

# American Sump Rescue Symposium

by Michael A. Raymond,  
Aaron Thomas,  
and Ian Flom

Nine American sump divers got together on Dec 10th, 2022 to conduct sump rescue training. A sump is an underwater tunnel with at least one entrance in dry cave. In the event of a rain storm raising the water level and trapping cavers, or an injury to a scuba diver in dry cave beyond a permanent sump, the members of the American caving community would be called upon to conduct a rescue. While civilian authorities would be in command, sump divers would provide expert advice, bring supplies to the trapped persons, and possibly swim those persons to safety.

To the best of our knowledge, this was the first-ever symposium in the U.S. focused on sump rescue. Many of the individual attendees had participated in training outside of the U.S., and had been discussing the topic online together for years. It was thought that we would never be able to do an in-person event because there were no sumps that were safe enough to train in. Once we realized we could practice all the key skills at a swimming pool or open water dive site, a major hurdle had been passed. We could start planning. There is only a small community of sump divers, and we are spread out across the country, but we settled on a site near many at Gray Quarry in Gray, TN.

We split the one day of training into two portions. We began with several hours of discussions about sump rescue theory, equipment, problem sets, and techniques. In the later portion we got into the water to practice some of the rescue tasks and try special equipment.

## Attendees

Jimmy Bennet (TN), Ian Flom (KY), Chris Garguilo (VA), Terry Hall (GA), Ashley Lewis (VA), Jon Lillestolen (VA), Michael Raymond (MN), Chrissy Richards (TN), Jason Richards (TN), Aaron Thomas (VA)

## Morning Classes Michael Raymond - High-Level Decision Making

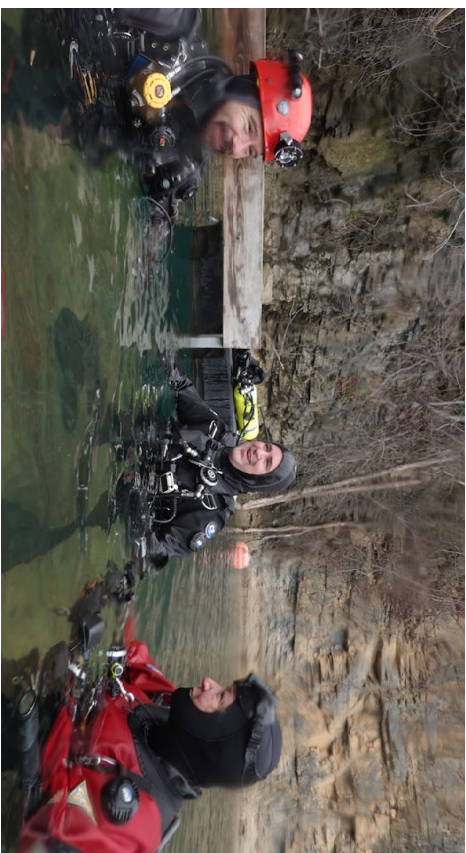
To kick things off, Michael led a discussion on the flow of events in a sump rescue. This included the decision making processes for sending divers to look for missing people, as well for whether non-divers should be swum back through temporary sumps. Both of these decisions need lots of information, and we discussed what to collect.

We talked about the two main types of patients. One type are dry cavers who get caught behind temporary sumps after a rainstorm. The other type are sump divers trapped behind a permanent sump because of injury, equipment problem, or problem with the sump itself. While the priority for both types of patients would be rearming them, the solutions for getting them out of the cave would differ significantly.

We also worked to define a worst case scenario to focus our training. If we are prepared to conduct a rescue in that scenario, then everything else will be easier. To come up with the worst case, we canvassed the attendees to learn about their sumps. In VA there are very deep sumps, while in MN there is



Jon Lillestolen discusses the KED backboard. © Chrissy Richards



Aaron Thomas, Jason Richards, and Chrissy Richards discuss their training dives. © Jon Liljestolen

climbing (SRT) required between sumps. We agreed the worst case was a cold 2000' long 200' deep sump. We did not settle on a worst physical injury, but options include a smashed face, compound broken leg, or back injury. Most interestingly, we agreed the largest hurdle would be working with incident managers who did not understand the complexities of a sump rescue, including the time pressures, and that there are people they could call upon to assist.

### Ian Flom - Initial Response Team (IRT) and Simple Medical Equipment

Hypothermia is the greatest risk to anyone trapped beyond a sump. To this end, Ian led a discussion of the things to bring and the ways to bring them.

The most important things to bring are items to warm patients. Candles and contractor bags can be used for Palmer Furtraces, and can be safely carried in thigh pockets. Camping stoves can also be swum. For chambers with limited volume, iron-based chemical heating pads can warm patients without generating toxic fumes. Items to sit on to prevent heat conduction are also useful. These include small foam pads, ThermaRest pads, or BCD wings.

Anything needing a dry space can be carried in a dry bag, dry tube, or in some sort of plastic container (Darin Drum, Nalgene). Old dive battery housings may work for small items. Jon raised the idea of vacuum sealing items. One discussion focused on the topic of carrying items inside your drysuit. Unzipping your drysuit inside a cave risks not being able to re-zip it. Stuffing things under a wrist seal risks tearing the seal.

There are other items that might be useful. Pain management is easy to carry with a small amount of Aleve, Tylenol, Aspirin, etc. Bing duct tape for many reasons, including its potential for drysuit repair. Water purifiers are small, easy to carry, and very robust.

Patient psychological care is also important. There are records of patients believing they hallucinated the visit of a rescuer. Leaving a light with the trapped party serves the two purposes of providing illumination and proving that someone really did visit them.

### Jason Richards - Considerations for Swimming out a Patient

Jason told a story about an incident where he swam out his dive buddy after the buddy panicked and did not think he could make it out of the sump on his own. Jason suggested that teaching a Discover Cave

Diving (DCD) class to an inexperienced diver or non-diver is not a good solution. In Jason's story, he asked the other diver to remove his mask and Jason pulled him through the sump. He suggested we practice this and use it as a technique for extracting patients. He suggested no masks, hands on regulator(s) and give the patient a pep talk before diving covering the need to remain calm, keep breathing, and to not reach out or try to swim. The point being that the patient is not expecting to have an airspace around their nose and eyes, and failure of the mask seal, either by accident or patient movement, is no longer a concern, and reduces the possibility of patient panic when the mask partially floods. This is particularly distressing for non-divers who are not going to be able to learn how to successfully clear a mask in a short discover scuba class.

Ear clearing is a concern. However, even the worst case injury of burst eardrums is minor compared to the long-term effects of being stuck beyond a sump. Suggestions were made following the water exercise that carrying a swimmers nose plug would help to simplify the no mask approach.

Michael followed this up with the story of the 2019 rescue of two German cavers trapped beyond a

temporary sump. In a commercial cave, a tour guide and tourist got trapped by rising water during a rainstorm. The tour guide was open water certified but the tourist was not. Rescuers swam in a stove to heat water, and used hot water bottles to warm the patients. They then helped the tour guide dive out through the temporary sump. After a thirty minute DCD class, they helped the tourist swim out as well. During this swim, the plan in case the tourist panicked was to bear hug him, swim him out of the sump, and revive him on the far side.

### Jon Liljestolen - Patient Movement

Jon led a discussion on additional issues regarding swimming patients.

Backboards and litters available to rescuers may be limited to what's available on local EMS and rescue vehicles. Something with handles or grab points is best. If the patient is in dive gear, there should be enough grab points available.

One commonly available device on ambulances is a Kendrick Extrication Device (KED) which is good because it provides some rigidity as well as handles, in addition to being smaller and easier to transport



Divers gear up to start the training session. © Jon Liljestolen.



*Mary drivers got their first exposure to FFM use. © Jon Liljestolen.*

One discussion focused on leashes and, if used, what their maximum length should be. A leash would be used to keep the patient attached to a rescuer while the rescuer used both hands to solve some problem.

A length of about 6 feet was decided to be the max length. There should be plenty of webbing or rope available during a rescue to make extra grab handles and leashes. The risks of a panicked patient taking a rescuer for a trip were also discussed.

There was also a discussion about the maximum number of people to send with a patient. There seemed to be consensus that there shouldn't be a reason to have more than two people swim with a patient at a time, especially if dealing with low-visibility or small spaces.

**Ashley Lewis - Patient Packaging in KED, OSS, SKED**

Ashley Lewis led a quick class on the KED spine board. It is very similar to the Oregon Spine Splint (OSS) that many National Cave Rescue

Commission (NCRRC) students are familiar with. The Petzl Nest filter and the Yates SPEC PAK, a spine board designed to make dragging easier were also discussed.

This led to a discussion of whether filters or spine boards would be needed for swimming patients. Cervical spine immobilization may not be necessary in the water. For other injuries, equipment like fins can be used to splint arms and legs.

A discussion on swimming patients face up or face down covered the reasons some teams choose one or the other. Face up is desired by some teams because it makes patient monitoring easier, but if a Full Face Mask (FFM) leaks then it will be increasingly uncomfortable for the patient. Face down is desired by other teams because it solves the mask leaking problem, and some regulators are meant to only be breathed from in that position. If the patient gets dragged across objects they may make contact with the patient's face though. After patients are slid into the water face-up, rotating them face-down for swimming can be an awkward procedure that requires practice.

**Terry Hall - Full Face Masks**

Terry Hall led a class on Full Face Masks. Many attendees had never used a FFM, and so this was a good chance to try them out. Getting a FFM to seal to your face is a difficult task. Putting one onto a patient is even more difficult. We had a healthy debate about when to use a FFM with a patient as opposed to a regular second stage regulator, with the end consensus being if the patient was conscious and aware, they should not be in a FFM.

The mask brands and models mentioned and/or shown by Terry include:

- OTS Guardian (Aaron says this is what Blacksburg Cave Rescue uses and he highly recommends them)
- Interspiro AGA
- Scuba Pro
- Kirby Morgan M48 Mod 1
- Ocean Reef Neptune

FFMs should be commonly available among public safety dive teams. It was mentioned that FFMs may conflict with a patient's helmet, and in this case the FFM should be preferred over the patient wearing a helmet.

**Michael Raymond - Gas Considerations for Divers**

Michael led the last discussion about breathing gas issues. In America we have a small number of 2000 foot or longer sumps. Given gas planning assumptions, this would likely require us to change the scuba tanks a patient was breathing from along the way. We had a chance to discuss gas blocks, quick connects, and related issues.

For gas planning, it was noted that experts in other areas recommend 1.4 cubic feet of breathing gas per minute as the worst case. The team agreed to use that value. Michael noted that the Italians place stage bottles for patients every 100M for shallow sumps and every 50M for deep sumps. He believed a stage swap was done at every bottle no matter the level of gas in the patient's tanks. The patient would be on a gas block connected to two cylinders, and one of them would only be used as the supply while the other

bottle was swapped out. It was agreed that the QC-6 connectors are the standard, with Male QC-6 fittings on supply bottles, and Female QC-6 fittings on the gas block receivers.

**After Action Report on Morning Session**

Everyone reported the sessions and location being good and a great basis for future discussions and training. Gray is available for future training events, but it may be more useful to move around the country to allow people that may not otherwise be able to travel far to attend. We will send out communication on future dates and locations. Things to change or add include more discussions on what equipment people use for their own sump diving projects and where to buy it. Also, future classes should probably span a full weekend to be able to cover more gear and skills. Mentone Alabama was mentioned as a good future training site if we wanted to combine a training event with one of the annual NCRRC sessions.

**Afternoon Diving**

After lunch, we put on our scuba gear and practiced underwater skills in the flooded quarry. All of the tasks were performed in open water. We feel that every task in sump rescue can be trained and practiced in open water, as opposed to a cave. This increases safety, observability by other students, and the number of repetitions that can be performed. Training in actual sumps would add realism, and force the members to deal with confined spaces and limited information through.

Safety and videography of the training were led by Chrissy Richards. As the Safety Officer for the day, she instituted a system to ensure that all tanks were analyzed before being taken to the water. Interestingly, one tank was identified as having been mis-analyzed using this double-check system. She also had everyone use personal cookies to mark whether we were in the water or on shore. This helped with accountability.

For the first underwater task, we practiced swimming non-divers. We split into two-person teams. One diver took off their fins and mask, and focused on just breathing. The other diver had to move them along a guideline. This included changes in depth. We found that controlling a patient's buoyancy while also moving them along is a skill we all need more practice at. Tim was a major issue, as for some of us, heavy fins are important to our weighting and

trim. Patients must be properly weighted and trimmed before being moved. For the patients, they weren't used to their eyes being exposed to cold water, and it took getting used to. It was identified that many divers had significantly unique wing and inflation systems. Learning how to inflate and deflate the casualties inflation systems (wing and dry/suit) and being in a position to do so while swimming had a significant impact on the successful outcome of the movement of the patient.

For the second underwater skill, we brought out two FFWs. The divers who had never used one before were given a chance to dive with them. This included practicing bailing out to a second stage regulator. We switched to teams of four divers. One was the patient, two were there for propulsion, and the last for safety. We swam the patient along the underwater course again. We found that we needed better ways to keep the two rescue divers from kicking each other, and also communicate about who was managing what.

For the last task, we practiced transitioning a patient from the shore to the water. Moving a patient into and out of the water is one of the most complicated tasks. It can take a long time, with people not moving much, which can result in everyone rapidly cooling off. We slid the patient (Jasson) into the water face up. Jon took over and led the process of getting Jasson's tanks attached and hoses routed. We then flipped Jasson over and started swimming with him. There are several ways to perform this task, and we know we need to practice a lot more.

#### Findings / Agreements / Areas of Focus

- We will use 1.4 cubic feet / 40 liters per minute as the breathing gas planning factor for patients.
- QCGs will be the standard connector for scuba equipment meant to be attached and detached underwater with QCG male on the supply bottles, female on the gas block.
- We will swim patients face down by default.
- Swimmer's nose plugs should be part of the rescue kit if using the no-mask approach.
- We will refine guidance for when FFWs should be used with patients.
- We will research hardware for long-range through-sump communication.

- We will gather a list of special equipment for sump rescuers and how to acquire it, and post it on the sump rescue website.

- Future training will include practice swimming non-divers and immobile patients.

- We will continue to recruit sump divers to join our training events.

- We will find additional ways to improve communication and collaboration between incident managers and sump rescuers.

#### Next Steps

We came away from the training with several action items. One is that we need to do similar training regularly in the future. We'll try to move the training site around so that more people can participate. Attendees said they'd prefer a two-day session to help justify the travel.

Aaron Thomas took notes on each of our sessions. We'll be going over those and making improvements to the sump rescue manual. We identified we need to come up with lists of recommended rescue equipment. There's also new equipment, like long-range electronic telecommunications, that we need to experiment with.

All in all, we believe that this was a good first step. Many people met for the first time, and/or saw people they had not seen in years. We brought a lot of issues out in the open. We had a chance to test whether procedures in the Guidelines to Sump Rescue manual worked or not. We all realized we have a lot of work to do to improve.

Lastly, we'd like to thank Gray Quarry for hosting the event. Their site was perfect for what we needed.

Michael Raymond is at work on a book about sump diving. He is Senior Editor of Underwater Speleology.

**See you at the 2023 International Cave Diving Conference May 26th - May 27th, 2023, Lake City, FL**

## Milestone Dives and Awards

by Gayle Hall

Congratulations to our members who've recently achieved milestone dives and awards. Let us know if you want to write up your special dive and publish it in *Underwater Speleology*.

Abe Davis Award	
Brad Acker	Jan 12, 2023
Pete Kibler	Jan 13, 2023
Kelly Baker	Jan 27, 2023
Jayne Lusterberg	Jan 28, 2023
Joe Rhardi	Jan 28, 2023
Carolyn Donahue	Jan 28, 2023
Henry Nicholson Award	
Laura Battle	Jan 12, 2023
Gayle Hall	Apr 25, 2023
Shack Eley Award	
Lanny Vogel	Jan 13, 2023

