Technical Diving: Too Far Too Soon?

http://www.iucrr.org/aa.htm

By Jeffrey Bozanic

Introduction:

In 1946, the first scuba units were imported into the United States. Not until 1960 was the first national certifying agency formed, providing instruction in the use of this equipment (Tillman and Tillman, 1995). During the 14 intervening years, prospective divers either taught themselves the techniques of diving, learned via written material, or had friends or equipment salespersons give them informal lessons. By today's instructional standards, the training from any of these sources was inadequate, or limited at best. This resulted in numerous accidents involving novice divers.

The effect of the training agencies was to mitigate the incidence rate and severity of these accidents (Hardy, 1975). As the agencies developed their curricula and extended their instructor corps, effective diving instruction began reducing the overall incident rate in diving. This resulted in diving becoming safer, and more accepted as an activity with a reasonable degree of associated risk. Consequently, increased numbers of people tried and stayed in the sport.

During this same time, in the 1960's and early 1970's, many of the early, pre-instructional era participants in this sport became very competent divers, and went on to extend the range of their diving activities. This commonly manifested itself in diving to increasing depths. These early pioneers slowly accumulated the personal knowledge, experience, and skills to accomplish their goals, and become generally competent in deep air diving.

However, this deep diving activity slowly became a problem for the entire scuba diving community. As deep dives were being made, they were also being widely publicized. Soon, an attitude developed that began to equate the depth of one's deepest dive with "prowess," effectively providing the yardstick by which one's diving ability was measured. This resulted in many divers overextending themselves in their diving activity, once again leading to increased numbers of diving fatalities.

The mere fact that deep diving fatalities were increasing did not deter newer, less experienced divers from participating in deep diving. While some individuals and organizations attempted to promulgate caution regarding the practice of deep diving, the psychological drive created by community-wide peer pressure overwhelmed these individual efforts to curtail these hazardous activities.

In part due to this, significant governmental efforts were instituted to regulate scuba diving. In some areas of the country, proposed legislation was successfully defeated before implementation, while in others legislation was enacted which placed limits on diving activities. This regulation impacted all divers, not just those engaged in "high risk" aspects of the sport, and was viewed negatively by the sport diving community.

To combat proposed and existing legislation, the dive community began working together to correct the underlying causes accidents. Instructional curricula underwent another evolution in design and content. Additional required dives were added to certification courses, and an effort was made to modify the "macho attitude" surrounding deep diving (Somers, 1974) and its perceived parallel to diver competence. Simultaneously, widespread diver protest raised political awareness of the degree of self-responsibility held by individual divers. These efforts were successful, and as a result much of the pending and existing legislation was either dropped or rescinded.

We have a similar situation today, with recreational divers over-extending themselves in their diving activities. The problem is compounded by the proliferation of nontraditional equipment and techniques used within the recreational community. These include the use of: enriched air nitrox (EANx) as a breathing gas (including use as primary gas, travel mix, and decompression gas), open circuit scuba trimix (helium/nitrogen/oxygen mixtures), stage bottle, closed and semi-closed circuit rebreathers, diver propulsion vehicles (scooter), solo diving, decompression diving as a routine activity, wreck and cave penetration, and once again, deep diving. In the past these modes of diving had not been considered to have been in the recreational diving realm. The use of these technologies today is generally referred to as "technical diving," and participants as "technical divers." Case histories illustrating alarming trends in the technical diving community follow:

Case Histories:

Case 1: A diver walks into a dive store, and requests that his diving cylinders be filled with EANx. He is unable to define the composition he desires, but states, "I need it to dive a wreck at 220 [ffw] depth." Upon request, he produces a certification card showing that he has received training in the use of nitrox. However, his class included no diving, only lecture work. (Somers, 1996)

EANx, when used as the primary breathing gas, is appropriate only for diving relatively shallow depths. For example, NOAA Nitrox I, with an oxygen content of 32% (EAN32), is limited by the partial pressure of oxygen (pO_2=1.6) to a maximum depth of 130 fsw. Beyond that depth, the potential risks of acute oxygen toxicity and the consequent probability of drowning are considered too great. The fact that this diver was unaware of this, even after receiving training, indicates that, at least in his case, the training was inadequate.

The International Association of Nitrox and Technical Divers (IANTD, originally the International Association of Nitrox Divers), a training agency specializing in the instruction of EANx for recreational scuba divers, was formed in 1985. Since then, many other agencies have instituted training or certification programs in EANx use, including American Nitrox Divers, Inc. (ANDI), Technical Divers International (TDI), the Professional Association of Diving Instructors (PADI), the National Association of Underwater Instructors (NAUI), and others. These agencies have differing standards for certification. This is most apparent in the number of dives required for introductory EANx training, ranging from zero to three (0-3) dives.

The argument used to support a course curriculum without diving requirements is that diving on EANx is no different from breathing air. Since the physical skills are the same, a diver who can dive on air can dive on EANx. I disagree. While the skills associated with breathing underwater do not change, the mindset required while EANx diving is significantly different. EANx is much less forgiving than air in many respects, and must be treated with a greater degree of respect. This caution is not learned by prospective users in a class with no diving involved. In fact, I believe that even courses with three dives are inadequate. It is my experience that divers do not learn the basic principles of EANx use until they have conducted four to ten (4-10) dives. This ensures that the theory of EANx and inert gas calculations is internalized by giving them the operational experience that makes the theory "real."

Case 2: A diver exploring a cave system is using EAN40. The average dive depth is 85 ffw, but ranges as deep as 105 ffw in a few short sections. There is a significant current in the cave. During the dive, the diver is observed convulsing. The dive buddy is unable to effectively assist the stricken diver, who drowns. (NSS-CDS Accident files)

This fatality occurred in a diver with training in EANx use. Presumably, he was trying to minimize his decompression obligation by diving with a high pO2 mix. However, his maximum pO2 of 1.64 ATA exceeded the maximum accepted limit of 1.6 ATA. In addition, he failed to consider the effects of carbon dioxide retention and susceptibility to acute oxygen toxicity. Because he had to fight the current during the dive, his level of carbon dioxide retention was probably high, increasing the chances that he would experience acute oxygen toxicity problems. For this reason, the maximum pO2 exposure recommended for the working or exertion phase of dives is considered to be 1.2 to 1.45 ATA. His training apparently did not contain this information, or was ignored if it did so.

Case 3: A diver using dual single cylinders was diving air at 220 fsw. In the course of the dive, he mistakenly switched to his oxygen decompression regulator, convulsed, and drowned. (Anon, 1993)

Case 4: A diver exploring a cave system was using stage bottles to extend penetration distances. At the start of the dive, he dropped his decompression bottle near the entrance for later use. During the exit phase of the dive, he picked up and switched to his stage bottle. Fighting the inflowing current, he was observed to convulse, and drowned. It was later determined that he had left the wrong bottle at his decompression stop, and was breathing his higher oxygen mix (EAN50) at depth (140 ffw). (NSS-CDS Accident files)

Both of these cases involved the inadvertent use of the wrong breathing gas at depth. In the first instance, the diver was breathing oxygen at a pressure of 7.7 ATA, while in the second the pO2 was 2.55 ATA. The first diver was required to switch regulators because of the cylinder configuration (two independent K-valves). With this type of rig, one alternates breathing from each cylinder to keep sufficient gas reserves in each cylinder to effect an exit. The second diver was using two extra single cylinders in addition to the doubles on his back, and confused the two cylinders.

Technical Diving

Technical diving involves using much more equipment than standard scuba gear. This increases task loading, placing demands on the diver far in excess of those associated with standard air diving. Before utilizing additional equipment, divers should first have a solid grounding with their "standard" technical equipment, in the environment in which they are extending themselves. Many cave divers are now "graduating" to stage bottle use while still in their full cave class, having less than twenty cave dives. This encourages them to continue such use once out of training. Instead of encouraging stage bottle use, low-time technical divers should be dissuaded from using such gear until they have attained minimal experience levels.

Case 5: A trained cave diver is using a scooter for the first time in a cave. He is also carrying dual stage bottles. Within 200 feet of the entrance, his buddy, who has no scooter, notices that the diver is no longer behind him. Swimming back towards the entrance, he finds the diver unconscious and not breathing near the mouth of the cave. Resuscitation attempts fail. (NSS-CDS Accident files)

Case 6: A diver is using a scooter for the first time to explore a wreck on a night dive. During descent, he loses control of the scooter, which impacts him in the head, knocking him unconscious. Unnoticed by his buddies, he settles to the bottom and drowns. (Fernandez, 1988)

The same comments made in previous cases about progression of equipment use apply here. In addition, in the second case the primary reason the diver was using a scooter at all was due to the urging of his friends, who all had scooters for the dive. In each of the cases, more benign environments should have been used for the initial use of the equipment, i.e. open water, daylight hours, with a basic gear rig.

Case 8: A diver, while involved in an instructional capacity in a diving course, makes a personal decision to make a deep air dive. During this dive he permits several lesser experienced divers to accompany him. One of these divers loses control while at depth (>300 fsw), but makes it back to the surface, shaken but unharmed. (Mullaney, 1995)

The insidious problem in this case is not that an instructor, who has been diving deep (>300 fsw) on air for many years opts to do so, but rather that he does so openly during a program in which he is an authority figure. By participating in that activity at that time, he tacitly encouraged other, less experienced divers to do so as well. This unspoken peer pressure was possibly compounded by the mindset that "if something happens, he can take care of me" attitude that students frequently have while diving with their instructors, even if they are not diving in formal instructor/student roles.

Deep air diving is perpetuated by the pride in which these divers esteem themselves. Comments such as "There's only a handful of us that can handle air at those depths [beyond 293 fsw]," (Menduno, 1993) challenge divers to meet those same "goals," showing that they, too, are part of the diving "elite."

Case 9: While participating in a rebreather orientation program, a diver starts feeling lightheaded underwater, and in the process of switching to the bailout scuba bottle, passes out. Later, it was determined that the battery had failed, yielding an incorrect pO2 reading. Breathing was spontaneous upon reaching the surface. (Stanton, 1996)

The introduction of rebreathers into the recreational diving community will likely bring a series of this type of problem. Failures in closed circuit systems are particularly insidious, as a failure may not be readily apparent to the diver. Everything may appear to be operating acceptably, when in fact there may be insufficient or even no oxygen in the breathing loop. Semi-closed systems have the potential problem of divers being able to over-breathe the units (Clarke, 1996), based on the low injection flow rates (0.3-3.0 l/min) recommended for use. Both semi-closed and closed circuit systems may have problems with excess carbon dioxide in the breathing loop, from any number of causes of canister breakthrough. These problems are compounded by the lack of oxygen sensors in some systems available on the market, and the complete lack of a viable carbon dioxide sensor in any system currently marketed.

Training standards for rebreather use in the recreational market have yet to be truly field tested. To date, significant numbers of units are not available in the market, which has hampered the development of curricula for any given unit. While courses can be modeled on military training programs, those programs are typically too involved and costly for the recreational training agencies to fully adopt. Different mission objectives also impact their suitability. This is one area in which I believe a close and continual evaluation of the programs in use will be required.

Case 9: A dive store contracts for the training of their instructor staff in EANx diving and gas blending. They had no prior training in EANx use. After six hours of instruction, they are certified as EANx diving instructors and as EANx blenders, having made no EANx dives and having mixed only one cylinder. Upon questioning what technique they are using to blend gas, one of the newly certified instructor/blenders stated, "We use a chart."

The reply made by the newly certified EANx blender implies a complete lack of understanding of what they were "trained" to do. Unfortunately, his comprehension of even basic EANx use was equally inadequate. The amount of time spent with this group was, in my opinion, barely adequate to provide a basic understanding of rudimentary EANx use, much less the level of understanding an instructor should have. Despite the fact this instructor had completed no EANx dives, and had demonstrated a poor awareness of basic theory, he felt confident he could provide EANx training because he had been given an instructor certification.

Case10: An person unqualified as an open circuit scuba instructor wanted credentials as a rebreather instructor. He contacted one of the three primary technical diving training agencies, and was turned down. Calling upon the second, he was approved, and became a rebreather instructor over the telephone, without any evaluation whatsoever. (Deans, 1996)

In my opinion, these last two cases are criminal! How can someone be expected to instruct something they have little or no comprehension of themselves? There is already a noticeable trend for technical diving activities to be pursued by divers with decreasing amounts of experience. now they are to be taught by instructors with little or no experience themselves??

Discussion:

It is difficult to provide a quantitative analysis of incidents and fatalities in technical diving. As with standard recreational diving, while we can quantify the number of accidents, incidents are rarely reported. In addition, we have no firm understanding of the overall level of diving activity. Approximated incident rates fluctuate widely, depending on the assumptions made by the researcher performing the analysis. It is in part for these reasons that the International Divers' Alert Network has funded and is in the process of implementing their "Project Dive SafetyWhen available, this data will be extraordinarily valuable for both the standard recreational and technical diving communities. However, pending its availability, we must rely on qualitative data. The remainder of this discussion does just that.

The first major problem I see is the lack of training. Although the first technical diving training agencies formed ten years ago, many of the programs in which they offer instruction are only a year or two old. They have had insufficient time to refine their instructional curricula, and in my opinion some of these programs are at least in part inadequate.

The second part of the lack of training issue are the numbers of people who are participating in technical diving activities without any training whatsoever. This is analogous to the situations in the 1950's and 60's where divers took their friends in the pool for "lessons," and then out to open water to dive. Lack of appropriate training is perhaps the primary cause of accidents in technical diving.

Peer pressure is another major contributor to the incidents we are seeing. Within the community of technical divers, divers are once again equating the pushing of limits with diver competency or worth. This can be inferred from typical questions heard at gatherings of technical divers, such as: "How far have you been in Devil's Ear?" "How deep have you been?" "What is your longest dive?" "Haven't you used a rebreather?" "Have you dove the Doria?"

Many divers are being recruited into technical diving activities who just a few years ago would never have considered, or been considered sufficiently experienced for, such activities. In part, this is due to the marketing activities of the instructors of the different technical diving agencies. This top-down marketing approach is augmented by the grassroots interest generated in the more traditionally oriented diving community by the glamorization of technical diving in such magazines as Scuba Times, aquaCorps Journal, and others.

Market pressure also drives all of the certifying agencies, to varying degrees. The need for the agencies to build a widely based instructor corps to capture market share is well recognized. While some of the agencies are attempting to do so within the confines of what may be perceived as "reasonable" limits and standards, some are, again in my opinion, grossly overstepping these bounds. The rush to market with training programs with new technologies, i.e. to be "the first on the block," compounds this problem.

Once involved in technical diving, many of these lesser experienced divers are either overtly or tacitly encouraged to overextend themselves. The slow accumulation of knowledge, skills, and experience that is necessary to progress deeper into the realm of technical diving is being short-circuited, and this is leading to an inordinate number of avoidable incidents and accidents.

Where are we headed?:

I see three potential likely outcomes of the current situation:

1. Technical diving will be regionally or locally regulated out of existence. This would be analogous to the legislation which was enacted in the 1970's for recreational scuba diving. While it is unlikely that today the spill over will impact "normal" recreational diving, such inclusive regulation has already been recently proposed (Anon, 1994).

2. Federal regulation will replace regional regulation. One likely avenue for this occurrence is via regulation by Occupational Safety and Health Administration (OSHA). While OSHA is primarily concerned with employer/employee relationships, the diving regulations promulgated by them specifically exempts recreational diving, which is defined as that, "performed solely for instructional purposes, using open-circuit, compressed-air scuba and conducted within the no-decompression limits." (OSHA, 1982) While these standards would not apply to individuals pursuing personal activities, they quite possibly could be applied to dive stores hiring instructors to teach any aspect of technical diving which exceeds this definition, and possibly to "independent contractor" dive instructors as well.

3. We could experience a shift in attitudes and practices regarding technical diving, moving away from the current headlong rush forward into these activities, replacing it with a more reasonable and considered progression. This would be the optimal solution to the current situation.

Option 3 will not be an easy solution to achieve. We will need a community-wide paradigm shift in order for this to occur. Such a major change in attitude will have to begin with the leaders of the technical diving community, specifically with the training agencies, instructors, and major participants. This will be difficult, as it may be the perception of these very groups that they have the most to lose from such a change in attitude.

The open water community was successful in changing previously held attitudes regarding deep diving, and prospered as a result. The cave diving community long had in place a "no promotion" policy, yet still provided instruction for those who sought it out. In fact, the cave diving community had an enviable safety record, until within the last five to eight years. During that time, there were no fatalities among trained cave divers. Since that time, there have been many. Perhaps it is only coincidental that this increase in fatalities is occurring at the same time as the promotion of cave diving courses?

Finally, in my opinion, we need to make training for technical diving activities generally more consistent and stringent. All of the training agencies should reevaluate their instructional programs, and as a community evaluate the need for minimum entrance requirements, minimum skills requirements, and minimum diving requirements for all levels of technical diving. While this may result in fewer technical divers, it will also result in a stronger, more competent, and safer community of divers.

Conclusion:

The point of this paper is not to cease technical diving activities, or to restrict personal choices made by technical divers. The main premise is that a significant problem exists, which needs to be addressed. Divers opting to participate in technical diving activities should obtain the necessary background to proceed with a reasonable degree of risk. Without an effort to control this problem, government could regulate technical diving out of existence. As with standard open water diving in the 1960's, there is significant room to mature in the realm of technical diving. If we fail to do so proactively and voluntarily, we may lose the opportunity to do so at all.

Acknowledgments:

This paper was presented at the Undersea and Hyperbaric Medical Society (UHMS) Pacific Chapter meeting held October 25-26 in San Francisco, California. It was read in manuscript by Michael Williams, Editor of Sources, and Billy Deans, Vice President of IANTD; I am grateful for their valuable comments. This paper is Number 46 of the Island Caves Research Center, Inc. Safety and Education Series.

References:

Anon, 1993, "Incident reports," aquaCorps Journal n6 p23.
Anon, 1994, "Scuba deaths prompt calls for oversight," New York Times (National Section), 6/5/94 p29.
Bozanic JE, 1994, "Cave diving fatalities," in Van Hoesen K (Ed), Proceedings of the 22nd Annual UHMS Pacific Chapter Meeting, UHMS, 5p.
Clarke J, 1996, Personal Communication, Rebreather Forum 2.0, Redondo Beach, CA, Medical Director, U.S. Navy Experimental Diving Unit, Panama City, FL.
Crosson D, 1996, Personal Communication, President, Delta-P, Ft. Pierce, FL.
Deans B, 1996, Personal Communication, Rebreather Forum 2.0, Redondo Beach, CA.
Fernandez R, 1988, Personal Communication.
Hardy J, 1975, "Some true facts on scuba diving," NAUI News, May, p20.
Menduno M, 1993, "To air is human?," aquaCorps Journal n7 p5.
Mullaney D, 1995, "Call of the wah wah," aquaCorps Journal n11 p77-82.
NSS-CDS Accident files, 1960-96.
OSHA, 1982, 29 CFR §1910.401(a)(2).
Somers L, 1974, "The deep diving syndrome," NAUI News, Apr/May, p3-4.
Somers L, 1996, Personal Communication, Diving Safety Officer, University of Michigan, Ann Arbor, MI.
Stanton G, 1996, Personal Communication, Diving Safety Officer, Florida State University, Tallahassee.
Tillman A and T Tillman, 1995, "A history of the National Association of Underwater Instructors," Unpublished Manuscript.

About the Author:

Jeffrey Bozanic
P.O. Box 3448
Huntington Beach, CA 92605-3448
(714) 846-5220
E-mail: JBozanic@hqonline.net