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Undercurrent®

The Private, Exclusive Guide for Serious Divers

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Saving Tubbataha Reef, Phillipines

— and saving myself, as well

Dear Reader,

After ten days at sea aboard the 65 foot research vessel Malaena, we started the long voyage home. The plan was to overnight in the Zabili Islands before returning to Negros Island. The sky was ominous. The waves grew. And grew. The prescient among us took Dramamine or plastered on ear-patches. The rocking of the boat accelerated till anything loose was sliding every which way. Our captain remained glued to the wheel, maneuvering the bow of the boat into the rising waves so we would not slide sideways into disaster. But our shallow-bottomed boat, so designed to enable it to negotiate the shallow coral reefs, would climb the slope of the 10-foot combers and shoot off into space, terminating its free-fall with a grotesque bellyflop that sent crashing shudders thundering throughout. This sequence of bone-jarring crashes went on and on. I and almost everyone else got seasick, and the boat began to spring leaks that had the crew frantically bailing water from four different spots.

INSIDE UNDERCURRENT

I peered ahead, hoping to see the Zabili Islands, slated to appear around 4:00 P.M. Unknowingly, the storm had forced us far off course. The boat had no navigational equipment, except a compass. We could find North, but there was no way to determine our East/West coordinate! The radio stopped working; a fuse had blown. We continued the monotonous series of violent up-and-down lurches northward with no prediction of when, if ever, we would sight land — though the theory was that we should eventually run into our home port.

Well after dark, I was able to get a few hours' sleep, emerging at 5:00 A.M. to discover that the waves had grown larger and all else remained unchanged. I felt desperate. I wondered if life jackets and life rafts were aboard. No crew member had mentioned them. We passed the 24-hour point of the storm with no change. The crew offered some nuts and hard-boiled eggs for breakfast. I worried that the captain might collapse, since he'd had almost no break in all that time. . .

My voyage had started innocently enough with a tantalizing announcement in Earthwatch magazine.

Ben Davison Succumbs to Home Brew!

No matter how many times we proof our stories, we occasionally goof.

Last issue, I inverted figures in our Nitrox story, stating that air is 79 percent oxygen, 21 percent nitrogen, a highly toxic formulation.

Apparently, I sampled that mixture prior to editing, like the home brewers who mix their own nitrox, and it got to me.

As everyone but I know, compressed air is 79 percent nitrogen and 21 percent oxygen.

Hopefully, the error was so silly you skipped right past it, figuring that the homebrew had gotten to me.

Ben Davison, editor

"Tubbataha Reef Marine Park, the Philippines – Tubbataha Reef is one of the world's greatest undersea wildernesses. Yet overfishing, careless anchoring, and blasting (an illegal fishing practice using dynamite) have damaged this submarine treasure, which Drs. Alan White (University of Rhode Island) and Hilconida Calumpong (Silliman University Marine Laboratory) hope to save from further devastation. Their work will help form an updated management plan for this spectacular underwater park. On the research vessel Malaena, cooks prepare meals, snorkelers and scuba divers map reef areas, identify large marine life such as dolphins, and note human impacts. Team I: April 16-26; $1,795 per person; co-sponsor: Conservation International."

My partner and I dive many times a year. We see first hand the destruction of coral reefs around the world and we wish to do our share to stop the destruction. We could do so by joining this tax-deductible expedition to the beautiful waters of the Philippines. As a veteran Earthwatch participant, I filled out the requisite forms (diving experience, general skills, self-descriptions, medical exams and clearance), pretty much knowing what to expect, so I thought.

Groggy from the 17-hour flight, we overnighted in Manila, then flew on to Domguete on the southern island of Negros, where we rendezvoused with our principal investigator and the eight other volunteer members of our team, who ranged in age from their twenties to their sixties.

During the first two days, Alan White briefed us on our one week boat tour. He wanted to know what percentage of Tubbataha was coral rubble, sand, and otherwise damaged from poison and dynamite fishing, and what percentage was healthy and vigorous live coral. He would then compare our data with that he had obtained in previous years to develop a management plan for Tubbataha Reef National Marine Park.

During our orientation, we stayed at the South Seas Hotel on the banks of the Sulu Sea, a pleasant resort with screened verandas off the air-conditioned rooms. Out at sea, a number of picturesque fishing boats with outriggers and colorful sails bobbed in the calm waters. Villagers fished by hand and waded in search of clams and other edible mollusks. The waters in front of the hotel were already a tribute to the efforts to protect and police the reefs. Alan said the reefs had been relatively barren only a few years ago, but the coral, invertebrates and fish we encountered were vigorous and varied.

The Malaena, owned by the local Silliman University Marine Lab, had been designed as a research vessel for conducting studies of coral reefs. She had a

flat bottom, appropriate for navigating in shallow areas, but not suited to high seas. A combined cooking, eating, and kitchen area in the stern doubled as the tank and equipment space. The crew functioned adeptly within this confined area with little confusion. Ours was the longest voyage they had attempted, and, as it turned out, our group of 22 souls (10 volunteers, four staff and eight crew) experienced a good many unexpected problems.

We traveled all day on smooth and beautiful seas, occasionally seeing dolphins, flying fish and whales. Several sperm whales spouted near the boat, departing only when the cameras we'd all dashed down to get were ready to shoot. That night, we anchored by the Cagayancillo Islands to recuperate before the next day's trip to Tubbataha Reef. Manta rays frolicked around the boat, but disappeared when we tried to get in the water with them.

On our first recreational dive that night, I dropped onto a magnificent wall that was sheer magic! Masses of rainbow soft corals flourished everywhere, their large polyps open to ingest whatever appropriate critters floated by. The usual sleepy tropicals were about, along with lots of squirrelfish and several exquisite red lionfish. Enthusiasm ran high.

But, research expeditions have their realities. Eight bunks are crammed in each of two compartments. The head below the deck near our bunks failed to function, leaving only the head on the stern for 22 people. It could be flushed only by pouring in water. To get to the head, I had to climb over the crew who slept on closely grouped benches and tables. For drinking, we had plenty of bottled spring water, but the fresh water was turned off in our downstairs shower – something about the complications of filling the tank. Science is never well-funded and the committed must make do. That's part of the adventure. If you wonder why Jacques Cousteau always makes out so well, it's because he's a film maker – not a scientist.

Next day, we proceeded to Tubbataha Reef to begin our daily schedule. We usually anchored next to a steep drop-off, so that while we conducted our surveys over shallow areas, we were close to more spectacular diving depths. Teams of two people would each alternate monitoring jobs. One team would run two transects of 50 meters each by setting the 50 meter tape twice on the bottom and plotting the nature of the substrate in some detail. The transects were often physically difficult; we had to anchor the tape over underwater hills and holes while struggling with the current to maintain as straight a tape extension as possible. Making judgments about the nature of the substrate every few centimeters took a lot of concentration. We indentified 34 different species of butterflyfish known to exist in the area, which we had been trained to recognize.

The other team would snorkel over a kilometer, stopping every 100 meters to estimate the percentage of each type of substrate within a 10-meter square.

Thanks for Draining the Lake

Diver David Gant and his buddy went diving in Tennessee's Nickjack Lake in August, slipping past a chain-link fence blocking a cave entrance. To hell with the barrier. They were in search of dinner — enormous catfish that grow up to 8 feet long and weigh 200 pounds.

Trouble is, Gant got separated from his diving partner and 1,200 feet into the cave, he ran out of air.

Gant held onto a stalactite and treaded water with his feet, breathing air trapped in the 8-inch space between the water and the top of the cave. His buddy escaped from the cave and notified authorities.

While the air in the pocket was running out, Gant hung on. The Tennessee Valley Authority, which operates the lake's dam, dropped the water level 2 to 3 feet, flushing the cave with fresh air. Sixteen hours after beginning his dive, Gant was dragged out, weak and nauseated, but in good condition.

Apparently, charges will be filed, although the whole experience means a mighty tab for us taxpayers.

The snorkeling was a delight, with extensive areas of 100-foot-plus visibility stretching all around us. I enjoyed paralleling the edge of the dropoff where I could see large schools of giant bumphead and plain parrotfish, barracudas, jacks, enormous Napoleon wrasses, frequent turtles, rays, and Moorish idols galore. Often below the surface, I spotted enormous schools of needlefish glistening in the sun or large batches of squid. Sharks and turtles and rays almost routinely cruised along the depths away from the wall.

We moved to new sites each day. Before or after our assigned tasks, we took whatever recreational dives we could. (I have been on other tax-deductible projects that allowed almost no diving beyond the daily assigned tasks.) I photographed a variety of anemone-and-fish societies (the usual orange and white but also black and white, and cream and white). In addition to the horizontal patches of anemone, there were steep, billowing curtain anemones. Weird and imaginative shaped wrasses boggled my imagination. Even snappers appeared in a range of fashions I would never have believed. Schools of jacks and trevallys swept in. Dozens of tiny damsel fishes clustered around soft corals, gorgonians and hard coral clumps. Groupers were everywhere, entertaining us as well as sometimes providing our supper. And the spectacular color and forms of lionfish were particularly satisfying, since they remained quietly in place while I bracketed f-stops, ASA settings and distances to my heart's content.

Often the abrupt arrival of a current would force us to postpone a dive. Occasionally, the crew would jump into an inflatable to rescue a pair of snorkelers who, at one kilometer's distance from the boat, faced an upstream battle. The crew was alert and helpful in this as in almost all other matters!

Tax Deductible Research Projects

Earthwatch is a membership organization with annual dues of $25. You can get a current catalogue for no charge by contacting Earthwatch, 680 Mt. Auburn St., P.O. Box 403, Watertown, MA 02272. Phone them at 800/776-0188. Prices begin at $1795 for two weeks.

- "Mapping Deep Reefs of Bonaire," May through July;
- "Canary Island Sea Life: Can Islands be protected from tourists?," July and August;
- "Saving the Philippines' Reefs" at Anilao, Batangas, May;
- "Mystery of the Pipe Wreck: What can the pipe Wreck reveal about the Dominican Republic's early trading history?" Santo Domingo, Dominican Republic, June through August.

CEDAM is a membership organization with a one time initiation fee of $20 plus $25 for singles and $35 for family membership. One Fox Rd. Croton-on-Hudson, NY 10520. Phone 914/271-5365. Deductible fees begin at $1395 for a week.

- Bonaire cleaner fish/shrimp study, July and August;
- Tahiti squid study, February;
- Belize fish and coral study, June;
- St. Kitts, marine flora and fauna study, July.

The Foundation for Field Research is a membership organization with dues of $20 for singles and $50 for family memberships. Write P.O. Box 2010, Alpine, CA 91903. Phone 619/445-9264. Deductible fees begin at $849 for the week, with several weeks available in 1992 and 1993.

- Shipwrecks of Grenada, Oct.-Dec. 1992, February, May and June 1993;
- Diving for Grenada's Lost Colony, June through August.

University Research Expeditions has not yet determined their diver needs for 1993. For information, contact University Research Expeditions Project, University of California, Berkeley, CA 94720.

P.S.: Air travel is tax deductible as well. Ask your accountant.

Alan's wife, Vangie, furnished the creativity for most meals. For breakfast, we had changing combinations of eggs, beans, French toast, meat of not-always-recognizable sorts (but good), plantains, yucca, cornbread Philippine-style, dry cereals, jackfruit, and "chico," a delicious fruit. And always fresh mangoes, papayas, and bananas. Rice was omnipresent, often mixed with mysterious but delectable things. Lunch and dinner almost always consisted of fresh fish:

parrot, surgeon, barracuda, grouper, and often, squid. Again, there were rice mixtures with both known and unknown vegetables and meats (bitter melon was a frequent component), salad, and sometimes, pasta. A special Mexican dinner was contrived with predominantly Philippine ingredients. Beer and soft drinks were available at all times.

But the accommodations got more onerous. The bunk area below was so hot it was almost impossible to sleep. I competed good-naturedly for deck space on which to plunk down my foam mattress and sleeping bag, but if I lost, I was stuck down below or forced to find a precarious perch on the top of the wheelhouse (the lounge was completely full). The heads and shower functioned only capriciously.

Most volunteers were veterans of these kinds of projects (several had been on more than 15!); so they were not prone to freak out over primitive circumstances. But we were sorely tried! To make matters worse, the boat developed a leak in the bilge, requiring the floorboards to be removed for bailing and cleaning both on the stern and next to the bunks, so the little available space was cut even further.

About this time, along came a purely-for-pleasure dive boat, the Lady of the Sea. Visiting her in our dinghy, I discovered forgotten luxuries like air-conditioning and plumbing, while remaining loyal to our ethnically pure craft. Her divers examined us with friendly but bemused expressions. But I remained smug. No eco-tourist, I. I'm here to save the reef so the future Lady of the Sea passengers can appreciate it. Indeed. . .

Well, at last it was time to return home. As you might surmise, we made it. Nearly 24 hours after we expected to find land, we did. And what a beautiful island it was, with grass huts, palm trees and curious natives gathering to watch us on the shore. None of Columbus' sailors was any more relieved and delighted than we! We leaped into the water for a refreshing swim while the crew headed in to determine where on Negros we had landed. But it was not Negros, it was Panay. Thanks to the storm, we had missed our target by 70 miles! We were still two bus rides and a ferry ride from home port.

Hanging Tough

Here's 26 year old spearer Rod Duguid, diving off Florida's Lantana's beach in August, when he spotted a fishing line at a depth of 15 feet. Hoping it might lead to some lost fishing gear, he gave it a tug. Up came a nurse shark, first bumping his chest, then sinking his teeth into his bicep.

Brian Blakney, Duguid's buddy, fired his speargun at the shark. But the spear bounced off the tough hide and the shark thrashed harder than ever.

"I grabbed Rod's good arm and the shark's tail and began dragging them back to shore," Blakney said.

At the shoreline, bystanders tried to get the shark off Duguid's arm, but they couldn't even pry its jaws apart with a knife.

For twenty minutes, the shark refused to release his grip. Finally, a brave police officer shot it in the head. It took two more shots to kill it.

Duguid needed surgery to stitch his bicep together.

Back at the hotel, I indulged in an orgy of washing, bathing and soaking up the joys of civilized living. We capped our celebratory dinner with sips of champagne and speeches. We'd survived our Sulu Sea ordeal amazingly well, with some darker thoughts that we may have come close to not surviving it at all.

My experience gives rise to sober introspection about the ultimate value of this kind of scientific endeavor. Earthwatch trips offer a special kind of satisfaction derived from the conviction that one is making a genuine contribution to knowledge. I worked hard and learned a lot, but I also had a good deal of fun meeting others with inquiring minds and adventurous spirits. But, then again, I have never felt so close to eternity.

The expedition did fulfill its purpose. I have subsequently received a warm letter expressing the personal gratitude for our work and an extensive report from Dr. White detailing the objectives achieved: e.g., "determining reef quality indicator values for all study sites through broad area survey using scuba and snorkel..." and measuring "reef substrate cover, fish diversity and abundance..." Dr. White goes on to state that "Tubbataha Reefs have apparently benefitted from protection management over the past two years. There is improved substrate cover of living coral and increased richness of indicator species as compared to 1989. Management is not preventing all destructive fishing. However, it occurs only on a hit or miss basis."

Swimming to Indiana

A cardinal rule: with divers in the water, one person should always stay in the boat.

Three Indiana scuba divers broke that rule in August. After their boat broke loose from its Lake Michigan anchorage, they spent 16 hours in the water trying to make it 8 miles to shore.

Swimming through the night, they battled 2 to 3-foot waves before being picked up by the Coast Guard, about a half mile from shore.

The men, who wore wet suits in the 71-degree water, were mildly hypothermic, but otherwise unharmed. Gotta thank those 30-year-old bodies.

So the study itself was of both practical and theoretical value. My personal verdict is trickier. Obviously, it would not have been worth it had we and our data sunk to the bottom of the sea. But, we did manage to come through it, with a reasonable amount of humor and dignity. Some of us got a paradoxical sense of satisfaction from the near death experience. After all, we did survive the Sulu Sea.

P.S. Become an Earthwatch Volunteer. You won't repeat my experience. Next year's Earthwatch team will be relocated to Batangas Reef, a few hours away from the home base. The Sulu Sea had shown itself to be too potentially violent and unpredictable for longer voyages in boats of uncertain virtue. But, the magnificent diving and worthwhile experience should remain.

S.W.

Diver's Compass: Round-trip fare to Manila from the West Coast was $837/person; RT from Manila to Dumaguete: $106 but expect charges for dive bags; no exception to a domestic check-in 45 minutes in advance. . . .At the South Seas Resort, my partner and I arranged two dives at a nearby island: lovely soft coral, damselfish and fairy basslets – and a close hand view of the ravages of the reef from dynamiting and overfishing. . . .Four lane highways in Manila jam with six and seven lanes of cars, trucks, pedicabs, buses and motorcycles; leave plenty of time to get to the airport. . . .At the restaurant Island Fisherman in Manila, take a grocery cart past the tanks of different fishes, and pick out your dinner, which they net and cook to your taste; select your fresh vegetables and fruits and discuss with the waiter how you want it all cooked: Thai, Chinese, French, Philippine, or whatever. What a treat for $20!

Why Divers Die: Part IV

—taking too many risks

This is the last of four installments of Why Divers Die, based on the 1990 Report on Diving Accidents and Fatalities, of the Divers Alert Network (DAN) and the National Underwater Accident Data Center, headed by John McAniff. We take all responsibility for editorial changes and errors.

* * * * *

Generally, there is more than one catalyst to a fatal dive accident. For example, ten divers first became lost in caves, wrecks, or under the ice, then ran out of air and drowned. Running out of air contributed to the fatality, but the initial cause was getting lost.

All phases of a dive require attention. Not being prepared to enter the water can lead to immediate and early dive problems. Late dive difficulties often evolve from low or out-of-air situations.

If a diver develops a primary problem at depth or on the surface, he may have to overcome negative buoyancy. Failure to release the weight belt contributed to three fatalities; one diver was at the surface. Failing to drop a weight belt complicated eight out-of-air ascents.

Three divers suffered injuries at the surface and drowned. Two were struck by boats in separate incidents, and one struck his head on rocks near shore in rough seas.

At least 16 victims with cardiovascular disease severe enough to have disqualified them as divers, knew about their disease. A problem may have started at depth, forcing the individual to the surface early. Cardiovascular disease can usually be diagnosed, so divers older than 40 should be carefully evaluated before participating in a strenuous activity such as diving.

Overhead Environments

In 1990, eight people died in caves, four under the ice, two penetrating a wreck and one while cavern diving. Three of these were double fatalities.

Thirteen of the fifteen failed to follow standard procedures. Six of these failed to maintain a continuous guideline to the surface. Two used homemade reels and became entangled in them. Two became entangled in their guideline that became detached from its tie-off. Two exceeded the recreational 130-foot depth limit, and one dived without a buddy. The two who adhered to safety rules succumbed to inexperience and error. Of the fifteen, seven had no specialty training.

Cave and Cavern Divers

A 38-year-old certified cave diver had been exploring an underwater cave system with two, 4-person groups. On the second dive, group one became disoriented and had difficulty determining the direction out of the cave system. When the first group did not appear, group two began an immediate search. One diver was found alive in an air pocket. The victim was found later with empty air tanks at a depth of 40 feet, 170 feet from the entrance.

A 46-year-old certified cave diver died while diving alone in a Florida spring. When recovered, his 80 cubic foot buddy-bottle was empty, but his twin 100 cubic foot tanks had 1200 psi of air. The primary regulator free flowed and the valve to the second was not completely turned on. He was recovered at 62 feet, 200 feet into the cave. He may have had a faulty regulator.

Four cave fatalities involved victims who did not have cave certification. The first incident cost the lives of two males, aged 18 and 19, in Florida. One source quoted the boys as saying they intended to go just "a little way" into the cave that was located about 80 feet down in a sinkhole. They were found more than 50 feet into the cave, completely entangled in their makeshift guideline.

A 55-year-old man certified as a rescue diver had no cave diving experience or certification. Despite warnings, he dived alone without using a guideline to the surface. His body was recovered 200 feet into the cave at a depth of 70 feet.

An instructor was accompanied by four of her former open water certified students in a dive at Otter Springs, Florida. They had been admonished against entering the cave. After the instructor and one other diver left the water, three others remained behind. A certified cave recovery diver who happened to be at the scene lent assistance when the instructor realized the three were missing. Within minutes, he located two of the victims, unconscious at a depth of 50 feet, well into the cave. He pulled one of them to the surface where CPR was successfully applied. In the meantime, he returned to the second victim, who had recovered consciousness; he used his octopus regulator to bring this man to the surface. On his third trip, he retrieved the body of the third man who had been down at least 30 minutes and had run out of air.

"While diving in Micronesia, a 67-year-old man failed to follow his guide, left his dive buddies, penetrated a wreck, and became lost deep in the stern section."

A 53-year-old man died in Florida while diving with a certified cavern diver and the latter's 10 year-old son. While exiting the silty cavern, the dive team leader failed to see the victim who was not on the guideline, and passed him.

Technical Diving Scenarios

A 25-year-old man with five years diving experience had been certified as a cave diver only six months. He had logged about 75 cave dives. He was unfamiliar with this specific cave, but was diving with a group of expert cave divers. He went to 250 feet, 20 feet deeper than his deepest previous dive. Using compressed air, he apparently succumbed to nitrogen narcosis and drowned.

A 29-year-old certified cave diver with extensive experience was found unconscious at the entrance to a 200 foot cave. He may have also suffered from nitrogen narcosis. He was not using a guideline to open water.

Wreck Penetration Scenarios

A 40-year-old instructor had logged hundreds of wreck dives, at least 30 dives on this wreck. He apparently experienced a severe silt-out and ran out of air before he could find his way from deep within the ship. It took five days to recover the body.

While diving in Micronesia, a 67-year-old man failed to follow his guide, left his dive buddies, penetrated a

Those Who Go Down in Caves

Research with cave divers indicates that psychological tests provide a rough gauge of who will be suc-cessful and who will fail in high-risk activities, says Milledge Murphey, a professor in the University of Florida's College of Health and Human Performance. His research was reported by the UPI.

"In this very extreme high-risk group of cave divers, there seems to be a cluster of certain types that do not do well, and another that do quite well," Murphey said. "The majority of successful cave divers are introverted. Scuba divers are mostly extroverts," he said.

His 10-year study of cave divers showed nine of 65 killed while diving fell into two personality types —one introverted and one extroverted — among the 16 personality types on the Myers-Briggs psychological test. The unsuccessful divers were "introverted-sensing-feeling-perceptive" and "extroverted-intuitive-feeling-judging".

Successful divers mostly fell into another four categories and were mainly introverted. The cave divers took the test at the beginning of the study, which compared personality traits with activity performance.

There are about 3,500 trained cave divers in the world today, said Murphey, himself a cave diver and President of the National Cave Divers Association. Since 1963, 430 cave divers have been killed in Florida. "Cave diving is the only sport where death is an absolute result of performance failure," he said. "It must be done right or there's no tomorrow."

With its high-tech equipment and precise set of instructions, cave diving requires someone with a mind-set for details. Many of the people the sport attracts work in technical professions.

"The general population probably believes that most people who cave dive are brash risk-takers who jeopardize their lives for a good time," he said. "But research on cave divers, aerobatic pilots, sky divers and other participants in high-risk sports shows that these are serious, professional people who enjoy technical precision.

"Cave diving, like other high-risk sports, has become increasingly popular since the 1970s, probably in part because of people's desire for greater risk-taking in their lives", he said.

"Many people in advanced cultures crave more excitement in their mundane lives than going to work, coming home and watching television," he said. "They seem to want to look back toward the gladiator days when people truly lived on the edge."

One reason for cave diving's growing popularity is rapid advances in the technology of the equipment, allowing people with relatively little experience to make deeper and longer dives into caves, he said.

Cave divers, like other participants in high-risk sports, often seek sensations of vertigo, Murphey said. "It's a little like floating outside of a space capsule in outer space," he said. "The environment of an underwater cave is so hostile that there's no possibility of being able to surface if you have an equipment malfunction or technical problem."

wreck, and became lost deep in the stern section. When found dead at 110 feet, he had wandered hundreds of feet into the stern.

Ice Diving Scenarios

Diving under ice resulted in two double fatalities in 1990. Two 43-year-old experienced divers, one of whom was a certified instructor, died in a Pennsylvania quarry. Their bodies were located two weeks after the incident in 60 feet of water. They carried 200 feet of rope, but one end frayed and the other end cut. On the surface there was no evidence of a safety line nor was a tender present. Friends still consider it a mystery that the two would have violated the safety principles that they believed in so strongly.

Two brothers, aged 33 and 26, died under the ice in Okauchee Lake, Wisconsin. There was no safety line, and no surface tenders were present. Both victims were experienced divers with advanced certification. They were not trained for ice diving.

Summary

Many factors lead to a diver's death. Some occur long before the diver enters the water. Pre-existing disease or inadequate training and experience are not difficult to recognize. Running out of air during a dive should be simple to prevent, yet it accounts for several deaths each year. Panic, rapid ascent and embolism continue to occur, usually involving inexperienced divers. A significant number of cardiovascular deaths occur each year.

Ultimate responsibility for safety rests with the diver who makes the decision to dive or not to dive. Each diver should have sufficient training to enable assessment of each diving situation before deciding whether to proceed.

P.S. For 1991, 68 recreational scuba fatalities have so far been reported. The record low for scuba fatalities was reported by NUADC in 1988 when there were 66 deaths. Thankfully, scuba fatalities are beginning to show a definite downward trend.

Diver's Elbow

— It happens, it hurts, it's preventable

Acute elbow pain (tendinitis or lateral epicondylitis) is a common injury for tennis players (tennis elbow), golfers, and baseball pitchers — and even for those carrying scuba tanks.

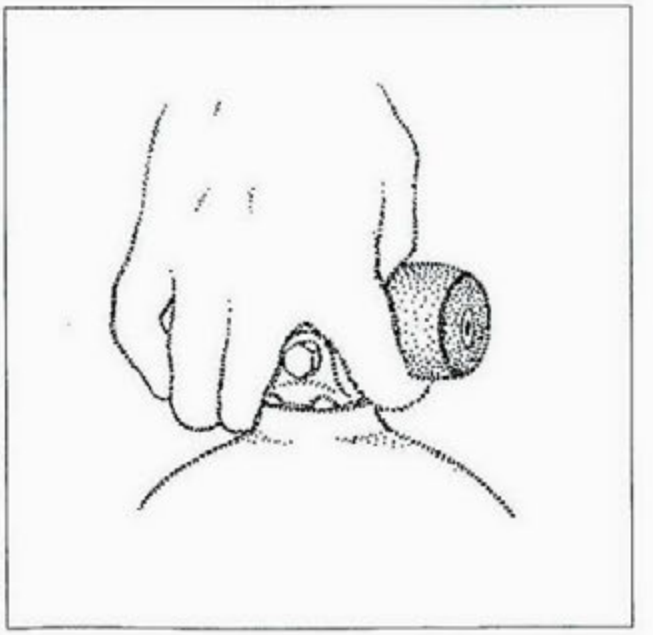
Pain runs along the elbow and the arm. Gripping may aggravate the injury. The grip may weaken. People often do not seek medical attention until the pain has affected them for several months. Here are a few examples:

A 50 Tank-a-Year Diver

This 48-year-old diver averages 50 dives per year but is otherwise sedentary. Four years ago, he developed agonizing dull pain in the left elbow. For a year, he endured the pain that occurred even with simple activities such as lifting a coffee cup. When his grip weakened severely, he feared that a diving mishap might occur (he also had limited range of motion of the left shoulder). He was put on a six-month trial of various anti-inflammatory agents. They provided no relief. An MRI shoulder examination revealed nerve impingement and surgery was recommended. He had his left elbow operated on at the same time, and has been pain-free for 18 months.

A Sedentary Diver

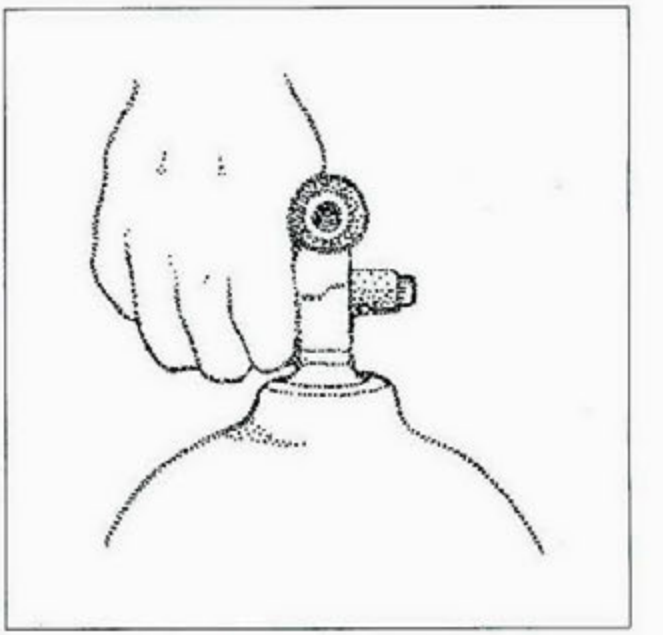
A 46-year-old male had a twelve-year history of intermittent elbow pain. While he spends the majority of his year in a supervisory position, two months involve intensive research diving trips, lifting and carrying tanks over 100 yards of rough terrain daily. The pain typically occurs during his trips and lasts one to nine months after returning to his sedentary life. The pain occurs when he rests and has no accompanying grip weakness. He has tried the entire spectrum of nonsteroidal anti-inflammatory agents with varying success.



SPLIT GRIP HOLD

A New Diver

After playing tennis for the first time three years ago, this 40-year-old female noticed that her right elbow was occasionally painful. Three months later, she began taking an open water certification course. As part of her course, she was required to pass forty tanks from one diver to the next. Three weeks into the class, she awoke with a sharp pain in her right elbow that felt like a hot poker. Her grip weakened.



SINGLE GRIP

After the course, she continued to lift the tanks by the valve stem and began using her left hand more than her right. Consequently, her left elbow became symptomatic within nine months. Surgery seems to have cured her pain.

Treatment

Conservative treatment requires ceasing the offending activity and using nonsteroidal anti-inflammatory agents. The majority of patients respond to treatment and return to a normal life. When symptoms are persistent and debilitating, a steroid injection may provide relief. The wrist may be immobilized by a splint and hand activity held to a minimum.

A small percentage of patients require surgery. Patients usually resume normal activity within a year.

Prevention

To determine whether a diver carrying a tank could alter his hand position to reduce the liklihood of injury during lifting, four subjects were wired with electrodes in sixteen separate trials lifting tanks filled to 3,000 psi. They used four grips. Two afforded the most stress and subsequently the greatest liklihood of injury.

These two grips were:

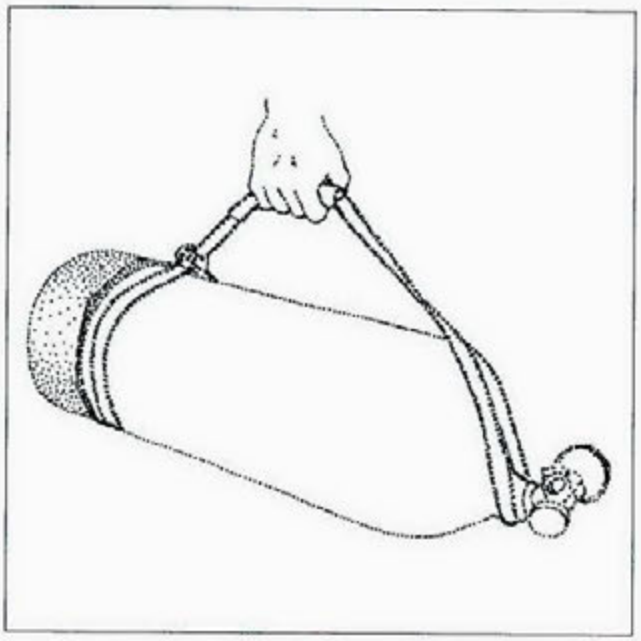
• the split hold grip consisted of grasping the tank by the knob and having the valve neck between the index and middle fingers.

• the single grip consisted of grasping the tank valve by the knob with all fingers on the knob side of the valve.

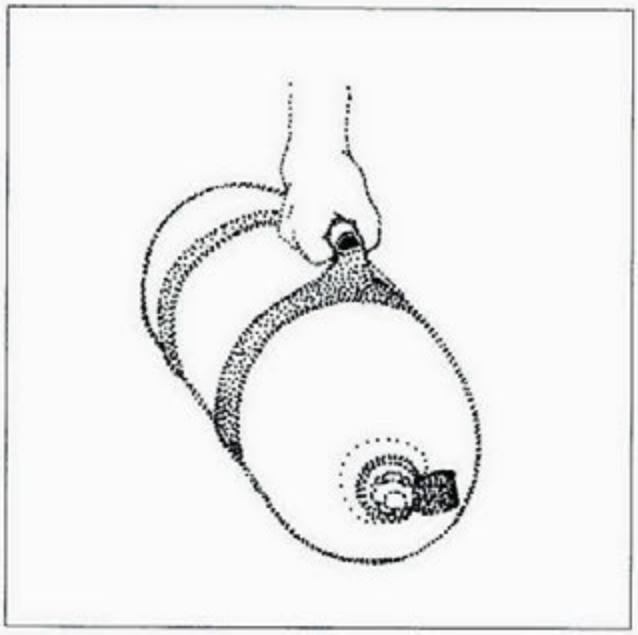
Two other methods provided significantly less stress and less liklihood for injury. They were:

• the Tank Handle (Silent World Products) provides a sloping sling that resulted in a 45 percent decrease in extensor muscle group activity and a 61 percent decrease in biceps activity.

• the Standard Tank Carrier (Trident Diving Equipment) provides the classic baggage-style handle. The extensor muscle group activity decreased 33 percent and the biceps activity decreased 52 percent. The carrier was less effective for the shorter person.



STANDARD TANK CARRIER



TANK HANDLE

The common extensor muscle group and the biceps muscle group demonstrate decreased activity when using carrier straps. Why the sling was slightly more effective than the handle may be due to the strap slope allowing for better distribution of the weight to all the muscle groups of the forearm.

Conclusion:

Unconditioned forearms and overuse during dive trips both predispose divers to tendinitis. A pre-dive training program involving both isometric and weight-bearing exercise combined with using tank carrier straps may decrease the risk of elbow and arm injury.

This article is based on two pieces published in the *Journal of South Pacific Underwater Medicine Society*, one by Dr. Lori L. Barr and Larry R. Martin and the other by Barr, Martin and Dr. Denis Brunt. Exerpted with permission of the Journal, we take all responsibility for editorial changes.

Why Computer Users Get Bent

— decreasing your risk of disaster

Over the past few years, models of dive computers have flooded the market. They have been promoted heavily by the manufacturers, distributors, and dive shops, each extolling the virtues of the particular unit being promoted. In their enthusiasm, many eager computer proponents have forgotten that, in reality, little is known about how well the various units actually perform.

Dive computers are programmed with various algorithms (i.e. sets of mathematical equations) that are designed to simulate the uptake and release of nitrogen within a diver's body. Before the computers were released to the market, many of these algorithms had little or no testing, especially for multi-level dives. No one could be sure how well these devices would do the job for

which they were designed—preventing decompression sickness (DCS).

Nevertheless, these magic little boxes have captured the imaginations of tens of thousands of divers throughout the world, conducting millions of dives with various units. As data of DCS incidence mounts, we can get a better idea of how safe the units are.

Computers and DCS: The United States

From mid-1988 through 1990, DAN (the Divers Alert Network) reported 371 cases of DCS in computer divers. In 1990 alone, 203 occurred, representing about 44 percent of the DCS cases that year.

"...81 percent of the computer users who suffered DCS had dived deeper than 80 ft; 73 percent of them had made repetitive dives."

An analysis of the 1987 and 1988 statistics show that divers who used computers were diving marginally deeper than those who used tables. In addition, it appeared that computer users seemed more likely to get the bends after multi-level dives and decompression stop dives. Although computer users also had a higher bends rate after repetitive dives, the difference was not statistically significant.

In 1989, 81 percent of the computer users who suffered DCS had dived deeper than 80 ft; 73 percent of them had made repetitive dives. Data for 1990 showed increases to 86 percent and 82 percent, respectively.

The 1989-90 data appear to indicate that computer users have a higher DCS incidence after deeper dives or repetitive dives than do table users.

Computers and DCS: Britain

In the United Kingdom in 1987, 16 percent of the divers treated for DCS had been diving within the limits of their dive computer. In 1988, 42 percent of the 95 divers treated for DCS had been using dive computers (there is no data as to whether they used the computers properly).

In 1989, 33 percent (45/137) of the bent British divers had been using a dive computer. Only 15 of these reported diving within the limits of their units. When six of these 15 divers were medically examined, five were found to have a patent foramen ovale (a relatively common defect in the heart that enables some blood to flow directly from the right side of the heart to the left), which possibly predisposed them to bends.

In 1990, 21 percent (17/80) of the divers who suffered DCS had dived within the limits of their computers.

The majority of the British bends cases in computer users occurred after dives deeper than 100 ft.

A Bright Note

Bret Gilliam reported on 44,277 dives done using computers, all conducted from the now defunct dive cruise boat, *Ocean Spirit*. In the only case of DCS in a computer user, the diver misused his computer.

About 70 percent of these dives were done using "Micro Brains," which employ algorithms that are reasonably conservative in most situations.

Why Computer Users Get Bent

Since it is unlikely that 20-30 percent of active divers use a dive computer, the DCS incidence in computer users may be disproportionately high. But this has not been confirmed.

Tables vs. Dive Computers

(percentage of total cases)

	1990		1989		1988	
	Tables	Computers	Tables	Computers	Tables	Computers
Deeper than 80 ft	62.9	85.7	38.5	81.0	67.0	81.0
Square profile	51.6	32.0	53.2	28.6	61.0	42.0
Multi-day	43.8	47.8	48.3	52.4	48.0	55.0
Repetitive	70.3	82.3	58.5	73.0	57.0	81.0
Single day	54.3	51.7	51.7	47.6	52.0	45.0

Note: There was a certain amount of overlapping of various categories. For example, some divers may have done a repetitive, rectangular dive deeper than 80 ft.

No Decompression Limits for Dive Computers and Tables

Depth (ft)	U.S.Navy Tables	DCIEM Tables	SME-ML Compote	Seaquest Solution	Aladin Pro/ Monitor II	Datamax Sport & Pro	MicroBrain Pro plus	Skinnydipper* *et. al*	Scubapro DC-11
30 ft.	-	300 min.	215 min.	222 min.	354 min.	260 min.	220 min.	225 min.	215 min.
40	200 min.	150	132	127	121	136	106	133	84
50	100	75	74	72	70	78	64	75	54
60	60	50	53	52	49	55	44	52	33
70	50	35	38	37	35	40	31	39	21
80	40	25	29	29	25	31	20	31	14
90	30	20	23	23	20	25	15	24	11
100	25	15	18	18	16	20	12	19	9
110	20	12	13	13	14	16	10	13	8
120	15	10	11	11	12	13	8	10	7
130	10	8	9	9	10	11	7	9	6

* The times for the Edge, Marathon and Phoenix are identical.

Sometimes DCS results because the diver disobeys the advice given by the computer (or tables). On other occasions, divers have suffered DCS after diving well within the limits of their computers (or tables). The algorithms programmed into the computers are based on general empirical experience and cannot consider all individual tissue variations or environmental factors influencing the rate of gas uptake.

"If using a dive computer for multi-day, repetitive diving, take a 24 hour break every 3rd or 4th day"

From my observations, many divers who own a computer seem to dive more frequently, often greatly extending their dive time during a dive, and performing more repetitive dives. If true, this would put a computer user at a greater risk of DCS. High risk dive profiles for computer users (and, in most cases, table-users) include dives 80 feet or more, especially deep repetitive dives, decompression stop dives, multi-day repetitive dives, and multi-level dives in which a diver descends deeper, rather than working shallower, during the dive.

Armed with the knowledge gained over the past few years, those who program dive computers now have a better idea of the shortcomings of their models. Nearly every computer manufacturer, with the possible exception of Orca, has taken significant steps to modify their algorithm. Certain computers (for example, the Suunto Solution) have recently become more conservative in the no-decompression stop times they allow (and decompression stop times they require), especially for repetitive dives. Hopefully, programmers will continue to address more of the shortcomings of dive computers, including their current inability to alter the off-gassing rate after a rapid ascent, and, in most cases, introducing more severe penalties for working deeper during a dive, or in subsequent dives.

Continued next issue.

The author, John Lippmann, is a Master Scuba Instructor and is the author of "The DAN Emergency Handbook", "Deeper Into Diving" and "The Essentials of Deeper (Sport) Diving", published by Aqua Quest Publications. They may be found in dive stores or ordered from *Undercurrent* by using the enclosed brochure.