

Underwater Speleology

Journal of the Cave Diving Section of the National Speleological Society



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**Rebreathers: Loop
Leaks and Water
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of Ben's Cave, Grand
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COVID-19 Era**

**Transporting an
Injured Diver Through
a Sump**



Postponed

2020 NSS-CDS International Cave Diving Conference

We're expecting an exciting group of expert speakers in May, including:

- **Doug Ebersole, MD: Cardiovascular Disease and Medical Issues in Aging Divers**
- **Ricardo Castillo: Cave Photography: Tips and Tricks**
- **Robbie (Xibalba) Schmittner: Cave Connections in Mexico**
- **Brett Floren: State of the NSS-CDS**
- **Todd Kincaid: Update on the Health of Florida's Springs**
- **Master of Ceremonies: Paul Heinerth**

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Cover: © Ricardo Castillo. Jorge Martínez dives in Dos Ojos.

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The magazine encourages members to submit news, stories, letters, trip and exploration reports, maps, and photos for consideration. Please contact the Editor for publication guidelines to avoid duplication of work.

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chair's note

Greetings everyone!

I will start by saying how grateful I am to be part of the NSS-CDS executive team. This is my first letter for the UWS as Chair, and my goal is to provide the membership with updates and information to help make our journey together a smooth one.

This is an interesting time as we navigate through these uncertain waters of COVID-19, causing travel restrictions and a massive reduction in the socialization of our local and international diving community. As our world experiences these ebbs and flows, we are finding new ways to connect, and this is so important!

Most of you are aware that the May International Cave Diving Conference had to be postponed. The Board of Directors did hold a Zoom conference on May 23rd. At that time the new board was seated, and the offices were determined as follows:

- Reneé Power - Chair
- Brett Floren - Vice Chair
- Jason Black - Treasurer
- Robby Brown - Secretary
- Ken Sallot - Property Manager
- Richard Blackburn - Committees
- Max Kuznetsov - Training Director

Our contact information is listed on the NSS-CDS website. You are invited to interact with us when you see us out diving or on social media and to reach out with comments, concerns, or questions. We can't fix problems if we don't know they exist. Kindly make us aware of areas that you value and those that need adjustments. Have an idea to solve a problem? We will take those, too. We are aware of processes that are problematic and have been for years.

Please be patient with us while we grow.



by Renee Power

A heartfelt thanks is extended to members of the outgoing Board who have generously given their time to NSS-CDS. They can take credit for several important projects:

- Working to keep Eagle's Nest open (twice).
- Putting together a team of volunteers who offered to fly to Thailand to participate in the soccer team cave rescue in July 2018. The team was not deployed.
- Collaborating with the NSS to protect Mill Creek Sink from development. The upstream section of the cave is now entered into public record.

The unexpected death of Reggie Ross, Training Director, in December 2019 was overwhelming for the Training Committee, the NSS-CDS as an organization, and especially to his closest friends. We are grateful to Lamar Hires, who generously stepped in to serve as the Interim Training Director until the new Board was seated.

Max Kuznetsov has recently been training students in Russia to help grow the international community. The Training Committee continues to update and develop standards for NSS-CDS specialties. Instructors have a unique and professional platform within the main NSS-CDS website that houses training standards, forms, a simplified student registration process, and more.

We are happy to report that NSS-CDS is in a financially stable position. Contributing to this was a successful Orlando DEMA Show in 2019. We profited just over \$1000 through the sales of books, our new logo shirts, renewals, and new memberships.

The Board held another Zoom meeting on June 8 to discuss plans to reschedule the 2020 International Cave Diving Conference that was postponed due to COVID-19. Options include having a smaller-scale conference in the fall, possibly in conjunction with the Hart Springs workshop.

Enthusiasm seems to be growing to hold an event in Mexico. Although we are anxious as a community to reconnect socially, our main focus is safety while COVID-19 continues to be a problem. No live conferences will be conducted until this improves. If you have paid for the International Cave Diving Conference, you have the choice of having the fees refunded, applying them to a future conference, or offering the funds as a donation to the NSS-CDS.

Changes have been made to our Property Management Plans in the "About Us" tab on our website, <https://nsscds.org>. You will find the updated guide list for Mill Creek (Alachua) Sink and a link that will direct you to the Mill Creek Management Plan on the NSS website, <https://caves.org>. Thanks to Ken Sallot for orchestrating this process.

(continued on Page 42)

Diving in the Era of COVID-19

Some of you know that I recently survived COVID-19. Because I'm a physician, the illness was just an occupational hazard.

I tested positive for the virus after seeing a patient in my cardiology clinic for an unrelated condition. He seemed quite short of breath, and he was admitted to the ICU and tested positive for COVID-19. He did not require a ventilator and recovered after approximately two weeks in the hospital.

I was notified of his positive test one week after my exposure. I had been wearing my N95 mask when I saw him, so I was advised to take my temperature daily and self monitor for symptoms. I did well for a few days and then developed a cough and profound fatigue followed by fever. I ended up testing positive and spent the next couple of weeks quarantined at home.

I have recovered and returned to work and to diving (more on that below). I am definitely a lucky person. Hundreds of thousands of others have been hospitalized and required ventilators.

This is a horrific global event, but we will come out the other side. Many of us question how to protect ourselves and, if we become ill, when can we return to diving? Staying safe means protecting one another by social distancing and other means. This involves some changes to the way we interact and gather, including diving and teaching diving.

A new, easily transmissible virus

COVID-19 is the kind of pandemic that virologists have warned and worried about for decades. SARS-CoV-2, the virus that causes the disease, is novel, zoonotic (jumps from animals to humans), and highly infectious. It rapidly became transmissible from person to person. The CDC has confirmed more than 4 million people infected in the U.S. alone, more than 140,000 of whom have died. Some 14 million people worldwide have developed COVID-19 in just over six months. At least 600,000 have died, among them more than 600 doctors and nurses (a gross underes-

by Douglas Ebersole, MD



imate, according to some professional organizations). Nearly one half of the reported cases have been in the Americas.¹

A recent report² reveals that an estimated 45% of people infected with COVID-19 have no symptoms and do not know they are infected. They can unwittingly transmit the disease for up to 14 days and possibly more. This underscores the importance of mask wearing and the need for universal testing and contact tracing.

"I can't make an accurate prediction but it's going to be very disturbing," infectious diseases expert Dr. Anthony Fauci told a June 30, 2020, Senate hearing. "We are now having 40-plus thousand new cases a day. I would not be surprised if we go up to 100,000 a day if this does not turn around, and so I am very concerned." The U.S., he added, is "not in total control." Younger people are making up a growing percentage of new coronavirus cases in cities and states where the virus is now surging.

Experts believe that a vaccine for COVID-19 is still at least a year or more away. The disease will continue to spread until one is available. There is no specific treatment.

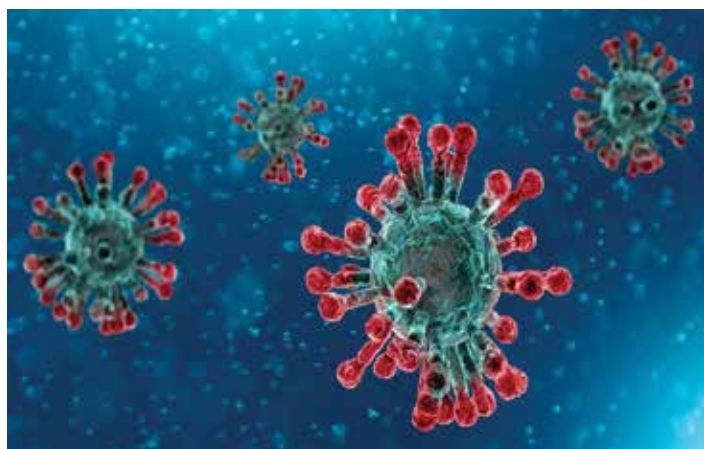
SARS-CoV-2 mainly attacks the respiratory system. Its cardinal symptoms are fever and a dry cough, but it also can cause headache, fatigue, muscle aches, and other symptoms of generalized illness. People who have mild illness can deteriorate rapidly, developing potentially life-threatening hypoxemia and respiratory failure. About 20% of patients are severely ill (14% develop pneumonia and hypoxemia) or critically ill (5% have respiratory and other organ failure, septic shock).³

The virus can wreak havoc on the heart, kidneys, central nervous system, blood, GI tract, and the endocrine system. Thromboembolic and cardiac events may accompany severe disease. The immune system can go into overdrive and attack the vital organs (“cytokine storm”). Some 90% of patients who need ventilatory support do not survive.

Recovery time varies and correlates with illness severity. Patients with mild symptoms usually feel well by 7-10 days. More severely ill persons have reported persistent fatigue, muscle pain, and mental fuzziness after the acute illness wanes. Confusion, cognitive impairment, reduced attention and concentration, and other neuropsychiatric problems are being reported on post COVID-19 follow up.⁴ These aftereffects are important considerations when contemplating a return to diving, particularly cave or other technical diving.

Creating safe conditions in which to dive, teach, and train

The best information available as of June, 2020, is that COVID-19 is spread mainly through close-up



Scanning electron microscopic image of SARS-CoV-2



The 16th-century plague mask. Its long bird-like beak was stuffed with herbs to protect against “miasmas” and maintained the infected patient at a distance. From The Encyclopedia of Infectious Diseases: Modern Methodologies: Tibayrenc M (ed), Wiley and Sons, Hoboken, New Jersey, 2007.

person-to-person interactions for extended periods (> 15 minutes), especially in enclosed areas. Crowded events, poorly ventilated areas, and places where people are speaking loudly (bars) or singing (such as church) maximize the risk. While transmission is possible during fleeting encounters with people outdoors or via contact with a contaminated surface, it's less likely.⁵

Take prevention seriously. A total lockdown of the country would be the most effective way to prevent disease spread, but this is impractical and would bankrupt society. So we need to return to normal but do so safely. Social distancing is important because larger aerosolized droplets containing the virus travel only about six feet before hitting the ground (coughing or sneezing excepted).

Airborne “microdroplet” infection spread. Consensus is growing that—like SARS and MERS—COVID-19 may be transmitted by the airborne route.⁶ Viruses are released into the air in microscopic droplets during exhalation, talking, or coughing. These microdroplets are small enough to remain suspended and pose a risk of exposure at distances well beyond one to two meters (3.3-6.5 feet) from an infected individual. For example: At typical room air velocities, a virus-laden five-micron droplet will travel “tens of meters...while settling from a height of 1.5 meters (5 feet) above the floor.” This may help

to account for the “superspreader” phenomenon. Ventilation with fresh air and avoiding crowded venues are key to reducing infection via this route. Some simple measures include opening windows and doors to the outside, reducing exposure to breathing recirculated air, and using high-efficiency air filtration.

Face masks make very good sense from a public health standpoint. They somewhat decrease (not eliminate) the viral load that an infected person puts into the air. You do not need a mask if you are not in close contact with people or are having only fleeting encounters (such as passing by someone during a walk around the lake).

In crowded areas, masks are important. You may feel perfectly well but be infected with COVID-19. Wearing a mask will help to prevent your infecting someone else. That person could get very sick or could infect an elderly relative or an immune-compromised person

who could then become gravely ill or die. From a common sense standpoint, a face mask acts as a barrier and may protect you from droplet exposure.

For the greater good. In an effort to protect society as a whole, we often need to do things for other people instead of thinking only about ourselves. If we don't continue to practice social distancing, don't quarantine ourselves if we get sick—and, yes, if we don't wear masks in crowded areas—the number of cases will continue to spike. Many people will get sick, some will get very sick, and others will die. Again at the end of June, cases are surging.

Ignoring basic public health principles will result in shutdowns again like those we saw in March, causing families, friends, and people we don't know to lose their jobs or businesses or go bankrupt. This includes the diving industry we all care so much about.

Position of the Belgian Society for Diving and Hyperbaric Medicine (SBMHS-BVOOG) on Diving after COVID-19 Pulmonary Infection¹¹

1. To avoid transmitting COVID-19: The Belgian Society recommends certain waiting periods depending on whether the diver:
 - has had symptomatic COVID-19 (two-month minimum);
 - has tested positive but remained asymptomatic (one month minimum), or
 - has never been infected and is asymptomatic (a variable waiting period because s/he may not have developed immunity).
2. To reduce the risk of pulmonary barotrauma, divers who have had severe pulmonary symptoms should wait three months and then undergo complete pulmonary function testing and high-resolution CT scanning of the lungs.
3. To evaluate cardiac event risk: A diver who has been hospitalized with COVID-19-related cardiac or pulmonary symptoms should, after the three-month waiting period (as indicated above), undergo cardiac evaluation with echocardiography and exercise electrocardiography to ascertain normal cardiac function. Cardiomyopathy (a condition in which the heart muscle has become enlarged, thick, or rigid) or cardiac scar tissue may be important factors in the occurrence of sudden cardiac failure and sudden death during diving.
4. To minimize likelihood of pulmonary oxygen toxicity, divers should avoid prolonged breathing of hyperoxic gas (with a pO_2 of 1.3 ATA or higher) until we know more about whether COVID-19 causes increased sensitivity of the lung tissue to oxygen toxicity. Simple “nitrox” diving should not present any problem.
5. To decrease the risk of decompression sickness, divers who have suffered from pulmonary symptoms of COVID-19 should remain well within no decompression limits. Even less is known about whether COVID-19 pulmonary infection alters the lung's “bubble filter” function. This may imply a significantly increased risk of decompression sickness.



Consider an analogy. I can legally drink alcohol, but I cannot drink alcohol and drive. Why not, if I'm willing to assume the risk? Isn't this a violation of my civil liberties?

No, of course not. It's one thing to drive under the influence and kill yourself. It's another matter entirely to kill an innocent person. With respect to COVID-19, you may be young and healthy and feel you don't care if you expose yourself to the virus. You may believe that you are unlikely to get really sick or die, and you are willing to take that risk.

But if you are infected and have no symptoms, do you believe that you have the right to expose others to a potentially fatal disease simply because it inconveniences you? Has our country turned into a collection of selfish individuals who have no sense of "the greater good?" Maybe wearing a mask will prevent me from contracting COVID-19, and maybe it will keep me from infecting someone else. Maybe. "Maybe" is good enough for me. After all, it's just a mask.

Gas sharing. The NSS-CDS Training Committee has modified S drill and gas-sharing practices so that no diver breathes from another's second stage regulator unless a genuine out-of-gas emergency occurs.⁷ The web site's upgrading now allows online class registration, instructor selection, and paying for class online at the same time.

Disinfection. Dive shop managers should clean and disinfect high-use surfaces using household products or a dilute bleach solution (CDC). Instructors and businesses that rent gear should consult the Divers Alert Network's (DAN) equipment disinfection protocols.⁸ These protocols specify using the Environmental Protection Agency's "List N" products.

Returning to diving after a COVID-19 Infection

What about the diver, such as myself, who has contracted COVID-19? When can this person safely return to diving? There is no definitive answer because there are no data. For now, experts are turning to followup of SARS-CoV-1 patients to develop some guidelines. Recommendations are being developed based on symptom severity and exercise tolerance.

Anyone who has had symptomatic COVID-19 should be evaluated by a physician knowledgeable about diving before returning to the water. Instructors and students will notice that the RSTC dive medical questionnaire now contains screening for COVID-19.

Factors to consider

Disease severity likely correlates with the extent of pulmonary injury and potential cardiac involvement. Intubation and/or an ICU stay can lead to severe deconditioning, muscle atrophy, and post-traumatic stress. Divers who have recovered from COVID-19 may require more than just a pulmonary evaluation.

As with any illness, divers must be completely symptom free and have good exercise tolerance before even considering a return to diving. COVID-19 in some cases aggressively attacks the lungs and the cardiovascular system. It is too soon to know the duration of these effects. They likely vary highly among individuals.

The Belgian Society for Diving and Hyperbaric Medicine¹¹ and other dive medicine groups have issued guidelines for returning to diving after COVID-19 infection (see box, previous page).

Pulmonary function and exercise capacity were impaired three months after hospital discharge in half of the recovered patients in a series of 46 SARS survivors.¹⁰ Impairment was mild in almost all cases, but many patients had reduced exercise capacity that could not be explained by their impaired pulmonary function.

Follow up of six divers with COVID-19. Frank Hartig, a senior physician at the Innsbruck University Clinic in Austria, recently published a report in the German dive magazine *Wetnotes* (an English translation was posted on Facebook). Dr. Hartig is an avid diver who heads the hospital's emergency department and coordinates care for its COVID-19 patients.

He reports that of the dozens of COVID-19 patients he has treated recently, six were divers. None of these six required hospitalization, and all felt as if they had recovered five to six weeks earlier. However, two developed hypoxemia under stress, two demonstrated reactive airway disease, and four showed "impressive" lung changes on CT scans. The English translation concluded that "the damage to the lungs is irreversible" even though the follow-up tests were done only about six weeks after symptoms had clinically resolved.

We must interpret this small case series with caution for now while awaiting further data. It is quite thought provoking and generates hypotheses for future research. But it consists of only six divers who had very short follow up. The report does offer a good reason to pause and consider how to decide when to return to diving after being infected with COVID-19. We just need to await larger, controlled studies with longer follow up before becoming overly concerned and making sweeping changes to evaluation of fitness-to-dive protocols around the world.

In a position paper,¹⁰ The Undersea and Hyperbaric Medical Society (UHMS) agrees that currently we simply do not have sufficient data to support or refute Dr. Hartig's conclusions. UHMS believes that many variables potentially affect how this disease manifests, its clinical course, and its long-term prognosis. These variables include underlying medical conditions, age, disease severity, and complications. It will take time before the peer-reviewed literature documents the potential impact on individual health and lasting effects on lung or heart function.

The University of California San Diego group¹² notes that "exercise tolerance is likely the most important definition used in our guidelines, and



Woody Alpern, Carol Ebersole, and Douglas Ebersole.

it is vital that physicians evaluate it carefully. It is our belief that a diver with significant cardiac or pulmonary pathophysiology would not have a normal exercise tolerance." Definition of the word 'normal' is critical, the group cautions. First, the diver must have returned to his or her baseline level of exercise and tolerance. Even minor deviations from the baseline ("getting more winded," longer recovery times, etc.) warrant further testing and investigation. Second, the physician must be satisfied that the diver's exercise regimen warrants an appropriate exertional test for diving.

The UCSD guidelines agree generally with those of the Belgian group. They also offer workup recommendations for scientific and commercial divers. The group notes that having unresolved COVID-19 symptoms does not necessarily translate to a lifetime ban on diving. Many of the currently disqualifying criteria (such as abnormal CT scans) may resolve over the next several months on retesting. Whether or not potential sequelae of COVID-19 will become chronic is not currently known. Reevaluation will likely be indicated until more evidence becomes available.

These recommendations are sensible and should help guide us while we await more data. Someone who suffered a mild case of COVID-19 and is now back to jogging five miles per day without issues can probably return to diving without restrictions or further testing. But a diver who had a prolonged ICU stay from the infection, especially if s/he required intubation, probably should have follow-up CT scans showing resolution of the changes. Even pulmonary function testing and

echocardiography may be advisable before resuming diving. Only time—and more importantly—data will tell.

What does this all mean? We are in the midst of a generation-defining pandemic that the world has not seen in 100 years. There's an appropriate amount of fear and uncertainty gripping the planet. Along with everyone else, cave divers are concerned about what the effects of this pandemic will be on our sport and, for some of us, our livelihoods.

The best advice at the moment is for any diver who has had symptomatic COVID-19 to be examined by a physician with diving knowledge before returning to diving.

As for myself, I am one of the lucky ones. My COVID-19 symptoms were no worse than a bad case of the flu. I had a normal chest x-ray and normal oxygen saturations. I never experienced shortness of breath. After about two weeks, all of my symptoms resolved, and my exercise tolerance on my home rowing machine was back to baseline. I have resumed diving without any problems.

Be safe, everyone. We will come out the other side of this, hopefully as better people in better nations and living in a better world.

April 2020 (updated and revised for *Underwater Speleology* on June 30, 2020).

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On the Loop

Loop Leaks and Water Intrusion

– by Joe Citelli

Leaks are bad, whether they are in Congress or your rebreather loop. They are annoying and dangerous.

Before diving, we should all use a check list to ensure our pre-dive system checks are done correctly. Two of these are the “positive and negative” tests whose purpose is to detect system leaks before we enter the water. We pressurize the loop for a positive test and draw a vacuum for a negative test. We then look for changes in counter lung volume and/or listen for hissing sounds. If the counter lungs deflate, inflate, or hiss we suspect a leak. If they hold pressure and are silent, we believe they “passed” and are safe to dive.

But are they? It’s possible that you have a leak that eludes this process.

The Mouthpiece

Probably the most common leak is from a split or torn mouthpiece. It can also be quite difficult to find. A tiny tear or hole in a mouthpiece can present quite the mystery. The loop will pass positive and negative testing and seem fine. Then during the dive you hear that ever so annoying “gurgling” sound. You listen for bubbles and hear none. You signal your buddy to check above you for leaks and s/he tells you there are none. But you keep draining water from your loop, so it has to be coming from somewhere. To further complicate things, the loop might take in water only on inhalation or when you tilt your head in a certain position. You may look for the leak on every exposed part of your rig and not find it.

So What Do You Do?

If you are getting water in your loop and cannot find the source, change the mouthpiece even if it looks good. This will often solve the problem or at the very least eliminate the mouthpiece as its cause. Sometimes the leak is so minuscule that only an exaggerated stretch, bend, or twist will reveal the tear or pinhole.

The cause of the leak may not be a perforation. Believe it or not, if your DSV or BOV is angled incorrectly, it will cause the side of your mouth to twist open (when you move in certain positions) and allow water in. This could potentially cascade into a very unpleasant event if it causes the loop to pop out of your mouth. If you are fighting your loop to keep it in your mouth straight, you need to adjust it to fit you properly. Loosen the hose clamps and move it so that it sits at the same angle as your mouth and does not pull up, down, or sideways. Be sure to retighten the hose clamps properly.

Loop Hoses

A small split in the accordion like crevices of a loop hose can be very difficult to find. The hose may only leak when it is stretched or turned in a certain way and be fine otherwise. For this reason, it’s important to perform a visual inspection of your hoses as part of your pre-dive ritual. Do this when you check your mushroom or flapper valves by stretching the hose. Look for cracks or splits in the crevices between the ridges and where they are clamped to anything (DSV, TEE pieces, etc.).

Anything suspect should be visually inspected and tested with a soapy water bubble test or by immersion. Remember, this type of leak can easily pass your standard positive and negative testing. I am not suggesting that it’s something to be paranoid



about, but it is not something to ignore. This is why I do not like hose covers. They may look cool but can conceal dangerous leaks. High-quality loop hoses are quite robust and do not need covers.

Be wary of rubber sleeves that cover loop hose clamps. They make the loop look pretty, but they can conceal a large tear. The loop hose (pictured) was torn by the clamp. But it passed a positive and negative test because the clamp was covered with a rubber sleeve which, in effect, sealed the leak.

If that is not practical or possible, an alternative is to grasp the hose with both hands and hold it in a position where it doesn't leak—that is, you can press the offending crevice together to stop the leak while you abort the dive. Usually the split or tear is at the bottom of the "V" so if you press the sides above the "V" against each other you will effectively defeat the leak. Obviously, this is only practical in a very limited number of circumstances in which the split is small and in which staying on the loop is a better choice than bailing out. Remember, a flooded loop can lead to a caustic cocktail and cascade into a series of disastrous and potentially fatal events. If you make this choice, do so judiciously.



© Joe Citelli. *This tear was caused by the hose clamp but was concealed beneath a sleeve.*

For example, if you suspect water is in the unit and proximate to the scrubber, you need to understand the unit well enough to avoid positions that will facilitate water reaching the absorbent. I will not go into specifics here because every unit is different. What works well on one unit might be bad on another. If you do not understand this process well or if you understand it but are not good at it you should remedy this deficiency as soon as possible. Practice the procedure often so it becomes second nature. If

If you find yourself in the water with a small tear in the loop hose, the safest option is to bail out.

O Rings

The o rings are the next most frequent source of leaks and water intrusion. They should be inspected every time you build your unit. Change any o rings that have flat spots, nicks or cracks. Lubricate any o rings that require it, but don't overdo it. Remember that lube is also a dirt magnet. Use care to not pick up any grit while the o rings are exposed to the environment. Visually inspect o ring grooves, and clean any accumulated dirt or excess grease. If necessary, remove the o ring and clean the groove. When removing use a plastic pick or something similar to help prevent accidental damage.

Dewatering

Every rebreather diver should be proficient at removing water from the loop. You should understand how water will collect in the rebreather you use so that you don't do anything to worsen the situation.

you do not understand how to facilitate water removal, ask your instructor to clarify it for you. Once you thoroughly understand the flow of the unit, dewatering becomes very simple.

If your rebreather does not permit removing water from its breathing loop, you need to account for that in your dive planning and factor in extra conservatism. Avoid dives or situations where the probability of water ingress into the loop is higher than usual (i.e. high flow or tight places where the loop might be torn or knocked from your mouth, especially where access to the surface is limited. A flood 1525 meters/5000 feet back in a cave with no well-rehearsed plan of escape is a less than pleasant experience.

Remember that a flooded unit becomes negative, making swimming on open circuit bailout more difficult. Even if you can no longer stay on the loop, the ability to remove water from it is important.



©Gene Page. Use a checklist before every dive to be sure that your rebreather is in good working order..

What is the Best Leak Test?

At the beginning of every dive, buddies should hover above one other and look for bubbles. The pre-dive positive and negative tests will find any larger leaks, but nothing surpasses an in-water bubble check at depth to find any smaller leaks. This can be accomplished at 6 meters/20 feet in conjunction with a cell linearity check. If this is not practical, perform the check at depth before you begin the actual dive. In any event, this should always be done.

Other indications of a leak include gurgling sounds in the loop, hissing noises behind your head, an unexpected change in buoyancy, or an increase in the work of breathing. The silence enjoyed by diving a rebreather permits hearing the smallest of leaks, so be acutely aware of any unusual sounds. Do not ignore them.

I hope some of you, especially newer rebreather divers, find this information useful. Until the next time, thank you for reading.

Joe

Joe Citelli teaches cave diving, open- and closed-circuit rebreathers, mixed gas, wreck, and other technical diving. He is a past president of the NSS-CDS Board of Directors.

From the Vice Chair

A Long-Due Information Technology Upgrade

by Brett Floren



My plans to present the NSS-CDS' "state of technology" to you at the May International Cave Diving Conference were scuttled along with the event. But I'd like to update you on the upgrades to our information technology (IT), which will streamline the processes of renewing membership and (for instructors) enrolling students online and more.

I ran for an NSS-CDS Board of Directors' position in 2019 because I wanted to update our technology. I believed this update to be overdue. Only after I actually got involved with Board duties, I discovered just how long ago this should have been done. So how did the organization get so behind — technologically speaking—in the first place?

The NSS-CDS is a non-profit organization, which has benefits and disadvantages. One of the major disadvantages is that everyone involved is a volunteer. Volunteers are not required to donate any specific amount of time. The majority of Board members work full-time jobs to support their families, which means that our volunteer time is finite. To address a technology overhaul requires that a software developer donate hundreds of hours of work to build a custom system from the ground up. There is nothing off the shelf that fits the NSS-CDS' structure.

Our organization has not been in a position to spend \$50,000+ on a custom system. A for-profit business would hire a team of developers to design a solution. People with this kind of expertise who were willing to donate the huge amount of time necessary to rebuild the system have not been in place. That has changed.

Below follows an overview of how the "technology snapshot" looked in May 2019 when I joined the Board and how it looks now. My goals for the end of the year follow.

But first, let me acknowledge the difficulties with membership renewals.

The Board is well aware that some of you have had problems processing and renewing NSS-CDS memberships online, especially items such as family memberships. Once the new portal is online, this will become easy.

Developing this portal is a major project. My goal is to have it available by the end of 2020. If you are having renewal problems in the meantime, please contact Adam Hughes, the CDS Manager, at cdsmanager@nsscds.org to request assistance.

Here is an overview of where our technology was in 2019, where we are now, and goals for the remainder of 2020.

In May 2019:

- The NSS-CDS's domain names were all in the possession of a third party.
- Our web site was hosted with a third-party hosting provider and inside of a shared hosting environment.
- The membership records were stored completely offline and managed by the CDS Manager. That person alone is responsible for processing renewals and new applications.

Over the years, many different hands added to and changed the website's various design aspects and behind-the-scenes code. Therefore there was little consistency. There was also a lot of obsolete and deprecated code, some of which no longer even has an upgrade path.

Today: June 2020

1. The organization's three domain names (nsscds.org, nsscds.net, and nsscds.com) have been transferred into a domain registration account under the NSS-CDS' full control. We owe thanks and acknowledgment to Tom Johnson (TJ) for the many years during which he acted as domain

- caretaker while he consistently and personally covered the annual renewal fees on behalf of the NSS-CDS.
2. The NSS-CDS is now registered with Guidestar (an information service that reports on US non-profit companies). This allows our organization to be eligible for non-profit donations. It includes getting the NSS-CDS online with Amazon (Amazon Smile), which allows us to receive donations from Amazon online purchases.
 3. Once registered with Guidestar, the organization was able to register with Techsoup, which supports donations for non profits. This allows NSS-CDS to be eligible for additional technology donations, including from Microsoft.
 4. The NSS-CDS has secured an annual grant from Microsoft in the amount of \$5,000 per year. This grant can be used to purchase software and services from Microsoft.
 5. Using a portion of the Microsoft grant money, the NSS-CDS has launched an entire virtual hosting operation leveraging the Microsoft Azure platform. This means that going forward, the organization will be acting as its own web hosting company by keeping all services in house. Currently we have multiple servers running inside of our own firewall-protected network, fully redundant and backed up, which are completely under our own control. We are no longer operating only inside of shared hosting because we are now the only “tenant” on our own servers on Azure. This has the benefit of added data security.
 6. The NSS-CDS now qualifies for an annual advertising grant from Google worth \$120,000 per year, distributed in blocks of \$10,000 per month.
 7. A new training website was launched at <https://training.nsscads.org>. This is distinctly separate from the main NSS-CDS website. It was created to allow the Training Committee to maintain more direct control over training-related content. Instructors can register their students online and receive immediate acknowledgement from our system. Paperwork registrations are now a thing of the past. I want to thank Harry Averill for having a significant hand in getting this training website online. He spent a lot of his personal time laying out the “look and feel” of the site and did a fantastic job.
 8. A new events website was launched at <https://events.nsscads.org>. Previously the NSS-CDS used a third-party platform to handle event ticket sales and paid a per ticket fee. We now handle and host our own ticket sales platform, which allows us to sell tickets for our events without having to pay an outside company.
 9. Plesk International GmbH granted us a non-profit license. It offers us the ability to leverage the industry’s leading hosting control panel (“Plesk”) to manage our web servers. This saves us nearly \$1000 per year in fees for a commercial license. It is important because NSS-CDS IT staff will need to have a convenient and easily managed hosting management panel.
 10. At our last Board meeting, we voted to create a new permanent Information Technology (IT) Committee. The Committee will ensure that trained IT professionals will be available to help maintain the new IT infrastructure. Once the initial build out is complete, the new IT Committee will be in place to take the reins. It made no sense to build an advanced hosting environment and a custom platform if the required talent would not be in place to keep it running properly in the future.

Goals For The Balance of 2020

1. An eLearning site has been set up but is not yet available for use. Due to the recent and unexpected loss of our Training Director, the development of training materials was disrupted. The website is in place and ready to go, but unfortunately the eLearning content is not. Please note that the software is in place to offer this at a future date.
2. The main website is being relocated to our own hosting environment. The original public website was left in place on the original server to allow time for other critical pieces to be built first. This has been accomplished, and the main website will be moved soon. We can then retire the account with the the third-party hosting provider. By moving the website into our own infrastructure that is covered by the Microsoft grant, we will have our own hosting company, top to bottom, 100% under our own control, with no associated annual cost to NSS-CDS.
3. Digital diving waivers: Once we have an updated

waiver back from legal review, it will be possible to process and sign diving waivers to sites such as Cow Spring 100% digitally.

4. Finally, and this has always been my primary goal, we will finish coding and deploying the member www.nsscads.org portal. This portal will allow you to:
 - a. process a new NSS-CDS (or CDS only) membership registration online.
 - b. renew an existing NSS-CDS (or CDS only) membership online.
 - c. see your membership data, including renewal dates, and select how you wish to be notified of upcoming renewals (email, text message, phone call).
 - d. see your NSS-CDS diver certifications and order replacement cards. **
 - e. see your NSS-CDS Cave Diving Awards. **
 - f. print your NSS-CDS membership card online.
 - g. submit an application for a new award, such as the Abe Davis Award.

Property managers, such as Dive Outpost, will have access to a restricted area where they can verify a member's status online in real time. So if you have misplaced your membership card, membership can be verified on the spot and the required digital waiver signed.

Certain committee members, such as the Awards Committee, will have access to managing awards via the portal. This restricted area will be for the printing of welcome letters, formatting and printing of award certificates, and adding award recipients to the correct list on the website.

Instructors will have access to an enhanced instructor database. This will allow our instructors to maintain a student list, issue certification cards, and more. When this is available, instructors will be able to issue multiple cards to multiple students and pay in a single transaction.

** Caveat to items #4d and #4e (certification cards and awards): For many years, NSS-CDS kept its records using only paper. Some of those records have been lost or destroyed over the years. We will do the best that we can to bring forward what is available. A worst case is that if you still have an old card, you will be able to submit it for "manual review and recording" so that we can update it into a digitally available record. More details on that will be forthcoming.

In summary, a lot of effort has been ongoing behind the scenes and a sizable amount of time put into bringing the CDS technology platforms up to date and made current. My goal is that when this custom-coded buildout is complete, I will be able to step back and hand over something to the NSS-CDS that will be functional, user friendly, and that was designed using a real upgradable path. This will help ensure that the organization never finds itself decades behind in technology and has something in place that can be easily carried forward by

Yours in service,
Brett Floren
Vice Chair, NSS-CDS

Bringing Submerged Caves to the Surface

by Cristina Zenato

In the aftermath of Hurricane Dorian, tending to my neighbors' immediate needs through relief work and rescue assistance was my first priority. As the community began to recover, my buddy Kewin Lorenzen and I redirected our attention to the environments that had also suffered from the massive flood that drowned 70% of Grand Bahama Island, including the caves.

The Bahamas National Trust, with which I have been collaborating for nearly 20 years, needed coastal surveys and reports on the caves. Ben's Cave in the Lucayan National Park was among these. Kewin and I went to work and completed coastal surveys and made over 30 cave dives in two of the major and most affected systems. We also made working cave dives in the ocean blue holes around the south shore of the island.

During the time we helped the Bahamas National Trust, we continued to work on our other projects.

Where to Survey

The weather, tidal changes, accessibility, time available, and even season and heat all dictated which cave and project we could work on. Some of our caves are located in swampy areas with uneven terrain. Accessing these requires several hours of gear transfer before and after the dive. Those caves demand a full day of work in order to make one dive. Other caves are more accessible and can be dived at night after work or on a half day. Each of the determining factors affected one area or another, forcing us to work around the difficulties for the best and safest outcome.



© Cristina Zenato. Kewin descends into the lower section of Ben's Cave.



© Alex Rose. *Cristina with camera gear.*

Back in 2015 while working on a National Geographic project in Abaco's crystal caves, I met Sebastien Kister. I had a firsthand trial on a new survey system, paired with his software. This little machine was light, small, and affordable to any cave diver interested in surveying. It is a true improvement compared to the traditional method in terms of efficiency, accuracy, and delivery.

The tool Sebastien created, which we now are using, is MNemo.™

The projects might seem different, but our ultimate goal is to put as many caves or suspected caves on the map as possible. We want to offer information about their location and direction, showing their true location and reach by overlapping the map on Google Earth. We want to bring these caves to the surface primarily for people who can't go cave diving to see for themselves. We want people to recognize that amazing landscapes, beauty, and precious resources lie directly below their feet. And we hope to connect them so that people can better understand the need for their conservation.

Currently, we are creating two interactive maps, one for the Lucayan System and one for the Old Freetown System. An interactive map allows a viewer to click anywhere on the map's landmarks. A video opens in a screen to show the segment of the cave that the person is viewing. As the video progresses, so does the dot on the map showing the progress through that area in real time.

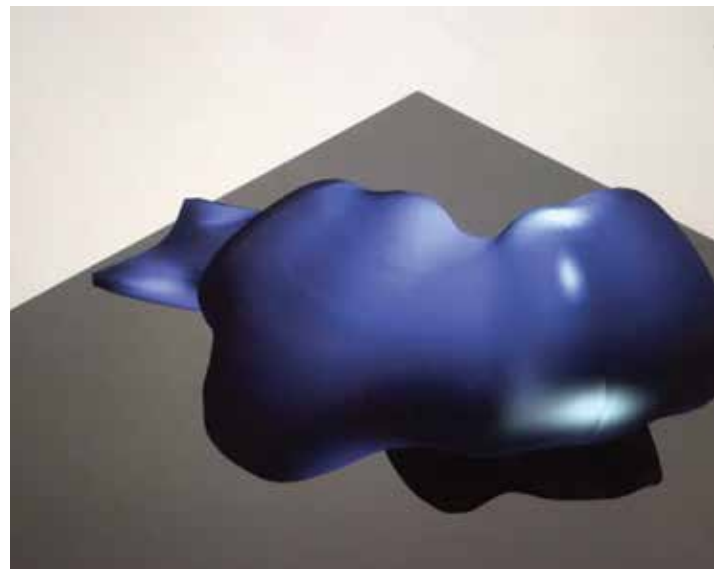
The viewer can see the cave as if s/he were swimming through the tunnel.

How we Organize the Work

Kewin and I work as buddy team to create these interactive maps. The video needs to be continuous. We can do this in post production, but for ease of work it's best to complete a full section in one session to avoid problems with matching the video with the map.

I enter as the first diver carrying a camera with video lights. The choice of the camera is personal. I work with both an action camera, Paralenz, and a high-definition 4K camera. The cave's location, distance to the entrance, and size (to allow for the bigger camera) determine which one I use. I take the video while swimming along the tunnel and following the bends and turns on the line. Kewin, behind me, completes the survey using MNemo™. The machine still requires input for each turn and change in the line, but it records depth, distance, and azimuth automatically.

After completing the dive, we put together both video and survey using the Ariane's Line™ software. The operation requires some time and patience, but the final result is an interactive map of the area filmed. Our purpose is to create an interactive experience for the guests who visit the Lucayan National Park.



© Cristina Zenato. *Three-dimensional image of Ben's Cavern, Lucayan National Park, Grand Bahama.*

By clicking on a portable tablet, they can see exactly what is directly beneath their feet as they walk through the park. The final phase is still a work in progress so that the technology can be used without WiFi.

The Blue Hippo

At the same time, we have been completing some three-dimensional (3D) mapping. We reserve this for some of the bigger rooms and the caverns. Working as a team, we deploy and survey a series of lines, following the sides of the room we want to map in 3D. The surveyor registers the lines' up-down-left-right distances from the floors and ceilings. If the room is big enough, we run a grid of lines to measure correctly the distance between the walls instead of estimating the left-right measures.

Once all the lines are in place, we use the same MNemo™ to measure each distance. Usually we split the work using our two devices, with one team member running the lines along the walls and the other measuring the width lines from side to side. We use a wrist slate to note the additional depth, ceiling,

and location of any junction in the grid.

The work is then transferred into the software, and a 3D map of the room is created. This is different than photogrammetry, in which thousands of images are collected to create a 3D image of the area. In this case the Ariane's Line™ software generates the visual volume of the area.

We're calling the 3D map of Ben's Cavern the "Blue Hippo."

At the same time, we are exploring every entrance that could possibly lead to a cave. We have been hiking through the island with some very good results and some very disappointing days. We check every area and record every hole, however big or small, and whether it is accessible. We then create a map that is overlapped with the satellite view of the area. If there is no cave, or if the entrance is collapsed and inaccessible, we mark the location with a red star. We mark accessible caves with a yellow star and a linear map.

The fact is that most people in the area might know where the entrance is or might be, but there are few



© Cristina Zenato. The dotted lines outline the cave passage. At certain points, visitors to Lucayan National Park will be able to see the cave directly beneath them, almost as if they were swimming through it.

data available showing where the cave actually goes after one leaves the entrance. We plan to create a database that can be used to facilitate future decisions on whether to develop an area or to protect it.

A Blueprint to Protect the Aquifer

By preventing damage to our underground, we avoid damaging the most amazing resource the Bahamas have: fresh drinking water.

The Bahamian caves are an immense, but not unlimited, reservoir of freshwater supply. We need to protect this precious resource. Heavy development on the land directly above the caves pollutes the area and causes extreme damage to the water table.

Many of these caves connect land with open water. Much of the karst shares an ecosystem with the mangroves, another vital feature of these islands. Mangroves are nurseries for all sort of animals, from invertebrates to sharks and bony fishes. Here the animals reproduce and allow their young to grow protected from the bigger predators. Pollution travels through the water and to these areas, changing the balance and consequently the health of entire interconnected ecosystems.

Caves are also the keepers of important geological and anthropological history. Recently we found the



© Kewin Lorenzen. *Cristina surveys using MNemo.™*

impressive remains of several crocodiles, which have been extinct from this country for several thousands of years. In Ben's Cave, human remains belonging to the original inhabitants of these islands lay hidden in the hypoxic level of the cave, out of reach and out of view. Should the water conditions change, their preservation would be affected, and their survival compromised. Hurricane Dorian's effects are very evident in these subterranean passageways. The sediments have changed locations. Some areas have suffered collapse. Certain tunnels have turned from completely black to completely wash-out white and orange. It is estimated that when the island flooded, the tunnels saw a change of more than thirty feet of water. When I swim through them, it looks as if a powerful river blasted through the passageways taking with it what the flood above the land hadn't.

It is now more critical than ever to reduce the environmental impact on this island. It is important to mitigate all the changes and effects of this storm and to plan for better development as a whole.

They say an image is worth a thousand words. By bringing the systems to the surface through our work, we want to connect land-based people to the underground and underwater system. This not only will reveal the caves' beauty but will highlight their importance and the connection of their health to the future of the island.

Cristina Zenato is an NSS-CDS cave instructor, explorer, photographer, and passionate conservationist. She lives and dives in Freeport, Grand Bahama.



Cristina Zenato and Kewin Lorenzen

Weeki Wachee Cave System

Hernando County, Florida, USA

Maximum depth: 429 feet
Total length: 34374 feet

Exploration/survey: Sheck Exley, Jamie Stone, Jim Benz, Steve Straatsma, Paul Heinerth, Jeff Petersen, David Miner, Brett Hemphill, Corey Mearns, Andrew Pitkin, Matt Vinzant, Charlie Roberson, Ted McCoy, Bob Beckner, James Draker, Derek Ferguson, Gary Donahue

Survey/map grade: BCRA 3B (equivalent to UISv1 3-2-BDF)

Cartography: Andrew Pitkin



KARST UNDERWATER RESEARCH
Reconnaissance • Documentation • Survey • Sampling

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News Snippets

— by Barbara Dwyer

Travel

Mixed news: Our friends in the Bahamas and Mexico have been hit hard by the epidemic. But diving is ready to resume. Businesses are taking reservations. Flights from the US have been cut sharply during the epidemic. Most of the airlines have made efforts to separate passengers, but at least one major carrier continues to fill every seat.

The COVID-19 situation remains fluid with respect to international travel. Travel advisories continue in the US and many places around the world. The US Centers for Disease Control advises citizens returning from international travel to self quarantine for 14 days. Some countries require visitors to self isolate upon arrival. Expect long lines and health checks at entry and exit points.

In Memoriam

Reports came in on May 27, 2020, that Helen Farr (née Rider) had lost her life unexpectedly at her home in Llangatock, South Wales. NSS-CDS extends heartfelt sympathy to Martyn Farr and to Helen's family and friends.

Exploration News

Florida

Charlie Roberson, Matt Vinzant, and other members of Karst Underwater Explorers (KUR) are exploring the new Minas Tirith section of the Twin Dees/Weeki Wachee system. You can see the updated map on pages 22-23 of this issue, courtesy of Andy Pitkin. <https://www.facebook.com/jcharlesroberson/posts/10117224358359591>.

Brett Hemphill, Andy Pitkin, and Charlie Roberson report that the upstream section of Alachua/Mill Creek "is still going." Following up on a lead from the late John Mosely, they laid several hundred feet of line through low rooms with sharp projections, black silt, and two-directional flow at depths of 180-200 ft. The tunnel runs directly underneath the Lowe's in Alachua and continues in a NNE direction. <https://tinyurl.com/y9js4r8y>

The Bahamas

Cristina Zenato and Kewin Lorenzen have added another 762 meters/2500 ft of line to Ben's Cave in the Lucayan system on Grand Bahama. The cave now extends out to 10,058 meters/33,000 feet. No part of this system can be scootered, so all exploration is done swimming.

Cristina reports finding a new lower level through the floor of Ben's Cave. "Through these low bedding planes decorations reappear. In one room the soda straws—about 3 feet high— carpet the walls of the already tricky area, making exploration ever so much slower." The room is completely orange from microbial growth, but some of the soda straws show an incredible blue color, Cristina says. She has named this exquisitely fragile room The Crystal Gates. <https://www.instagram.com/p/CAh0BJVF8vU/>.

Brian Kakuk discovered a dome room off Odyssey passage in Dan's Cave, Abaco Island, more than a mile from the entrance. He called it The Big Rock Candy Mountain. Its passages reach depths of over 160 feet. Video: <https://preview.tinyurl.com/ya7hesaa>

México

Robbie Schmittner is heading up the Xunaan-Ha exploration with an all-woman team (himself excepted). The international group includes Ellen Cuylaerts, Rannva Joermundsson, Melodie Treviño, Maria Bollerup, Julia Gugelmeier, and Tamara Lelani May. <https://robbieschmittner.com/the-xunaan-ha-expedition/>

Luís Sánchez reports finding virgin passage with many beautifully preserved prehistoric fossils in a cenote near Mérida, Yucatán. Luís will share details and photos in our next issue. #rangostyle.

Jake Bulman, Skanda Cophield, Jaime De La Puerta Salazar, and Patrick Widmann have connected Cenote Regina and Sistema Ox Bel Ha. They collectively added 4.7 km/3 miles of line to Regina while exploring "plenty of cave" below 35 meters/115 feet in a new area in the back of the saltwater section. The Ox Bel Ha connection was made through a 20-meter/66-foot passage that meets a jump from Mayan Blue's "A Tunnel" (marked by the first set of double arrows). "It's some of the best passages we've seen here in Mexico."

Guillermo "Memo" de Anda of the Gran Acuífero Maya project has discovered a trove of beautifully preserved Maya ritual objects in Balamkú (the cave of the Jaguar God) deep beneath Chichén Itzá. He came upon the find unexpectedly while squeezing through tunnels on his belly, searching for the water table beneath the city. Balamkú was sealed off a half century ago after a University of California archeologist explored the cave but did not excavate. The UC archeologist's report surfaced only recently.

It's significant to find such a large cache of sacred objects in such a difficult-to-reach place, Memo says. He expects that the findings may yield important clues about the rise and fall of the Maya civilization. <https://www.nationalgeographic.com/culture/2019/03/maya-ritual-balamku-cave-stuns-archaeologists/>

Harry Gust and David Marlowe have connected White Dunes (part of Sac Actun) with Cenote Outland. Between the two is Cenote Naia, which can be used as a bailout point if necessary. Harry says that the cave features beautiful calcite formations, fossilized underpassage, and a lot of varied terrain. A large part is suitable for back mounted divers.

Jerónimo Áviles Olguín published an analysis of a skull belonging to a pre-Maya era woman, discovered in Cenote Chan Hol in Tulum. This is the first report to suggest what kinds of illnesses may have affected the Americas' Paleoindian peoples some 10,500 years ago. The woman, known as "Ixchel" or Chan Hol 3, is the third major skeletal discovery in the Chan Hol system. <https://doi.org/10.1371/journal.pone.0227984>

Events Rescheduled or Canceled:

The NSS-CDS workshop still is on hold. The Board of Directors is discussing rescheduling options. It could, possibly be combined with the Hart Springs winter workshop or held in Mexico.

Beneath the Sea has been rescheduled for October 9-11, 2020.

The 2020 Long Beach, CA, Scuba Show was held online. Virtual sessions are on its Facebook page.

The NSS Convention 2020 will be virtual. It will be held July 27-30, 2020 at <https://nsscon2020.org/> .

Book Review

INTO THE PLANET: MY LIFE AS A CAVE DIVER

by Jill Heinerth

Reviewed by Ellen Sophie Cuylaerts

When I received my copy of Jill Heinerth's *Into the Planet* to prepare for an interview with her, I did not expect that I would finish the entire book by the next day, reading it on my laptop, which is something I usually struggle to do.

From the first page, Jill's autobiography reads like a thriller, adventure, drama, and romance all at once. It's hard for the reader to take a break. There is so much that everyone can relate to in this intriguing honest story of a tall, smart girl who didn't really fit in at school but found her way to becoming one of the world's top cave divers and explorers.

Pointing out that her earliest memory is of almost drowning, Jill notes, "I am not fearless. I'm alive today because I've learned to embrace fear as a positive catalyst in my life."

This is the book's recurrent theme. Not for Jill was conventional "success" as defined by an a home in the suburbs, two kids, and working an office job. She "wanted the life of the photographers that [she] saw featured in *Skin Diver* magazine and *National Geographic*. Her decisions led to circumstances that "forced [her] to succeed," she says. These events were to pave the way to the Cayman Islands, where she would hone her photography skills and learn to cave dive with Paul Heinerth. They would later marry.

Diving, and especially cave diving, plays out in a male-dominated world. When she was relatively new to the specialty, Jill staked her spot on the US Deep Cave Diving Team's rugged Huautla expedition and proved her competence to the skeptical Bill Stone. Jill and Paul spent their honeymoon camping in the Yucatán jungle with the scorpions, helping to connect Sistema Dos Ojos to nearby cenotes and establishing a record for the world's then-longest submerged cave. There was the National Geographic expedition to Antarctica, which involved a treacherous crossing from Chile through the thickest ice that anyone could remember. Phones, refueling stations, food restock-



Into the Planet: My Life as a Cave Diver by Jill Heinerth. Ecco: An Imprint of Harper Collins Publications, 2019.

ing options, and land-based support were not options. Getting trapped inside of an iceberg and thinking her way out was the culmination of that trip. Later, Jill walked out of the dense Yucatán jungle after getting badly bent on a 400 foot dive in The Pit. She set a distance record during the Wakulla 2 expedition that bested that of cave diving's then-most notorious bully.

No Girls Allowed

The feeling that her best was not good enough was frequently reinforced by her male counterparts. Some divers saw her as "Paul's sidekick" or commented that "we don't need any women cave diving instructors." Threatening notes were left for her in the Wakulla system. When she set her distance record there, a support diver posted on a tech forum that the bully's record had just been surpassed "by a girl." The way in which Jill stood firm and even made these encounters part of her mission broke considerable ground for other women. She believed that all women could fulfill their visions by choosing the right career, relationships, and experiences.



Into the Planet author, cave diver, and explorer Jill Heinerth.

Jill's work brought joy as well as tremendous loss. Her passion for cave diving was an important component of her marriage and also played a part in its ending. Its thread ran through the deaths of close friends, colleagues, and even strangers who she rescued or whose bodies she recovered. Jill's diving worried her new husband Robert, who supported her decisions nonetheless. Cave diving was especially intertwined with the strain on her long friendship with Wes Skiles, "a man who I considered [my] brother," and his death.

Jill's turning point came after her own brush with death during a cave dive in which everything went wrong. When the alarm went out, her friends sped to the cave, hoping to rescue her but also prepared to recover her body. They had not called Robert, wanting to spare him the immediate anguish. Jill surfaced on her own, having made it out by focus, problem solving, and determination to stay alive.

Bringing about a reckoning

The close call "made me reflect on the meaning and purpose of my work and the risks I was taking. It also made me think more deeply about the other people who were entangled in my decisions....My military veteran husband...had experienced more death in the first four years of our relationship than he had during his entire career as a combat photographer. He didn't want to get close to any more of my cave-diving friends. Although he recognized that cave diving made me who I was, he didn't want to go to any more funerals, especially mine. Every time I hopped in the water, I had to think about Robert too."

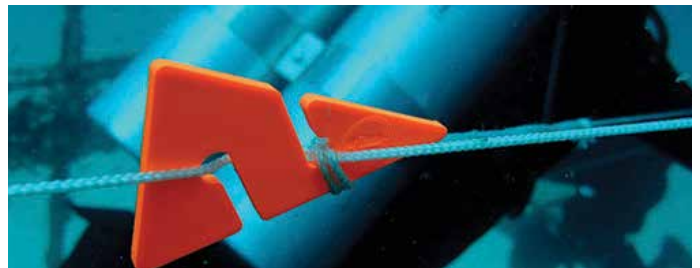
No one can stay mired in death and also move forward. Jill's resolve to focus on life while continuing to remember and honor her dead friends propels her

toward focusing more on education, outreach, and mentoring. Cave divers have much to share with science, government, and academia. Old wounds heal faster when one is helping others, protecting the planet, and working to make the world a a better place.

Finishing *Into the Planet* is like winding down a roller coaster ride, easing off from the adrenaline released before. This is a cave diving book and so much more.

Jill's story speaks to everyone. It invites us all to examine how we respond to life's existential questions and the normal fears that they generate. Do these responses stop us cold? Or do we look fear in the eye and learn to think through it, to summon strength, to learn from it? Can we let go of old resentments and forgive each other? Can we summon our experiences of beauty, awe, and magic to help transform life's inevitable griefs? and by sharing them, help to transform others' thoughts and opinions? The beauty and magic make the heartbreak of grief a little easier to manage. In the purity of exploration, Jill concludes, she continues to blossom.

"I'll be afraid, but I'll never concede."



Ellen Cuylaerts is an ocean advocate, underwater & wildlife photographer, Fellow International of the Explorers Club and the Flag and Honors Committee member, and a member of the Women Divers Hall of Fame. Born in Belgium, she lives in in Grand Cayman.

Breathless: Immersion Pulmonary Edema During a Cave Dive

– by Gene Page

Some cave divers have the unconscious mindset that we are invincible. We may not admit it, but I think that deep down, most of us believe this to some extent. I do, and I'm a 57-year-old guy. It's the "heads down, barge through any and all obstacles" mentality. I see this as a positive trait. But last year I had an episode of immersion pulmonary edema (IPE), which sharply reminded me of my mortal limitations.

I was making my third cave dive in three weeks at a popular North Florida site. I had made this dive numerous times, but with different buddies.* The dive plans involved going through some tight spots using bypasses — all familiar to me. We planned for a maximum depth of about 30 meters/100 feet for 70 to 80 minutes, with minimal decompression. I was breathing 31% nitrox for all dives and had my AL 40 bottle of 100% O₂ for deco.

**The location and dive buddies' names are undisclosed.*

The first dive went smoothly. But while ascending, I noticed a very slight gurgling sound upon breathing. This happened on the surface. I wondered why I was making these sounds, but they were quiet and went away quickly, so I didn't think anymore about it. (I'm invincible, right)?

We made a second dive a week later. I had no gurgling or other problems during or after the dive. I thought that maybe I'd had some congestion that had caused the previous week's strange sounds. But events took a different turn during our third dive on the following week.

I was happy to be back in the water on this beautiful north Florida April day. I had a different dive buddy. As always, we fully discussed our dive plan, one that we had each done a number of times.



© Gene Page. Shortness of breath can start at any time during the dive.

My buddy led in, and we happily descended through our watery world of wet rocks. I feel sorry for people who can't see it. One reason I love underwater photography is to help non divers to appreciate our underwater springs' beauty.

We moved smoothly along. I followed my buddy through a restriction but got myself wedged in. It took me a minute or so to get free. It felt like it was more of an effort than is normal. Once free, I followed, but I started to notice that I was coughing here and there. I figured it was just leftover congestion from a cold that I'd had the previous month.

As we swam into tighter spaces, the coughing became more frequent and forceful. I was getting irritated but told myself, "what the hell, get a grip" and swam on. I took a sip of spring water to clear my throat. Eventually we made it back onto the main line and paused so my buddy could run his line again into another tight passage.

I swam to the surface thinking that it would be easier to breathe there without a regulator in my mouth. I was wrong.** As I broke the surface and spat the reg out, I quickly realized that no matter how hard or fast I breathed, I wasn't able to get enough air. I gurgled when I tried to take a breath.

I was shocked and tried to figure out what was happening and why. How could I fix this? Could I handle it myself? I realized quickly that I could not. I felt as if I were losing consciousness. Things were not right. I couldn't see clearly and couldn't breathe well.

I managed to ask a couple that was paddling by in a canoe to call 911. I had to repeat myself because I was having trouble speaking. The man in the canoe wanted to know what county we were in, and I answered.

Fortunately, some divers came over to check on me and asked where my buddy was. (He was finishing up

Symptoms increase at the surface. Assist the diver completely out of the water to prevent drowning.

It was here, while I was floating in what should have been my happy place, that my coughing increased. I started to suspect that something was wrong. My buddy went to enter a smaller passage. I started to follow, then thought, "no, dammit...any diver can call any dive at any time for any reason, right?"

I didn't want to be that diver. But I was listening to my inner voice, which we all need to do, all of the time. I knew that my friend would be okay with my calling this dive now. But I actually felt guilty doing it. I told myself that I was being a baby and that a little coughing here and there wasn't that bad. (Seriously, I told myself this). We had an uneventful swim out, and soon we exited the cave and were about to start our few minutes of decompression.

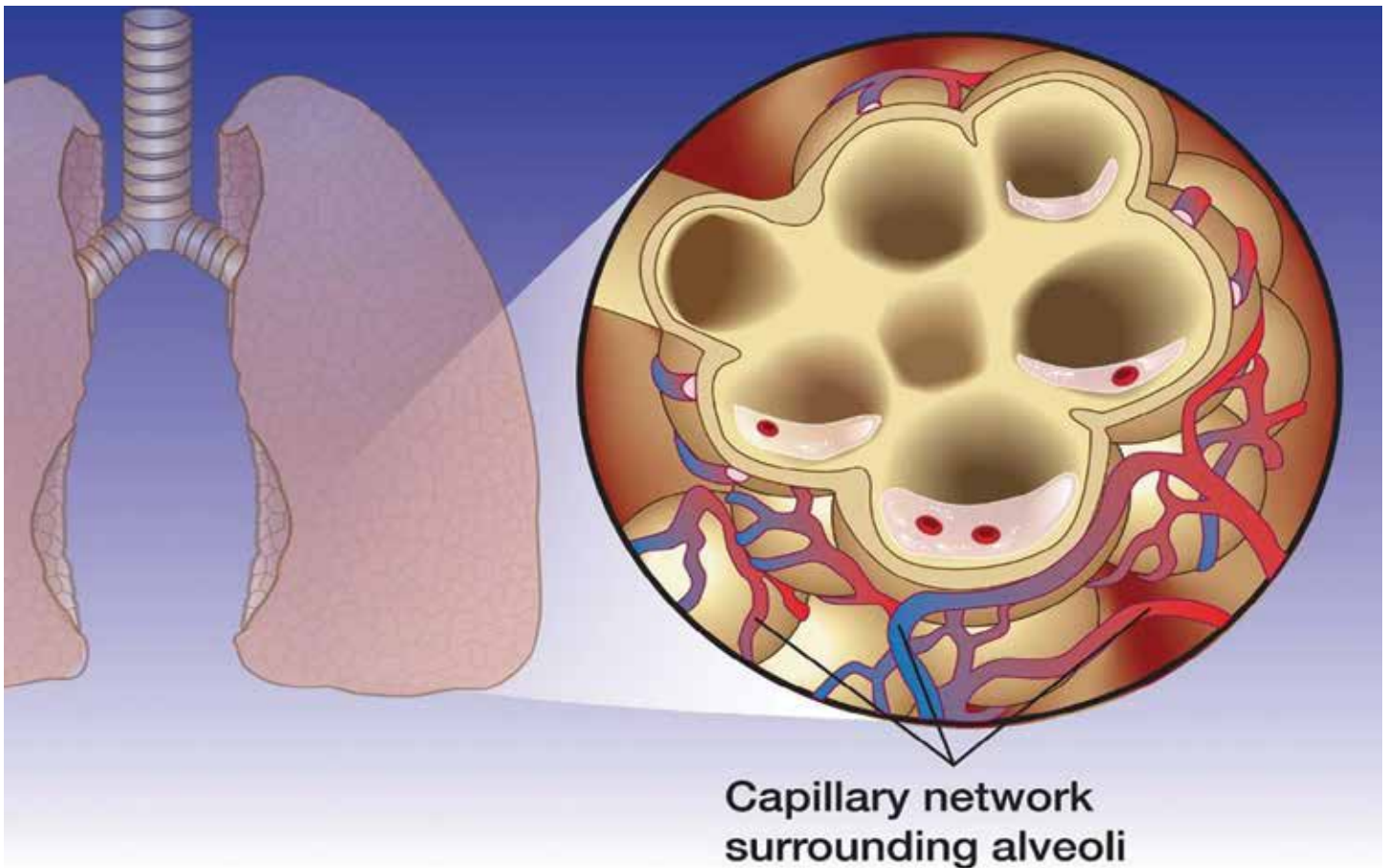
It was then, while resting at five meters/17 feet of depth, that I couldn't get enough air into my lungs. It didn't matter how hard I tried to breathe. This went on for a few minutes before I said to hell with it. I only had about a minute of deco time left.

his deco). They suggested that I swim to the shore. I could not. They quickly pulled me through the water and got me on the steps. I was so out of it that I didn't even recognize the rescuing divers, whom I knew.

As they were taking my tanks off, a nearby swimmer identified herself as a doctor and said that I was going to be okay. That was reassuring, but I was still having great difficulty breathing. A dive instructor whom I've known for years placed an oxygen mask on my face. In what seemed like seconds, I was able to breathe a little more easily. Someone said that an ambulance was on the way. The dive site manager came over to check on me.

I felt embarrassed to be causing all of the fuss, but at least I was getting some much-needed oxygen to my lungs and brain. My dive buddy took care of my gear. I began to feel as if things were somewhat in control (at least more so than they had been minutes earlier). But still, I wondered, what was causing all of this?

** *Symptoms worsen on ascent and at the surface*



**Capillary network
surrounding alveoli**

Courtesy Divers Alert Network. *Increased pulmonary capillary pressure results in fluid leak to the alveolar sacs and pulmonary edema.*

The paramedics arrived quickly and took over. They got me on their oxygen set up, put me on a stretcher, and wheeled me to an ambulance. Once inside, the lead paramedic told me that he also was a diver and that everything would be okay. That too made me feel better. I am so thankful for our diving family, even if it sometimes is a bit dysfunctional.

En route to the hospital, the paramedic asked me if I had any heart problems. I told him no. The electrocardiogram showed otherwise, he said. He gave me some nitroglycerine and called ahead to the emergency department.

When I arrived at the first hospital, the doctors told me I had an extremely low left ventricular ejection fraction (LVEF). A normal LVEF ranges from 55% to 70%. It refers to the ratio of the amount of blood that each heartbeat pumps to the organs with each heartbeat to the total volume of blood available for pumping. My LVEF was 18%. The physicians were concerned that a bubble or bubbles could be causing my symptoms. We need to fly you to another hospital that has a working recompression chamber, they said.*** I felt

strongly that I didn't need a chamber, but I was in no position to argue.

A helicopter transported me to Orlando. I love flying, and I tried to make the best of the trip. The flight crew was a squared-away group that reminded me of my Air Force days. Soon we approached the Orlando hospital, where I lived for the next week. Everyone here was extremely kind. The cardiologist was from Cuba, where I'd recently visited, so we had plenty to talk about. He was concerned about my low ejection fraction and ordered numerous diagnostic tests. It became apparent that I wouldn't be leaving the hospital anytime soon. Over the next six days, I had cardiac scans, chest MRIs, a cardiac catheterization, and more. All were okay except for my very low LVEF.

The doctors were fairly adamant that my diving days were finished. I could not accept this; there had to be another way. After five days, I was more than ready to go home. I dressed in my own clothes each day so that the staff would take my wanting to leave seriously.

My insurance had to approve a portable defibrillator that is worn all of the time other than while bathing.

*** This hospital no longer uses its chamber to treat divers.

The cardiologist referred me to a colleague in Gainesville. I left the hospital on Day 6 feeling almost normal but knowing things weren't all right. I didn't know if I would be able to dive again. But my first job was to get better and be ready for my TV film work. Then I would concern myself with my diving future.

I saw the Gainesville cardiologist over the next six months. My LVEF improved steadily and came back up to around 50%. I had long been back to work, and I definitely felt normal. I lost 17 pounds on a reduced fat and sodium diet. My doctor cleared me to return to diving in October 2019, but work kept me out of the water until after the New Year.

It was great getting the news that I had completely recovered and was able to return to diving. It was interesting that there was a presentation on IPE at the last CDS workshop. Someone else had had a similar experience the same week I had my episode.

I'm now paying attention to what my body tells me. If I ever hear that gurgling again, have excessive coughing, or become short of breath, I'll check with my primary doctor and/or cardiologist. Our cave diving family seems to be getting older, and I think it's our responsibility to be aware of potential issues. I'm grateful to everyone who helped me at the dive site and afterwards. DAN was available for phone

Rescue and Field Treatment

- While initiating rescue, assign someone to contact EMS and DAN.
- Assist or remove the diver completely from the water to prevent aspiration or drowning. This reverses the immersion-related hemodynamic shift, and symptoms begin to recede.
- Ensure a clear airway, and administer oxygen.
- Sit conscious persons upright to reduce the work of breathing. Watch for vomiting and protect the airway accordingly.
- Keep the diver warm to reduce vasoconstriction and central venous blood pooling.
- Limit fluids to sips of water.
- Transport the diver to emergency care.

I made an easy test cavern dive with a long-time buddy. We stayed above 18 meters/60 feet and ascended once to check on how I felt. With all well, we went back down for a short dive to 30 meters/100 feet. Later that week, I went diving with the buddy who was with me during the incident. We had a wonderful dive and a great day out in nature. I'm back to normal diving now, but I'm constantly mindful of what happened. I never want to experience that again and sincerely hope that I don't.

The doctors believe that my episode was caused by the aftereffects of a virus that I had caught in February 2019. I had had a deep chest cough that went on for about two months. The only unusual thing I had noticed before the day of my episode was some shortness of breath and — two weeks before my incident — the slight gurgling sound upon breathing, briefly, while at the surface. That's it.

calls and followup, and they took care of that chopper bill. My wife stayed with me most nights. I couldn't imagine going through all this without my family and their support.



Gene Page is a cave diver and underwater photographer who lives in Micanopy, FL. His images have appeared frequently in Underwater Speleology.

Immersion Pulmonary Edema Quick Guide

– Barbara J Dwyer, RN, MA

What is IPE? Immersion pulmonary edema is a syndrome of acute lung congestion that may develop during diving, swimming, or snorkeling. Water pressure on the extremities causes blood to shunt to the pulmonary blood vessels.¹⁻³ Shunting also occurs in colder water to conserve heat. This "load" increases the pulmonary capillary hydrostatic pressure and—at a critical level—produces fluid leak into the lungs' alveolar sacs. The result is pulmonary edema and decreased vital capacity, both of which inhibit oxygen uptake and CO₂ elimination.

What it looks like:⁴ Symptoms can develop at any point in the dive. They begin suddenly, increase during ascent, and may continue to worsen at the surface. The diver has difficulty breathing and "cannot get enough air." The intensity of respiratory distress ranges from slight shortness of breath to violent coughing and labored "wet" breathing. The diver may cough up frothy and/or bloody sputum. Chest pain is uncommon with IPE and should raise concern about a possible heart attack. As hypoxemia worsens, the person becomes increasingly anxious, confused, and exhausted. At this point s/he is at risk for panic, loss of consciousness, and/or drowning.⁵

Contributing factors:⁶ IPE can happen to anyone, including healthy athletes and military divers. But studies note higher incidence and fatality rates in divers above the age of 50, particularly those with hypertension⁷⁻¹⁰ and cardiovascular disease. Other risk factors include:

- intense dive-related physical exertion (this increases cardiac output and pulmonary capillary pressure)^{3,11}
- rebreather diving (involves negative pressure breathing)¹²
- being overweight or out of shape
- taking certain common medications. Beta blockers such as propranolol and its cousins decrease the force of ventricular contractions. Sympathomimetics including albuterol and pseudoephedrine (Sudafed™) raise blood pressure and can aggravate pulmonary hypertension.¹³

IPE reportedly reoccurs in around 30% of affected persons.⁷ The true recurrence rate is uncertain because divers may quit or reduce their diving after an episode.

Immediate treatment: While initiating rescue and first aid, assign someone to contact EMS and DAN or other insurer.

- Immediately remove the diver completely from the water. This reverses the immersion-related hemodynamic shifts, and symptoms begin to recede.
- Clear the airway if necessary, and administer oxygen.
- Sit conscious persons upright to reduce the work of breathing. Watch for vomiting and protect the airway accordingly.
- Keep the diver warm (to reduce vasoconstriction and central pooling).
- Do not give fluids other than sips of water.
- In consultation with DAN, transport the diver to emergency care.

Symptoms resolve within two days for 83% of patients.¹⁴ The treating physician will look to rule out decompression illness, water aspiration, an episode of laryngospasm, or a heart attack.

There is no definitive therapy for IPE. One study suggests that sildenafil (Viagra) reduces pulmonary vascular pressure during underwater exercise.¹⁵ Its use is off label because it still is under investigation.

Before returning to diving, a cardiologist should evaluate the diver for fitness and for underlying heart disease. It's important to let dive buddies know about previous IPE episodes and to have oxygen and a phone available. Using adequate thermal protection is important, as is adjusting equipment for minimal resistance. It's prudent to avoid overexertion and copious pre-dive hydration.

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This article is not intended as medical advice. It is for general information only. Divers who develop IPE or any dive-related distress should contact their physicians for evaluation before getting back into the water.

---Editor's note

aquaCorps is back!

Do you remember AquaCORPS? Michael Menduno, who coined the term "tech diving," is making it available on line, no charge. The "re-breather issue" from 1993 is now available. Stories by Rob Palmer, Bill Stone, Oliver Isler, Bill Hamilton, and others in this issue.

Download it here: <http://aquacorps.online/download/>





DIVING WITH THE REAPER

— by Elliot Smith

Cave divers know that the Grim Reaper lurks in every cavern and cave. His picture warns away the untrained and reminds the rest of us that he's just waiting for us to screw up. So we train and we practice. We know the risks of silt outs, complex navigation, high flow, and equipment failure. We plan for these situations, and we have procedures and protocols to mitigate risk.

But we cannot know how our brains will react in a real-life high-stress situation in a cave. I've always been confident that I could handle an emergency by following procedure and exiting the cave. I pictured myself as some sort of diving robot. I didn't take into account the primitive urge to survive and the crazy things I might do in an emergency.

Never forget that the Reaper is out to kill you.

It's already been surveyed

My college buddy Jake Bulman and I both have had the long-term goal of becoming cartographers. We needed to brush up our survey and cartography skills before producing maps for the public. We decided to



© Kim Davidsson

© Kim Davidsson. *Even previously surveyed caves can yield surprises.*

resurvey Chan Chemuyil Norte, located in the pueblo of Chemuyil, about 100 km/62 miles south of Cancún. This cave is close to Playa del Carmen, and it's fairly challenging. We planned to survey the areas where the original explorers tried to connect to the adjacent cenote, Chan Chemuyil Sur, and subsequently to Sistema Xunaan-Ha. We anticipated finding ourselves in some major restrictions toward the back of the cave. I considered myself fairly experienced in diving small cave and thought that because the cave had already been explored, it could not be that bad.

How wrong I was.

A gnarly cave

Chan Chemuyil Norte is small, silty, and crumbly with some stagnant offshoot tunnels. We decided to leave a bit of distance between ourselves. Jake entered first, running the primary reel. I waited on the surface to give him a head start, then began my descent and entered the cave. As I placed my marker on the primary line, I could barely make out the faint beam of Jake's light. My first 50 minutes of the dive was a commute through previously surveyed and lined passage. Just past Jake's jump line, I made my own jump and, swimming further, navigated a T where I marked



© Kim Davidsson. *En route to the survey station.*

my exit and went T right. When I reached the station from which I would start my survey, I carefully clipped my stage bottle to the line. I could not then appreciate the role that it would play in the next 40 minutes. With a spring in my frog kick, I started to survey in.

Ahead I noticed that line dropped about two meters/six and a half feet, and the cave began to shrink in on me. I barely made it through the restriction without removing a tank, which in hindsight would have made it a lot easier. Ploughing on with the survey, I noticed that I was getting caught up more and more on the cave. It was becoming harder to orient my body in a position that made it easy to collect my survey data.

Then I noticed that the guideline in front of me was slack. Following my training, I searched for a tie off, wrapped the line until taut, and continued on. Again, I came across a slack guideline and saw that a small chunk of rock had ripped from the cave and was still attached to the line. I removed it and struggled to find a new tie off. The floor was composed of full thick clay, and there were no tie off points on the walls, so I decided to tie the line to the ceiling.

Looking ahead, I saw the end of the line through a tiny restriction. Thirty seconds spent looking through the

restriction convinced me to end my survey one station before the end of the line. I know my limits and did not want to push myself, especially knowing that the original explorers had pushed this cave to the extreme to try and make a connection.

When I turned the dive, I encountered complete zero visibility and referenced the guideline. In only 10 meters/33 feet of water, having dropped my stage only ten minutes beforehand, I knew that I had loads of time to get out. There's a small flow in this cave, so I decided to wait for it to clear. After ten minutes, the viz was still zero. I could see the flow moving sediment out of the cave, but I had not considered that my exhaust bubbles were causing percolation. It dawned on me that this passage hadn't been dived for years. I realized my mistake, took a deep breath, and prepared to exit in zero visibility.

Within two meters/six and a half feet from my turn point, I felt the line go slack. I was already crawling on the floor, so with one hand on the guideline I felt around for a tie off. After what felt like an eternity, I found a suitable tie off and began to wrap the line until I started to feel tension.

Snap! The line had broken.



© Kim Davidsson. *Phillip Lehman pushes a restriction.*



© Kim Davidsson. *I thought that finding the exit side of the line would be easy.*

Distraction is the Reaper's friend

My mind started to wander. I was stuck in a restriction in a very crumbly section of the cave with a broken guideline. The only saving grace was that the tunnel was very small, so finding the exit side of the line should be fairly easy. Holding onto one piece of the guideline, I started a methodical search for the other half.

After about five minutes of searching I felt my heart rate increasing. My breathing rate began to go through the roof, and I started to feel the Reaper at my shoulder.

This was the first time in my diving career that I had experienced the gut feeling that "I need to be on the surface – now!" Thoughts started rushing through my head. I began to think about my family and whether I could get out of this situation alive.

I started to feel the urge to just swim for it—swim in any direction—it's better than staying here. But I knew that panic would kill me.

This is what we train for

I stopped searching. Grasping my piece of the guideline, I rested on the cave floor and began a rhythmic breathing pattern. I started to talk to myself (mentally) and began fact checking everything I knew about this situation. I reminded myself that my stage tank was no more than 30 meters/98 ft away. I slowly and methodically searched again, this time with success. I deployed my safety spool, fixed the broken guideline, and slowly continued my exit.

Ahead I saw the visibility clearing and the comforting sight of my stage tank clipped to the line. I grabbed it as if it were the last scuba tank on earth and began my exit, relaxing progressively with each breath.

I worked out that I was stuck in the restriction for 30 minutes. Anyone who has been in zero visibility knows that five minutes feels like an eternity. Upon surfacing, I ripped my tanks off and lay on the ground, not thinking about anything. I was just happy that I could look at the clouds in the sky.

Fight or flight: A hardwired survival instinct

The human brain generates powerful chemicals—neurotransmitters—and reactions to threatening situations. The body responds by producing hormones (cortisol and adrenaline), reflexively provoking the primitive “fight or flight” reaction. When we go into potentially hostile environments, we need to know that we can control panic and not let it control us.

The rational brain enables us to work slowly through the problem-solving phase of an emergency. But the older, primitive amygdala generates the initial stress response. It can provoke panic and irrational responses that could get a diver killed.

Cave divers must know how to harness and compartmentalize intrusive thoughts. This means blocking out thinking that serves no purpose in responding to the situation. In an emergency, we cannot afford to think about our families or berate ourselves for getting into a mess. We need to put aside thoughts of how far back we are in the cave or how small the restriction is that we need to pass through. Survival depends on methodically working out the logical next steps necessary to get out of this situation. It sounds trite, but the “fight or flight” response is evolutionarily hard wired. Our physiologic responses are far from simple.

Anticipate the worst

What we can do as cave divers is prepare for the worst. Back-up masks and lights, underwater tools, and contingency plans are essential components of cave dive planning. Trained cave divers should be prepared to overcome any emergency that may occur by following our time-tested procedures and protocols. Part of this involves understanding how to contain our instinctive response to stress.

Having experienced how my thoughts affected me during an emergency, I will be paying a lot more attention to them. We all need to heed the Reaper’s tap on the shoulder. This means knowing how to put aside thoughts that serve no purpose in getting us out of the cave. Only then can we stop, plan what needs to be done, and live to dive another day.

Elliot Smith is a cave diving instructor and guide in Playa del Carmen, Mexico.



© Kim Davidsson. *Focus on what you must do to exit the cave, and put all other thoughts aside.*

Face Up or Face Down?

Transporting an Injured Diver through a Sump

—by Michael A. Raymond

In some ways we are fortunate to have so little experience with transporting severely injured patients through sumps. This demonstrates that this is an extremely rare need. On the other hand, it also means we have few data points to answer some of the open questions. One of the areas with the widest variety of reasoning is whether to swim litter-bound patients face up or face down.

In this setting we are interested in injuries that occur to cavers in dry cave after swimming through a sump. You can also imagine an injury occurring amongst a party of purely-dry cavers who have their day really ruined by their exit additionally being halted due to rain flooding a tunnel. The most common dry-caving injuries are sprains and breaks to the lower and upper extremities. Cave rescuers train to respond to requests for assistance by local emergency management personnel, in situations outside the domain of an average fire fighter.

The most difficult scenario that most sump-rescue teams train for is the movement of a patient who has a severe head, neck, or back injury and an altered state of consciousness through a sump. This necessitates the use of a litter. Leg injuries may require a litter while moving through dry cave, but then a patient with a properly splinted extremity can be swum without it. Even with a suspected head or spinal injury, limited immobilization with a backboard such as an Oregon Spine Split (OSS) or Kendrick Extrication Device (KED) is still preferable to a full litter. The water will provide good spinal support,¹ and litters are difficult to maneuver. If an individual has a broken neck with an injured spinal cord, the odds of their surviving extraction from a cave are extremely low. Still, situations requiring a litter may arise.

In this situation, you will have to decide whether to swim the litter with the patient facing up or facing down. Right now, there is no consensus on which option is better. Good arguments exist for both options,

and in training exercises around the world you will see both used. In this article I would like to discuss some of the factors involved so that you can evaluate your situation and make an informed decision when the time comes.

Considerations

All divers naturally swim in the face down orientation. This feels normal and helps several physiological processes. The natural buoyancy of the lungs, coupled with the pressure differential between the depth of the second stage and the lungs, enlarges the alveoli. These factors make it more efficient to exchange gas than when laying supine (on the back).² The regulator's position below the ears also makes it easier for the patient to equalize. Note that you will not be able to equalize the ears for a patient in an altered-conscious state and should expect to tear the eardrums.



Courtesy of IUCRR. A full face mask protects the patient's face and allows team communications.

Transporting the patient above the litter (face up) is easier for the rescue team. The team will move with the litter in this orientation while traveling through dry cave and stream passages. If the litter or patient has sidemounted scuba tanks and the team decides to go face down, rotating the litter may prove challenging when moving into and out of the sump. While swimming with the litter, the rescue team will most likely swim above it. Face-up transport will make it easier to monitor the patient and breathing apparatus.

You will almost certainly have your patient wearing a full face mask (FFM). If the FFM leaks and the patient is facing down, then the water will pool at the bottom of the mask. If the patient is facing up, then it will be easier to purge the mask but some of the leaking water may also get into the mouth. Note that a FFM may increase the buoyancy of the patient's head and thus impart increased forces to the neck. This is a slight argument in favor of face down, as the head position will be protected by the litter above the body. If the patient is using a regular regulator instead of an FFM,

keep in mind that some regulators perform poorly when upside down.

Overall patient comfort is another consideration. The patient will need to be strapped to the litter. An informal survey by the author suggests a slight preference for face up. Comfort is a much lower priority than the other factors discussed so far, though. Whether or not to give the patient a cutting tool to free him- or herself from the litter straps is another open issue. During training exercises the mock patient should absolutely have cutting tools.

All cave rescues negatively impact the cave. It is not clear that either orientation reduces cave impact. The degree to which the rescue team is spread out around the litter will likely have a greater effect. If the guideline is run along the floor of the passage, which is likely, then traveling face up may be better. This will keep the smooth side of the litter near the line and the patient's snag-inducing kit away from it.



© Germán Yáñez. *Swimming the litter face up makes monitoring a severely injured diver easier.*



©Steve Reames. *Face-up transport keeps the patient's gear from snagging a guideline running along the cave's floor.*

A Judgment Call

The decision whether to swim a severely injured diver face up or face down involves many factors. Almost every physiological consideration suggests that face down is better. In training, though, the vast majority of teams swim their mock patients face up, and this experience should not be ignored.

One rule of thumb may be that if the balance of effort is spent getting the patient in and out of the water, then the patient should stay face up. If the majority of the effort involves challenges under the water, then face down should be strongly considered. In all situations, remember that your mission is to get the patient out of the cave as quickly as possible while causing as little additional harm as possible.

Notes:

1. Personal communication, Dr. Richard "Harry" Harris
2. Personal communication, Peter Buzzacott, PhD, MPH

Michael A. Raymond is at work on a series that explores controversies and best practices in sump rescue. He is Associate Editor for Underwater Speleology.

letter from the chair (continued)

...continued from Page 5

Our bylaws are due for revision. Kelly Jessop has agreed to serve as the Committee Coordinator. Once the team reviews our bylaws and changes are accepted by the Board, they will be voted on by the membership. This will all occur before the next election in early 2021.

The Website Committee continues with a major overhaul of our website. The new member and renewal processes have not been ideal. Brett Floren is working on a custom platform that will take us to an IT standard that the CDS has not seen before. He promises this to go live by the end of the year.

Richard Blackburn has reactivated our committees, some with new coordinators. These committees are listed on our website under the "About Us" tab. Please let Richard or me know if you are interested in being considered to serve on or to coordinate a committee or if you have project ideas for a committee.

Everyone who is interested likely knows that DEMA 2020 has been cancelled. The event will be back in Las Vegas in fall 2021. While the CDS does not plan to participate in an official capacity, it is expected that many of our members will attend.

Please ensure that the contact information we have on record for you is accurate to ensure the timely receipt of materials. Changes can be directed to Adam Hughes, our Operations Manager. Adam works behind the scenes handling the day-to-day tasks that keep us on track.

Keep in mind that Board members are volunteers who also have families, jobs, pets, and other responsibilities. Although we may desire to live and breathe the NSS-CDS, everyone has to balance competing demands. Please be patient with us because at heart, we truly strive to do our best for the NSS-CDS and our membership.

The next Zoom board meeting will be held in September. These meetings are open; the membership is encouraged to attend. Announcements will be posted 14 days prior to the meeting on our Facebook group.

Enjoy this issue of *Underwater Speleology* and please join me in giving Barbara Dwyer a hearty "thank you" for her dedicated work with the magazine!

Stay safe out there!

Warmest regards,

Renee S. Power
NSS-CDS Chair

Below you'll find a listing of the instructors who were in Active status as of 26 March 2020. Because this can change, you will want to go to the NSS-CDS website for the most up-to-date instructor listings. For each instructor, you will find:

- Current instructor rating
- Authorized specialty instructor ratings
- Clickable buttons that will take you to the instructor's website, Facebook page and email



Bahamas

Cristina Zenato 325

Mexico

Juan Carlos Carrillo 342
 Ricardo Castillo 386
 Jonathan Kieren 397
 Olivier Prats 384
 Luis Sanchez 387
 Michael Silva Netto 398
 Roger Williams 396

Russia

Elena Kryzhanovskaya 382
 Maxim Kuznetsov 352
 Timofey V Novikov 393
 Evgeny V Runkov 371

USA

Harry Averill 218
 Brenton C Booth 241
 Chris Brock 392
 Peter Butt 186
 Mel Anne Clark 373
 James Draker 395
 Steven D Forman 106
 Mark E Fowler 379
 Georges Gawinowski 369
 Jill Heinerth 340
 Paul Heinerth 165
 Lamar Hires 191
 Thomas L Johnson 368
 Jonathan Kieren 397
 Maxim Kuznetsov 352
 Jeff M Loflin 360
 Mal Maloney 374

Bill Oestreich 253
 Daniel C Patterson 353
 Conrad Pfeifer 287
 Renee S Power 383
 Ken Sallot 390
 Edd Sorenson 375
 Pam Wooten 388
 Jim Wyatt 355
 Timothy Young 400

Western Europe

Johan Asplund 399
 Martin J Robson 350
 Phillip Short 365
 Jose Mario Roberto Ventura 389
 Sébastien Wilem 394

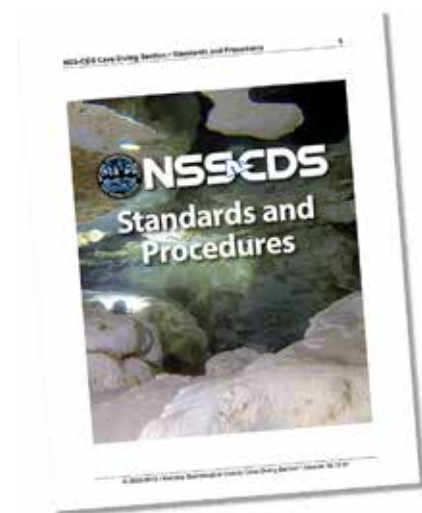
There's more in store...

Up-to-date instructor listings are not all you will find on the NSS-CDS website. Among other things, you can:

- Renew your CDS membership
 - Order books and apparel
 - Replace a lost card
 - Contact CDS Board members
- In the *Training* section, you will find an in-depth description

of all current NSS-CDS diver training courses. You will also be able to download the current standards for each CDS course. Here you will find:

- Student prerequisites
- Required dives, bottom time
- Course content
- Skill requirements
- Limits of training

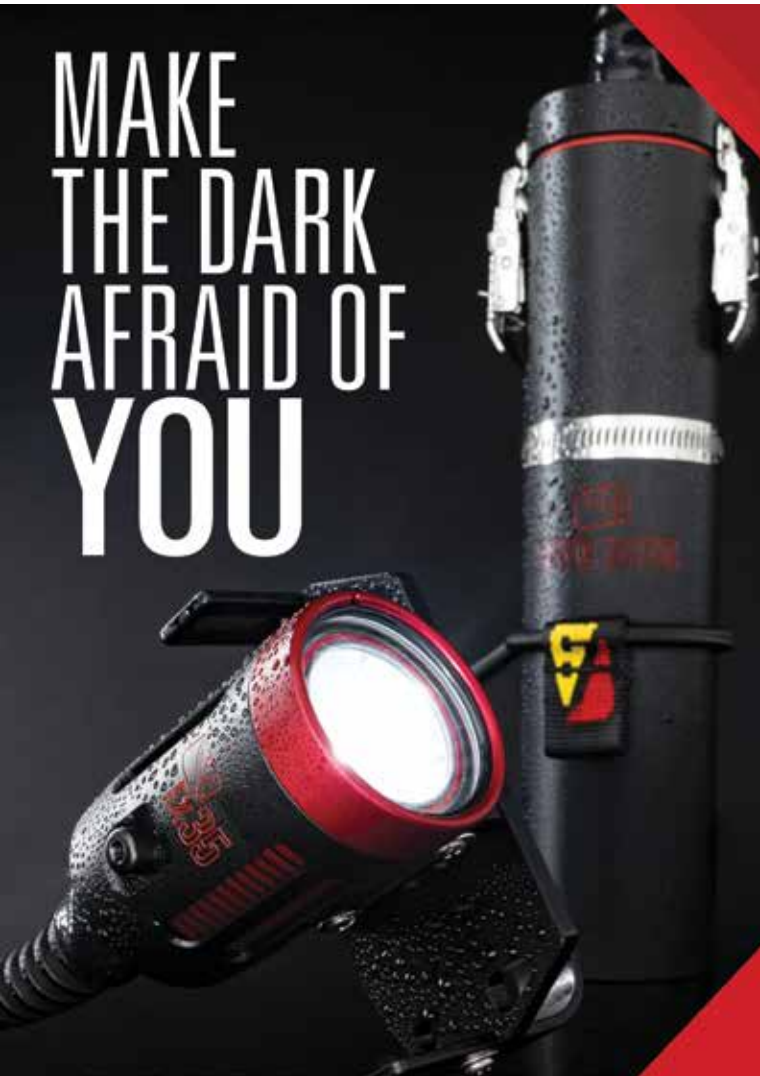


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