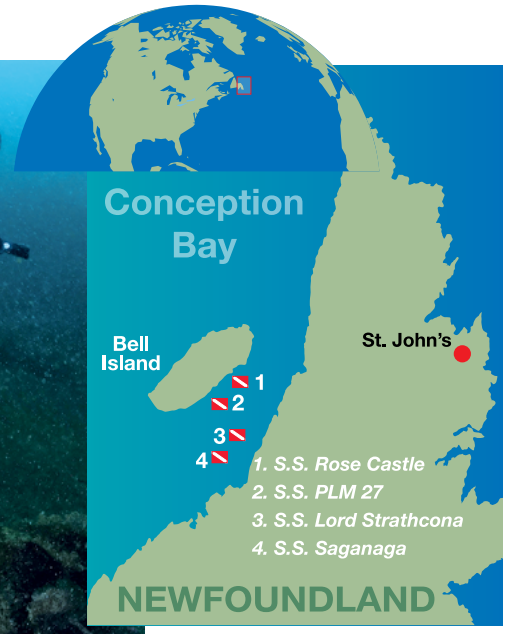
Despite these shipwrecks, Newfoundland doesn't come to many divers' minds when considering dive destinations. In fact, only a very few have braved the North Atlantic in these parts. My traveling companions and I really didn't know what to expect except mind-numbingly cold water. As it turned out, we would be as astonished as Grubber with our first visit.

Most of the diving — but certainly not all of it — is done at the southern part of the island near the city of St. John's. Enormous Conception Bay, which contains numerous reefs and other underwater treasures, lies nearby. Bell Island in Conception Bay is the home of what was once one of the largest iron-ore mines in North America. The 5.5-mile-long by 2-mile-wide chunk of rock drew the attention of German U-boats during World War II, and it's the resting place of the four ships mentioned previously.

Those four shipwrecks are the island's signature dive sites, and the remarkable degree of their preservation should not be missed. Despite some heavy damage that you'd expect of vessels sunk in war, much of the ships' equipment and bric-a-brac and even sailors' personal effects still exist in place. One reason they're so well preserved is the less-than-warm water in which they lie.

Our first dive was on the S.S. *Paris-Lyon-Marseilles*, or *PLM-27*. It's the shallowest of the four, and it's smothered with marine life. Its prop and rudder are intact, as is most of the stern. There we encountered our first lumpfish, and we all fell in love with the odd critter. It seems to be part frogfish and part puffer rolled into one, and there's an amazing sucker (adhesive discs) on its belly it uses for


Intact whale vertebrae at Dildo Harbor



hanging out. The *PLM-27* was one of the ships lost during the second attack in November 1942. It sank in less than a minute with 12 crewmen aboard.

The second dive took us to the S.S. *Saganaga*. A little deeper at 110 feet to the bottom, the *Saganaga* went down with 29 men in the September attack. It's even more coated with marine life, which includes vast numbers of metridium anemones, crabs, fish and colorful sponges. Of the wrecks in the area, the *Saganaga* also has the most deck swim-throughs, which make for a very three-dimensional experience, even without penetration.

Both the S.S. *Lord Strathcona* and S.S. *Rose Castle* are located in slightly deeper water but are consequently more intact. If you have the training and experience, the

HOW TO DIVE IT

CONDITIONS: The surface conditions are quite mild in the summer. Even when winds kick up they rarely make more than a small wind-chop on the bay. It's very much like the Pacific Northwest. Water temperatures are in the 40s (°F) for most of the summer; below 100 feet it's usually down into the 30s. The main diving season is from May through September, with the coldest water temperatures in May and June. Early in the season icebergs may drift into the bay, and, yes, divers can visit them. One year an iceberg brought a narwhal with it. Unless you're a polar bear, a drysuit and proper undergarments are a must. Currents are rare, and visibility can reach 100 feet (40-75 feet is normal). Air temperatures vary but range from the 50s to the 80s in the summer.

GETTING THERE: St John's is the point of entry for international visitors. Direct flights are few and mainly originate in the northeastern U.S. A small number of airlines, including United Airlines and Air Canada, service Newfoundland. The time difference from Eastern Standard is 1.5 hours ahead. Trekkers from the eastern provinces can drive here via the Trans-Canada Highway and a ferry ride.

ON THE SURFACE: If you come to Newfoundland in the summer you had better like water and the color green. There are literally thousands of miles of rugged, forested coastline and dozens of quaint fishing villages that seem almost frozen in time. But if you come expecting to find folks living in igloos, you'll be disappointed. St John's is a thriving modern city with some 200,000 people. Oil is the new "fishery," and the economy is booming. City delights include just about any type of pub or restaurant you can imagine. And because the city was founded in 1623, there's no shortage of historical landmarks, museums or unbelievable scenic overlooks. There are accommodations in the city proper, but most diving visitors stay in South Conception Bay, about 30 minutes away from St. John's.

Rose Castle provides almost limitless potential for penetration. The *Strathcona* is the only ship that did not suffer any casualties, as all managed to abandon ship before the torpedo struck. The *Rose Castle* lost 28 sailors.

One of the amazing things to see on these ships is the quantity of wood that is still in place — there are even intact hatches. These vessels have been down longer than the wrecks in Chuuk but are in much better condition. In addition to the cold temperatures, pillaging has been kept to a minimum out of respect for these gravesites. It's worth noting that the RMS *Titanic* rests only 350 miles away, so, yes, it's cold — but it's not as bad as we thought it would be. From around 60 feet and shallower you can expect temperatures in the mid- to upper-40s (°F) with the surface temperature in the mid-50s. On the deeper wrecks such as the *Rose Castle*, it can get down to the mid- to upper-30s deeper than 100 feet. As long as you're dressed properly, 40- to 50-minute dive times are quite possible. However, these are summertime temperatures.

Conception Bay is well protected, and flat water is the norm. Boat rides don't get much easier, and there are many shore-diving possibilities. We took advantage of a popular beach entrance in the fishing village of Dildo. This was one of the last whale-processing plants in Newfoundland, and an enormous whale graveyard is located just offshore in 50 to 80 feet of water. It's one of the sobering reminders of why this part of the world was settled to begin with. Whales here have it much better now, and snorkeling with humpbacks at the right time can almost be guaranteed. The boat rides are short, and whales are usually spotted immediately; you just have to find one or two that want to play. Slowly swimming with these gigantic marine mammals as they watch you intently is truly something to cherish.

Our group was unanimous in wanting to come back as we felt we hadn't even scratched the surface of what's available. On some of our shore excursions we could see stunningly clear secluded coves and reefs just begging to be explored. The accommodations, dive boat, and crews of Ocean Quest Adventures were top notch. Yes, the water is cold, but the different marine life, authentic ship wrecks and warm, generous people go a long way toward balancing the need to pack a drysuit. AD

LIFE AQUATIC

THE SYMPHONY OF

Over the past few millennia, humans have spent countless hours listening to rhythmic and melodic compositions; but there is music in nature, too. The natural din that emanates from a pristine environment can be — like man-made music — discordant, soothing or rousing. Environmental soundscapes may go unnoticed, but they can reveal purpose and meaning if listened to carefully.

The sporadic calling of birds, the snapping of shrimp or the whine of cicadas is not just meaningless background noise. Research conducted in the past 50 years indicates that the racket made by animal populations has evolved to facilitate communication, navigation, reproduction and hunting. Evidence acquired within the past two decades points to sound being essential to the survival of many organisms — particularly those that dwell underwater.

Sound is basically an energetic pressure gradient that sets in motion molecules of the conducting medium. The pressure gradient pushes together surrounding molecules and then allows them to settle back into their original positions as the gradient (noise) moves past. Water is much

Sound travels farther and faster in water than in air, so countless marine organisms have evolved to produce and detect it. The constant cycle of life and death on coral reefs plays out amid a rich cacophony.

TEXT AND PHOTO BY ETHAN DANIELS

THE REEF

denser than air, and thus sound generally passes far and fast through it — five times faster than through air.

ANGLING FOR AN ADVANTAGE

Beneath the lapping waves, and typically unnoticed by humans, a variety of marine organisms employ complex organs to both create and distinguish sounds. The perception of noise underwater is not necessarily a simple thing, but since sound travels so efficiently underwater, numerous marine creatures have developed methods of sensing it. In generation after generation, all sorts of marine creatures have gained reproductive advantages from beneficial mutations that promoted the creation of or sensitivity to sound. Invertebrates, fish, reptiles and mammals in marine environments have a variety of methods for sensing vibrating water molecules, and, just as important, they've developed important adaptive reactions.

Some species' sensory organs are similar to those seen in humans. Specialized cells called neuromasts on the lateral lines of fish, for example, have nerve structures much like those found in mammals' cochleas, the auditory portions of the inner ears. Other organisms have evolved distinctive structures; fish use swim bladders to generate noises, and mollusks, echinoderms, crustaceans and cnidarians can detect sounds using balance sensory receptors called statocysts.

A RAUCOUS SOUNDSCAPE

Any diver who listens attentively knows the ocean is not the hushed and still environment it may appear to be. Waves, thunder claps, howling wind and rain create a clamorous natural backdrop. Tides and currents resonate as they sweep across coral, sand, kelp or rocky bottoms. Rumbling volcanoes and seismic events add to the acoustic milieu. Include the countless sources of biological noise in the sea, from miniscule crustaceans to the world's largest beasts, and the ocean becomes a raucous soundscape of natural music.

On a healthy coral reef, fish of all shapes, sizes and families grunt, grind, sing and scrape to manufacture sounds used to delineate territory, form bonded pairs and hunt. More than 1,000 species of fish make and use sound in one way or another. Crustaceans make noise for defensive and, possibly, courtship purposes, but the unknowns far outweigh the data. A variety of crabs, lobsters, shrimps and other crustaceans have developed noise-making capabilities as diverse as those employed by terrestrial insects.

The crackling made by barnacles as they open and close and move their articulated appendages can be detected for miles. The predominant sound coming from coral reefs is the incredibly loud popping of tiny bubbles (cavitation) generated by hordes of small snapping shrimp for hunting and communication. Mussels can produce sound by stretching and breaking the byssal threads that attach them to the substrate. Urchins have been observed making crackling noises by clicking their sharp spines as they move. This crackling can also be caused by the urchin's test (the shell surrounding its body cavity) rubbing against its Aristotle's lantern (feeding apparatus).

USES OF SOUND

Over the past 20 years marine scientists have employed listening technologies originally developed by the military. With these previously classified instruments and methods, researchers have been able to sample biological soundscapes throughout the marine environment; however, the natural compositions have not been easy to decipher. Singing whales, courting fish,

unexplained ticking and humming, rumbling, grinding, groans and thuds can all be heard as marine species live, hunt, bond and procreate. But massive gaps persist in our understanding of the meaning of these sounds and their ecological role. The importance of sound to individuals, populations and entire communities of marine life remains largely unknown.

One poorly understood aspect of biological sound in the sea is marine organisms' auditory perception. We don't know the extent of the marine creatures that are adapted to use sound in one way or another. Fish such as groupers may use noise to establish territory for hunting or to attract mates. Schooling fish such as bigeye trevally use sound to synchronize the swimming patterns of the school and, perhaps, for navigation.

It is now known that the larvae of many fish and invertebrates employ sound as a navigational tool for finding the appropriate habitat in which to live out the next phase of their lives. Some organisms that incubate on reefs may imprint on reef noise; in others the attraction may be innate. Anemonefish spend their larval phase in the open sea far from reefs. On the verge of metamorphosing into their brightly colored juvenile forms, drifting anemonefish larvae detect the dissonance of noisy reefs, and they vigorously swim toward the nearest or loudest.

Recent studies have also led scientists to believe that reef fish have the ability to use underwater sounds coming from different habitat types to guide their nocturnal movements. Some nocturnal fish feed in deep, dark waters at night but return to the protective confines of coral reefs as day breaks. The acoustic differences among habitats may cue the fish to return to their preferred microhabitat during twilight hours. New data have also shown that minute coral larvae (planulae) can distinguish noises generated by bustling reefs. The sounds attract the larvae, which swim, using cilia, toward an appropriate settling site on the reef.

SIGNS OF LIFE

In the past few years marine scientists have discovered that the healthiest reefs, which concentrate the most life in a given area, are also the noisiest. These noisy reefs may act as magnets, attracting more fish and invertebrate larvae than less-diverse reefs nearby. Pelagic species, which spend their adult lives in deep, open water, can detect the noise of boisterous reefs as well, but they actively avoid the reefs, preferring the feeding grounds of the open ocean.

A study performed at three well-managed marine protected areas (MPAs) in the Philippines found that the MPAs are significantly louder than overfished reefs where algae and urchins dominated. It appears that fish and invertebrates are probably able to locate reefs using sound as well as discriminate between the quality of thriving and damaged reefs. As the field of marine-soundscape ecology grows, more surprises emerge.

Arthur Myrberg of the University of Miami noted, "[S]ound production is important in the lives of fishes, and it is possible that we humans may be able to make use of that information as well." Several years ago scientists from the U.S. National Oceanographic and Atmospheric Administration (NOAA) and the University of Hawaii developed the Ecological Acoustic Recorder (EAR), which records the sounds of coral reefs. The hope is that EARs can demonstrate the disparity between healthy and stressed reefs and make for an inexpensive monitoring method. EARs might also contribute to identifying and managing spawning aggregation sites, since many commercially valuable species generate sounds in the course of reproduction. Whether this technology will be an effective, unobtrusive and inexpensive means of keeping tabs on the world's reefs remains to be seen.

HUMAN NOISE

It is now known that for at least some and maybe most marine life, sound is essential to livelihood. This fact should be incorporated into the development and management of fisheries and other marine resources. Because such a wide variety of creatures adapt to their surroundings through sound perception, it is likely that anthropogenic noise has a greater impact on the ocean environment than previously supposed.

It is difficult to determine the impact of human sound on marine ecosystems since its immediate effects go unseen. Accounting for soundscape ecology in the design of future technologies could drive the development of acoustic transducers (used for oceanographic, defense, geophysical and marine-life applications) toward more sensitive receivers rather than more powerful transmitters. This same approach could also be applied to seismic exploration, which involves the use of low-frequency sounds to probe the geology of the deep seafloor. Noise generated by the next generation of commercial vessels could be reduced through the use of anti-fouling technologies applied to hulls and low-cavitation or noncavitating vortical drives in place of today's loud, high-cavitation propulsion systems.

Biological sound undoubtedly conveys an extraordinary volume of information in marine ecosystems, and it's only beginning to be understood; the purpose of most of it remains a complete mystery. Phillip Lobel of Boston University is one of the world's experts on fish bioacoustics. His startling prediction is that "future research will find fish matching the complexity of communication we see in birds." Cracking the codes in marine-life clatter may help illuminate the evolution of communication, hearing, mate detection and territory defense, but at present all this remains speculation.

Far from being a place of placid silence, the wet world below the waterline is a magnificent concert hall filled with rich, meaningful and evolving biological music that researchers hope to understand more fully. AD

RESEARCH, EDUCATION & MEDICINE

Banggai cardinalfish brooding
Anilao, Philippines
By Mike Bartick

Just Another Day at the Office

STEPHEN FRINK

BY MEGHAN K. MACCOLLUM

What started as just another routine day at my favorite Florida Keys dive site ended with a five-hour hyperbaric-chamber ride at Mariners Hospital in Tavernier, Fla. As a recreational diver for 15 years and a dive professional for three, I've been through all the required training, I've read and reread the manuals, I read *Alert Diver* and several other dive publications, and I do my best to learn from others' mistakes. I consider myself a conservative and prudent diving instructor, but I still wound up in the chamber after two relatively shallow dives.

That day my job was to guide eight certified divers on two easy reef dives. Knowing that the group consisted of novice divers, I gave an extensive briefing on the way out to the reef and another quick one to reiterate the safety protocols just before we were ready to splash. I instructed the divers to do weight checks while holding onto the tagline, as there was a moderate current running on the surface. If they were properly weighted, they were to descend into a sandy bowl under

the boat and wait for me there. Four of the eight followed instructions and patiently awaited my descent.

One buddy team had let go of the line during the weight check and was now drifting away. Then, as the last pair entered the water, one of them went into full, active panic — regulator disregarded, mask thrown, thrashing and climbing onto me to stay afloat. "I'm going to die! I'm going to die!" he said over and over. I responded as I was trained to, inflating his BCD, replacing his regulator and mask, and ensuring we remained connected to the boat via the tagline.

The struggle on the surface lasted quite a while as the rescue line was being used for the pair that was drifting down current. After instructing the two buddy pairs still on the surface to get back aboard the boat and sit that dive out, I was finally able to get down to the four divers who were still waiting for me under the boat. Sixteen minutes had passed, and although I didn't feel exhausted from the rescue, I now realize it may have had a significant impact on the rest of my day.

After that dive, the nine of us regrouped for a discussion on safety protocols and the importance of listening to briefings. We moved to a new site, and after a short surface interval, I was ready to splash with seven divers (the diver who panicked earlier was still sprawled out dramatically across the deck of the boat). His buddy — who, like him, was 6.5 feet tall and about 300 pounds — soon proved to be an in-water disaster himself. He had no control over his buoyancy and crashed repeatedly into our nationally protected coral reef, kicking off obliviously, too focused on snapping photos and running into other divers. Despite the fact that he was a foot taller than me and more than twice my weight, I yanked him off the reef, adjusted his buoyancy and administered a brief underwater scolding. He rolled his eyes and headed off in the other direction, breaking off a large piece of staghorn coral on his way. I turned my head to check on the rest of the group, and when I turned back the diver was gone. He had power-inflated himself to the surface.

The diver floundered in a horizontal position, trying to make air escape from his BCD and ignoring my signs to get vertical and descend. I surfaced, told him to not leave my side for the rest of the dive and initiated a controlled descent onto a sand patch. Moments later, he was back on the surface. For the rest of his dive he continued racing to the surface or crashing uncontrollably onto the seafloor while I continued ascending to help him back down or descending to lift him off the bottom. Luckily he sucked down all his air relatively quickly, and instead of surfacing for this "diver" one last time, I stayed below and watched the rescue line pull him back to the boat. The rest of the group seemed as pleased as I was, and we continued our dive.

Forty minutes into the dive, I began to feel a strange pain at the base of my skull. Something was wrong. I recalled the divers and signaled it was time to ascend. True to that group's nature, two out of the six followed directions, while the other four looked me in the eye, looked at their gauges and swam off in the other direction. I surfaced and left those certified divers to their own devices.

As I climbed the ladder to get back on board, everything looked strange, as though I was looking out through someone else's eyes. The pain was still pulsing in my head, and although I wasn't sure what was going on, I went straight to the oxygen unit and put the mask to my face. The first mate was quickly by my side asking questions and handing me water. That's about when the tingling began. We called ahead and arranged for transportation to the hospital to be waiting for me at the dock.

The hospital was confusing, with different doctors and nurses coming in and out of my room telling me I was going for this test and that test. After blood work, a chest X-ray and a CT scan, they informed me I was going for a chamber ride — a five-hour U.S. Navy Treatment Table 6. "Is this really happening?" was the one question that kept coming to my mind over and over again. My dives had been fairly shallow, and although there were many ups and downs, all my ascents to the surface had been slow.

One thing I knew for sure was that DAN® was with me every step of the way — and DAN has been with me throughout the aftermath. Nothing is scarier than opening a medical bill that amounts to more than your annual salary and reading that it needs to be paid in full by the end of the month. My amazing representative, Denise Mulkey, talked me off the ledge and assured me not to worry, that she had my back and that this would all be taken care of. Without DAN I would have lost everything simply because I was doing my job. AD

SHARE YOUR STORY

Has DAN been there for you? Tell us about it at *ThereForMe@dan.org.*

Mastering Neutral Buoyancy and Trim

BY MICHAEL MENDUNO


TOM BOYD

Above: **Good buoyancy control is a prerequisite for photography and many other underwater pursuits.**

Opposite: **Some divers favor wings over jacket-style BCDs because they can promote a horizontal orientation.**

These days there are a multitude of opportunities to expand your diving horizons. You can take a cavern- or ice-diving course, learn to dive sidemount, sign up for a nitrox or tech class or even get certified on a rebreather.

But whether you're a beginning diver or an experienced one, perhaps the most important thing you can do to improve your diving is to master the ability to be neutrally buoyant and maintain a stable, horizontal position — also known as good trim — throughout the dive.

These skills are not learned overnight or through a training course alone. Without practice most divers find it difficult to maintain neutral buoyancy for more than a few moments while holding perfectly still, and many swim in a head-up, feet-down attitude (or position), which leads to excessive exertion as they move through the water.

But for those willing to do the work, the rewards are dramatic. Divers who perfect these techniques experience less fatigue, reduce their gas consumption, may learn new skills more easily, safeguard the environment and benefit from improved confidence and control underwater.

UNDERGROUND TECHNIQUE

Cave divers became strong proponents of good buoyancy and trim in the 1980s in response to the challenges of diving in an overhead environment. In caves, precise buoyancy control is critical; gas and energy are precious resources that must not be wasted through inefficient technique. Effective position control also prevents collisions with the cave, which can stir up silt and or knock debris from the ceiling, destroying visibility and jeopardizing the safety of the dive team.

Good trim is also essential in caves. By maintaining a streamlined horizontal orientation with the head forward, the legs bent at the knees and the feet elevated, divers minimize their surface area in their direction of travel and can therefore move through the water with less resistance. This reduces workload and gas consumption. Furthermore, movement up or down while horizontal is subject to greater resistance, which further enhances divers' ability to control their position in the water column.

DEFINING GOOD BUOYANCY AND TRIM

Explorer and educator Jarrod Jablonski, founder of Global Underwater Explorers (GUE), recognized the importance of these techniques outside of caves and created a program to promote and teach them in the late 1990s. His key insight was that some important skills in diving such as running a reel, shooting a surface marker buoy (SMB) or sharing gas with an out-of-air diver were easy once a diver had a stable platform to work from. Accordingly, Jablonski made buoyancy and trim the focus of GUE's core curriculum in a course called GUE Fundamentals, which serves as the starting point for the organization's recreational and technical training.

Most training agencies now offer a course or a module that addresses good buoyancy and trim (see sidebar). However,

many divers have yet to get the message. Pick up a dive magazine or visit a popular dive site and you will see divers struggling through the water in "seahorse" position or a circle of divers kneeling on the seafloor to do drills. But the message is spreading. Recently the Professional Association of Diving Instructors (PADI), the world's largest training agency, announced that it would begin emphasizing trim and buoyancy in its revised open-water training program beginning in 2014.

Good buoyancy and trim means being able to descend slowly in a horizontal position and then stopping at will without touching the seafloor or sculling with the hands. From there, the diver should be able to start swimming without breaking position or float motionless for several minutes in a horizontal position without rising or sinking. Divers should be able to clear their masks or share air with a dive buddy while maintaining good trim and without changing depth by more than a few feet. They should also be able to turn to the left or the right or even move backward using only their legs.

PUTTING IT ALL TOGETHER

Taking a training course is probably the best way to begin to perfect your buoyancy and trim. Most of the available courses offer a mixture of lecture, pool practice and open-water dives.

One training method that can help you master these skills


TOM BOYD

is the use of performance metrics. For example, specify a number of feet you may vary from your target depth during a training exercise or quantify in degrees how far you wish to permit yourself to deviate from horizontal (e.g., no more than 20° or 30°). Metrics offer a precise way to track and measure performance instead of relying on qualitative judgment alone.

A second method is using video to record your (or your students') training exercises to get accurate feedback about progress. Video enables you to see what you're doing right and what needs work. Underwater mirrors, which are sometimes used in pool practice, are also excellent feedback tools.

Good trim makes for a solid platform from which divers can manage bulky equipment with ease, share air with a buddy or maneuver efficiently using only their fins.

Typically the first step in training is making sure you have the right equipment and that it's adjusted properly. Some divers find that traditional jacket-style BCDs tend to lift the upper part of the body, making it more difficult to maintain a horizontal position. For that reason, divers who desire a more horizontal attitude may prefer a back-mounted BCD or wings.

Maintaining proper trim is also more difficult if you rely solely on a conventional weight belt. The best approach is to distribute weight around your torso. This can be accomplished by using a stainless-steel back plate, a steel tank and/or keel or tail weights.

Finally, it's important not to be overweighted, which necessitates putting more gas into the BCD, which increases drag and, thus, the energy required for swimming. Weight yourself so you are able to hold your position in 10 feet of water when your tank is nearly empty.

BASIC PROPULSION TECHNIQUES

The following propulsion techniques can improve your trim, stability and buoyancy control.

Frog Kick: The frog kick is the kick used when swimming the breaststroke. The legs mirror each other. This kick is powerful enough to be used in strong currents, and it's relatively easy on the leg muscles, so it can be maintained for extended periods.

Flutter Kick: In contrast to the open-water flutter kick, the bent-leg flutter uses only the lower half of the legs for propulsion. Keeping the knees bent, the diver kicks and recovers one leg and then the other in rapid succession, initiating movement from the knee joint. The movement is completed by the ankles, which whip the water back and up with each cycle. The hips and thighs stay motionless throughout and should not dip below the horizontal plane of the body.

Back Kick: The back kick is extremely useful for adjusting and maintaining your position relative to your dive buddy, the reef, a wall or a shipwreck. It's an essential kick for instructors, cave divers and underwater photographers. The kick applies the same concept as the frog kick but in reverse. It's a challenging but worthwhile kick to learn.

Helicopter Turn: The helicopter turn enables divers to turn completely around without breaking horizontal trim or flapping their arms. As a result, the turn minimizes the movement of gas in your BCD or drysuit and therefore helps maintain stability. The movement is essentially a combination of the back kick and the frog kick. One foot completes one of the movements before the other foot starts the other one, and the diver pivots around a vertical axis without dropping the lower back or the knees.

PRACTICE IS KEY

Once you've completed your course, you'll need to practice your new buoyancy and trim skills until muscle memory is established. This may take dozens of hours. Consider practicing in a pool as well as during your dives. Progressive practice is an effective approach. Start by floating motionless at your target depth and then add skills such as mask clearing, valve shut-off drills or gas sharing while remaining neutrally buoyant and holding a trim position. Practice making three-minute stops at 10-foot intervals while descending and ascending. And practice your kicks. By building your skill level progressively, you'll have a solid diving platform and, with it, greater confidence and control — and more fun. AD

BUOYANCY AND TRIM TRAINING COURSES

British Sub-Aqua Club: Buoyancy and Trim Workshop
Global Underwater Explorers: GUE Fundamentals
International Association of Nitrox and Technical Divers: Essentials
National Association of Underwater Instructors: Introduction to Technical Diving
Professional Association of Diving Instructors: Peak Performance Buoyancy
Scuba Schools International: Perfect Buoyancy
Technical Diving International: Intro to Tech Diving
Unified Team Diving: Extreme Scuba Makeover

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Legal Liability in Diving

TEXT BY MAUREEN ROBBS / PHOTOS BY STEPHEN FRINK

Lawsuits are prevalent in modern society, and the diving community is not immune to them. It's important for both certified divers and dive operators to understand their legal rights and responsibilities. We ask the experts.

NOTE: This article is not intended to provide legal advice regarding any given set of circumstances. Laws vary widely depending on where an accident occurs or the jurisdiction where it is litigated. You should always consult with legal counsel if you believe you have suffered an injury or loss due to the failure of a party to meet a legally required duty of care.

Prior to diving, divers are asked to sign a waiver and/or release. What does that document mean for divers, and what kind of protection does it offer for operators?

Michael Steidley: When a diver signs a liability release and assumption-of-risk form, he is acknowledging that he understands the risks inherent to scuba diving and that he releases the operator from responsibility should he be injured or die. Many diving waivers include a statement of safe diving practices and require the diver to review and agree to follow them.

Releases and assumptions of risk in scuba diving have varying degrees of strength. A well-written waiver can help defend an operator in the event of an accident and subsequent lawsuit. With a properly executed and enforceable waiver and release, a plaintiff would typically have to prove gross negligence to win a lawsuit.

Stephen Hewitt: The diver is agreeing in writing not to sue the dive operator for injuries and damages caused by ordinary negligence within the scope of the diving activity. The release is used as a bar to the prosecution of a lawsuit by an injured diver. It may not bar claims for injuries and damages caused by gross negligence or events outside the ordinary scope of diving, such as leaving a diver adrift at sea. References to assumption of risk in the waiver and release agreement are circumstantial evidence that the diver's injury was due to an inherent risk of the activity. The court determines whether the risk that caused the injury was inherent to scuba diving and could not be prevented without altering the sport.

When the waiver and release agreement are not enforceable, the developing trend is that the trial court will let a redacted version of the waiver and release be shown to the jury as evidence of the diver's agreement to adhere to safe diving practices, the scope of the diving activities, a testament of fitness to dive and evidence of the diver's skill and awareness.

David Concannon: The diver is acknowledging that scuba diving involves certain risks and is agreeing to assume those risks — including the risk of injury and death — by engaging in diving. The release is intended to show a judge or jury,

Dive operators promote diver safety through practices such as establishing emergency procedures, providing surface support and conducting predive briefings.

Opposite: **In addition to limiting dive-operator liability, medical statements and assumption-of-risk forms help remind certified divers they're responsible for their own safety.**

who normally are not aware of the risks of diving, that the diver knew and accepted those risks before entering the water. Generally, the protection offered to operators by a signed release is very high, especially if the release is well written and detailed. However, enforceability can vary from jurisdiction to jurisdiction and often from court to court within the same jurisdiction. But more often than not the release is upheld.

What role does the medical statement play in liability cases?

Concannon: The medical statement is critical. Its purpose is to alert the diver to medical conditions that may cause injuries while diving so the diver can seek proper medical attention and advice before engaging in diving. People with medical conditions that may preclude diving often fail to disclose those conditions on the medical statement and then sue the dive professionals after they are injured while diving. I have never seen one of these cases end in favor of the diver.

Hewitt: The medical statement is hugely significant evidence in the defense of the dive operator when it reflects that the diver was fit to dive pursuant to a physician's statement and/or that the diver concealed a physical condition that was a contraindication to diving. Courts and juries rarely think twice about finding in favor of the dive operator when the injury or death was due to a physical condition concealed by the diver or that was not recognized or considered by the physician to be a contraindication to diving. The medical statement may also help the dive operator's counsel find additional evidence to establish that a medical condition was related to the injury or death, such as a family history of cardiac problems or sudden death. It also places the responsibility for the fitness to dive on the diver and relieves the dive operator from further responsibility to evaluate the diver's fitness or health.

What is the duty of the operator and of the certified diver?

Concannon: The duty of the operator is to safely transport the diver to the dive site and ensure the vessel and crew have the necessary safety equipment and procedures on the surface to support a safe experience for the certified diver. The duty of the certified diver is to ensure he personally has the proper gear, training and skills necessary to ensure his own safety underwater. The bottom line: You are responsible for your own safety while diving.

Steidley: Dive operators' duty to their guests includes but is not limited to following generally accepted diving practices and having equipment that functions properly and safely.

Certified divers need to be both physically and mentally fit to dive and stay within the limits of their training, skill level and certification. Divers should follow standard safe diving practices, including use of the buddy system. Finally, all divers should conduct thorough buddy and equipment checks before every dive.

Hewitt: The dive operator has a responsibility to deliver divers to a location generally commensurate with the skill level of the group, assess the dive-site conditions, have procedures to address emergencies, conduct dive briefings when warranted and organize the diving in a manner consistent with general diving practices.

The duty of the certified diver is to be fit; be current and proficient in his diving skills; be familiar with his gear and

confident it's in working order; dive within the limits of his training, ability and comfort level; adhere to generally accepted safe diving practices; adhere to the dive briefings and, unless expressly agreed upon otherwise, dive with a buddy. The diver must be familiar with the skill level and equipment of his buddy, and there should be an agreed-upon dive plan.

Dive operators may deny service to divers who they believe will be a danger to themselves or other divers.

When is it OK for an operator to deny a diver service?

Steidley: It is appropriate for an operator to deny service any time a diver demonstrates unsafe diving practices.

Concannon: The operator should deny service to a diver whenever the operator reasonably believes the diver will be a danger to himself or others. The operator is better off losing a customer than a life. I would rather defend the rare case where a disgruntled diver is suing an operator for failing to provide service than the more common case where a disgruntled family is suing because the operator lost a diver who they allowed to dive despite safety concerns.

Hewitt: A dive operator may deny a diver the opportunity to dive when the operator objectively and reasonably believes the diver poses a danger to himself or his fellow divers. The dive operator cannot deny service on a discriminatory basis.

The consequence of denying service to a diver is that the dive operator may face a breach of contract claim if money is accepted in consideration for the dive trip. Such a claim is highly unlikely (especially when any monetary consideration is returned to the diver). The risk of the dive operator losing a customer is far outweighed by the risk of a lawsuit due to injury of the diver or others. The general consensus of the lawyers defending scuba-diving cases is that it is better for the dive operator to err on the side of caution and avoid unnecessary risks.

What do you consider to be landmark liability cases in the dive community? Why?

Hewitt: In recent years, there have been three landmark scuba diving cases. The first, *Barrett v. Ambient Pressure Diving*, involved a death related to the use of a rebreather. In the trial, the jury acknowledged the risks associated with technical diving and readily placed the responsibility on the diver for fully understanding the equipment, ensuring it was working properly and using the equipment correctly during the dive. They did not hold the manufacturer to higher safety standards such as those of automobile or lawnmower manufacturers.

The second, *Carlock v. M/V Sundiver*, involved a dive boat leaving a diver at the dive site. The court ruled that such an incident was not within the scope of the waiver and release and was not an inherent risk of scuba diving. The jury determined that every one of the dive professionals involved had responsibility for the incident. While the jurors believed the adrift diver had some fault for failing to adhere to the buddy system and the dive briefing, they found it relatively minor in comparison to the fault of the professionals.

The third case, *Goetz v. Horizon Charters,* involved a claim of negligent rescue in which two divers became separated, and more than 30 minutes passed before a search was initiated to locate the missing diver. The court ruled that the family of the deceased diver must establish gross negligence, because the waiver and release signed by the decedent barred the ordinary negligence claim. In a precedent-setting decision, the court decided that a redacted version of the release could be shown to the jury to demonstrate the deceased diver's agreement to adhere to safe diving practices (i.e., buddy-diving procedures). The case also highlighted the family's inability to rule out the possibility that the diver's underlying health condition played a role in the death and underscored the coroner's limited ability to determine the cause of the drowning.

MEET THE EXPERTS

David Concannon, J.D., is a trial attorney who represents a variety of clients in the dive industry in personal injury, products liability and wrongful death litigation. Concannon investigates a number of scuba fatalities every year and has led panel discussions on accident investigations and scuba fatalities at DAN's Recreational Diving Fatalities Workshop and Rebreather Forum 3.0 in 2012.

Michael Steidley has served as an expert witness. He is an active PADI Course Director, NAUI Instructor, DAN Instructor Examiner, Visual Cylinder Inspector Instructor Trainer for the Professional Scuba Inspectors Organization and a TDI Instructor Trainer for semiclosed rebreathers, decompression procedures and extended range.

Stephen Hewitt, J.D., a trial lawyer of 30 years, practices in California and Hawaii, representing dive professionals, associations and manufacturers. He has served on industry committees, panels and lectures and writes on dive law, authoring "Survey of Sport and Leisure Waiver and Release Law in the United States" among other works.

Availability of oxygen and other first-aid supplies is another means by which dive operators support diver safety.

Concannon: The recent case of *DeWolf v. Kohler*, which resulted in a defense verdict in favor of a charter operator to the *Andrea Doria* wreck, was a landmark decision. The diver died of a heart condition, which he failed to disclose, shortly after entering the water. The diver's family sued the trip leader, dive boat, a training agency, the diver's instructor and a scuba equipment manufacturer, alleging that they had a duty to ensure the diver's safety underwater and seeking $16 million. The practice of technical diving and the concept of accepting personal responsibility were put on trial. The jury found that the trip leader was not responsible for ensuring the diver's safety underwater and made an additional finding that the diver specifically assumed the risk of his injuries, including death, and he was solely responsible for causing his own death.

Few diving cases ever go to trial, especially when so much money and the practices of an entire industry are at stake. Even fewer result in such an astounding verdict. After the trial the jury specifically told the parties that they wanted their verdict to send the message to not only divers but all people who engage in risky activities that they — and nobody else — are responsible for ensuring their own safety. AD

STEPHEN FRINK

BY GENE HOBBS

Rescue of an Unconscious Diver

Dive accidents are rare events, but they do happen. When divers become unconscious underwater, they face an incredibly high risk of injury or death. In these situations, the victim's fellow divers must draw on their strength, training and intelligence to bring about the best possible conclusion to the emergency. Rescues of unconscious divers are very complicated events, and even perfect, by-the-book rescue attempts by the most well-trained people frequently result in poor outcomes.

There are many reasons why a diver might lose consciousness underwater. It may result from a lack of oxygen (hypoxia), a medical emergency such as a heart attack, an excess of carbon dioxide (hypercapnia) or an excess of oxygen (oxygen toxicity). One thing these situations have in common is the need to get the diver out of the water and into the hands of qualified medical professionals as quickly as possible.

BACKGROUND

In 2007 the Undersea and Hyperbaric Medical Society (UHMS) Diving Committee was asked to review the practices being taught for in-water resuscitation. Our committee, chaired by Dr. Simon Mitchell, is comprised of an international team of experts in diving and hyperbaric medicine.

The now defunct YMCA Scuba Program had requested guidance following new recommendations that appeared in the 2005 American Heart Association's Emergency Cardiac Care standards, which emphasized compressions during cardiopulmonary resuscitation (CPR). Confusion was arising during courses and training drills about the administration of ventilations (rescue breaths) while on the surface with a victim. The scope of this review was expanded at the request of the scientific diving community as well as committee member Jarrod Jablonski of the Global Underwater Explorers (GUE) training agency. Jablonski requested a more detailed review that included consideration of oxygen toxicity events.

METHODS

The review was drafted primarily by Drs. Simon Mitchell and Michael Bennett. The reviewers first identified the questions to be addressed and then conducted an exhaustive literature review to identify the best possible evidence to support the committee's conclusions. In situations where supporting literature or case histories were not available, committee consensus was reported.

Our team used the Professional Association of Diving Instructors (PADI) Rescue Diver Manual as a starting point for the expected behavior of a rescue diver assisting a victim. Rescues were analyzed and reviewed in three phases: 1. preparation for ascent to the surface, 2. retrieval of the victim to the surface, and 3. procedures for the care of the victim at the surface. Special considerations for victims found with a rebreather were reviewed for each of these phases.

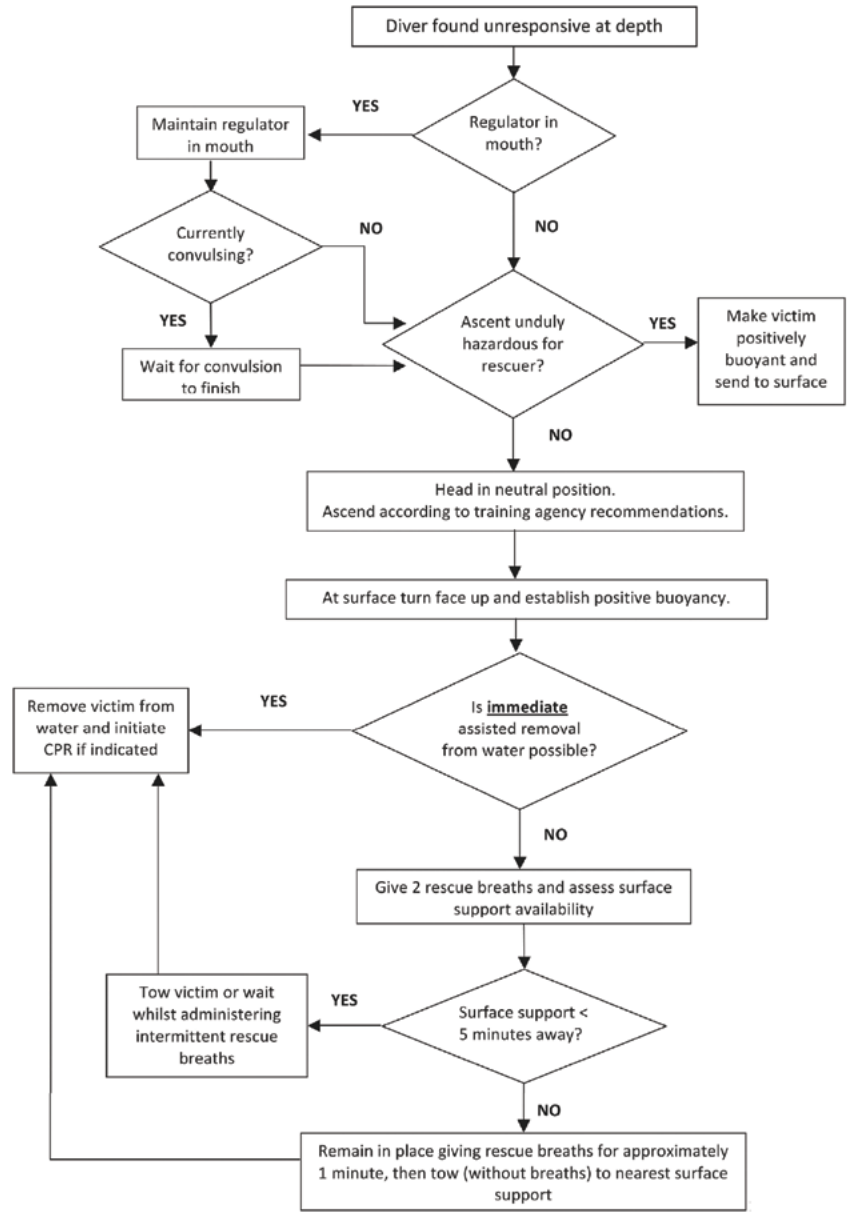
SUMMARY

The submerged-diver-rescue decision tree is a graphical

representation of the various points the committee addressed. In the initial phase, the discussion focused on what to do if the regulator or rebreather mouthpiece had come out of the diver's mouth and, if it was still in place, whether the diver was experiencing a convulsion. For the ascent phase it was noted that the best ascent rate for the victim may be "as fast as possible," but that might conflict with what is safe for the rescuer. In some cases, the rescuer might have a decompression obligation, and a direct ascent could place him or her at considerable risk. In such cases it might be necessary to make the victim positively buoyant and send him unassisted to the surface. Once the victim is on the surface and positively buoyant, the rescuer must then promptly assess the need for rescue breaths and quick egress from the water.

The application of this decision tree depends on the rescuer having the appropriate foundational knowledge and experience of formal diver-rescue training. (It is never too late to learn new skills or practice old ones.)

It is completely appropriate for rescuers to ensure their own safety when using these recommendations. The degree of risk you are willing to assume to help another is something only you can determine. Keep in mind that a safety stop is only a recommendation following a no-decompression dive and should not be considered a decompression obligation.



Summary of important recommendations and decision-making processes in the rescue of an unresponsive diver from depth. (Mitchell S, Bennett M, et al. "Recommendations for rescue of a submerged unresponsive compressed-gas diver." *UHM* 2012; Vol. 39, No. 6. Image reproduced with permission from the Undersea and Hyperbaric Medical Society.)

The committee doubts the recent changes to CPR instruction are relevant to submerged-diver rescue. In a dive accident that includes respiratory arrest, there could be a variable period of time in which rescue breaths may prevent the accident from progressing to cardiac arrest. This is because the respiratory arrest in a dive accident is likely due to a lack of oxygen (asphyxia).

Our committee appreciates that there are circumstances that aren't adequately accounted for in these guidelines; the intention is to provide guidance that is not overly complicated. These should not be considered immutable rules for all situations.

IMPACT

This intensive, evidence-based review of diver-rescue procedures has already begun to have an impact on the diving community. The GUE training standards have been amended to include guidance provided by this effort. AD

REFERENCE

Mitchell, Simon J; Bennett, Michael H; Bird, Nick; Doolette, David J; Hobbs, Gene W; Kay, Edward; Moon, Richard E; Neuman, Tom S; Vann, Richard D; Walker, Richard; Wyatt, H Alan (2012). "Recommendations for rescue of a submerged unresponsive compressed-gas diver." *Undersea and Hyperbaric Medicine* 39 (6): 1099–1108. *http://archive.rubicon-foundation.org/10161*

SHARE YOUR STORY

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RICK MELVIN

Keep Your Skills Sharp

BY TOM CARR

Early in the evening on May 10, I received a text message that brought on both chills and an incredible sense of pride at the same time: "Just performed the Heimlich on my mom (choked on carrot in the kitchen). She was on the verge of passing out … so scary!"

The text was from my friend David Ginsburg, an assistant professor at the University of Southern California (USC). We've worked together for the past four years teaching a scientific diving course for the Environmental Studies Program at USC.

Dave and his family were at his mother's home in Malibu, Calif., preparing to have dinner when his mother began choking on a piece of carrot. As Dave described it, he was in the living room and heard her start to cough in the kitchen. He then heard her gasping for air and went to the kitchen to find her holding onto the edge of the sink and beginning to turn blue. He couldn't believe this was actually happening and wondered if he needed to intervene or if she would be able to expel the object by herself. He worried that he might break her ribs. Her house is in a fairly remote area, and he thought that if she passed out, help might not arrive in time to save her.

He put his doubts aside and performed three or four abdominal thrusts. He didn't see the carrot come out, but after the last thrust she was breathing again.

I texted Dave back and asked how she was; he replied, "A little bruised from me pumping my fist into her diaphragm,

but happy and laughing now." Because he had the proper training and was prepared in advance, an event that could have devastated his family was being laughed about.

Just a few months prior to the incident, Dave had attended a DAN Basic Life Support: CPR and First Aid course combined with a DAN Emergency Oxygen for Scuba Diving Injuries course that I was instructing at USC. These courses are provided annually for our scientific diving students. Dave had attended to renew his certifications and keep his status current for the scientific diving program.

I occasionally hear complaints from colleagues and students about having to attend renewal courses for CPR or first-aid training. I always ask when they last practiced the skills taught in the program, and the typical response is "the last time I took the course."

I hope we, as divers, would not undertake a dive that required us to use skills we hadn't practiced in a couple of years. Most of us would plan at least one skill-refresher dive in advance to make sure we could safely handle the dive. The same applies to our emergency-preparedness skills — they get rusty if we don't use them.

For an instructor teaching basic life support courses, one of the most rewarding things that can occur is having a former student tell you about saving a life. It's only happened to me twice in 35 years of teaching CPR. The first was in the late 1970s: A student who had taken my course just a month prior visited our office visibly shaking and on the verge of tears. He told us that his two-week-old son had gone into cardiac arrest, and he had been able to revive him with CPR. That moment will stay with me forever. Dave's story had a similarly chilling impact.

Many students who take CPR and first-aid courses are doing so to fulfill a requirement, often for their job or another activity that requires the certification. At the start of all of my classes I ask my students when they think they might use the skills they are about to learn. I get a lot of different answers; most are based on their frame of reference for taking the class. For the dive-oriented courses, they often serve their fellow divers. I make sure they understand at the start of the class that the most likely group to benefit from their skills is their own family.

I'm in the process of setting up a DAN Instructor course for Dave and some others. He already has a great story to tell his future students about the value of keeping their skills up to date.

When's the last time you practiced your emergency skills? AD

The Nitrogen Saturation Myth

DAN medics and researchers answer your questions about dive medicine.

STEPHEN FRINK

Q: I work as a divemaster on a small island. Last weekend some of my coworkers went to the local chamber for "wash-out treatments," despite not having any symptoms. We all dive a lot, but I'd never heard of anything like that before. Is that something I should do?

A: There is a misconception among some divers — particularly recreational dive professionals and fisherman divers — that a degree of tissue nitrogen saturation will occur over weeks or months of frequent diving activity. Some of these divers believe they may benefit from occasional "wash-out treatments" in a hyperbaric chamber, but that is a fallacy. Such a concept is completely at odds with all credible diving and decompression research and is inconsistent with informed clinical practice standards. Efforts to determine the origin of this misunderstanding have thus far proven unsuccessful.

Similarly, there are reports of chamber operators actually propogating this myth by offering routine "nitrogren desaturation treatments" — for a price, of course. Decompression sickness (DCS) can certainly manifest as musculoskeletal pain, so any such presentation within 24 hours of diving would warrant prompt evaluation and perhaps treatment in a chamber. However, while chronic pain has many possible causes, diving-related trapped nitrogen is not one of them.

Inert gas uptake and elimination during air, nitrox and heliox diving will obey both Dalton's and Henry's gas laws. Should bubbles be produced upon decompression (whether there are symptoms of DCS or not), then Boyle's law also comes into play. Asymptomatic bubbles may remain in tissues for a day or so at most.

Throughout the compression phase of a dive and while at depth, the associated increase in inert gas pressure in the breathing gas is delivered to the diver's lungs (Dalton's

law). From there it is gradually taken up by the blood and delivered to the body's various tissues (Henry's law). The rate of inert gas uptake in the blood and other tissues depends on several variables. Key among them are speed of compression, type of inert gas breathed and its related solubility coefficient, body temperature, inherent tissue perfusion and level of exercise or work load.

In recreational diving, nitrogen uptake essentially ends once the diver begins his ascent to the surface. I say "essentially" because the body's "slower" tissues — those that are less well perfused or are supported by simple diffusion, for instance — may continue to take on nitrogen during the early and intermediate stages of ascent if their nitrogen pressures remain lower than the blood's. Thus, nitrogen in the blood will continue to transfer into these tissues until such time that blood nitrogen levels fall to the level of those tissues. It is at this point that slower tissues will begin offgassing. This is why it is important that ascents be mostly direct and largely linear. Divers who slowly meander back to the surface may accumulate levels of nitrogen in certain tissues in excess of those assumed by decompression tables. In this way, repetitive dives can lessen the protective capabilities of the table in use.

If a diver remains at depth more than 12 to 18 hours (in a seafloor habitat or a commercial oilfield saturation-diving complex, for example), all of their tissues — fast, intermediate and slow — will re-equilibrate with nitrogen (or helium) at the new depth. This is called saturation diving. Except for tiny variations that may occur with body-temperature fluctuations, it is physiologically impossible for any additional inert gas to be taken up without further change in depth. When a diver ascends from a saturation dive, inert-gas elimination occurs in the same manner as it does at the end of a recreational dive, as described by Henry's and Dalton's gas laws.

Once a diver has returned to the surface, regardless of whether the dive was a short recreational dive or a long saturation dive, all tissue inert gas in excess of normal atmospheric pressure will be eliminated over the following 12 to 18 hours (i.e., his body's tissue nitrogen levels will be re-equilibrated to the ambient atmospheric pressure). After that period, no additional nitrogen above normal atmospheric (sea-level) pressure will remain in the body.

Residual nitrogen is never "trapped" in the body, so there is absolutely no basis to treat divers for chronic nitrogen saturation. It is a misunderstanding at best, and a hoax perpetrated on divers at worst. Don't fall for this.

— Dick Clarke, President, National Baromedical Services


STEPHEN FRINK

Q: While vacationing in St. Maarten, I plan to do a day trip to Saba and do three dives there. I would fly out in the morning and return in the evening. The first dive would be between 90 and 130 feet deep, and the two subsequent dives would be no deeper than 80 feet. The dive operator assured me it would be safe to fly back the same day, as the aircraft would not exceed 2,000 feet during the 12-minute return flight. Would it be safe to fly in this situation, and is 2,000 feet the cutoff altitude for flying after diving?

A: You are asking about a pattern of exposure for which there is very limited empirical data. The guidelines in this low altitude range are cobbled together from a combination of expert opinion and whatever research can reasonably be applied. Knowing that there is a high likelihood of some degree of vertical travel postdive (and no evidence of a huge problem resulting from such activity) and appreciating the implications of research data from Switzerland based on 1,700-foot exposures, the 2002 Divers Alert Network® flying-after-diving guidelines stipulated a cabin altitude within the 2,000- to 8,000-foot range to qualify for flying-after-diving discussion. Lesser altitudes were excluded. Alternatively, the U.S. Navy flying-after-diving Table 9-6 (2008, Revision 6) begins with an altitude table of 1,000 feet, although it applies postdive surface-interval penalties only for high repetitive groups.

While the above may seem promising, the dives you propose to do could easily achieve extremely high postdive repetitive groups. The remaining wild cards are the flight altitude and duration. Staying below 2,000 feet may be possible, but it is certainly not guaranteed. Weather and traffic conditions might prolong flight time or result in a higher altitude. At the same time, low atmospheric pressure could increase the decompression stress of any given altitude. The person giving you the advice was describing an optimal case that may or may not reflect reality.

The overall risk in the day you describe could be acceptable, but it is certainly not a plan I would encourage or choose to do for recreation. Three dives to the depths described indicate that this would not be a low-stress day under the best conditions. The true net risk is determined by multiple factors — dive profiles, thermal stress, exertion level, between-dive surface interval, preflight surface interval, environmental conditions (weather, atmospheric pressure, geography), pilot discretion, other air traffic and individual susceptibility. The plan entails enough risk that it would not take too many factors going in the wrong direction to produce a bad day.

Safety margins could be added through the use of nitrox with a decompression algorithm set to air (but carefully respecting the maximum depth limits to avoid oxygen toxicity) and/or diving more conservative profiles and/or delaying the return time. The problem with planning such an ambitious day is that once it is set in motion it may be hard to stop. A compromise here or there or in any number of ways could easily increase the hazard.

Ultimately, you have to decide what risk you are willing to assume. Unless you are diving alone, your partner or partners would have to make similar decisions. In thinking of this, remember that decompression injuries tend to be probabilistic events. Getting away with something once, twice or 99 times does not make it safe. My advice is to focus on all the ways to increase safety margins to make diving as worry-free as an enjoyable activity should be.

— Neal W. Pollock, Ph.D.

Q: I read in a recent issue of *Alert Diver* (From the Medical Line, Spring 2013) that coral cannot grow under your skin, but can other sea creatures? I scraped against something while diving;

the wound healed, but a couple of weeks later I noticed redness and small, painful nodules at the site of the scrape. My doctor gave me antibiotics and prednisone, which helped, but the symptoms returned after a week of treatment and now seem to be spreading. Could something be growing in me?

A: It is possible you have an infection caused by a bacterium called *Mycobacterium marinum*. *M. marinum* is a very slow-growing bacterium that requires incubation periods of two to three weeks. It is not always considered in differential diagnoses because it primarily affects those specifically exposed to aquatic environments. *M. marinum* infections may look like jellyfish stings at the outset, and they may get better with the use of steroids such as prednisone. Although steroids can relieve symptoms, they do not address the cause of the infection. As the infection slowly spreads, additional nodules can appear along lymphatic pathways. Cultures for *M. marinum* are slightly different than standard wound cultures (e.g., requiring particular growth media), and the infection may be missed if the doctor isn't looking for it. This bacterium is resistant to many antibiotics and generally requires specific and combination antimicrobial therapy that usually lasts for two to four months. This period includes continued antibiotics for one to two months after the infection disappears. Once treatment has begun, your primary care physician, a dermatologist or an infectious disease specialist can monitor it. AD

— Scott Smith, EMT-P, DMT

Due to the risk of infection by *Mycobacterium marinum* or other pathogens, divers should avoid diving with open wounds.

STEPHEN FRINK

Recognition is Essential

BY MARTY MCCAFFERTY, EMT-P, DMT

THE DIVER

The diver was an experienced 48-year-old female with more than 300 lifetime dives. Her medical history included hypertension that was well controlled with a single medication. She also took a prescription drug to manage her cholesterol. Her general health and fitness were otherwise good.

STEPHEN FRINK

THE DIVES

The diver was on a trip at a popular Caribbean island. The first four days of diving consisted of two morning dives each day. None of these dives was deeper than 80 feet, and all bottom times were within her computer's no-decompression limits. Her second dive each day was to 60 feet or shallower, and she breathed air on all the dives. On the fifth day, her first dive was a multilevel one to a maximum depth of 85 feet for a total time of 40 minutes. The dive was uneventful, and she exited the water at approximately 11:30 a.m.

Within five minutes of surfacing, the diver began to feel slightly short of breath while she was removing her equipment. This was followed by soreness in her middle and upper back. As she was moving her equipment she noticed reduced strength in her right arm. Almost simultaneously both of her feet began to tingle, and the sensation progressed up both legs to her waist. Fatigue accompanied all these symptoms.

She reported the situation to the dive boat crew. They did not act alarmed and suggested that oxygen was not necessary because the reported weakness in her right arm resolved on its own within 15 minutes. The diver chose not to participate in a second dive. The other divers were in the water for an hour. During that time her symptoms seemed to resolve, except for the tingling in her feet.

Back at the resort the symptoms did not return, but the tingling in her feet remained unchanged. She did not engage in any vigorous physical activity that afternoon and, after dinner, retired for the evening at approximately 9:45 p.m.

THE COMPLICATIONS

At 11:30 p.m. the diver awoke due to acute discomfort in her bladder. She discovered that she was unable to urinate and upon reflection realized she had not urinated since the dive that morning. She took a warm shower, during which she became aware of unusual sensations in her feet and patchy sensitive areas on her legs. She reported that her legs also felt rubbery. As her concern grew she contacted DAN® and spoke with the medic on call. Based on the evolution of signs and symptoms she reported, the medic recommended that she be evaluated at a nearby medical facility immediately.

She spoke with the resort manager, who transported her to the local clinic.

As the clinic staff began their evaluation, the first priority was to empty the diver's bladder, and they promptly did so using a urinary catheter. The staff recognized the possibility of a decompression injury and began making arrangements with the local hyperbaric facility. They also placed the diver on high-flow oxygen (15 liters per minute via a nonrebreather mask). Due to staffing issues the diver was not transferred to the hyperbaric facility for another two hours, but she did continue breathing high-flow oxygen during her time at the clinic and during transport, which was uneventful.

THE EVALUATION

Upon arrival at the chamber facility the diver was fully alert and oriented and able to provide the treating doctor with a detailed account of the events and the evolution of her symptoms. The physician conducted a neurological exam and discovered no problems with the diver's right arm. Strength in her arms was equal, and reflexes were normal. The soreness in her middle and upper back had not returned.

Neurological evaluation of the lower extremities revealed reduced strength in the right hip-flexor muscles compared with the same muscles on the left side. There was also reduced sensation in the left leg and patchy areas of altered sensation in the right leg. Perception of hot and cold stimuli was altered in both feet. The diver was unsteady while attempting to walk heel to toe, she found it difficult to stand on one leg, and she reported that her legs still felt rubbery. The treating physician diagnosed her with decompression sickness (DCS) Type II with spinal cord involvement.

The staff initiated a U.S. Navy Treatment Table 6 (TT6). About halfway through the treatment the diver reported improvement. Following the treatment, a repeat neurological evaluation revealed marginally improved strength in the right leg. The diver also reported improved sensation in her feet. She was helped back to the resort, where she slept for a few hours before returning for an additional treatment. During a shower she noticed improvement in her ability to distinguish hot and cold sensations. The diver's ability to walk heel to toe was also improved, and she had less trouble standing on one leg. The doctor decided to administer a second TT6, after which an evaluation showed further improvement.

The next day the diver was evaluated again and treated with a U.S. Navy TT5 (a shorter chamber treatment), again with incremental improvement. Three additional shorter U.S. Navy TT9 treatments were provided. The diver had reached a clinical plateau, showing no further improvement after the second and third TT9, so no further treatments were administered. Some slight sensory decrements were still present, but the physician's opinion was that the diver would continue to improve. After waiting the recommended

72 hours, the diver flew home and experienced no worsening of her symptoms during the flights. Two weeks later she reported continued daily improvement with only mild sensory alteration remaining in her feet.

THE DISCUSSION

It would be easy to criticize the boat crew for their failure to act; they had probably seen people dive those profiles without incident many times and were thus lulled into complacency. Further confounding this case was the spontaneous resolution of most of the diver's symptoms. Such resolution of symptoms is typically a response to breathing oxygen, but in rare cases it may even occur in the absence of oxygen first aid. Although not all of this diver's symptoms resolved, the improvement of most of her symptoms made this situation appear much less severe than it actually was.

It is important to remember that the signs and symptoms this diver exhibited can be considered profound, but even subtle signs or symptoms warrant at least an informal conversation to determine the extent of problems. Any loss of muscular strength should prompt immediate evaluation and intervention. The DAN Neurological Assessment course provides knowledge and skills for recognizing and assessing potentially injured divers; no matter what training you have, don't hesitate to recommend that a diver seek professional medical evaluation. Regardless of whether symptoms that appear after a dive are subtle or obvious, if they resolve with oxygen first aid — or even without it — don't discount the possibility that they will return. AD

Soft-Sided Rescue Pak Extended Care

This bag is designed to transport and deploy oxygen with ease. Using the EZ-Grab pull bars, two main panels open for accessing the oxygen unit and supplies. Its large internal mesh pockets and dual external zipper pockets offer ample storage. This bag is ergonomically designed for use as a backpack. It is water- and stain-resistant and is equipped with an adjustable yoke backpack strap harness system, which distributes weight for added comfort. Oxygen delivery capacity: approximately 60 minutes. Weight: 17 lbs.

Product code: 601-1030; Price: $600

Oxygen Unit Annual Maintenance Kit

The Annual Oxygen Unit Maintenance Kit includes all the components required for routine maintenance. This kit comes with a new pair of nitrile gloves, one nonrebreather mask, two oxygen O-rings and a DAN tank sticker.

Product code: 601-7500; Price: $8.95

Full Oxygen Update Kit

These new oxygen update kits contain everything needed to update all important oxygen unit components. The kit comes complete with new nitrile gloves, a nonrebreather mask, a pocket mask, two oxygen O-rings, a DAN Oxygen Unit slate, a tank sticker and an Oxygen On Board sticker. Check your unit regularly — you never know when you might need it in an emergency situation.

Product code: 601-7600; Price: $19.95

CO-PRO Five Pack

A quick and effective way to detect carbon monoxide (CO) in breathing air. If the air is contaminated by CO, the capsule inside the balloon changes color.

Product code: 641-0110; Price: $24.95

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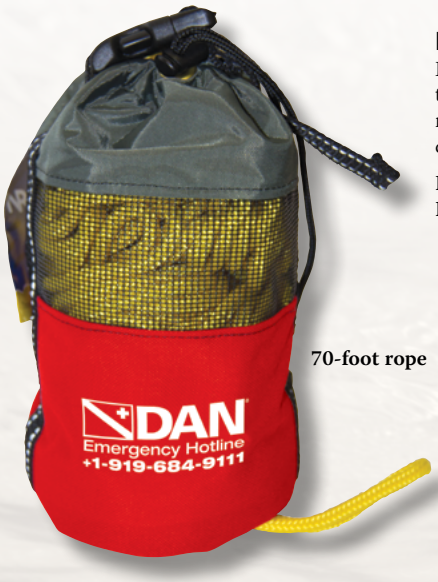


70-foot rope

DAN Throw Rescue Bags

Easy and accurate-to-deploy in a rescue toss situation, these rescue bags come in two sizes: Choose from 55 feet or 70 feet of floating quarter-inch polypropylene rope. Both bags come with a one-inch quick-release strap and a barrel-lock drawstring for smoother, longer throws.

Product code: 641-4200 (55-foot rope); Price: $44.95
Product code: 641-4100 (70-foot rope); Price: $49.95

55-foot rope

Surface Signal Kit

Signal for help and never be left stranded. The DAN Surface Signal Kit comes with a 6-foot signaling sausage featuring a 2-inch reflective strip on both sides and a radar reflective panel on the inside of the tube. The kit includes a whistle, signaling mirror and a Princeton Tec safety light with batteries.

Product code: 641-1000; Price: $80

DAN 100-Foot Finger Spool

Deploy your surface marker buoy easily with this neutrally-buoyant finger spool machined from solid Delrin®. With 100 feet of line, you can deploy your buoy from your desired depth, signaling your surface location and alerting boaters to maintain their distance. Designed to fit with the DAN Surface Signal Kit.

Product code: 641-2400; Price: $39.95

Blue sharks gorge on a massive anchovy baitball off Cape Point at Africa's southwestern tip.

SOUTH AFRICA

PREDATOR'S PARADISE

BY CHRIS FALLOWS

South Africa is well known for its terrestrial big five, the iconic game found in the country's savannah that include the lion, leopard, elephant, Cape buffalo and rhino. Yet just offshore swim equally compelling marine predators, most notably, of course, the great white shark. In addition there are many other shark species, megapods of dolphin, various species of whales, flocks of penguins and a huge diversity of other marine life — all within a few hours' drive of each other.

CHRIS FALLOWS

FALSE BAY

Cape Town, South Africa's mother city, is situated at the southwestern tip of Africa, and it's the region's hub for expedition travel. **False Bay** is only a 35-minute drive from Cape Town's city center. From March to June massive shoals of sardines and anchovies enter False Bay, and this influx of prey attracts a host of predators. Massive schools of dolphins crash through the shoals of bait fish, which are simultaneously attacked by squadrons of diving Cape gannets. The annual sardine run starts in False Bay around March each year, and the size of the dolphin schools is astonishing.

This influx of common dolphins has brought a new predator into the bay: Orcas are now being spotted here for the first time. The orcas along the Cape coast appear to be dolphin-hunting specialists, and the action is intense. On numerous occasions we have witnessed pods of orcas running down schools of dolphins, stunning and killing their prey with dramatic breaches into the fleeing masses.

By early June the schools of baitfish have moved up the east coast, and the schools of dolphins, flocks of gannets and pods of orcas have for the most part moved on. The next wave of seasonal predators will have begun arriving in False Bay around late April. That's when the area's legendary flying great white sharks (as seen in *Planet Earth*, *Air Jaws* and more than 50 other nature documentaries) start showing up at Seal Island. The aptly named island is home to Africa's largest island-bound seal colony, which numbers around 65,000 at its peak. By early June the young seals have been weaned off their mothers' fat-rich milk and start heading out to feed and fend for themselves. That's when the energy around Seal Island really ratchets up, and unbridled action involving the ocean's most famous fish takes center stage.

In any given season, the Apex Shark Expeditions crew records around 600 to 800 predatory events around this tiny island. Nowhere else on earth offers such a good chance of seeing this spectacular behavior. The sharks are successful in about 50 percent of all hunts; their average length is about 11 or 12 feet.

For those who need to get their hair wet, cage diving offers an opportunity — once the early morning's predations slow down — to get close to the sharks in their domain. Fifteen- to 20-foot visibility is normal, and water temperatures are generally brisk (in the upper 50s°F).

Seal Island is unique among great white shark diving destinations in that it offers visitors the opportunity to watch the sharks hunting and breaching as well as a chance to cage dive — all on the same trip (weather permitting, of course).

By late August seasonal changes occur in the bay; winds out of the northwest begin shifting to come out of the southwest and then the southeast. This brings another sizable, seasonal visitor into the bay: Southern right whales move in to mate and calve. Boat-based whale-watching trips from Simon's Town take passengers within a stone's throw of the whales; people can also enjoy excellent land-based whale watching.

Local dive operators generally report the best reef-diving conditions in the bay during winter (May through September). Wrecks and soft corals abound, and nudibranchs and a host of temperate-water fish add interest to most dives. One of the truly spectacular — and very accessible — dives in the bay is with the large, endemic


TOBIAS FRIEDRICH


CHRIS FALLOWS


CHRIS FALLOWS


JUAN VENTER

Clockwise from top left: **blue shark in clear water 20 miles off Cape Town's spectacular coastline; mako shark gaping at the camera; sevengill shark at Pyramid Rock, False Bay; common dolphins and baitball**

sevengill sharks, which patrol the magnificent kelp forests that flank both the eastern and western sides of the bay. Pyramid Rock, only a 10-minute boat ride from Simon's Town, offers what is probably the world's best sevengill shark dive. The visibility is generally good (in the 15- to 50-foot range), and the kelp forests these massive prehistoric predators patrol are spectacular. The sharks are curious but docile — a good mix — and they often closely inspect divers. If you book in advance, a two-tank dive can permit a visit to a colony of Cape fur seals roughly a mile away from the shark dive. These ever-playful seals never hesitate to show off their agility and cavort and play with gay abandon around any divers willing to be their playmates. Depth in both these areas is generally around 30 feet, and the conditions are generally appropriate even for novice divers.

As the Southern Hemisphere's summer unfolds, so does the opportunity to head offshore into the realm of the open-ocean predators. Simon's Town is the point of departure for pelagic shark trips, which showcase spectacular mako and blue sharks. Rounding the dramatic cliffs of Cape Point — one of the world's great nautical landmarks — the next stop is the open sea, and this trip is about as adventurous as any you can do in a single day.

The warm Agulhas Current washes down the cape's east coast and rounds Cape Point about 15 to 25 miles offshore. The water here is warm, clear and often quite blue. Dives here are primarily undertaken by drifting in a cage that floats some 10 yards behind the boat, allowing sharks to easily circle the divers within. The use of the cage is not only to increase safety, but also to compensate for the current. Being in the cage allows divers the chance to concentrate on the action rather than keeping up with the boat. On flat, calm days divers may be allowed to drift and free dive, depending on their skill level. Water temperatures range from the high 60s to mid-70s, and visibility is typically 30 to 60 feet. Yellowfin and albacore tuna, sunfish, turtles and even marlin are seen on these remarkable trips. Be warned, though, that these excursions are highly weather dependent, so a few days should be set aside to accommodate this excursion. The best months are typically December through April.

If after the shark, whale, dolphin and seal action you feel a more relaxing expedition might be in order, the Boulders Beach penguin colony has more than 2,000 pairs of African penguins and offers a chance to get close to these comical birds in a magical setting of large boulders by a pristine sea.

There are few, if any, places that can match False Bay in terms of diversity of predators, ease with which they can be seen and year-round options for activities that range from very mild to pretty wild. Be warned that during September, October and November the wind can really blow; divers should consider contingency plans for land-based activities such as wine tasting or visits to Cape Point Nature Reserve, Table Mountain, Kirstenbosch National Botanical Garden or Robben Island (where Nelson Mandela was imprisoned).

GANSBAAI

If great white sharks are your priority, you should visit **Gansbaai**, the "great white shark diving capital of the world." Gansbaai is 2.5 hours from Cape Town by road; you travel through some beautiful areas, including Hermanus, which is

Playful Cape fur seal, False Bay

CHRIS FALLOWS

home to some of the best land-based whale watching in the world.

Gansbaai is the commercial center of shark diving in South Africa and a shining example of how living sharks are so much more valuable than dead ones. Eight operations offer varying degrees of eco-friendly shark diving, and large boats are generally the order of the day. Some operations emphasize education and conservation; I recommend seeking out one of these companies to get the most out of your encounters with these magnificent predators. On visits in early spring and late autumn, cage diving occurs near the preferred anchorage of Dyer Island, a spectacular breeding and roosting area for seabirds. Shark Alley is the name given to the channel between Dyer Island and nearby Geyser Rock, which is home to more than 50,000 Cape fur seals. Inshore visibility is typically poor (in the 3- to 15-foot range), but around Dyer Island it can be as good as 50 feet in the winter and spring.

PHOTO TIPS

For all surface photography in False Bay, which includes great whites hunting, the enormous schools of dolphins and gannet or seal action, I use a 70-200mm f/2.8 lens. When shooting breaches I like to get low and choose a focal point that's below the center of the frame. This elevates the shark farther out of the water and creates less negative space below the action. For natural predation, start by shooting slightly wide, as this provides more room for error and allows you to get a feel for the action before you go tighter. There are also many opportunities to shoot wide-angle, so a 16-35mm or similar lens is also a good idea.

For underwater shooting from the cage, divers should be aware that the ports of the cages used throughout South Africa are narrow. Strobes, unless compact or on short arms, can be cumbersome. The cage also floats right on the surface, so ambient light will be in full supply. For the pelagic and sevengill sharks I recommend camera housings that allow for wide-angle lenses (8-20mm). The subjects often come very close to divers, and the kelp forests offer a beautiful backdrop.

SARDINE RUN

The "greatest shoal on earth" is what sardine-run pioneer Peter Lamberti termed the annual movement of billions of sardines along the South African south and east coasts. Starting in April off Port Elizabeth, huge shoals of sardines move close to the coast as sea temperatures cool to around 67°F — the preferred swimming conditions for these planktivorous bait fish. With the huge shoals comes an equally impressive suite of predators. Starting with the aerial assault, amazingly well-adapted Cape gannets plunge-feed into the fish using air pockets in their wings to absorb the tremendous shock as they strike the water. The force with which they hit the water quickly attracts the attention of massive schools of dolphin, which can easily number in excess of 1,000 individuals. As the dolphins begin feeding on the fish, the sharks (duskys, bronze whalers and blacktips) arrive to join in the feeding frenzy. The final and most impressive sardine assassins are the 50-foot-long Bryde's whales, which soon appear and plow open-mouthed through the baitballs like giant ice cream scoops.

When the action is hot, it's on fire, but you do need to allow yourself time to get lucky; a stay of at least five to seven days provides a realistic chance of seeing some good action. The baitballs are undoubtedly the pinnacle of the show, but there is also a migration of humpback whales along the coast that coincides with the run. Most days provide a chance to shoot breaching humpbacks.

It can get dangerous underwater when the frenzy is in full swing, so pay close attention to divemasters. It is definitely worth doing your homework to make sure the company you choose has experience with high-action baitball situations. Baitballs are dynamic and, as such, shift like willow trees blowing in the wind. While you want to be close to the action, you do not want to get caught up in the ball. Not only can that dissipate the action, but you could literally do a "Jonah and the whale" as Bryde's whales tend to race through baitballs, mouths agape. If you are in their path the results could be unpleasant, to say the least.

Generally the key to a great day on the run is visibility of at least 15 feet and focused gannet action. When the gannets are diving with a purpose it is likely that the other players will turn up, and good visibility means your chances of seeing something special are high. You will probably be diving from 25-foot rigid inflatable boats (RIBs), and it's wise to have your gear well organized. When you chance upon action, the sooner you can get in the water the better. Typically the activity will occur in 5 to 25 feet of water, and the water temperature will be in the high 60s.

When photographing sharks, let them come to you instead of chasing them. Position yourself next to the action, and for a few minutes simply watch what's going on. By doing this you will begin to see patterns in how the dolphins sweep into the shoals in well-orchestrated attacks, and you'll learn where the sharks spend most of their time in the ball. Finally, you'll pick up on how the light allows different shooting opportunities. By spending just a little time observing you'll be better at predicting where the action will be next, and that will definitely improve your results. It is also a good idea to have a vigilant dive buddy — when the action heats up the sharks can become very "friendly," and a gentle push away may be required.

The peak time for sardine-run activity is May through July. Port Elizabeth, East London, Coffee Bay and Port St. Johns (in that order) are the towns that people who follow the run use as bases to access the shoals as they move up the coast. Be sure to check on travel logistics, cancellation fees for bad-weather days and available down-time options when booking one of these trips.

A 14-foot great white launches a polaris-style breach at Seal Island — the home of *Air Jaws* — in False Bay.

CHRIS FALLOWS

TOBIAS FRIEDRICH

ALIWAL SHOAL AND PROTEA BANKS

BY PAM LE NOURY

The KwaZulu-Natal coast of South Africa is pleasantly affected by the warm waters of the Agulhas Current, which run down from the equator and make the country's east coast warm and tropical. Even at 30° south divers will experience balmy waters (72°F to 77°F in summer and 60°F to 70°F in winter) and a smorgasbord of tropical and temperate species vying for space on the fabulous and far-out rocky reefs of Aliwal Shoal and Protea Banks.

Aliwal Shoal and Protea Banks are home to a great diversity of hard and soft corals, sponges, reefs fish (more than 1,200 species), turtles, invertebrates and sharks. In the summer months you might see whale sharks, manta rays, guitarfish and tiger sharks. Protea also gets hammerheads and Zambezi (bull) sharks. In the winter months you can dive with congregations of ragged-tooth sharks (also known as sand tiger or grey nurse sharks), and you can listen for the eerie calls of humpback whales as they head north to breed. Year-round you can experience some of the best shark encounters on earth with as many as 80 blacktips circling around a baited dive in midwater near either of these reefs.

ALIWAL SHOAL

Aliwal Shoal is three miles offshore and partially in a marine protected area. It is serviced by several dive-charter operators in the small town of Umkomaas, which has grown into an interesting little dive-bum mecca. The charter boats are mostly RIBs, and they usually launch from the Umkomaas River. Boarding the RIB, which accommodates 10 divers and a divemaster, is quite easy in the river, but you'll have to hold on tight as the skipper powers under the bridge and out into the surf. This often involves some fast turns or punching through waves — it's all quite thrilling. If the tide is too low the boats will launch from the beach, and that involves pushing the boat out into the sea and only jumping into the boat once the engines are in sufficiently deep water. Diving at Aliwal is not for wimps.

It's just a 15- or 20-minute boat ride out to the shoal, and boats often spot dolphins, whales (in winter), flying fish and seabirds on the way. Once at the site, divers gear up, and it's "3-2-1-go" with a backward roll off a pontoon. Visibility is inconsistent, particularly in the summer, but it averages about 30 feet and peaks at around 80. A mild current and a little surge are typical, and stronger currents are common as well. The reef runs north to south for three miles, and there are many lovely spots of interesting topography between 30 and 90 feet. Most dives are no deeper than 60 feet.

A summer highlight is the presence of guitarfish and rays — including mantas that cruise overhead. In the winter the highlight is the ragged-tooth sharks (*Carcharias taurus*) that congregate there to breed. You can see 15 to 50 of them hovering in caves and scattered all across the reef — all totally undisturbed by divers. Whether you see sharks or not, make sure to look out for fallen shark teeth in the sand.

PROTEA BANKS

If Aliwal is not for wimps, Protea is restricted to mermaids and Neptune's brethren — confident and experienced divers only. It's well worth tuning up your skills (perhaps at Aliwal Shoal) before

you dive Protea, as it seldom fails to deliver excellent sightings. Operators launch RIBs from Shelly Beach (50 miles south of Umkomaas), and divers push the boat into the shore-break for a wet launch through the surf. It's a 15- to 20-minute ride out to the reef (which lies five miles out to sea), and before the plunge everyone deflates their BCDs fully so they can do "negative entries" — back rolls into the water followed by immediate finning toward the seafloor. This method offers dive groups the best chance of hitting sites accurately in the strong currents (strongest at the surface) common to the banks.

The reef lies between 90 and 130 feet; it's a deep dive, so be prepared for the possibility of nitrogen narcosis. The reef is colorful with plenty of fish, good topography and interesting caves and swim-throughs. In winter the ragged-tooth sharks congregate here in large numbers, and year-round it's possible to see Zambezi sharks — usually keeping an eye on you from a distance. Watch for manta rays, tiger sharks and large schools of scalloped hammerheads in summer. No-deco time is short, and the current pushes you along quite enjoyably, which allows you to cover a significant distance during your slow ascent. That's the best time to listen for humpback whales (in the winter) and watch for … well, just about anything.

Both Aliwal and Protea feature opportunities for baited dives. These memorable experiences involve a chum bucket suspended from a buoy at about 30 feet. The chum bucket is a large, round, perforated ball filled with sardines — like a tea bag of shark food. The bucket drifts along, the divers drift with it (alongside it, not down-current of it), and sharks from all over the area pick up the scent and travel upcurrent to investigate. Many blacktip sharks (*Carcharhinus limbatus*) are now so habituated that they start circling as soon as the boat arrives. These days it's common to get 20 blacktips, and divers may see as many as 80. They buzz around hungrily, zipping in and out. It's intimidating at first, but soon you'll begin to relax, and you might even feel like the sharks barely notice you.

That feeling of relaxation may be suddenly dashed when, in the summer, a tiger shark arrives on the scene, large and confident, gliding nonchalantly between divers to approach the bait and pick off escaped morsels. Soon enough you will close your gaping mouth and resume breathing to realize that you are hovering in midwater with a large ocean predator. If it's interested in you at all, it won't act in a threatening manner; regardless, it will be absolutely magnificent. New or unhabituated tiger sharks may loiter for a while, circling wide before they come closer. When they do approach, they'll check you out with their big black eyes — an experience you may never forget. Before long there might be 30 sharks of three or four species around you, circling the bait as you hover there in awe. It's a truly amazing experience. In terms of a topside South African safari, it would be like walking up to a lion kill and standing there among the lions, hyenas and vultures — just watching. AD

Two large tiger sharks curiously approach the camera at Aliwal Shoal on the south coast of KwaZulu-Natal.

Opposite: **Thousands of common dolphins churn up the surface waters just inside Cape Point, the western entrance to False Bay.**

DOUG PERRINE

A Well-Rounded Strait

A diver hovers over the soft-coral-covered reef at California Dreaming.

THE BIG AND SMALL OF LEMBEH

TEXT AND PHOTOS BY ANDY AND ALLISON SALLMON

Five was obviously the magic number. We'd had some great dives on the wreck of the ***Mawali*** over the past week, but as we began our fifth descent toward the large freighter, we knew instinctively that something had changed. There was more current than on our previous dives, but the visibility had improved. We could clearly see the bow more than 100 feet away from the mooring.

We made a beeline for it, sensing that whatever we would discover would be extraordinary. We were right. Three gaudy scorpionfish sat in various positions, innocently staring up into the water column. As we surveyed the scene, the current abruptly strengthened. It became instantly clear why the predators were arranged as they were. They were hoping to ambush glassfish, which had begun clouding the ship's prow in the brisk flow. A tight school of mackerel gulped greedily at the water that moved rapidly past the deck, and in the distance I saw a pair of large cuttlefish hunting next to a cluster of sponges. With this kind of sensory overload, it was hard to know where to look, much less where to point our cameras.

A peacock mantis shrimp protects a clutch of eggs at the mouth of a rocky burrow.

Our air supplies didn't last long in those conditions, however, and before we knew it we were sadly heading back to the mooring line. But our chagrin was short-lived. The resident school of batfish near the line was taking advantage of the swift current to feed, and they swirled around us indifferently, forming a ravenous wall of gold and black. A pair of scrawled filefish darted hungrily between the offgassing divers gripping the line, and several large squid hovered just out of camera range, gorging themselves in the flow. We couldn't help but laugh — is this a shipwreck or a buffet? I guess it depends on your perspective.

We surfaced jubilantly, and as we joined the other divers on the boat, the elation was palpable. When the captain started the motor for the 10-minute ride back to our resort, however, we noticed that one diver was sitting quietly, staring back at the mooring.

"Is everything OK?" I asked him.

"Huh? Yeah. Sorry. I just can't believe it," he replied.

"Can't believe what?"

He turned to look at me, perplexed. "I've been all over the world," he said. "That was one of the best wreck dives I've done anywhere, and I am in the middle of Lembeh Strait. No one will ever believe me."

GRAINS OF TRUTH

Sand. To the average vacationer, the word brings to mind warm sunshine, idyllic beaches dotted with swaying palm trees and frothy umbrella drinks. To many divers however, it is the definitive four-letter word. It gets into our wetsuit booties, it stretches endlessly between the parking lot and our favorite shore dive, and it threatens to destroy the O-rings of our regulators, camera housings and other gear.

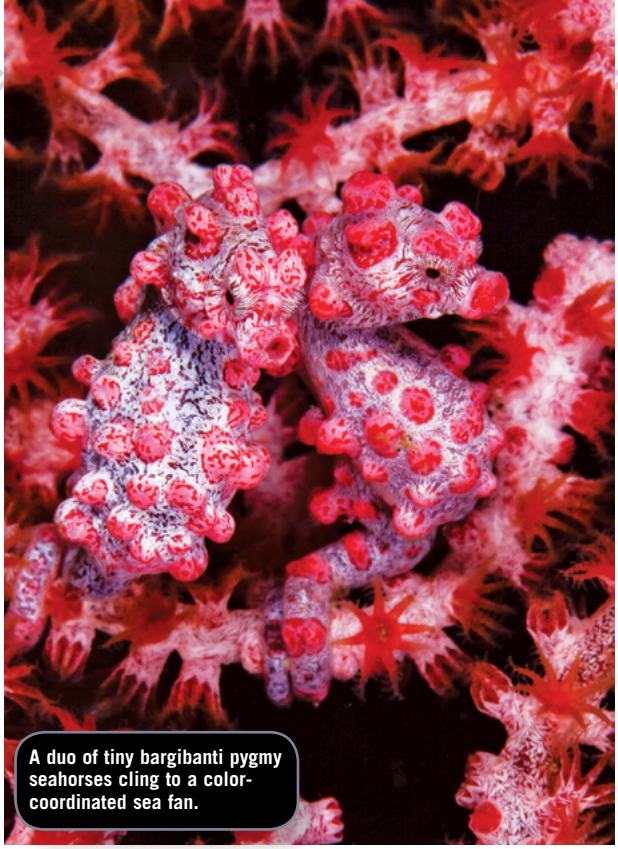
Consequently, it can be difficult to convince divers that sand-heavy sites are worth a prolonged visit. Against the odds, Lembeh Strait has become a dream destination. Nowhere else do seemingly unremarkable stretches of seafloor yield such an astounding variety of strange, diminutive creatures. Eager critter hunters flock from all corners of the globe to partake in the bounty of this sandy paradise, a place largely considered to be the muck-diving capital of the world.

The grainy stuff comes in two varieties here: black and white. Sites like **Hairball**, **TK** and **Air Prang** feature fine, black volcanic sand and are among Lembeh's most famous, though they require diligent attention to positioning. One aberrant fin kick can generate a resilient gray cloud of silt that will infuriate nearby divers. Sites with white-sand or coral-rubble bottoms such as **Rojos, Makawide** and **Critter Hunt** are also popular — and they have the advantage of being somewhat more forgiving when finning mishaps occur. In the end, the color of the seafloor hardly matters; both are equally yielding of incredible creatures.

A TITLE WELL EARNED

Our trip to the world's muck-diving capital was an "off" visit, or at least that was the story our dive guide tried to sell me. Given that I spent 20 minutes photographing a blue-ringed octopus the morning after my arrival, I wasn't buying it.

Initially the theme seemed to be shrimp. Commensal shrimp were absolutely everywhere: on soft coral, black coral, nudibranchs, crinoids, sea urchins, sea cucumbers and anemones. I'm quite certain that I could have found a shrimp living symbiotically on another shrimp if I'd looked hard enough. After a few days our guide decided that shrimp were for amateurs. There was not a single hairy frogfish to be found, and that apparently meant things were slow.



A duo of tiny bargibanti pygmy seahorses cling to a color-coordinated sea fan.

I disagreed. Once I'd gotten my fill of photographing shrimp, I determined that if the local marine life had been informed about the "off" nature of our visit, that had only served to increase their hormone levels. Rampant procreation was evident, dive after dive. Everything seemed to be either mating, tending eggs or freshly hatched. Mantis shrimp held large egg clutches, while mandarinfish paired off in the water column at dusk. Squid guarded nests on mooring lines at multiple dive sites. Miniscule juvenile boxfish and filefish bobbed wide-eyed in front of our cameras, while baby barrimundi and sweetlips wiggled shyly next to coral heads.

We moved from site to site, logging viewings of fantastic creatures the likes of which I had only read about: Lembeh sea dragons! Ambon scorpionfish! A pair of tiger shrimp (again with the shrimp)! We also saw painted frogfish and warty frogfish, frogfish the size of a fingernail and frogfish bigger than a cat — but still no hairy frogfish. Our guide was beside himself.

One afternoon, after a strenuous day of critter overload, I saw him glumly filling tanks for a night dive. I walked over and patted him consolingly on the shoulder. I leaned toward him and quietly revealed my greatest insecurity, a thought that had haunted me since the second day of our trip. "Thank goodness this is an 'off' visit," I said. "If it were an 'on' visit, I don't think I could keep up."

CEPHALOPOD CENTRAL

Lembeh tends to attract a goal-oriented crowd. In other words, it's not uncommon for visitors to arrive bearing hopeful suggestions for their dive guides so they can make the most of their time spent looking at the sand. Since Lembeh's bizarre underwater residents change address a lot, most guest requests don't refer to particular sites but particular creatures. Critter wish lists are the order of the day in the strait, and while they vary, there is one thing that's common to nearly all of them: cephalopods.

Perhaps that's because this class of animals, which includes octopuses, cuttlefish and squid, singlehandedly showcases the incredible diversity of Lembeh. The beautiful-but-deadly blue-ringed octopus, the adorable bobtail squid and the brilliant flamboyant cuttlefish are all creatures divers wait years to see, and these three species represent just a small fraction of the cephalopod population that can easily be viewed within the strait.

Another reason for their popularity might be their substantial brainpower; these creatures rank among the Einsteins of the ocean. Cuttlefish seamlessly alter their coloration to blend with their environment and (it's thought) to communicate; coconut octopuses will play peek-a-boo with observers from their chosen dwelling, be it a coconut shell or a discarded bottle. If that's not convincing enough, we refer you to the mimic octopus, which can hide in the open by emulating lionfish, sea snakes and other marine animals.

The one disadvantage of the fabulous cephalopod density in the strait is the inevitability of being lured away from one species to admire another. Anywhere else, we would be thrilled to look up from viewing a flamboyant cuttlefish to discover that we were being closely watched by a broadclub cuttlefish, but this type of encounter is just a starting point in Lembeh. A glaring example of this phenomenon took place during a night dive at **Jahir**, where we spent 90 amazing minutes moving exclusively from one cephalopod species to another. That evening's lineup included a poisonous oscillate octopus, multiple coconut octopuses, a wonderpus, a starry night octopus and, as a finale, reef squid in the water column during our safety stop. Now that's a wish list.

THE WIDE WORLD OF LEMBEH

It isn't easy to walk away from a sure thing, and Lembeh's concentration of incredible small creatures is about as close to a sure thing as divers may ever experience. After a couple

"THANK GOODNESS THIS IS AN 'OFF' VISIT," I SAID. "IF IT WERE AN 'ON' VISIT, I DON'T THINK I COULD KEEP UP.'"

Mandarinfish pair off at dusk in a fleeting mating ritual, making for a desirable and challenging photographic subject.

The multicolored crinoid shrimp's garish coloring and pattern are a near-perfect match for the host crinoid it inhabits.

Right: A snorkeler enjoys the crystal-clear water and lovely shallow reefs of Pantai Jiko.

How to Dive It

Lembeh Strait is located in Indonesia's North Sulawesi province between the mainland of Sulawesi and Lembeh Island. The diving is good year round, and the strait's location near the equator means it is not affected by typhoons. There are seasonal variations in the weather and water temperature, though seasons have been less predictable in recent years. The dry season tends to last from June through September, generally bringing with it cooler water (75°F to 79°F), good visibility and the optimal chance of incredible critter life.

The rainy season often spans November through April and is commonly accompanied by increasing water temperatures (79°F to 84°F) and lower visibility. Weather and sea conditions during the rainy season can prevent access to sites at the northern reaches of the strait, but sites on the east side of Lembeh Island are more likely to be accessible during the rainy season.

There is a hyperbaric chamber in Manado, a two-hour drive from Lembeh Strait.

of weeks of inspecting the sand, however, we knew we'd hit a wall. We needed a rest, and it was time to focus our eyes (and our camera lenses) on something larger than a deck of cards.

Our dive guide welcomed our request to do something a bit different, and he signed us up for a visit to **Bangka Island**, just north of the mainland of Sulawesi. The boat ride would take about two hours if the ocean cooperated, he told us, so we'd stay there for three dives, conditions permitting. The weather obliged, and we spent the day photographing Bangka's renowned soft-coral-covered reefs in crystal-clear water.

That one-day trip inspired our curiosity. What other offbeat diving opportunities could be found near the muck-diving capital of the world? And would they all require long boat trips? When we approached the dive staff about paying some visits to other local reefs and wrecks, they excitedly got on board with the idea and helped us set up a week's worth of dives that would allow us to view a very different side of Lembeh.

The next day, while everyone else's boat went to search for tiny creatures, ours ventured around the southern tip of Lembeh Island. As we motored toward an uninspiring rock that pierced the surface of the water, I felt a momentary pang of regret about missing that morning's muck dives. (Would the guides find the pair of pygmy seahorses that had been seen on Tuesday?) But then a thought occurred to me: Some of the best dives I've ever done started with an uninspiring rock piercing the surface of the water.

When we reached the rock, we looked down and were greeted by the sight of the seafloor 95 feet below. Thoughts of tiny creatures immediately disappeared. We geared up and entered the water in record time.

Buniang was the polar opposite of the strait's archetypal critter dives. Under the ocean's surface not an inch of that incredible rock was bare. Colorful soft corals and tubastrea swept with anthias and fusiliers overwhelmed every inch of the site. We watched a pair of whitetip reef sharks swim lazily past and then turned to watch as two banded sea kraits weaved between the rocks. When we began our ascent we discovered a huge canyon down the center of the pinnacle that was crowded with large crimson sea fans and a swirling school of striped catfish.

To occupy our surface interval, we headed over to a nearby beach, **Pantai Jiko,** for some snorkeling. The water was incredibly clear, and as I looked down I noticed a sheer wall rimmed with large sponges. As it turned out, that was our next dive site; we soon descended to discover a pristine wall covered with huge sponges of all shapes and colors. We passed a patch of barrel sponges as big as motorcycles to discover that the wall was covered with a tangle of rope, paddle-shaped and encrusting sponges.

That was just the beginning, and as the days passed, the guide who made finding blue-ringed octopuses look like child's play began to get very skilled at locating larger subjects. **Dante's Wall,** at the northeast corner of the strait, was a lovely drop-off frequented by turtles and coated in multihued gorgonians, soft corals and starfish. Dense pockets of anthias swarmed the shallows, and predatory lionfish had followed; they moved between the sea fans and whip corals with graceful, ominous ease. A bit farther south lay the addictive **California Dreaming**, a stunning, current-swept reef loaded with fiery orange and pink soft corals. Unbelievably, we were just around the bend from a site where we'd searched for nudibranchs in the rubble two days earlier, a fact that quickly became a bit of a joke ("Are you sure you want to dive California Dreaming? We could go around the corner and hunt in the rubble instead."). Even traditional critter-hunting sites such as **Nudi Retreat** and **Nudi Falls** yielded some incredible wide-angle photo opportunities, including gorgonian-covered bommies and soft-coral branches within inches of the water's surface.

There are also some lovely artificial reefs in the strait. The ***Mawali***, the wreck featured in our introductory tale, became a favorite. This large World War II-era Japanese freighter, which rests on its port side in 95 feet of water, has attracted a phenomenal array of marine life and is located minutes away from many of the popular dive resorts. The propeller, engines and bridge are intact, and the superstructure is layered with hard and soft corals that compete for space with sea fans and barrel and vase sponges. Nearer to the southern edge of the strait is the smaller ***Kapal Indah***, which translates appropriately as "beautiful ship." This fishing boat sits on its keel in 90 feet of water near an equally beautiful sloping reef. The intact engines are easily visible, and the superstructure is overgrown with soft and black coral.

With our research concluded, our outlook toward Lembeh had shifted decidedly. We had only a few days of our visit remaining, and we didn't want to miss a single thing the strait had to offer. We began bringing cameras suitable for both small creatures and larger vistas on the dive boat, no matter the destination, just in case.

On our final day, this heedfulness (some might call it paranoia) came in handy. During my safety stop at a well-known macro site, I spotted a lovely, pale pink giant frogfish on a gray sponge. I sighed regretfully. The frogfish was simply too large to photograph with the camera I carried, which was equipped to take images of creatures no bigger than a dime. Seconds later, I felt a tap on my shoulder. I turned to discover that my guide, one of the best critter spotters in the strait, was proudly holding my wide-angle camera rig, which was perfectly set up to photograph the giant frogfish. Delightedly, I exchanged cameras with him and snapped a few images before surfacing to meet the waiting boat.

I looked at my guide and said effusively, "Thank you so much! You knew?"

He smiled shyly, shrugged and simply responded, "That was wide-angle, right?"

"Yes," I replied, laughing. "Yes, that was absolutely wide-angle!" AD

A desire to encounter a relatively rare dugong in its natural environment can quickly degenerate into a mob scene straight out of a horror film.

the observer effect

AN ILLUSTRATED ESSAY BY DOUGLAS DAVID SEIFERT

One universally accepted principle in the study of physics is the observer effect, which acknowledges that the very act of observation alters the phenomenon being observed. This fundamental law exists in the underwater world as well, and it is man himself who effects the change.

When you dive into the alien world of the ocean, your simplest actions — regardless of your intent — and your very presence, by the nature of your physical size, equipment, movements and sudden appearance, have an effect upon the environment's natural inhabitants.

Like it or not, human presence in the ocean is intrusive. The life forms there face consequences from humans' clumsiness or carelessness as well as from their purposeful actions. This not a judgment that requires the assignation of good, bad or neutral designations; it is a fact. Actions cause reactions. In addition to obvious activities such as tropical fish and shell collecting, spearfishing, underwater photography, and the feeding or attracting of particular species, human engagement with marine ecosystems brings about effects that are direct results of human presence.

These effects range from the relatively minor (disturbance or temporary displacement) to the more blatant (the interruption of feeding or mating) to the indefensible (harassment, injury or provocation of a creature's fight-or-flight response). The most serious repercussions include fatal outcomes for sea life. Scuba divers who are caught up in the strange beauty and complexity of a reef environment may fail to ponder how the inhabitants of that reef react to their presence.

Blue Corner is arguably Palau's signature dive; it's a moderately shallow rock and coral plateau jutting out from an inshore fringing reef with a sheer drop-off into deep water. The site is renowned for excellent visibility and a strong current that runs parallel to the edge of the reef. It offers divers a chance to see schools of many different species of fish, such as chevron barracuda, trevally, snappers and others. Sea turtles and sharks cruise past in the blue, well within a diver's field of vision. The dive site is a crowd-pleasing favorite, and the majority of divers surface delighted with the experience and absolutely unaware of any impact they may have had on the site.

Once back aboard the boat, there will be mention, perhaps even proud boasting, of seeing sharks "naturally" out in the blue, unlike at other dive locations where scent attractions are used to overcome sharks' natural wariness. But upon closer inspection this is a delusion. If you were to dive Blue Corner without other divers you would discover an entirely different Blue Corner. The schools of shining, silver chevron barracuda that can just be seen in the distance during a high-traffic dive are usually on the reef flat itself, above the sand gullies and schooling between the coral heads. They're not out in the blue, among their predators and away from fish they may prey upon. The same holds true for the schools of trevally and snappers. These are reef fish, which by definition are naturally inclined to stay on the reef. Even the sharks would be above the reef flat, cruising among the coral heads, patrolling their territory in search of unwary prey.

When a group of divers approaches a reef, moving along with strong and determined fin kicks, fish see the divers' physical forms, and the silhouettes are unlike those of any other animal likely to be encountered in the sea. Divers are rather large — of a size generally associated with predators — and have what appear to be two tails moving up and down. Then there is the noise. Perhaps more than any other sound divers make, the gurgle and bubbling of air exhaled through regulators is incessant and very loud. This is especially true to animals with acute acoustic sensitivity — a common adaptation in a medium in which sound travels five times faster than in air. "The Silent World" is anything but silent when scuba divers enter the sea.

Compounding the loud noise is the related effect upon a fish's "sixth sense": its lateral line. The lateral line is a system of sensory organs that aids in predator–prey interaction, spatial awareness and orientation. It relays signals to the fish's brain about objects in the vicinity as well as continuously monitoring the fish's immediate surroundings, analogous in practice to a proximity alarm or whiskers in mammals.

With these senses combined, fish not only can see the physical form of an approaching diver and hear the noise of the equipment, but they also can watch as the bubbles emanating from a diver's regulator float upward, expanding as they ascend and manifesting the signature form of a large inverted pyramid above the diver. In the sensory-processing centers of a fish brain, this stimulus is generally alarming enough to interrupt its routine and trigger its instinct to flee.

Somewhat tragic instances of diver displacement can occur with egg-laying fish, which are extremely active and expend a tremendous amount of energy to bring about the next generation. They carefully tend to their nests of thousands of embryos gestating within fragile, transparent eggs: They aerate the eggs to make certain that oxygen-rich water bathes them and to prevent the growth of algae; most important, they defend those nutrient-rich eggs against predators until the young hatch.

A titan triggerfish may well be able to defend its egg nest against a diver who inadvertently crosses into its protective zone. The diver is perceived as a large predator by the triggerfish, which is fearless and unrelenting in defense of its territory against the hapless diver. The triggerfish will swim to confront the diver at frenetic speed and perhaps bite a chunk out of him with its formidable teeth and strong jaws. However, while the triggerfish is on the offensive, opportunist egg-eaters such as wrasses, surgeonfish and butterflyfish will take advantage of the opening in defenses. They dart in to gorge upon the momentarily unprotected eggs in an unabashed frenzy, while the triggerfish deals with the intruding diver.

A similar outcome occurs when a diver strays too close to fish such as the sergeant major damselfish. They lay their nests of thousands of eggs upon rocks and protect them from neighboring generalist predators; but rather than confront a diver, the tiny damselfish flee in the interest of self-preservation, abdicating their protective roles as guardians. The opportunists instantly swarm, plundering gluttonously. In these situations, the future fish generations are affected by inadvertent intrusion.

Divers who are more observant and situationally aware — better able to read the reef and the behavior of its inhabitants — and conscious of their impact on those inhabitants can take measures to avoid interfering or at least minimize the effects of their presence.

Divers have been frequenting some sites for 30 years or more, and some animals have figured out how to use divers to their advantage. This is especially evident on night dives at some well-established sites in the Red Sea. As you swim along in the perfect blackness of the night with your torch illuminating finds here and there, a glance to the periphery of your light's beam will reveal one or more lionfish, delighted to have a diver pointing out sleeping fish to be gobbled up. Alas, these situations have become unavoidable unless one wants to give up night diving entirely.

Some planned dives are unquestionably conscious decisions to enter situations that may disrupt animals' lives. Visits to cleaning stations can be counted among these. Cleaning stations are particular spots on a reef that are home to various species of gregarious wrasses, whose niche on the reef is to feed upon external parasites on the bodies of manta rays and other large fish.

It's easy enough to rationalize such excursions as not being too intrusive. With careful planning, decent instruction, a

CONNECTIONS: THE ART OF OBSERVING SEA LIFE AROUND THE WORLD

Clockwise from top left: **pygmy seahorse in Raja Ampat; barracuda school at Blue Corner, Palau; a fish-eat-fish world in Raja Ampat; a humpback calf checks out the camera in Tonga; a manta ray cleaning station in Raja Ampat; a cleaning station at Alcyone, Cocos Island**

modicum of skills, good breathing technique and luck, divers may observe cleaning behavior — a fascinating symbiotic arrangement between enormous manta rays and tiny wrasses. Generally, if conducted in a small group of participants who minimize their silhouettes by trying to blend in with reef cover, staying low, keeping movement to a minimum, breathing slowly, leaving an open passage for the mantas to approach and depart, and allowing time for the manta rays to become used to the bubbles, the cleaning phenomenon can be observed. The normally wary manta rays may eventually overcome their predator-avoidance instincts and become accepting of the intruders' presence to be relieved of parasites. But should another boatload of divers drop in on the cleaning station while the first group remains motionless and respectful of the animals' comfort level — as happens all too frequently in the Maldives and Indonesia — then the mantas will bolt for the blue and keep a distance from the cleaning station.

Some might conjecture that the mantas could go to another cleaning station unknown to divers; that may be true, but it fails to consider the caloric needs of the wrasses that perform the cleaning service. If they cannot feed on the parasites brought to them by large manta ray hosts because divers keep the mantas away from those cleaning stations, do the wrasses eventually starve and die? As most fish are territorial, it seems unlikely that small wrasses forced to migrate from their cleaning station due to diver pressure would be welcomed by the wrasses established at another cleaning station.

When it comes to encountering cryptic critters, invasive intrusion is a given. Pygmy-seahorse fascination is a well-known scenario on dive boats. Speculations about whether constant intrusion, lights or photography has a detrimental effect upon the diminutive members of the seahorse family are legion. On any trip within the pygmy seahorse's range, it is inevitable that a dive guide will indicate one using a pointer stick, a magnifying glass or his fingers to identify a quarter-inch seahorse hunkered down in the branches of a gorgonian sea fan. It is a rare situation when the guide, in the process of doing what is expected, does not touch the gorgonian to make the flowerlike polyps retract to improve the view of the seahorse. The effect of this intrusive custom on the pygmy seahorse is obvious, but the overlooked effect is that the polyps retract a lot more than they naturally would, and when the polyps retract the coral cannot feed. Furthermore, these human interactions may obliterate the protective slime that covers the sea fan, possibly weakening it and making it susceptible to disease.

Even snorkeling can have an observer effect, as I'm often reminded when exploring certain inshore reefs of the Red Sea. There is a shallow bay where tourists are taken daily on a dozen or more safari boats, each carrying as many as two dozen vacationers, to have a snorkel experience among the bay's corals and fish and watch green sea turtles feeding on seagrasses in the shallows near the shore. It is not uncommon to see more than 100 people spread out across the bay at the same time. While they are told in briefings not to stand on or touch the corals or come in contact with the sea turtles, with so many people the exceptions occur daily, and the obvious transgressors behave appallingly. When the turtles are left alone, they feed on seagrass for long stretches of time, surface to breathe and continue all day long; when the turtles are disturbed, they move off with slow but deliberate speed.

Another unfortunate and not-infrequent situation in the region occurs when the area's sole dugong is in the bay, also feeding upon seagrasses, and the general alarm is raised to the throng of tourists, who erupt in a cacophony of screams and shrieks. This dugong, known locally as Dyson, behaves uncharacteristically for a dugong, a species that's generally elusive and retiring. Dyson is tolerant toward humans intruding in his feeding areas, yet even Dyson has his limits.

What starts off as a genuine desire to observe a relatively rare, large, charismatic and harmless aquatic mammal in its natural environment degenerates quickly into a mob scene straight out of a horror film. Rather than keeping a respectful distance and floating passively above the animal as it feeds rather obliviously 15 to 20 feet below, snorkelers kick their fins and paddle furiously, pushing past each other, kicking, elbowing, clawing and even climbing over one another to be directly above the animal or next to it when it has to surface for air.

The dugong uproots and munches on seagrass stalks while spitting out billowing plumes of sand as it makes furrows in the soft seabed. A dugong's strictly seagrass diet requires an inordinate amount of feeding, as seagrass is modest in nutrition. Thus, dugongs, like their terrestrial cousins the elephants, need to eat constantly to thrive.

When humans motivated by excitement or a lamentable need to show off begin dive-bombing the feeding dugong (or trying to touch or grab or ride it) and crowding it when it comes to the surface to breathe, its behavior changes. Dyson is not only harassed, he is actively pursued and disturbed to the point that he can no longer feed. The eventual outcome is that Dyson departs the bay, swimming away forcefully and leaving shouting, deluded humans high-fiving in its wake. These snorkelers pushed the act of observation into an act of harassment, and the result for the dugong is that he cannot feed where he needs to feed and must expend precious energy searching for food where he can feed on it in peace — or die trying.

The possibility of interacting with sea life is perhaps the most irresistible and addictive aspect of going into the sea, but we have to accept that every action we take in the sea will likely have consequences for the life there. This is an unavoidable aspect of submerging ourselves in a world of which we are not naturally a part. Each individual must decide what kind of impact he or she is prepared to live with.

In many places, the animals most likely to interact with divers are marine mammals. This is not as common an occurrence as it might be because laws in many countries forbid humans from getting close to marine mammals, particularly whales

Territorial females such as this titan triggerfish may guard their egg nests aggressively against all comers.

and dolphins. But for those willing to travel to places where regulations are more lax, the rewards of marine-mammal interactions are great. In Mexico, the Galapagos Islands and South Australia, among other places, sea lions can be inquisitive and playful. Some sea lions will seek interaction with waterborne humans by gently biting a diver's fins or wetsuit hood or by swimming dizzying loops and barrel rolls around a diver.

If one travels to one of the few places where swimming with whales and dolphins is permitted, then the opportunity for truly magical experiences is a distinct possibility. In the Kingdom of Tonga, for example, it is legal to swim with humpback whales when with a licensed operation and in the company of a licensed guide. Humpback whales migrate from Antarctica each year to mate and calve in the tropical waters of the South Pacific. The whale season is four months long, and during that time a newborn whale calf learns about the world around it as it grows an inch and 100 pounds each day on its mother's rich milk, gaining strength for the long journey back to Antarctic waters at the season's end. During this time each mother keeps watch over its baby but grants the young whale a bit of leeway to explore the new world. Calves can be inquisitive and will leave the protection of their mothers to investigate strange things, and to a newborn whale there are probably few things stranger than human beings snorkeling in rolling seas. As the snorkelers are clumsy, so too are the humpback calves just learning how to swim and dive and breach.

If one is lucky, while floating next to a 45-foot humpback whale mother with her calf tucked beneath the shadow of her body, her great eye will fixate upon your intent gaze across a few yards of open water, and you will instantly comprehend that you have made eye contact. A shudder, a tingle, a frisson may accompany the realization. There is no way of knowing what the whale is thinking, but there must be a glint of recognition — an acknowledgement of a kindred species. This recognition found in the eye of any animal connects us to the natural world from which we have become increasingly alienated. When a marine mammal initiates an interaction with a person, there is an effect — a cross-species connection — even if it lasts only moments.

When an animal with intelligence different from our own, living in a world so unlike ours, willingly overcomes its fight-or-flight instinct and draws in for a closer look at strange human animals in an aquatic environment in which they are ill-equipped to survive, then one thing is certain: The animal is the observer, and the effect they are having is on us. AD

Emergency Simulations for Dive Professionals

BY TEC CLARK

It was a great day to be diving at the lake— until a panicked diver ran up to report a missing buddy. A group of dive professionals were nearby, and they hastily entered the water. Several lines of bubbles moved away from shore in random patterns. A short time later, Sheri and Jill, a pair of dive instructors, surfaced with Jimmy, an unresponsive, 240-pound diver. They towed him to the dock, where they fumbled their way through removing his equipment and theirs; after a few false starts they managed to get the large, limp diver out of the water.

Once the two instructors had the man on the dock they began CPR. Sheri walked quickly up the hill to the parking lot to retrieve the oxygen unit, the first aid kit and emergency phone. To her dismay the van was locked; she ran back down the hill and began rifling through her colleagues' backpacks to find the keys to the van. She found a cell phone and placed a haphazard call to emergency medical services (EMS). At this point Jill was exhausted from performing CPR alone since the time they got Jimmy out of the water. She began yelling at Sheri, ordering her to move faster and to come help. Sheri's reply was thick with frustration and colorful language.

Sheri found the keys, ran back up the hill and acquired the emergency equipment from the van. She made it back down the hill and onto the dock where she flopped to her knees, opened the oxygen unit and stared blankly at its parts — the unit had been disassembled in a rescue class the previous week. Jill saw Sheri freeze up and asked her to take over CPR. Jill set up the oxygen unit and administered supplemental oxygen to Jimmy. At about that time some of Sheri and Jill's colleagues surfaced and asked what was happening. Twenty-four minutes had elapsed since Jimmy's buddy asked for help; Sheri and Jill were depleted, fatigued, frustrated and desperate for relief.

"Time! End scenario! End scenario!" bellowed their evaluator. It was a drill — an in-service training scenario — but you wouldn't know it by the reactions of the two emotional instructors. Jill was shaking and visibly angry. Sheri cried and immediately got defensive. Everybody was aware it was a training exercise, but it was this group's first full-blown emergency simulation, and it featured many of the complexities of a real incident. Gone was the modular training familiar to students in CPR, oxygen provider and first aid classes. In its place were confounders including sand, wetness, adrenaline, sweat, emotions, wetsuits, confusion, shouting and disorder — the true benefits of realistic training scenarios.

THE NEED

In-service training is on-the-job education or skills development designed to improve staff members' capabilities. Its importance for dive professionals cannot be overemphasized. Although this type of training is most commonly associated with police forces, EMS crews and lifeguards, recreational industries including snow sports and whitewater paddle sports practice it as well. The risks inherent to scuba diving mean dive professionals may be called on to act with competence, proficiency and professionalism when an incident occurs.

Dive professionals attend training-agency meetings and trade shows, and they take courses to maintain their CPR, first aid and oxygen provider credentials every two years. Although these are all important aspects of their continuing education, meetings and courses cannot fully prepare people for situations that require split-second decisions in stressful circumstances — circumstances such as kneeling, sopping-wet, over an unresponsive diver in heavy seas while dive buddies are crying hysterically. That's where realistic training comes in.

WHO SHOULD DO IT?

In-service emergency training should be mandatory for all staff who supervise or lead divers at dive centers, resorts, charter operations, educational institutions, public-safety departments or commercial-diving companies. This includes teaching assistants, assistant instructors, divemasters, dive control specialists, instructors, instructor trainers and course directors.

Dive professionals aren't the only links in an injured diver's chain of care, and a chain is only as strong as its weakest link. At any given dive site there are other people who would play a part in an emergency plan's execution. Coordinate training exercises with these associated parties, which include pool staff, dive-site personnel and boat crews. Dive professionals should contact the aquatics director of the pool where they train and discuss their interest in creating a coordinated emergency plan for scuba activities that take place in the pool. The plan should be tested

TEC CLARK

Effective CPR and application of AED pads require access to a victim's bare chest. Use scenarios to empower students to perform skills such as cutting away a wetsuit.

The closer the simulation is to real life, the better prepared the participants will be in the event of an actual emergency.

in a combined training exercise involving the dive professionals and the lifeguards. Both parties will learn a lot. This approach is also relevant to dive boats and managed dive sites.

Another group to engage when conducting training simulations are any divers with advanced (or higher) certifications. These divers make great bystanders, victims or dive buddies. They've already shown an interest in learning more about diving, and their involvement in an emergency simulation might motivate them to take a CPR, oxygen provider or rescue diver course. Plus, these divers will appreciate the opportunity to observe their local dive professionals improving their preparedness and skills.

ELEMENTS OF GREAT TRAINING SCENARIOS

Planning: Great emergency simulations incorporate as many elements of real-life incidents as possible. It's often the subtle nuances of these scenarios that throw the curve balls to staff. For example, a diver showing signs consistent with decompression sickness acting defensive about his dive profile and insisting he is not bent adds realism and a dynamic not encountered in most training courses. Dive accidents are never routine; they include twists and turns and differ substantially from one another. A great place to get ideas for fresh and engaging scenarios is the Incident Insight column of *Alert Diver*.

Set the Stage: Scenarios should never put any participants or bystanders in harm's way. Supervisory staff should oversee and orchestrate the training at all times and should notify anyone in the vicinity who is not participating that training is taking place. Supervisory staff should also be prepared to recognize and respond to a real emergency should one occur during training.

Another key to successfully setting the stage is establishing rules and parameters for the scenario. Do not set up participants to fail by neglecting to explain the nature of the training or declare what areas are off limits. Instruct participants on how they should call for help, and make sure they know who is an available bystander and who is a nonparticipating evaluator. Be mindful of how the training could go wrong, and take steps to prevent those outcomes.

Rope off the training area, and post signs to inform passersby that they're witnessing a training exercise. Make sure to appropriately manage any hazards to participants or the public. Be careful of equipment that gets strewn around the site, and ensure it is picked it up reasonably promptly to minimize the training's impact on others.

Give key players such as "victims" and "bystanders" precise instructions on what to say and do. Allowing them to improvise or freelance can be problematic and may complicate the scenario in ways that don't enhance learning.

Evaluators: Keep at least one person out of the scenario to act as an evaluator. The evaluator should take notes and monitor a stopwatch to note when key events occur. The evaluator's record should include both good and bad decisions and actions; it will serve as the basis for the debriefing at the end. The evaluator should monitor not only the training exercise but also activities outside the exercise, since the public or the setting may necessitate changes to the scenario. If the training needs to be stopped, all participants must be prepared to pay attention to the evaluator if he or she intervenes.

Add Realism: The closer the simulation is to real life, the better prepared the participants will be in the event of an actual emergency. Add realistic elements such as cell phones for making "emergency calls," discarded wetsuits that can be cut off unresponsive victims, emotional bystanders and victims who can be relied on to stay in character. Consider the following ideas:

- ***Cell phones:*** Preprogram a number into a cell phone that can be used to simulate a call to EMS. A person at the other end of the line should be standing by to play the role of a 911 operator and ask the caller questions about the emergency. Since a cell phone could become wet or damaged during a scenario, you might wish to use a dummy phone and conduct conversations out loud.
- ***Bystanders:*** Have some individuals designated to create background noise or distractions. Prepare grieving, horrified and/or helpful bystanders to make comments such as, "Oh no! This is awful!" or "How may I help?"
- ***Victims:*** If someone is playing the role of an unresponsive diver, that person should be as limp as possible. Dead weight adds surprising and realistic difficulty to patient transport.
- ***Old wetsuits:*** Have participants prepare unresponsive victims for CPR and the application of AED pads by actually cutting retired wetsuits off a person or manikin.
- ***Training units:*** Realistic training exercises can be hard on equipment. If possible, designate oxygen units and first aid kits that are functional but can get wet, sandy and slightly banged up.
- ***Timing:*** Allow an appropriate amount of time to pass until "EMS arrives" on scene. According to national EMS response-time data, the interval between a scenario's phone call for help and the theoretical arrival of EMS should be about 8 minutes in urban locations and 10 minutes in rural areas.

Debriefing: A critical element of any training simulation is the post-training critique and review session. Before you begin, consider participants' readiness for learning. Allow them a short period to relax and collect themselves, but reconvene within a few minutes in a comfortable location that's free of distractions. Participants should describe

TEC CLARK


TEC CLARK

Well-run emergency simulations include supervision by an evaluator, a means to notify the public that training is in progress, a thorough post-training review session and provisions for responding to an actual emergency.

> It's often the subtle nuances of these scenarios that throw the curve balls to staff.

what they did and, especially, their feelings. Often they know exactly what actions needed to be taken, but stress or emotions led to shortcomings. This is generally an indication that the training yielded benefits and that they may be more comfortable and capable in similar scenarios in the future.

Critiques must be nonjudgmental and participant-focused, and evaluators should guide the conversation toward discussions of how improvements can be made. Evaluators should also highlight the consequences and relative importance of staff members' actions or inaction during the scenario. They should not overdramatize individuals' faults; they should remind participants that a primary goal of the exercise was to provide an opportunity to make mistakes in a low-consequence setting. This approach will keep staff appreciative of in-service training rather than viewing it as an embarrassing burden.

Document: At the end of all training simulations, make a list of every person involved, and record the date and some details about the scenario. This documentation is a good way to track staff-member participation and may also be helpful in the event of legal action. Dive professionals and their employers might be viewed more favorably when defending a lawsuit if they can demonstrate a focus on accident management with detailed in-service training records.

THE COST OF NOT DOING IN-SERVICE EMERGENCY TRAINING

The two biggest arguments against conducting emergency training exercises are cost and time. Employers pay staff for the time, and without income to offset it that time can weigh heavily on a budget. Employers should create a separate budget for in-service training and, if possible, schedule trainings for times when the staff is already together. Trainings can be conducted at inexpensive locations such as pools, beaches or lakes. Opinions vary on how often in-service training exercises should be conducted. Whether they're run monthly, quarterly or semiannually is up to the dive professionals and their employers and may depend on the size and scope of the business and the size of the staff.

For those who dismiss in-service emergency training exercises as impractical or unnecessary, consider this: After a dive accident is not a good time to discover problems. Scuba diving is fun, and most dive professionals are not often reminded that it can be deadly. When an incident occurs it may be immediately obvious to all parties that certain staff members have not kept up their skills and knowledge. The time, energy and cost associated with reviewing a serious incident with the training agency, insurance companies, investigators, law-enforcement officials and attorneys will dramatically exceed the cost of frequent, realistic training scenarios. AD

Mandy-Rae Krack on her 164-foot (50-meter) constant weight no fins world-record dive.

COURTNEY PLATT

THE WORLD OF COMPETITIVE FREEDIVING

BY MANDY-RAE KRACK

Bob Talbot's movie *Ocean Men: Extreme Dive* (2001), featuring Umberto Pelizzari and Pipin Ferreras, was filmed back when competitive freediving was fairly new. In this visually stunning and inspiring movie, Pelizzari set the constant-ballast world record with a dive to 262 feet (80 meters), while Ferreras did a no-limits dive to 531 feet (162 meters). Those may sound like unbelievable depths, but wait until you hear what those records are today.

I started freediving in 2000, when proper freediving gear was hard to come by in North America — particularly for women. Now the gear is not only readily available but also has evolved greatly. You can get a wetsuit so flexible it's like wearing an extra layer of fat for warmth. For improved efficiency, most athletes choose monofins over traditional fins. Mainstream dive computers now come standard with a freedive mode.

In addition to advances in gear, athletes are benefitting from improvements in training techniques. Companies such as Performance Freediving International (PFI) send instructors all over the world to teach people to freedive deeper, longer and more safely.

The way freedivers train has changed a lot since 2000. Today a student who comes into an intermediate course doing 20- to 40-foot dives and breath holds of one to one and a half minutes will leave four days later diving to more than 100 feet and doing breath holds of four to five minutes. Advances in training and gear have helped take freediving to a whole new level.

There are three pool disciplines in freediving today:

- *static apnea* — a timed breath-hold underwater with no swimming
- *dynamic apnea* — the distance a diver covers swimming on one breath
- *dynamic apnea no fins* — the distance a diver covers swimming without fins on one breath

Then there are the depth disciplines, three of which are self-powered:

- *free immersion* — pulling oneself down a line and back up without fins
- *constant weight/constant ballast* — using a fin to kick down and back up without dropping weight or using a line
- *constant weight no fins* — kicking down and back up without using a line or fins and without dropping weight

There are two assisted categories:

- *variable ballast* — using weights and, usually, a sled to descend and then leaving the weights at the bottom and using a line and/or kicking to ascend
- *no limits* — using any means to get down and back up; usually involves a weighted sled to get down and a lift bag or pulley to get back up

Now for the big numbers. The following are the current world records in all disciplines from the Association Internationale pour le Développement de l'Apnée (AIDA), the worldwide federation for breath-hold diving.

- *static apnea:* men, 11:35; women, 9:02
- *dynamic apnea:* men, 922 feet (281m); women, 768 feet (234m)
- *dynamic apnea no fins:* men, 715 feet (218m); women, 597 feet (182m)
- *free immersion:* men, 397 feet (121m); women, 289 feet (88m)
- *constant weight:* men, 413 feet (126m); women, 331 feet (101m)
- *constant weight no fins:* men, 331 feet (101m); women, 223 feet (68m)
- *variable:* men, 466 feet (142m); women, 417 feet (127m)
- *no limits:* men, 702 feet (214m); women, 525 feet (160m)

SAFETY

Those numbers are why many people think freediving is absolutely crazy. But there has been only one death ever during a record attempt.

Most freediving fatalities occur in recreational freediving. They're usually the result of people thinking they aren't pushing themselves and are playing it safe. Because of that, they think they can dive without the direct supervision of a buddy. But such supervision is critical for every freedive.

During AIDA-approved record attempts and competitions, athletes must follow the organization's safety guidelines to the letter, or the judges will not allow the attempt/competition to proceed.

PFI held its annual Déjà Blue competition Oct. 5-11, 2013; as usual three different safety systems were in place during the depth part of the competition. Even in the pool safety freedivers were there to spot/follow every athlete along with an evacuation boat and medics on site.

The competition employed the following three systems:

Safety freedivers: These people are probably the most important part of the safety system. They time the athlete's dive and meet him or her at about a quarter of the total depth on the way back to the surface. These people secure the diver's airway if he should lose consciousness underwater. They can bring a diver to the surface in a matter of seconds and have him conscious and alert shortly after that.

Counterbalance system: This is a retrieval system. All divers wear a 3-foot-long (1-meter-long) lanyard (for constant-weight it is usually secured around the wrist); on the other a carabiner is clipped to the competition line. At the bottom of that line is approximately 25 pounds of weight; at the other end is about three times that amount. If the diver does not come up in the expected period of time the system is released, and the heavy weights sink, pulling the lighter end — and the diver — to the surface.

Scuba divers: Not every competition or record attempt uses scuba divers, but PFI still does for the added safety as well as the help with video. These divers keep an eye on the freediver all the way down and back. They have a lift bag they can attach to the diver (or the line) to bring him to the surface faster. (They also usually cheer for the freedivers after they touch the bottom plate at depth, which I always appreciated.)

It may surprise some people to learn that I've had 14 blackouts in training, but thanks to these safety protocols each was a learning experience and nothing more.

When I first started freediving I thought that world records were set by freaks of nature — people who were just different from the rest of us. After 13 years in the sport and after having achieved seven world and 13 national records, I can tell you it's not that way at all. Records are set by ordinary people who dream big and who find the drive and desire to train harder than everyone else. They let themselves achieve the unimaginable.

Mandy-Rae Krack is a seven-time world-record-holding freediver. She and her husband, Kirk, teach freediving through their company, Performance Freediving International. AD

IMAGING

Pack-hunting sailfish chase down the remnants of a school of sardines off Mexico's Yucatan Peninsula.

DOUG PERRINE

Surfing bottlenose dolphins leap from the back of a wave in South Africa.

SHOOTER

PHOTOS BY DOUG PERRINE
TEXT BY STEPHEN FRINK

DOUG PERRINE

Doug Perrine does not consider himself an underwater photographer. That might come as a surprise to those who have seen his images of marine life, underwater, in a wide variety of publications for more than three decades. But Perrine sees his career differently, insisting that neither he nor his subject is necessarily underwater when he creates an image.

Rather, Perrine sees himself as "a wildlife photographer who specializes in marine life."

"I think of it as a subset of nature photographer," he said, "as opposed to being an underwater photographer, which could be a subset of sports photographer or fashion photographer or even product photographer, depending on how you approach it. I don't mean any disrespect to any other field of photography, but I see little in common between what I do and the work of guys who photograph models in silky dresses in swimming pools, for example. Since I photograph naked fish and dolphins having sex, I have also billed myself as the world's foremost marine-life pornographer, and no one has stepped up to challenge me for that title yet."

Doug Perrine grew up in Dallas, Texas, immersed in a life he refers to as "Leave It To Beaveresque." But even as a child he seemed to know suburbia was not for him. He would make his way to whatever creek or patch of nature he could find and was frequently bringing home turtles and frogs, much to his mother's dismay. He even had forays into underwater imaging back then; he destroyed at least one Brownie camera by trying to use it in a swimming pool in a plastic bag.

By the time he graduated from high school in 1970, Perrine realized he needed to go to college. Besides the obvious educational benefits, he had a draft lottery number of 5, and he would have soon found himself in Vietnam if he hadn't received a student deferment. Inexplicably drawn to the ocean, the college he chose was the University of Hawaii, where he was free to juggle student life with learning to surf, snorkel and scuba dive.

Perrine's direction was murky in those days. He tried psychology and chemistry before settling on an amorphous major called "liberal studies" and a certificate in the university's Marine Option Program. With a bachelor's degree that prepared him for very little, Perrine worked as a papaya picker and a lifeguard for a while before joining the Peace Corps and then spending 1978 and 1979 backpacking around the South Pacific and Southeast Asia.

Western author Louis L'Amour referred to the time people spend traveling and discovering themselves before their life's true purpose is revealed as their "yondering years." Perrine's yondering years included a stint with the Peace Corps in Morocco followed by another in Pohnpei, a sleepy Micronesian posting that allowed him plenty of time to spearfish and scuba dive while he conducted research on mangrove crabs. His immersion in the dive industry came in 1979 when he became a scuba instructor and began working for Blackbeard's Cruises, leading dive and sailing trips to the Bahamas. In 1980 he went to work at Bob Soto's scuba operation on Grand Cayman. Perrine was encouraged to teach a specialty course to better monetize his instructor status, and he chose underwater photography. Armed with his specialty instructor rating from the Professional Association of Diving Instructors (PADI) and a Nikonos camera, he decided to learn all he could to better be able to teach his newly acquired skills, but as it turned out he never taught a PADI underwater photography course.

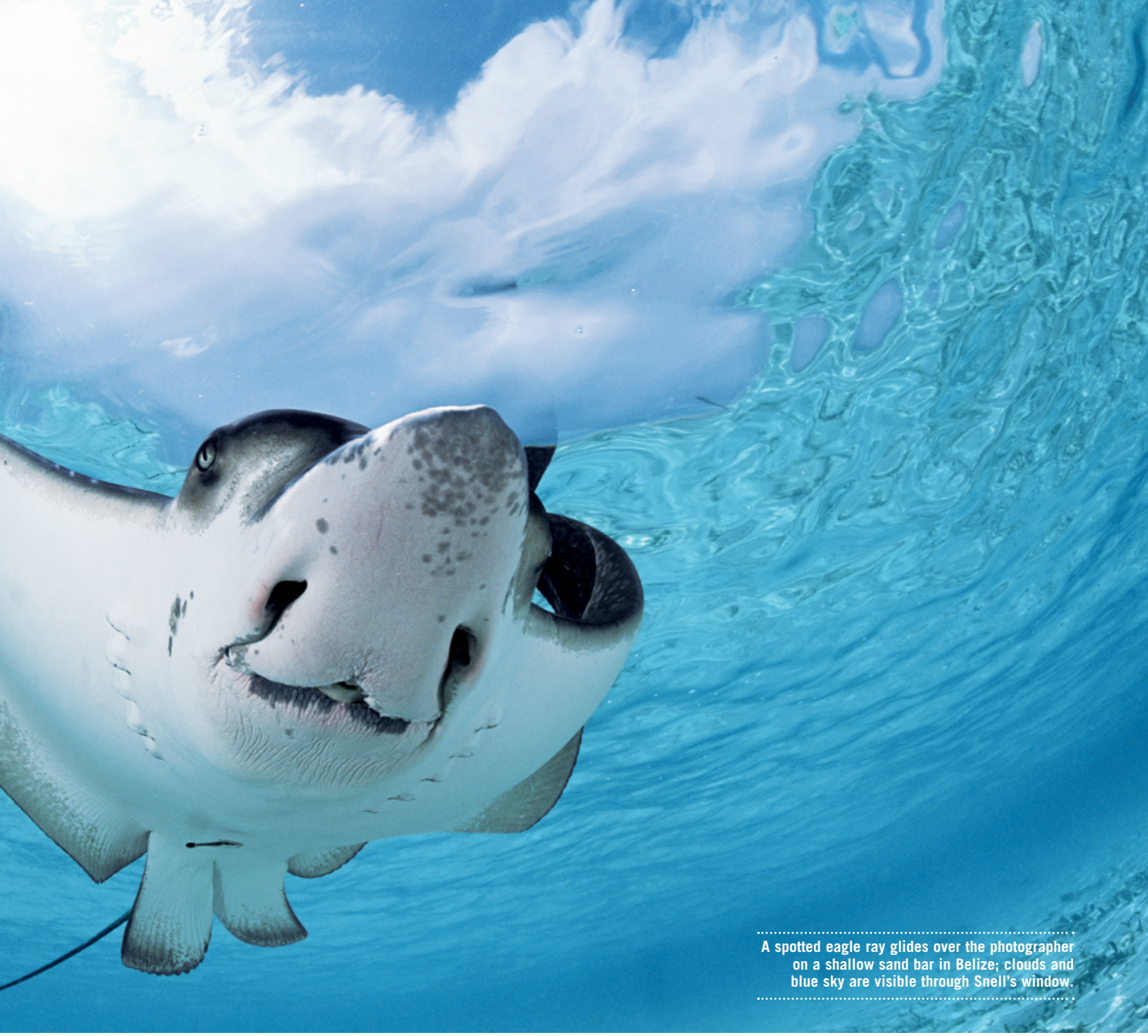
Perrine enrolled in a graduate program at the University of Miami's esteemed Rosenstiel School of Marine and Atmospheric Science, earning a master's degree in fisheries biology. But just as he never taught photography, he never again worked as a marine scientist. That would have meant a desk job, and Perrine had made up his mind to be on or in the water.

His primary interest was marine-life behavior, and he saw a chance to combine his scientific knowledge with his underwater photography skills by working as a freelance journalist. One of his first submissions to *Underwater USA* was rewarded with a cover story and a check, and Perrine decided it was the right path for him.

STEPHEN FRINK/ Underwater photojournalism has not been an easy way to make a living, particularly in the early 1980s. What made you leap into the deep end of that pool?

DOUG PERRINE// Actually, you were one of my inspirations when I made that fateful choice to leave science and go into photojournalism. You seemed to be making a living from your photography, so I figured maybe I could, too. I also knew someone who was doing a lot of work for *Skin Diver* and telling me fabulous lies about how much money he was making; it wasn't until later that I realized how much exaggeration had gone into his boasts.

I didn't go full time right away though. I was getting pretty steady work contributing text and photo submissions to *Sea Frontiers* magazine and *Underwater USA*, but I was also working part time as an interpretive naturalist. In that role I led tours of



A spotted eagle ray glides over the photographer on a shallow sand bar in Belize; clouds and blue sky are visible through Snell's window.

marine environments, working for both Dade County Parks and the Marine Resources Development Foundation in Key Largo, Fla.

I joined the American Society of Media Photographers around that time, and I got some work and experience assisting other pro photographers. My expenses were few and my desire strong, so I was able to tough it out through the periods of little income. I got some assignments from *Skin Diver* and *Scuba Times* magazines as well, but I think it was at least five years before I could say I was making a living in this game.

SF// As you so eloquently noted, there are a variety of niches within the genre of underwater photography. I think of you as a "behavioral" guy. Is that fair?

DP// Fair enough. My goal is to tell the life stories of ocean creatures, and the technology of underwater photography is a tool I use in pursuit of that goal. In those early years when I was trying to refine my personal vision I was a big fan of Rick Frehsee's work in *Skin Diver* and the original *Sport Diver* magazine. I tried to emulate his work, but I felt like a fashion shooter, always seeking a good-looking model in a color-coordinated dive outfit. I was also shooting macro, but at that time that amounted to using a Nikonos camera and extension tubes, so I was capturing the same nonmoving subjects at 1:2 or 1:3 magnification that everyone else was. Even though underwater photography was more of a novelty then than it is now, my photography was not unique. When I was a kid I wanted to be an astronaut and go meet alien creatures. And there, beneath the sea, were creatures far more bizarre than any sci-fi writer could conjure. I felt compelled to present those

creatures in ways no one had seen before, and larger marine animals afforded me that possibility. I found that I could use photography not only as a tool for education but also for scientific discovery, revealing biological phenomena that were previously unknown.

SF// Can you give an example?

DP// My photos of a vampire snail feeding led to a peer-reviewed scientific publication that described the eating habits of that blood-sucking mollusk. It had been described scientifically by genus and species, but no one really knew what it did for a living until I captured a shot that showed it using its proboscis to pierce the oral membrane of a sleeping parrotfish and suck its blood. Another set of photos that led to a scientific publication were my images that showed, for the first time, the spectacular mass-spawning behavior of dog snappers.

I wish I could convey to your readers, especially the younger ones, the excitement of shooting big animals underwater in the '80s and '90s. Just about every time I photographed a species that I hadn't shot before I was documenting something that almost nobody knew what it looked like underwater. With sharks, especially, if you could get a good underwater shot it was fairly likely to be the first publishable picture of that species in its natural habitat. It was the same with many cetaceans.

In fish-ID books in those days, most of the sharks were illustrated with pictures of bloody, contorted specimens lying on boat decks or artists' renderings that were often inaccurate. It has taken three decades, but it's finally rare to read about "the shark," as if all sharks belong to a single species and behave in an identical fashion. I credit photographers even more than scientists with dispelling that myth. Although there are still many species that haven't been properly photographed and lots of behaviors and phenomena yet to be discovered, a new wave of largely recreational and semipro photographers is rapidly enlarging the collective visual record of marine life, even as many species are being drastically diminished by overfishing and environmental change.

In the ocean, we are on the last frontier of exploration, trying to document things that have never been seen and species that might be vanishing from the planet. I've made it my business to put effort into doing something unique.

SF// Define "unique." Are you looking to photograph that which has never been seen or to present things in ways they've never before been shown?

DP// I'm more interested in the former, but the latter can be equally compelling. A quintessential example of a novel presentation is David Doubilet's iconic over/under shot of a stingray on Grand Cayman's Sandbar 30 years ago. He saw in his head this beautiful picture, and he had the technical skills to surmount the challenges of capturing the image. Others have stood in that same spot trying to replicate the same image many times, and maybe some have even done it better, for capture technology has obviously improved, and perhaps someone had the good fortune of better synergy of light and life, but no one else did it first.

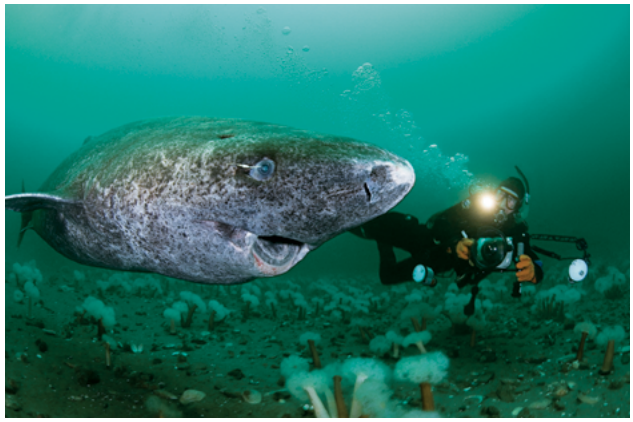
In many ways, the era of the secretive nature photographer has come to an end. I have always tried to be generous with sharing information about photo techniques and equipment, but like many old-school pros I have not always immediately broadcast every detail of where, when and how I got a unique image. That would enable copycat photographers to flood the market before I could earn back the investment I made in cracking the nut for the first time. I rarely lead tours or teach workshops that would put me in direct competition with my own students or clients, but these days you can have an amazing once-in-a-lifetime encounter in a remote fishing village of 30 people, and by nightfall your dinghy driver has posted about it on his Facebook page, and a dive tour operator has read about it and begun putting a group together to do the same thing. Social media and the immediacy and colossal reach of the Internet have changed everything … for good and for bad.

SF// You have been very active in the stock photography business, even to the extent that you founded your own agency. How has that fit into your overall business plan?

DP// I can't say I ever really had a business plan, I've just stubbornly insisted on always doing what I liked. My stock photo agency has now morphed into SeaPics, an evolution of Innerspace Visions, which was an outgrowth of the International Shark Photo File.

At one time, back in the late '80s and early '90s, I had something of a lock on underwater photos of bull sharks, lemon sharks, silky sharks, tiger sharks, Caribbean reef sharks, sharpnose sharks, shark births, shark skin, shark fossils and a few other subjects. I was getting lots of calls from people doing books and magazine articles on sharks. But they also wanted things I hadn't photographed, such as blue sharks, makos and great whites. It didn't make sense to me to run around the world photographing species that had already been extensively

Opposite, clockwise from upper left: **Greenland shark with a copepod parasite attached to its eye, Quebec; triton's trumpet eating a crown-of-thorns starfish; rarely-photographed Morelet's crocodile in a cenote, Yucatan Peninsula; minke whale; Amazonian manatees; bronze whaler sharks in the sardine run, South Africa; bioluminescent plankton in the Maldives; humpback whale pod in Hawaii (NMFS research permit #587)**



Doug Perrine photographs mantas feeding at night in Kona, Hawaii, during the Kona Classic.

Opposite: **A Bryde's whale with its throat pleats expanded engulfs a school of sardines off Cabo San Lucas, Mexico; its baleen is visible hanging from the upper jaw.**

photographed, so I figured I'd just call a few friends from California and Australia and create a one-stop shop for shark photos. Most of the guys who had the photos were traveling all the time, so it was helpful to them to have their photos in an office with an assistant who was there every day and who was already getting lots of calls from buyers.

This was before the Internet, and I was pecking out articles on my trusty typewriter and sending submissions by mail. In those days it was a challenge for photo editors to come up with a comprehensive selection of images for subjects like those we specialized in. There was even a job description at most publishing houses called "photo researcher." Pretty soon I was curating the word's most comprehensive collection of shark photos.

It worked so well, I created another file for whales and dolphins. After a few more subjects were added it became a small specialty stock agency, which I called Innerspace Visions. That turned out to be impossible for clients or couriers to spell or understand. My mail got delivered to the Walmart Vision Center, and I received checks made out to "Interstate Vistas." When it came time to reserve a domain name I knew I needed something shorter and more obvious. SeaPics was available, so I took it, never imagining how many alternate spellings people would come up with for that! I sold SeaPics in 2003 and have been just a freelancer for the past 10 years.

SF// In your pursuit of one-of-a-kind images, which ones stand out in your mind?

DP// I have a shot of bronze whaler sharks tearing through a school of sardines that is likely the photo that most photographers associate with my name, although it's no

longer as unique as it was when I took it. It was the grand-prize winner in the 2004 Veolia Environment Wildlife Photographer of the Year (WPOTY) competition, sponsored by the Natural History Museum in London and BBC Worldwide. It was also the first photo from a digital camera to win any award in that competition. I would be surprised if any images shot on film even made it to the finals this year. I sank more than $20,000 (which would be a lot more in today's dollars) into that sardine run self-assignment over a three-year period with long odds of earning any of it back. Thanks largely to the publicity from WPOTY, I actually did recoup my investment on that project. Not all my expeditions have fared so well.

Another shot that earned back its cost, which you may find hard to believe, is a shot of a blue whale pooping. It expelled a massive cloud of processed red krill, and I took a shot just to document the behavior. I never thought it would make a nickel when I clicked the shutter, but, oddly, it has done pretty well.

Other personal favorites include a fisheye close-up of an eagle ray with the sky and clouds visible above and the "starry shore" image of bioluminescent plankton washing up on a beach at night.

SF// Unlike many shooters today who have known only digital, you've been doing marine-life photography long enough to have made a conscious decision about when to transition from film to digital. What motivated your migration?

DP// I transitioned in 2003 with a Canon EOS D60 6-megapixel camera. I live on Kona, Hawaii, and my neighbor at that time was James Watt, one of underwater photography's most prolific and talented shooters and a digital pioneer. He started with a Canon EOS D30, but I couldn't get enthused about the 3-megapixel quality, so I waited for the next generation. I'm not one to be right on the leading edge of technology, for there are too many failure points, but I try to be not too far behind either.

Today I shoot a Nikon D4 and a D800 topside and a D800 in a Nauticam housing underwater. I use either Ikelite DS161 or Inon Z-220 strobes . The Inon strobes get the nod when I'm traveling where weight is restricted, but when I'm shooting in my home waters of Hawaii I typically use the more powerful Ikelites. I'm also using an Olympus OM-D E-M5 now, primarily because of airline restrictions. It's a small mirrorless camera that, coupled with a Panasonic 8mm fisheye lens and a Nauticam housing, creates a small wide-angle rig I can use with a polecam or to swim after rapidly moving pelagic animals.

The digital revolution is exciting but challenging. Clients can't lose the original film you had to send them like they did with a few of my favorite slides. Instead of FedEx and next-day deadlines it is FTP service and same-day deadlines. With a laptop and Internet access I can transmit images to clients from anywhere. Plus I can photograph things I could only dream of before — like my shot of bioluminescence on the beach. That was a 30-second exposure at ISO 2500. I saw it in my mind's eye back in the days of film, but only the digital technology of my Nikon D700 could make it a reality.

It used to be that I opened the box of slides, threw away the bad ones and put the good ones into archival sleeves. I was done until it was time to send them to a client. Now I get home from a trip with thousands of digital pictures, and before I can get through those I'm off on the next trip to accumulate thousands more. Sometimes I feel like Hercules having agreed to clean the Augean Stables. Not that I want my images compared to horse poop, but you know what I mean. AD


MARK CHAPMAN

Wide Angle with Models

BY STEPHEN FRINK

It is rare for me to be on the other side of the lens in an underwater photo, but during a recent shark-photography event in the Bahamas, Mark Chapman captured an image of me with a tiger shark that was swimming away with my camera and strobe. It was a benign encounter — I swam along with the shark briefly until she discovered my strobe was not particularly edible and released it — but it made for a more striking image than a simple shark portrait. The presence of the diver in the photo adds a sense of scale, showing just how big and impressive this tiger shark was; it also makes for an interesting narrative.

Shots like this one require the photographer to be skilled and adaptable — able to catch a fleeting image of opportunity. But there is much more to working with models: It requires planning, collaboration and expertise with a wide-angle lens.

Underwater photography that features models may be of a commercial nature — to illustrate dive gear, for example. That's the sort of photography Doug Perrine (Shooter, Page 92) described as being a subset of fashion photography or product illustration, an observation I thought particularly astute. Images of models underwater might tell the story of a particular dive destination or adventure. Those are the kinds of images that launched my career as a dive journalist decades ago. I honed those skills during the 17 years I spent traveling the Florida Keys and the Caribbean for *Skin Diver Magazine*. "Diver in some kind of underwater environment" was my assignment.

Working with a dedicated model is much better than waiting in front of some scenic sponge and hoping for a diver to swim by as a chance element of composition. I've done the latter, but nothing beats a model who is ready and willing to work with you on a dive and understands your objectives. So how does one find such a person?

RECRUITMENT

The obvious people to reach out to first are your significant other, your children and regular dive buddies or other friends. Both my wife and daughter have been excellent models for me over the years, which carries the advantage that we always get the opportunity to review together what worked and what didn't and try to do it better the next time we work with each other. A willing dive buddy is a huge asset; one who you can work with repeatedly is ideal.

For commercial shoots we hire models, of course. With only a few days to shoot and a lot of products to illustrate, we can't accept the risk of finding a willing model on the dive boat. Plus, products used in photo shoots are often the very first of their kind and likely aren't available in every size, so the models must be hired according to size as well as physical appeal and appropriate age demographic.

As far as skills are concerned, the most important are comfort and facility in the water. Underwater models have to be able to position themselves in some very exact compositions and either hold position or move relative to marine life in the foreground. They must have excellent buoyancy skills so they appear comfortable and graceful in the water and can avoid contact with fragile corals even when proximity is required.

Modeling agencies are notorious for lying when describing the dive skills of their talent. It's probably not malicious, but the booking agent is likely not a diver and typically won't understand how crucial dive skills are to a successful underwater model shoot. Just being certified does not mean a model will possess the necessary skills. Unless the shoot is predominantly topside, years of experience underwater and an intuitive understanding of what the photographer is hoping to achieve make all the difference.

Compensation is also appropriate, but the level varies. With hired models there is an expected day rate in exchange for a model release. For dive buddies it may be something as simple as a complimentary photo they can post on Facebook. But at the very least there should be sincere thanks and appreciation for the skills of an underwater model — their contributions to this genre of photography can't be overstated.

COMMUNICATION

Unlike topside photography, underwater work requires the photographer to direct a model without speaking. Typically we discuss a complete set of underwater signals on the boat before the dive. I have signals for telling models when there is too much backscatter on the scene and it is time to move on, when we are shooting verticals or horizontals (as that will affect their posture in the water), how far or near they should position themselves relative to the reef or marine life in the foreground and optimal eye contact.

Eye contact is an extraordinarily important variable, as it directs the viewer's eye when seeing the image. Rarely is there a reason for the model to stare directly into the camera; it's much more natural for the model's eye to be cast toward some underwater feature of interest. Most models will figure that out on their own, but if they don't the photographer will need some signals to direct them. A lucky photographer will achieve some level of mind-meld with a talented model, as that makes the collaboration much more rewarding. But ultimately it is the photographer's job to communicate where in the frame the model needs to be and what he or she is meant to do.

WARDROBE AND GEAR PREPARATION

In a catalog shoot, gear is paramount, and particular attention is given to logo placement and diver position relative to a preconceived layout. But in editorial photography compositions are less restrictive. In terms of wardrobe, it is nice to incorporate a bit of color, although that can be tough since so many wetsuits and BCs are black.

Masks and fins offer an opportunity for color coordination. Clear silicone skirts are much easier to light than black-skirted masks, and colorful fins add definition to divers in silhouette. It is especially important that masks be clear of fog, and new masks are particularly troublesome. The glass must be scrubbed thoroughly and repeatedly with toothpaste, Soft Scrub or some other product such as 500 PSI mask scrub. Both the glass and the inside of the silicone skirt need to be scoured; standard defogger isn't usually up to the task for new masks.

Equally important is to tether the dive gear properly. Hoses should be clipped to the BC so they don't dangle and damage coral — and create the psychological impression through the photo that it is appropriate to dive that way.

EXECUTION

The density of water is important to remember with model photography, because strobe power diminishes rapidly with distance. A model more than eight feet away from a strobe-lit foreground will essentially be an element of composition and should be positioned accordingly. A strobe simply cannot punch through that much water, which is 800 times denser than air and of cyan color cast, so aiming a strobe toward a distant model will likely only create backscatter without appreciably illuminating the face mask or bringing in color from wardrobe. It would be better in that case to concentrate the strobe beam on an interesting element of the foreground.

However, when a model is within a couple of feet of the foreground or, for that matter, is the foreground, lighting the model is critical. The strobe should be directed so it doesn't cast a shadow from the mask's skirt or rim across

When photographing product illustrations (as, in this case, for a Subgear catalog) it is important to illustrate not only the underwater "lifestyle" but to show logos when possible.

Right: **In an editorial shot such as this Red Sea shipwreck, the diver is often an element of composition, providing scale and human interest.**

the eyes. Caucasian hands and highly reflective bits of gear should not be too close to the beam of the strobe, as they're easily overexposed.

Perspective should be considered as well, as whatever is nearest in a wide-angle photograph will appear larger than the background subject. That can be used to great effect with an already-large subject such as a whale shark. A snorkeler in the background will accentuate the immensity of the shark and make it appear even more impressive. Likewise, a soft-coral-festooned reef can be made even more captivating by using forced perspective with a wide-angle lens and artfully applying strobe light to highlight color and texture. However, perspective can work against you, too.

Years ago I shot a campaign for one of America's largest ad agencies; one photo had a treasure diver ostensibly discovering a massive gold chain on the bottom near the wreck of the RMS *Rhone* in the British Virgin Islands to illustrate the concept "taste of success." This was back in the days of film, so we didn't see my shots until the next day, and the exposure, eye contact and background were all perfect to my eye. However, the art director wasn't quite so pleased. He rather vociferously lamented, "These are the hands that ate Chicago!" Apparently he wasn't used to seeing forced perspective in wide-angle underwater shots, so I had to go back the next day and reshoot. That time I made sure the hands were on the same plane as the body rather than outstretched toward me. A topside shooter might have shot the same scenario with a normal lens from 10 feet away, and all would have been perfect, but the underwater photographer (me) had to cover a subject as large as a diver from only three feet away and ensure maximum sharpness and color. The wide-angle lens, with its inherent optical characteristics, was the only solution.

So choose your models well, communicate clearly, and thank them. Make sure neither the photographer nor the model comes in contact with the coral, and determine the most important element to illuminate in the foreground. Consider how perspective distortion can work to your advantage, and, above all, don't let your model's hands eat Chicago! AD

MEMBER TO MEMBER

Tips, advice and updates from your fellow divers

An Ounce of Prevention

TEXT AND PHOTOS BY
ELLEN MASSEY LEONARD

Not many people have dived the pelagic waters of Ascension Island, where mahi-mahi swim yards from shore. The island's fringing corals hide immense moray eels and stonefish. Ascension's Comfortless Cove, where the swell breaks in clouds of spray, teems with black durgon, cowfish and triggerfish.

Ascension lies just south of the equator in the Atlantic Ocean, roughly halfway between Brazil and Angola. Reaching the volcanic speck by air is difficult and costly, requiring transit by British military plane. My husband, Seth, and I arrived aboard our 38-foot sailboat, *Heretic*, near the end of a four-year round-the-world voyage. It was the jumping-off point for our final, monthlong ocean passage.

The route Seth and I traveled to Ascension was actually much longer and more difficult than the one involving the Royal Air Force base, but along the way we had dived with manta rays in an uninhabited Polynesian bay and with hawksbill turtles at Ashmore Reef on the edge of Australia's continental shelf. Experiencing such isolated places is one of the great advantages of independent travel under sail, but it requires a great deal of self-reliance. The fact that Seth and I never had a medical emergency during our voyage was partly due to luck, but a greater factor, I believe, was the high margin of safety we employed.

Diving in remote locations requires the utmost caution. One simple risk-management technique we adopted when it was just us was to minimize depth, keeping all our dives to 60 feet or shallower. We never did decompression dives on our own, nor did we do more than one dive per day. Experienced divers often go beyond the limits used in open-water courses, yet experience does not confer immunity against mistakes or gear problems. So when outside help was not an option, we used conservative dive planning as a hedge against risks such as a stuck BCD inflator button.

Before every dive, Seth and I examined our marine charts. Our plans were simple: out-and-back excursions beginning at our deepest depth and returning at a shallower depth. Our halfway points were marked by as much as 1700 psi, and we always made three-minute safety stops at 15 feet. We became proficient at using compasses and finding landmarks underwater. We checked our gear before donning it and checked each other before taking giant strides off *Heretic*'s deck. When other boats were nearby, we scheduled radio calls to confirm our return.

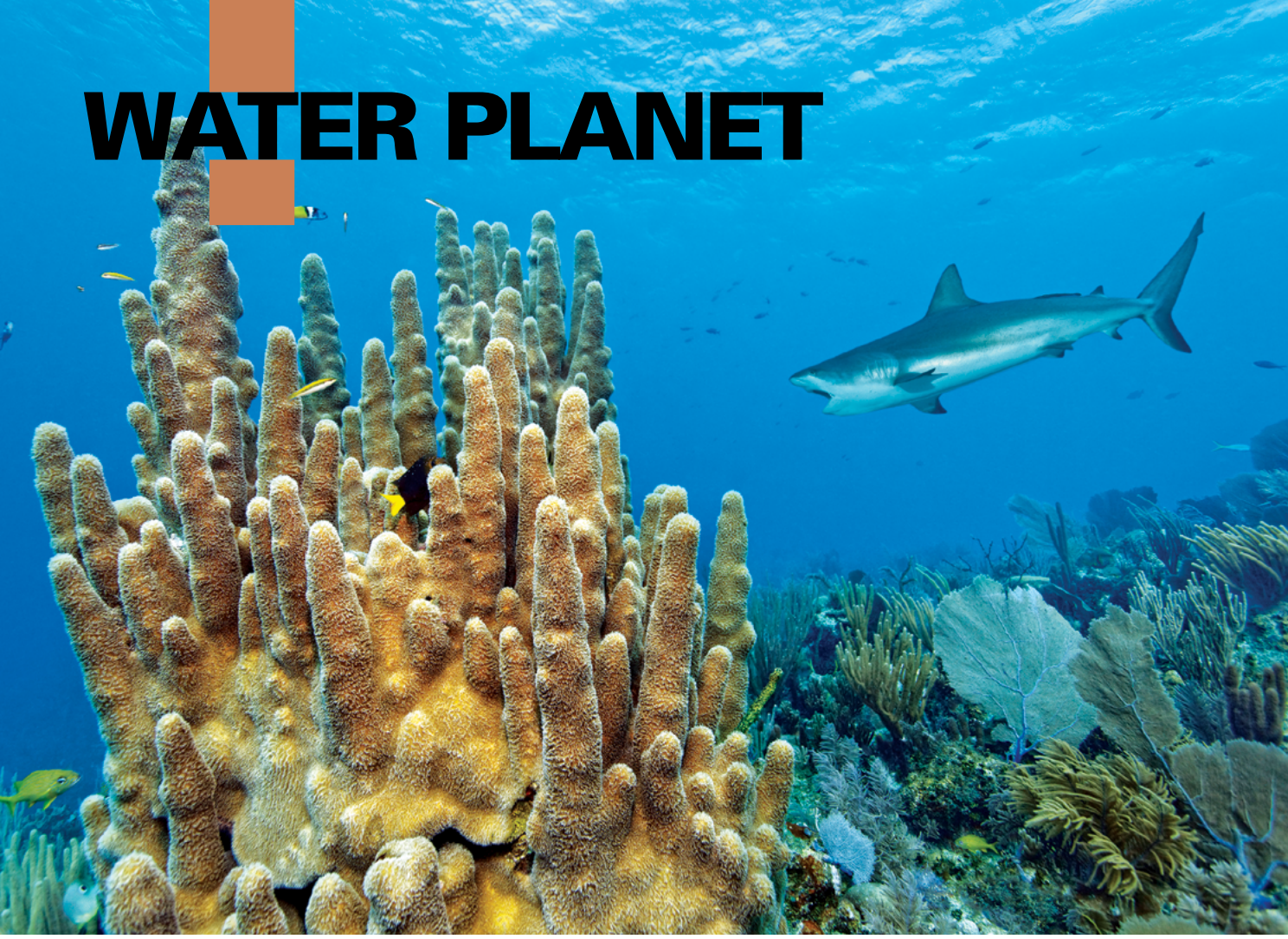
Although we had to lug fresh water from shore, we always rinsed our gear thoroughly. Hydrostatic testing of tanks is required every five years, but we had ours tested every two. Our gear was new at the beginning of our voyage, and we had it serviced after 50 dives. We carried analog gauges as well as computers.

Finally, Seth and I took care of ourselves. We took basic precautions such as avoiding alcohol, ensuring sufficient hydration and getting enough sleep, and we educated ourselves on matters of dive medicine such as whether any medications we might take could present problems during or after dives.

Diving from *Heretic* allowed Seth and me to discover our own dive sites; some had probably never been dived before. We watched eagle rays off a deserted islet in Rangiroa, one of the world's largest atolls, and we came across 19th-century cannons in the Indian Ocean's Cocos (Keeling) Islands. Such isolation forced us to be completely responsible for our own safety, but with caution, luck and respect for risk, we enjoyed some of the world's most remote and spectacular places without having to call on DAN®. AD

SHARE YOUR STORY

Do you have tips, advice, travel strategies, dive techniques, lessons learned or other words of wisdom to share with your fellow divers? *Alert Diver* wants your story! Email it to M2M@dan.org, or mail it to "Member to Member," c/o *Alert Diver*, 6 W. Colony Place, Durham, NC 27705.



Cuba's Coral Reefs

At a crossroads

TEXT BY MELISSA GASKILL / PHOTOS BY NORBERT PROBST

A clipboard-toting young soldier in green fatigues counted heads as we boarded the dive boat. When the boat docked after the dive, he took another count. It's the government's intention that all divers who go to sea come back — to Cuba.

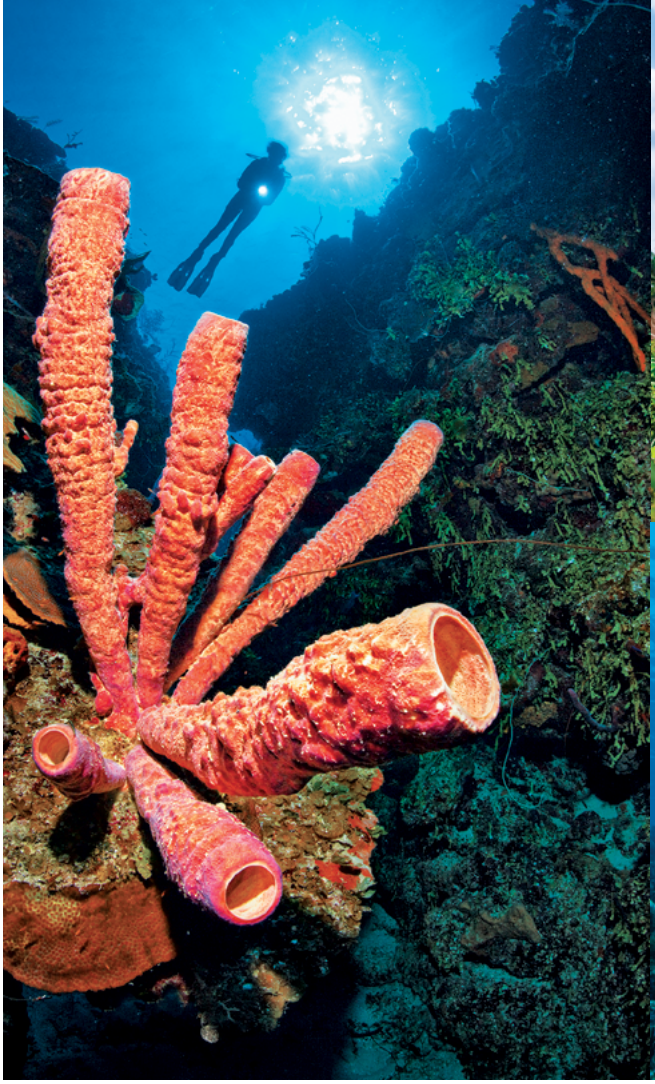
We're on the Guanahacabibes Peninsula at the far western end of the island nation, five hours from Havana but only 100 miles from Mexico's Yucatan Peninsula. The Villa Maria la Gorda Hotel and International Diving Center makes three daily trips to more than 30 dive sites located just minutes from shore.

U.S. regulations prohibit Cuban "travel-related transactions," which means American citizens can't spend money to travel to, from or within Cuba. There are a few exceptions, including for government officials, religious groups, education, research and journalism, which is how I came to be here. Meanwhile, divers from elsewhere on the planet have long enjoyed a marine environment that remains much as it was 50 years ago.

AN "ACCIDENTAL EDEN"

Both internal and external forces created Cuba's surreal time warp. In response to Fidel Castro's 1959 revolution, which created a socialist economy, the United States implemented a trade embargo that is still in place today. The travel restrictions and other economic sanctions led to reduced pressure on the island's marine resources. Furthermore, for decades Cuban development efforts largely ignored tourism, and even today it is seen as something of a necessary evil.

Cuba's small population (11 million residents versus 19 million in Florida, its geographic equal) also contributed, according to Fernando Bretos, director of the Ocean Foundation's Cuban marine program. So did the relative remoteness of three of its four coral-reef chains, particularly



Opposite and above left: **The Gardens of the Queen (*Jardines de la Reina*) is the gem of Cuba's underwater reef system, with healthy corals and ample marine life.**

Top right: **The agricultural methods in Cuba remain primitive and largely organic. Less chemical fertilization means less damaging runoff to degrade the coral reef.**

Bottom right: **Dive visitation to these pristine reefs is relatively modest, but that could change with relaxed travel restrictions to Cuba.**

in light of agricultural practices on the island. Cuba's farming is largely organic — not by policy or intention, but because the pesticides and fertilizers used throughout the industrialized world are prohibitively expensive or simply unavailable to Cuban farmers — and this minimizes agricultural runoff that could harm the reefs.

WALKING THE WALK

However, these uniquely healthy seas also owe much to an intentional commitment to the environment made in the 1990s. "Cuba began walking the walk," said Dan Whittle, Cuba program director for the Environmental Defense Fund. "They established policies that recognized the marine environment's economic importance and the tourism value of nature, and they began developing the coast cautiously. "

Of course, any country's laws and policies are only as good as continuing political will to uphold them, and Whittle notes ongoing conflict between Cubans who see environmental protection as a luxury in a country struggling to feed its people and those who say it's a worthwhile long-term investment. So far, Cuba's current leadership seems committed to sustainability, but looming economic changes place it between Scylla and Charybdis: On one hand, economic development threatens the health of Cuba's marine environment, but on the other, economic growth will allow Cuba to invest in better infrastructure, research and resources to protect the natural environment. "Economic growth can be the savior of environmental programs as well as a threat to them," Whittle said.

The threats include increased impact from more tourists. An end to the U.S. embargo — conceivably on the horizon — will mean an immediate 10-percent increase in visitors, at a minimum. "There will be tremendous temptation to cut corners," Whittle said, noting that in other countries, environmental protection has taken a backseat when money starts rolling in.

Schooling grunts swarm around a sponge formation in the Gardens of the Queen.

The Gardens of the Queen, an archipelago on the island's south side, is one of Cuba's most renowned dive locations. To date, protecting its pristine coral reefs has been a priority, and diving has benefitted local communities while the reefs have remained healthy. But Cuba is expanding tourism here, and scientists are concerned the Gardens will become one of the first places overburdened by tourism. "The demand could just overwhelm the infrastructure," Whittle said, "and as Cuba races to accommodate that demand they may mess it up."

Cuba's economic growth is also fueling increased oil and gas development. This poses a major potential threat to the marine environment in the form of infrastructure development and in the possibility of a spill, Whittle added. More prosperity could also change Cuba's system of agriculture. Increased use of pesticides and fertilizers will mean more land-based runoff and consequent eutrophication, to the detriment of the marine environment.

STRATEGICALLY SITUATED

Cuba occupies the junction of the Atlantic Ocean, Caribbean Sea and Gulf of Mexico — essentially one large, interconnected marine environment, and one that relies heavily on Cuba's healthy ecosystems. "Lobster larvae, larval reef fish and coral spawn all travel by ocean currents from productive Cuban reefs throughout the system," said Bretos, who was involved in a 1991 study that released 1,900 floating bottles on the south side of Cuba. One of them traveled to West Palm Beach in just 46 days. "If Cuban reefs go downhill, it will affect us all."

Scientists and conservationists began working years ago to keep that from happening. Scientists from the U.S., Cuba and Mexico formalized this work in 2007, forming the Trinational Initiative for Marine Science and Conservation, an ambitious research effort with the ultimate goal of establishing a multinational, coordinated approach to managing and protecting this shared marine environment. The Environmental Defense Fund, the Ocean Foundation, the Nature Conservancy and Mote Marine Laboratory are just a few of the players that are already involved.

Back at Maria la Gorda, we enjoyed spectacular visibility, balmy water temperatures and thriving reefs in depths from 15 to 100 feet. Sandy valleys and seagrass beds lay between them, and every dive site swarmed with marine life. This is one of more than 100 marine protected areas (MPAs) proposed or in place in Cuba — the largest network in the Caribbean. But here, as elsewhere, MPAs suffer from lack of awareness and enforcement. The crew tossed cigarette butts from the dive boat, and I spotted a fishing vessel on the horizon that was clearly in protected waters. Still, it's a start.

"This is a unique time in the history of Cuba and in U.S.-Cuban relations," Whittle said. "There is real desire in both countries to make Cuba a model for sustainability and biodiversity conservation and for innovative and effective fisheries and marine management. That will benefit not just the resources but the people of Cuba as well. I think we can show that you can have a healthy economy and a healthy environment."

"What many will tell you is that Cuba is the linchpin, given its size, location, diversity," he added. "It's key to a healthy Caribbean, Gulf and Atlantic. People go dive there and come back raving; they had no idea such amazing coral reefs were so close." The challenge is to do all we can to keep them amazing. AD

Learn more about traveling from the U.S. to Cuba legally at *lawg.org/component/content/article/77/884*.

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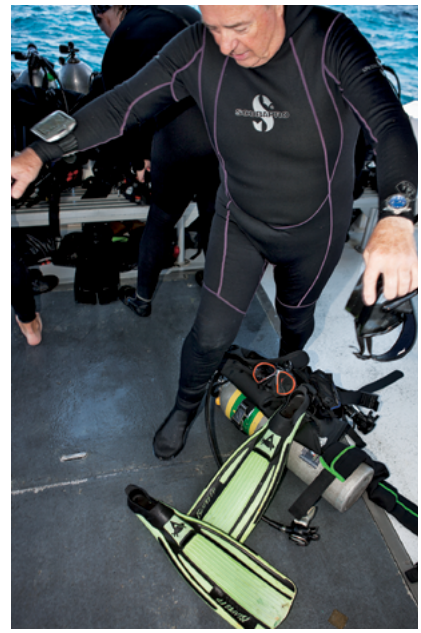


Maintain Your Gear

TEXT BY COLBY CLINE / PHOTOS BY STEPHEN FRINK

You've finally booked your next dive trip, and you can't wait to relax into the cool, blue depths. But a nagging thought creeps into your mind: "*Will my dive gear perform as expected?*" You remember your last trip when your alternate second-stage regulator began to free flow just as you were about to get in the water. The captain quickly replaced the hissing regulator, but he said he noticed some corrosion and sand, which probably caused the free flow. That dive was saved, but you worry your equipment might act unpredictably again.

Remember that your dive gear is life-support equipment — designed to help you breathe, see and control your movement underwater. To be confident your gear will function properly, you should develop a few important habits. First, thoroughly rinse all your dive gear in clean fresh water after every dive or at least every day of diving. This is especially true when diving in the ocean; rinsing away as much salt as possible will help keep the equipment functioning as intended. After rinsing, allow gear to dry completely in a cool, shady and well-ventilated area before you put it away.

Always be conscious of your gear's exposure to the sun. Ultraviolet (UV) radiation can be very damaging to dive equipment. Some exposure to the sun may be inevitable, but the more you can limit it, the better. On the way to a dive site, store your gear in the shade if possible. If there isn't any shade available, cover your equipment with a towel.

Here are some recommendations on how to care for specific pieces of dive gear to maximize its longevity and reliability.

MASK, SNORKEL, FINS AND COMPUTER

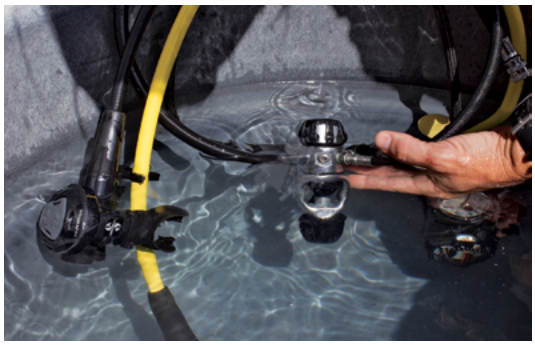
Treat these items carefully so they aren't crushed by heavier gear. It's also a good idea to keep this equipment (as well as the rest of your gear) well organized to minimize the risk of it getting stepped on or kicked overboard. After rinsing and drying these items, store them properly. The box that came with your mask, for example, will help prevent other equipment from crushing or deforming the lenses or silicon skirt. Remember to check the battery icon on your dive computer, and replace the battery as needed.

WETSUIT, BOOTS, GLOVES AND HOOD

Neoprene can be especially susceptible to UV damage, so take extra care to keep your wetsuit and other neoprene items in the shade. If your wetsuit takes on an unpleasant odor, add some wetsuit shampoo to the postdive rinse tub. After rinsing, hang your wetsuit inside out on a wetsuit hanger, and allow it to dry completely before you turn it right side out. If it's possible to turn your gloves and hood inside out as well, do so. Check the manufacturer's recommendations on wetsuit zipper maintenance; some require periodic lubrication.

REGULATOR ASSEMBLY

Test your regulator's function as soon as possible after you board a dive boat so you can address any problems before you get too far away from the dive shop. If possible, clean your regulator assembly while it's still connected to a scuba cylinder and pressurized. Soak the components for several minutes to



Don't ever forget that your dive gear is life-support equipment. Keep it in good working order by rinsing it thoroughly at the end of every day of diving, inspecting it before and after you dive, getting it serviced regularly and handling it with care.

allow the fresh water to dissolve the salt in all the nooks and crannies. If the system is pressurized, purge both second stages several times while they're submerged in clean fresh water to promote removal of contaminants from their interiors. If it's not possible to soak the regulators while they're connected to a cylinder, make sure the dust cap is firmly in place so water is prevented from entering the first stage. Also, take care to not press the purge buttons as that can allow water to enter the hoses and possibly reach the first stage.

Once the second stages are adequately soaked, shake off any excess water and set them out to dry. If your second stages are equipped with knobs for controlling breathing resistance, turn them all the way out to decrease the spring tension on the internal components. Once the regulator assembly is completely dry, store it in a regulator bag to keep dust, debris and pests away from your vital breathing equipment. Follow the manufacturer's recommendations on how often to have your regulators serviced by a professional technician — an annual overhaul is a good idea.

BCD

As with your regulators, test your BCD before diving to make sure everything is working properly. When soaking your BCD after diving, press down on the inflate and deflate buttons while holding the BCD underwater to work out any trapped salt, sand or debris that might be inside. Orally inflate the jacket and, while it's submerged, pull on each of the dump valves to work out any debris that might be trapped around them. Be sure to rinse out the inside of the BCD bladder — sometimes salt water will enter in the process of deflating the BCD while diving. Using a hose, introduce clean fresh water into the bladder as you hold down the deflate button. Next, fill it with air by mouth. Hold up the BCD and rotate it so the fresh water sloshes around inside and coats all the interior surfaces of the bladder. Hang the BCD on an appropriately sturdy hanger and pull the lowest dump valve (or hold the BCD upside down and press the deflate button) to allow all the water to escape. Repeat until you are confident that little or no water remains inside, and then partially inflate the jacket for storage. Again, the manufacturer will provide a recommendation on how often to have your BCD serviced; dropping it off at your local dive shop every year with your regulator assembly should ensure it works reliably.

CYLINDER

Always handle pressurized cylinders carefully as they contain a lot of potential energy. To prevent the incursion of water, never drain a cylinder completely of gas. When rinsing your cylinder after diving, thoroughly rinse around the valve, and remove the tank boot regularly to prevent buildup of salt or other debris. (For more about the care of high-pressure cylinders, see "Tank Safety," *Alert Diver,* Spring 2012.) Remember to have your cylinder visually inspected every year and hydrostatically tested every five years.

It doesn't take much time or effort to ensure your life-support equipment will work as intended. Proper care and regular maintenance of your dive gear is an important way to stack the deck in your favor. AD

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PARTING SHOT

BY IMRAN AHMAD
www.escapeinc.com.sg

The blue-ringed octopus (*Hapalochlaena maculosa*) is a difficult subject to photograph because of its very small size as well as its cryptic nature. There is also the issue of toxicity: An adult blue-ringed octopus carries enough venom to kill two dozen people.

I wasn't even aware of this pair until I saw the hand signals from the dive guide, and even then I wasn't sure if the aerial assault unfolding before my eyes was a territorial dispute or a mating ritual. I had only three shots before the two parted ways.

Subsequent research confirmed the octopuses were mating. During reproduction the male climbs onto the female's back and uses a specialized arm called a hectocotylus to deposit spermatophores into the female's ovipore. The female then lays between 50 and 100 eggs and carries them under her tentacles until they hatch into planktonic young about 50 days later. The female is unable to eat while she guards her eggs; after they hatch, she dies.

Most divers will never see a blue-ringed octopus. To have witnessed these two mating was very special indeed. AD

Blue-ringed octopus (*Hapalochlaena maculosa*)
CAMERA: Nikon D3, 60mm f/2.8, Seacam housing, Ikelite DS161 strobe
SETTINGS: 1/250 sec @ f/10, ISO 200
LOCATION: Lembeh Strait, Indonesia

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Barry Fackler, Hawaii, SeaLife DC1400

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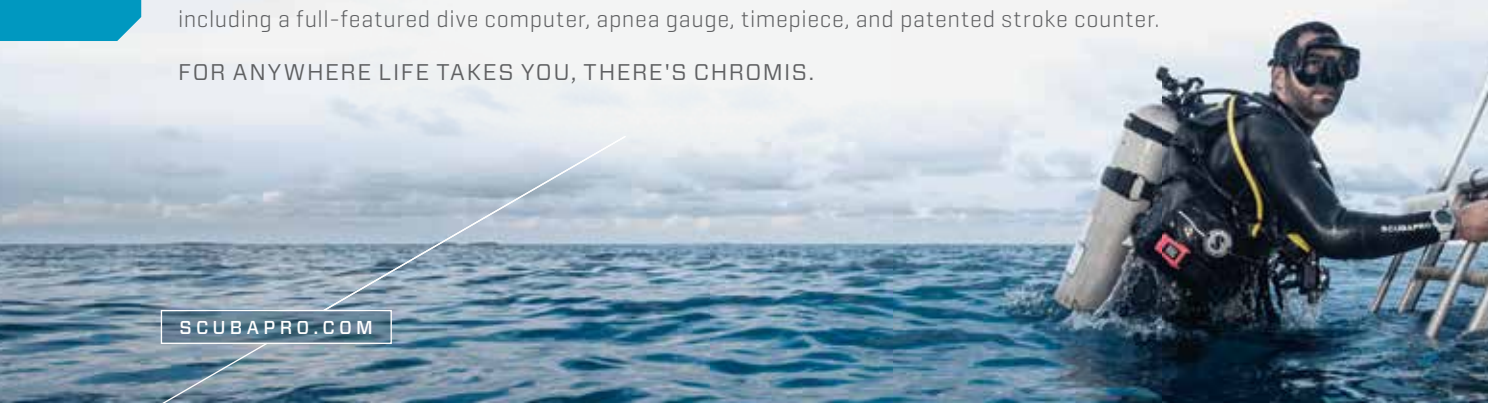

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