1989 Report on Diving Accidents and Fatalities

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Introduction

Scuba diving requires training and certification in order to participate. Like most other recreational sports, there is a risk of personal injury while scuba diving. A special risk exists in scuba diving, however, because the normal ambient environment changes from air to water. Breathing compressed gas at increased partial pressure while in the water may cause decompression sickness (DCS) and arterial gas embolism (AGE). Associated injuries such as barotrauma, marine life injury, drowning, and near-drowning are also possible, in addition to complications of underlying disease.

In 1980, an increasing need for a diver assistance service resulted in the initiation of the Divers Alert Network (DAN). Its mission was to enhance diving safety for recreational scuba divers by:

1. Providing assistance to injured divers, including treatment referral.
2. Collecting statistics on diving casualties to prevent future fatalities and injuries.
3. Providing information to physicians and the general public regarding health issues pertaining to scuba diving.

The Divers Alert Network has advanced along with the increasingly sophisticated dive equipment and multitude of divers' destinations. Wherever divers go throughout the world, they can call a single number for assistance or information.

As the largest diving safety organization in the world, DAN lends its expertise and structural framework to other assistance agencies. In 1991, DAN will host the first *International Workshop for Diving Assistance*. Additionally, a worldwide accident insurance program is being investigated. It is hoped that this international event will provide the basis for a global diving safety network.

DAN has been accomplishing its safety mission by providing a wide variety of medical and advisory services to recreational divers and physicians.

24-Hour Medical Emergency Hotline (919-684-8111) — DAN maintains a 24-hour emergency service to provide injured divers with medical consultations and referrals. ***This service is free to everyone.*** DAN receives over 1,000 emergency calls each year.

Non-Emergency Advisory Line (919-684-2948) — DAN maintains an information hotline to provide answers for commonly asked questions about scuba diving medicine and safety.

These include fitness for diving, medications and diving, and advice in areas of scuba safety. Callers may be referred to physicians who specialize in dive medicine. Calls are answered 9 a.m. to 5 p.m., EST, Monday through Friday. ***This service is free to everyone.*** The DAN medical information line now handles over 8,000 calls each year.

Alert Diver — *Alert Diver* is the official newsletter of Divers Alert Network. *Alert Diver* is automatically sent to each DAN member every other month. Issues are also distributed free to medical professionals, government and law enforcement agencies, and at diving trade shows. *Alert Diver* is the industry leader in providing the latest in diving medical safety information.

Diving Safety Courses — Hundreds of divers have benefited from DAN's One-Week and One-Day Diving Seminars. These seminars are CME and CEU accredited and offer continuing education hours for medical professionals. DAN's *Oxygen First Aid in Dive Accidents* program is a new and exciting course to teach the basics of administering oxygen to injured divers. All DAN courses provide recreational divers an unrivaled opportunity to increase their awareness and level of understanding of diving injuries and accident management.

Dive Accident Insurance — Divers Alert Network pioneered diving injury insurance for recreational divers. Diving injuries such as decompression sickness, air embolism, and pulmonary barotrauma are all covered. Also included under this plan are emergency air evacuation and all in-water injuries. DAN members are protected no matter where they dive.

Annual Report on Scuba Diving Accidents — DAN collects and analyzes recreational diving injuries in an annual report. Trends in injuries, types of injuries, and effectiveness of treatment are reviewed each year. Identifying specific causes of diving injuries and common denominators is very useful in educating the diving public in the prevention of accidents.

Report on Diving Fatalities — The latest DAN service to the diving public is a collection and analysis of recreational scuba diving fatalities. Mortality studies are valuable in identifying specific causes of death, such as experience, activity, and health. By publishing this report, DAN hopes to increase diver awareness and ultimately attempt to reduce diving deaths.

1.0 Introduction to Dive Fatalities

DAN began collecting fatality data in 1989, during which data were obtained on 114 recreational scuba fatalities. The aim of DAN's collection effort is to collect all fatality data on diver deaths which occurred in the United States, U.S. territories, and Caribbean basin islands. Any fatality in the collection area was included if sufficient data were available for analysis. In addition, data were collected on fatalities overseas of U.S. citizens. Of the 114 fatalities reported, three were not U.S. citizens.

For each fatality, an attempt was made to obtain a medical examiner's report, sheriff or police investigative report, and eyewitness accounts to assist in determining the nature and cause of death. DAN cross-referenced information from local and national investigating agencies to attempt to ensure that diving fatality information was accurate.

In order to attempt to obtain consistent reporting of data, DAN promotes the use of a standard worksheet (appendix B) by all agencies who investigate scuba fatalities.

There may be as many as 2.7 million active recreational scuba divers. Over the last four years between 553 to 678 recreational divers reported receiving treatment for decompression sickness or air embolism each year. Because the total population of divers is approximate and the number of reported injuries does not include divers who do not seek treatment, the exact incidence of injuries cannot be calculated. Using the estimate of active scuba divers and the existing DAN data there have been approximately 2.0 to 2.5 injuries per year for every 10,000 active divers. In addition, data gathered by the National Underwater Accident Data Center and Divers Alert Network indicate there have been 66 to 114 fatalities per year in the last four years, giving an approximated estimate of 2.4 to 4.2 deaths per 100,000 divers per year. This compares to 1990 National Safety Council fatality rates for swimming of 2.4 per 100,000 people and an injury rate of 14 per 10,000 people per year.

Complete information is not always available in fatality cases because:

1. The investigator must rely on secondhand accounts of what may have happened.
2. The event or series of events leading up to a scuba fatality generally go unobserved.

This report represents DAN's efforts in tracking fatalities and in gathering accurate information for each individual case.

2.0 Methods of Fatality Data Collection

Table 2.1 First Contact

DAN Membership	39	34.2%
Subscription Services *	26	22.8%
DAN Emergency Hotline	15	13.2%
Legal/ Investigative **	14	12.3%
NUADC ***	11	9.6%
Chambers	6	5.3%
Medical Examiners	3	2.6%
TOTAL	**114**	**100%**

* *LUCE and COMPUSERVE*

** *Sheriff/Police/U.S. Coast Guard*

*** *National Underwater Accident Data Center*

Reports from DAN membership and emergency hotline account for almost 50 percent of all first contact sources on fatalities. Subscription (or news) services also provide DAN with much of its information on diving fatalities. Secondary contributions to the number of diving fatalities are made by the U.S. Coast Guard, medical examiners, private physicians, law enforcement agencies, and DAN's national network of hyperbaric chambers. After initial contact, a series of calls are made to local sheriff or police departments, medical examiner offices, and when necessary to an eyewitness or family member. Sufficient information is usually contained in most investigative reports.

Table 2.2 Location of Diving Fatalities by State

Florida	28	24.6%
California	22	19.3%
Washington	8	7.0%
Hawaii	6	5.3%
Massachusetts	3	2.6%
Georgia	2	1.8%
New York	2	1.8%
North Carolina	2	1.8%
Rhode Island	2	1.8%
Arizona	1	0.9%
Connecticut	1	0.9%
Kentucky	1	0.9%
Maine	1	0.9%
Missouri	1	0.9%
Montana	1	0.9%
Oregon	1	0.9%
Pennsylvania	1	0.9%
South Carolina	1	0.9%
Texas	1	0.9%
Wisconsin	1	0.9%
TOTAL	**86**	**75.9%**

Distribution of scuba diving fatalities for 1989 are shown in the table above. Florida and California are popular diving destinations and represent a heavy concentration of scuba activity. Reflective of this is the fact that not all deaths reported in these two states are residents. The small number of fatalities in other states however, usually represent state residents.

Table 2.3 Location of Diving Fatalities by Country, other than the United States

Mexico	6	5.3%
Bahamas	5	4.4%
West Indies *	4	3.5%
Virgin Islands	3	2.6%
Belize	2	1.8%
Bermuda	1	0.9%
Bonaire	1	0.9%
Borneo	1	0.9%
Canada	1	0.9%
Fiji Islands	1	0.9%
Honduras	1	0.9%
Japan (Okinawa)	1	0.9%
Morocco (Benyounis)	1	0.9%
TOTAL	**28**	**24.8%**

* *Gustavia, St. Barts, Barbados, and Antigua*

The scuba deaths listed for Canada and Barbados were not U.S. citizens, but were included in this report because the dive locations are frequented by U.S. divers.

The distribution of these deaths is most likely a reflection of the popularity and frequency of diving at these locations. It is unknown to what extent the deaths may also indicate differences in dive conditions or danger at the various locations. The five deaths in the Bahamas all occurred at different sites, and the six deaths in Mexico were at three different locations in the country.

3.0 Diver Population

Table 3.1 Age and Sex Comparisons

Age Group	Number	Percent	Male	Female
10 — 19	9	7.9%	9	0
20 — 29	20	17.5%	20	0
30 — 39	32	28.1%	28	4
40 — 49	24	21.1%	21	3
50 — 59	17	14.9%	15	2
60 — 69	11	9.6%	10	1
70 — 79	1	0.9%	1	0
TOTALS	**114**	**100%**	**104**	**10**

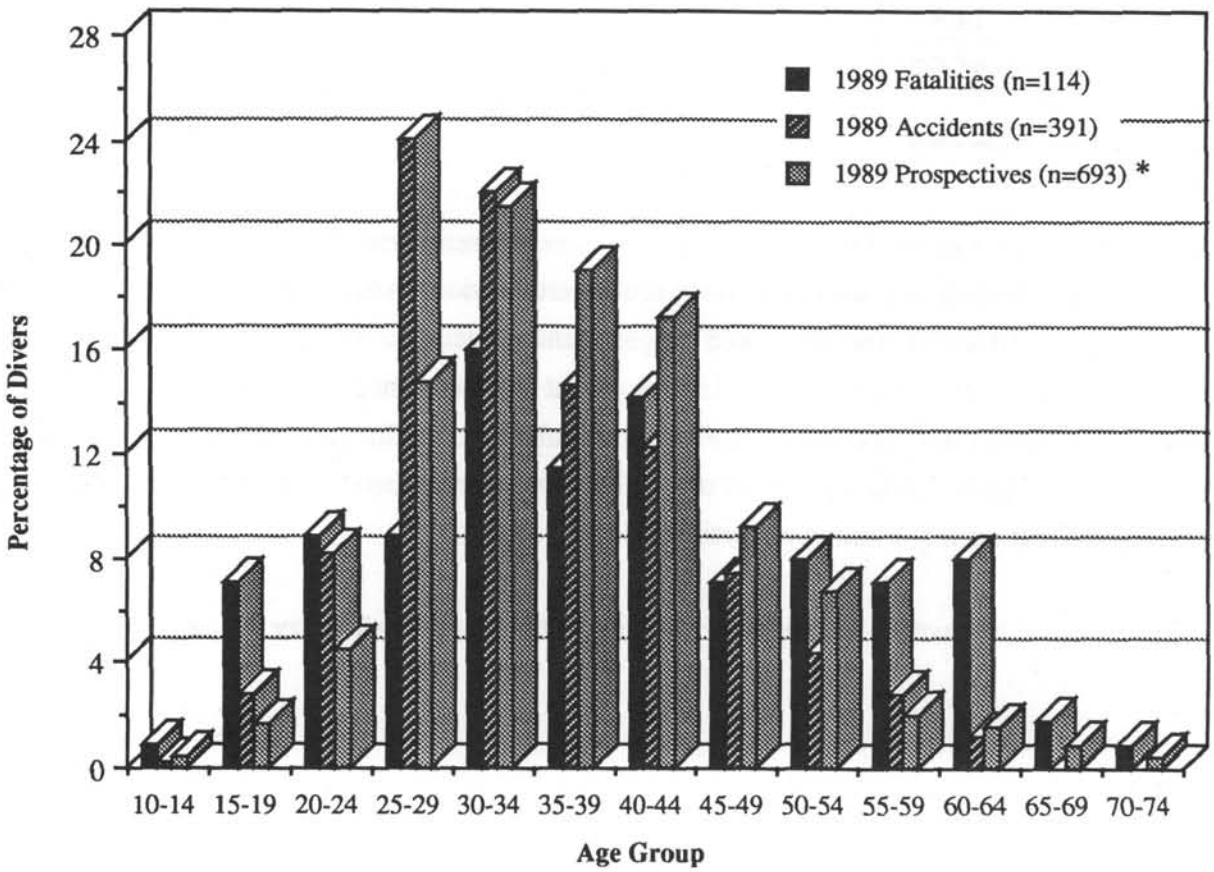
In 1989, scuba fatalities occurred among individuals ranging from 10 to 71 years of age. The age distribution is listed above.

The fatality cases were made up of 104 males and 10 females. The females represent only 8.8 percent of the total fatality group. This may indicate a greater proportion of male divers. The male-female proportion of dive fatalities contrasts to the percentage of females who experienced dive injuries requiring recompression therapy in 1987 to 1989 (24.5 percent). Additionally, a random sample of insured DAN members (n=695) revealed a female population of 27.1 percent.

Alternatively, perhaps males perform more difficult and hazardous diving, as suggested by the under-representation of female deaths in the age group 20-29. Or, perhaps the causes of death among divers were not as likely to afflict females. Females appear to be underrepresented in deaths in the age ranges of 20-29 and 60-79, however, the number of female fatalities is so small that differences in age distributions are not statistically significant. Analysis of future yearly data will provide some idea of how reliable this data is.

The activity and experience of the females also seems to have played a role in these deaths. Of the ten fatalities represented by this group, three women were receiving instruction, and another four had questionable health (including one myocardial infarction by autopsy). The three other female fatalities involved one instructor who died as the result of injuries sustained while freeing line from a boat prop; one newly certified diver; and one woman who had indicated reluctance to make the dive.

Graph 3.2 Comparison of Age Range by Percentage in Three 1989 Populations



** Two prospectives did not provide their age.*

A comparison is made of diver ages in fatalities, treated dive accidents, and a prospective study population, randomly selected from insured DAN members in 1989. The observed fatalities in the combined group of 1989 divers was higher than expected in the 20 to 24 year-old group and in the 50 to 74 year-old groups. This may be due to inexperience or inadequate physical ability in the younger group and either known or undiagnosed health problems among the older diving population. DAN's findings for 1989 fatalities clearly suggest, at least in the older population, that associated health problems such as coronary artery disease, are in part responsible for scuba deaths (table 4.2).

Table 3.3 Certification

Certified	92	80.7%
Noncertified	17	14.9%
TOTAL	**109**	**95.6%**

No information on certification levels in five divers.

Ninety-two of 114 scuba fatalities involved individuals who were currently certified. Seventeen individuals (14.9 percent) were diving without current scuba certification. Among the 17 uncertified divers, seven were under instruction, and ten lacked proper training available through scuba certifying or instructional agencies. By comparison, the 1989 accident data contained in this report, showed 95 percent of all divers had received official agency scuba certification, and five percent of injured divers were not certified. Three percent of these divers were under instruction, and two percent were diving without agency training or certification.

It would appear that lack of instruction, or improper training, is therefore a risk factor for death while scuba diving.

Table 3.4 Diving Experience

Noncertified	17	14.9%
Novice (≤ 5 dives)	16	14.0%
Inexperienced (6 — 20 dives)	34	29.8%
Intermediate (21 — 40 dives)	17	14.9%
Advanced (41 — 60 dives)	5	4.4%
Experienced (≥ 61 dives)	17	14.9%
TOTAL	**106**	**92.9%**

Eight divers missing information.

The divers level of experience, and the criteria used to establish this level of experience, is listed in table 3.4. It is difficult in fatality cases to obtain the exact number of dives and years the individual has been diving. Therefore, analysis is based upon the number of dives reported to have been made by each individual. Nearly sixty percent of all fatalities occurred in divers who made 20 dives or less in their entire dive career. Additionally, some divers in the intermediate to experienced level were infrequent divers who only used scuba once yearly.

The data at this point would seem to support the assumption that a relatively inexperienced group of divers account for the majority of scuba fatalities. However, it is possible that the greatest proportion of diving is done by divers who only take up the sport for a short period of time. Therefore, the fact that most accidents occur in inexperienced divers could be merely an artifact of that statistical distribution of divers.

4.0 Diver Health

Table 4.1 Physiological Factors

Table 4.1 lists the maximum or intended depth of the dive. All dive depths were not known and not all health factors are included. Table 6.2 contains information on the depth where specific problems occurred.

Depth	AGE*	DCS**	M.I.***	Fatigue	Panic	Injury	TOTALS
Surface			13	6	12	2	**33**
1-33 feet	2			1	5	2	**10**
34-99 feet	7				1		**8**
100-132 feet							**0**
133-165 feet		1					**1**
TOTALS	**9**	**1**	**13**	**7**	**18**	**4**	**52**

* *Arterial Gas Embolism*
** *Decompression Sickness*
*** *Myocardial Infarction*

Arterial Gas Embolism

Arterial gas embolism, or air embolism as it is commonly referred to, may be suggested in many cases, but difficult to prove when complete information is not available. When seen on autopsy, air bubbles blocking cerebral or other arterial blood flow are usually considered indicative of arterial gas embolism. The exact location of bubbles reported is necessary to determine if it played a role in the death.

Nitrogen absorbed by body tissues during scuba use can be provoked into forming bubbles when victims are brought to the surface and ambient pressure is rapidly reduced. This is especially true when victims have made long or deep dives prior to the fatal incident. This allows for the accumulation of excess nitrogen in all body tissues. A scuba diver pulled to the surface after a prolonged immersion is likely to have bubbles in the tissues, including the blood. The appearence of bubbles alone, without an account of the event, does not produce enough evidence to confirm a diagnosis of arterial gas embolism.

The most common associated event in air embolism cases is a rapid ascent causing pulmonary over-pressurization. Any activity that would interfere with a patent airway places the diver at risk for an embolic event. It is important to know what the diver was doing during the dive and the exact nature of the ascent to the surface. It is also important to know if there was a medical history of obstructive or restrictive airway disease. Autopsy reports are also reviewed for evidence of respiratory disease. Illnesses such as pneumonia, emphysema, and asthma could potentially block the free flow of air out of the lung and trap small volumes of expanding gas in lung alveoli. There were no known asthmatics in the 1989 fatalities, but there was one individual with emphysema by history and autopsy report. Medical histories remain difficult to obtain, and it is possible that the underrepresentation of asthmatics among the fatalites is an artifact of incomplete data collection. Efforts are increasing to achieve more thorough histories on each fatality.

Air embolism (AGE) is listed as the cause of death for nine divers, and as a possible cause of death for three other divers. Where it was possible, three factors were considered in order to arrive at the diagnosis of air embolism:

1. An eyewitness account of the dive.
2. A knowledge of any symptoms following the dive.
3. Autopsy results listing cerebral air bubbles.

In five cases, these three factors were met. Accounts of the five dives revealed rapid ascents from 24, 25, 40, and 40 feet, and one breathhold ascent from 35 feet. Upon reaching the surface, all were unconscious, and two were bleeding from the mouth. Autopsy findings revealed cerebral air bubbles in all five instances with two reports of subcutaneous emphysema.

Four cases did not contain enough information for the above criteria to be complete. However, the sequence of events provided a strong case for the diagnosis of air embolism. The following is a summary of information in these four cases:

• 38 year-old male diver was diving at a depth of 50 feet, was caught in an upcurrent and shot rapidly to the surface. The diver was recovered immediately and was found to be unconscious. There was no pulse or heartbeat, and the victim could not be revived with CPR.

• 68 year-old male diver was diving alone with a topside observer. An observer stated that the diver surfaced after having dived for approximately 45 minutes at a depth of about 40 feet. The diver surfaced, hung onto a rock, and immediately began yelling for help. He then collapsed after a

minute or two. The medical examiner reported "cerebral bubbles and columns of gas" and diagnosed "apparent air embolization versus possible drowning." An examination of the equipment revealed 700 psi in the tank, and the tank contained some water. This may have interfered with the proper functioning of the regulator, compromising the diver's ability to breath from the tank in cold water, possibly resulting in an inadvertant breath hold during ascent.

••41 year-old male diver was diving with a buddy at night. They were at a depth of 40 feet with rough water above and below the surface. The buddies separated, and subject was found six hours later near the shore in five feet of water. The diver was wearing twin air tanks, but a tank pressure reading was not obtained. The coroner reported, "systemic air embolism as a consequence of pulmonary barotrauma after an apparent rapid ascent." This is a typical case where there simply isn't enough evidence to determine if the victim embolized sometime during the ascent from the dive or simply ran out of air. Trans-pulmonary passage of air into the arterial tree could have occurred during recovery of the victim from a shallow depth.

••32 year-old male diver became trapped at 85 feet in a cave. He was recovered after one-and-a-half hours. When discovered, the diver was not wearing his face mask or tank; his tank pressure was 800 psi. The autopsy disclosed "air within vascular channels," and the medical examiner diagnosed "air embolization." However, the time to recovery of the body and the fact that the autopsy report does not specify the location of the air bubbles makes it difficult to draw a firm conclusion of air embolism.

Air embolism is considered a possible cause of death in three cases:

••62 year-old female diver, off the coast of Belize, came out of the water in distress and then collapsed. A U.S. Embassy official confirmed that she died in an island medical clinic. The reported cause of death was pulmonary embolism, but no autopsy results were available.

••38 year-old diver is thought to have died as a result of a strong up-current causing a rapid ascent from 30 feet. The diver was recovered immediately. Although little is known about this diver, autopsy findings of "small bubbles in the meningeal vessels" lends support to air embolism in this case.

••19 year-old diver ran out of air at 90 feet. The diver made a normal ascent to 30 feet, panicked, then sank to the bottom. The body was found one hour later at 100 feet. The medical examiner's report listed "systemic air embolus due to barotrauma as a consequence of rapid ascent while scuba diving" as the cause of death.

Decompression Sickness

A medical examiner's report listed one death as decompression sickness (DCS). Autopsy evidence also suggested some pulmonary over-expansion injury. This 33-year-old male diver died during re-compression therapy, so direct evidence of bubbles may have been eliminated. The diver had a history of DCS on several occasions with various symptoms including: episodes of paralysis, incoordination, speech, and visual problems.

Injury

Four deaths resulted from injury other than DCS or air embolism, and all four incidents involved a boat. A buddy team surfaced into a boat propeller killing both divers. A boat propeller also killed a female diver who was freeing a tangled line around the propeller shaft. One diver was struck by a speeding boat and died.

Myocardial Infarction

Myocardial Infarction (M.I.) was the listed cause of death on the medical examiner's report in five cases. However, a higher incidence of myocardial infarction is suggested by the case information. In four cases where the sequence of events seem to indicate a myocardial infarction, asphyxia due to drowning is the stated cause of death. Eyewitness accounts, family interviews, and local contacts provide the evidence for four more apparent myocardial infarctions. Overall, there were thirteen divers suspected of having experienced a myocardial infarction. This figure represents 11.4 percent of the total fatality population.

All 13 myocardial infarctions occurred on the surface, three just prior to the dive, and the remaining ten post-dive before they could exit the water or within minutes of surfacing. The diagnosis of myocardial infarction is supported by medical fact in nine of these cases (autopsies revealed evidence of coronary artery disease in these nine cases). The other four cases of myocardial infarction rely on information obtained through witness accounts of the dive and through family interviews revealing previous medical problems. The following is a summary of information in these four cases:

- 51 year-old male diver was very experienced, and reportedly very fit. He complained of chest pain and shortness of breath on the surface prior to making the first dive of the day. He was seen hanging onto the anchor line prior to descent. The diver had a known medical history of hyperuricemia two years previous, but this is not considered a contributing factor in his death.

• 62 year-old male diver was experienced and had no past medical history. Ten minutes into the dive, the diver signaled to his buddy that he wished to surface. After a normal ascent, he went to the anchor line and then collapsed. CPR was ineffective.

• 63 year-old male diver was on the surface following an uneventful dive. He was talking comfortably with his buddy on the surface when he suddenly collapsed. The diver was revived with CPR, and said, "That was close, I felt like I had a heart attack or something." He then collapsed again without warning. Attempts at resuscitation were not successful.

• 62 year-old male diver had a history of "weakness in the legs after diving or exertion," The diver left the dive group early, after only seven minutes, and was observed making a normal ascent from 65 feet to the surface. On the surface, the diver lost consciousness and was brought aboard immediately by the boat captain, who tried unsuccessfully to revive him with CPR.

In only three of thirteen myocardial infarction cases was the medical condition diagnosed prior to the dive. In seven of the myocardial infarction cases, the medical condition was not diagnosed prior to the dive. One diver had a history of high blood cholesterol, one diver had a history of leg weakness during dives, and there is no known medical history on another diver.

Age Group Analysis

Twelve out of the 13 suspected myocardial infarctions occurred among divers in the 50 or older age group. Only one was younger than 50 years of age (48 years). The 50 or older age group comprises 29 fatalities (25 percent) of the total 114. Forty-one percent of individuals within this 50 or older age group experienced a myocardial infarction.

Table 4.2 Age Group Analysis

Ages*	Number	Heart**	Tumor	Emphysema	Dystrophy	Epilepsy	TOTALS
20 — 49	76	4	1		1	1	7
50 — 71	29	16		1			17
TOTALS	**105**	**20**	**1**	**1**	**1**	**1**	**24**

* *There were no known medical conditions for the nine persons in the 10 to 19 year-old group.*

** *Coronary Artery Disease*

As stated previously, it is difficult to obtain medical histories of fatalities. From the information collected, 24 divers (21 percent) had a medical condition. Nineteen of these medical conditions are supported by eyewitness accounts and family interviews.

By Age Group

In the ≥ 50 year old age group, there are 17 out of a population of 29 (or 59 percent) with known or suspected medical conditions. Out of these 17 medical conditions, 12 are supported by medical examiner findings or clinical histories. The following is a listing of the 12 documented conditions:

- 50 year-old female with a history of high serum cholesterol, and evidence of "small infarcts of the lower IV septum of the myocardium, old and fresh" on autopsy.

- 50 year-old male with evidence of "complete occlusion of the left anterior descending coronary artery" on autopsy.

- 62 year-old male with a history of high serum cholesterol, "80 percent occlusion of a coronary artery" per cardiac catheterization results, and a "silent myocardial infarction" per routine ECG.

- 56 year-old male with evidence of "irregular dilatation of the alveoli with focal interstitial fibrosis" (emphysema) on autopsy.

- 55 year-old male with evidence of "coronary artery disease" on autopsy.

- 57 year-old male with a history of triple bypass surgery performed five months prior to death. The body was not recovered.

- 60 year-old male with a history of hypertension over the past six years.

- 52 year-old male with a history of hypertension, and evidence of both cardiovascular and cerebrovascular disease on autopsy (cardiomegaly with biventricular hypertrophy, intracerebral, and recent subarachnoidal hemorrhages).

- 58 year-old female with evidence of "congestive heart failure" on autopsy.

- 62 year-old male with evidence of "massive myocardial infarction" on autopsy.

- 71 year-old male with evidence of "severe aortic atherosclerosis" on autopsy.

- 54 year-old male with evidence of "80 percent occlusion of a coronary artery" on autopsy.

The five undocumented medical conditions in the ≥ 50 year old age group follow. They are the same cases as those listed in the myocardial infarction population with the addition of one case:

- 51 year-old male was visibly fatigued and required flotation assistance at the surface. Buddy observed that subject was struggling and clinging with one arm to an inner tube. Before his buddy could reach him, subject collapsed facedown in the water.

All seven medical conditions in the 20 to 49 year-old age group are supported by medical documentation, phone interview, or investigators' report.

The seven documented medical conditions in the 20 to 49 year-old age group are as follows: coronary artery disease (4), brain tumor (1), mild muscular dystrophy (1), and epilepsy (no history available) (1).

5.0 Dive Profile

Table 5.1 Dive Activity

Sightseeing	70	61.4%
Under Instruction	12	10.5%
Cave Diving	10	8.8%
Spearfishing/Game Collecting	9	7.9%
Work/Task	6	5.3%
Wreck Diving	6	5.3%
Night Dive*	5	4.4%
Ice Diving**	2	1.8%
Photography	1	0.9%
TOTAL	**121**	**106.3%**

* *Four night dives were also sightseeing dives, and one was also a work/task dive.*

** *One ice dive was also a photography dive, and one was also a sightseeing dive.*

Seven divers were involved in more than one dive activity at the time of their death which is reflected in the total of 121 activities.

Over 60 percent of dive fatalities occurred while the diver was sightseeing. One cannot infer from the number of pleasure or sightseeing dives that it carries any higher risk for the diver than any other style of diving. Since sightseeing or pleasure diving is by far the most popular single activity while scuba diving, it is within reason that most fatalities would occur during this activity.

Divers who were under instruction was the next most common activity and involved 12 deaths. Four different areas of being under instruction were identified in these 12 fatalities. Six of these 12 deaths occurred in divers who were seeking their initial scuba certification. Three more deaths occurred in certified divers who were under instruction for advanced certification, such as divemaster or advanced diver. There were two fatalities in certified divers that were very inexperienced and were participating in a guided scuba activity for inexperienced divers in the Caribbean. Another fatality occurred in a certified diver who was being trained in the use of a dry suit.

There were ten cave diving fatalities, which was the third most common activity among the 1989 fatality population. As in most previous years, none of the individuals who died while cave diving in 1989 had received specialty training. Wreck and ice diving pose risks similar to cave diving. There is always a danger of entrapment and losing one's way, once structures have been penetrated and visual landmarks are lost. Even brief excursions into enclosed underwater structures pose a greater risk of death, and therefore require a minimum of safety equipment such as a compass, safety lines, a secondary air source, extra lights, and a knife, in addition to the normal scuba equipment.

Spearfishing was involved in nine deaths. Like scuba itself, spearfishing holds a certain allure for divers. Three of these nine divers had 12 or more years of diving experience. Four divers were relatively inexperienced, one was not certified, and another had unknown certification. The skill of spearfishing involves not only the accuracy of shooting fish, but maintaining an open airway while making multiple excursions up, down, and along the contour of the ocean bottom. Attention must also be paid to depth and pressure gauges to prevent excessive depth and running out of air. Managing the additional equipment of a spear gun and game collection bag or fish stringer are also of concern. The bodies of two spear fisherman were never recovered, and one was recovered two days after being reported missing, having sustained shark trauma apparently post-mortem.

Table 5.2 Dive Platform

Entry	Frequency	Percent
Shore	28	24.6
M/V* Private	39	34.2
M/V Charter	45	39.5
Pool	2	1.8
TOTAL	**114**	**100.0**

**Motor Vessel*

It is difficult to interpret the dive platform data. There is no record of how many private or charter (for hire) dive vessels operate in the U.S. However, it would seem logical that more dives are conducted from charter than from private dive vessels. If the latter is true, then the private dive vessels would seem to have a disproportionate share of the diving fatalities when compared to the charter vessels.

Table 5.3 Number of Divers in a Group

# In Dive Group	Frequency	Percent
Solo Diving	12	10.5%
2	30	26.3%
3	15	13.2%
4	10	8.8%
5	7	6.1%
6	10	8.8%
7	6	5.3%
8	14	12.3%
9	3	2.6%
10 or more	6	5.3%
TOTAL	**113**	**99.2%**

One diver missing information.

This table shows the number of divers that were at the scene when the fatality occurred. Diving alone is not recommended by any of the certifying agencies, yet 10.5 percent of fatalities occurred in lone divers. Most of the divers chose to dive in a buddy team to:

1. Share the underwater experience or work together on a specific dive project;
2. Provide an experienced dive partner for less experienced divers;
3. Provide for safety-assistance when the unexpected occurs.

When only a few divers (2 to 4) participate in any dive activity, the likelihood of immediate assistance and recovery is reduced when an emergency or unexpected event occurs. The 1989 fatality data indicate that 59 percent of all fatalities occurred in groups of four divers or less. This may have been due to the lack of immediate assistance, or that divers at higher risk tend to dive with others who have similar diving habits.

Table 5.4 Effective Dive Buddy Teams

Buddy — Yes	85	74.6%
Buddy — No	27	23.7%
Two Buddies	6	5.3%
More Than Two Buddies	3	2.6%

Two divers missing information.

Twelve divers started their dive alone, however, table 5.4 shows that a total of 27 divers did not use the buddy system during their dive. Additional information regarding the overall effectiveness or ineffectiveness of the buddy system is gained from reviewing eyewitness statements and investigation agency reports. Sixty-four of all fatalities were not directly observed by the dive buddy or anyone at the surface. Moreover, in 16 instances where the buddy system was reportedly practiced, the buddies became separated.

6.0 Characteristics of Fatalities

The time and phase of the dive that the fatal accident occurred is listed below. These times are fairly evenly divided with the exception of post-dive fatalities. The post-dive fatalities contain thirteen deaths listed as myocardial infarction. Exact times of dives are often difficult to obtain. When the event went unobserved, the last sighting of the diver, and the scheduled time the dive was to end, have been used as a guide for the phase of the dive and when the event occurred.

Table 6.1 When Problem Occurred

Immediately	21
5 – 10 Minutes	23
Mid-Dive	26
Late-Dive	25
Post-Dive	16
TOTAL	**111**

During Descent	9
At Depth	42
During Ascent	12
On the Surface	35
Cave/Wreck	11
Under Ice	2
TOTAL	**111**

Three divers missing information.

There are a number of conditions in scuba diving that make it inherently dangerous without training, proper skill, and supervision. These conditions can occur at any depth regardless of what specific activity a diver is participating in. It is clear from table 6.2 that there is no single cause for fatalities or any certain depth at which they occur. It has already been noted that all cardiac deaths occurred at the surface, and this is the single exception in the table.

There were six cases where diver equipment was a problem. Equipment failure is believed to have possibly caused the death of two individuals. One fatality occurred because a free-flowing regulator caused panic and a rapid ascent in an adolescent. The other death may have been caused by the powerband breaking when the diver retracted it to load the speargun.

Equipment can be a factor in accidents even when there is no failure involved. Divers were reported to have not been familiar with the equipment they were using in seven cases. In six other cases divers knew they were using at least one piece of faulty equipment. Five divers were reported to be overweighted with 24 to 54 pounds of weight. One can only say that these circumstances most likely contributed to the events in the diver deaths and may have hampered self-rescue. They did not directly cause the deaths.

Table 6.2 What Problem Occurred Where*

Depth	#	MI	AGE	DCS	Injury	Fatigue	Panic	Entangle	Trapped	Rough Water	Low/Out Air	Equip.
Surface	35	13			2	6	12			1		
1–5	7				2		3	2				
6–20	13					1	2	2	1	2		2
21–33	10		2				1	1	2	1	1	2
34–66	18		7				1	1	7	2		
67–99	17						1		2	2	8	1
100–132	5								3		2	
133–165	2			1							1	
166–198	0											
199–231	0											
232+	3									1		
Unknown	4											1
TOTALS	**114**	**13**	**9**	**1**	**4**	**7**	**20**	**6**	**15**	**9**	**12**	**6**

** This table has the primary problem counted only. No factor is counted twice.*

The number of cases with successful CPR is not recorded by any agency. There are no valid numbers for a comparison between near drowning victims who received CPR and survived, and scuba diving fatalities where CPR was not effective. There is strong evidence in the general drowning literature to indicate that survivability is a function of the length of time it takes to establish a patent airway and effective CPR is begun. The shorter the underwater, non-breathing interval, the better the chance of survival. We know that scuba has two distinct disadvantages which prolong the interval after the event and delay immediate rescue. First, special equipment is required to perform in the underwater environment. This is especially true when depth is a factor in a rescue. Second, the event is often unobserved, and the time to recovery is increased.

Much of recreational diving is done in the oceans and at sites distant to emergency medical care. The need for such care is just as urgent in diving accidents as it is for any other land-based injury. Unfortunately, by the above definition, urgently needed care will be further delayed by distance. Not all divers know CPR or could perform it, in the event it is needed. Despite the best efforts of

U.S. Coast Guard assistance and medical evacuation, there is no guarantee of a successful outcome given the nature of injuries associated with scuba fatalities and the long distances which commonly have to be traveled.

Table 6.3 Diver Recovery and Rescue

Time to Recovery	Number	Yes (CPR)	No	USCG* Assisted	Medivac
0 – 5 Minutes	39	39		4	4
10 Minutes	12	12		4	5
20 Minutes	8	8		2	2
30 Minutes	4	4		1	1
40 Minutes	3	2	1		
50 Minutes	2	2		1	
1 Hour	2		2	1	
2 Hours	9	1	8	1	
5 Hours	12		12	1	
1 Day	7		7		
5 Days	2		2		
Body Not Found	10		10	3	
TOTALS	**110**	**68**	**42**	**18**	**12**

Four divers missing information.

**U.S. Coast Guard*

7.0 Fatality Information Analysis

Table 7.1 Primary Information Source

Autopsy and Investigative Report	27
Autopsy and Witness or Family Interview	9
Autopsy	18
Physician Summary or Death Certificate	14
Eyewitness Statement	20
Investigative Report	18
News Clipping	8
TOTAL	**114**

The primary source of information generally gave a description of the events surrounding the fatality and associated data. Overall, reliable information was available in 93 percent of the cases. The best and most reliable data was obtained when an autopsy and police or sheriffs' report were available. Both reports were available almost 24 percent of the time. The autopsy report was sent to DAN in 51 percent of all cases where autopsy results were accessible. Ten bodies were never recovered, and no autopsy was performed in at least seven other cases. Autopsy information was refused in four cases. Autopsy reports were not always needed because a great deal of information was contained in a physician summary or investigative report. The least reliable data came from news clippings as they did not contain enough precise information, and they could not be substantiated with a second source. All other primary sources had at least one of the other sources of information.

A problem DAN has identified in collecting data is the lack of adequate medical histories in diver deaths. This is one of the most valuable sources of diver information. It is important to get adequate medical records to identify known and as yet unknown health risks that may contribute to diver deaths. Only two medical histories were able to be reviewed for possible contributing medical problems for the 1989 fatalities.

Autopsy information can give some indication of current health. For instance two divers had cannabinoids in their system, one diver had cocaine metabolites, and one diver was legally drunk. Two other divers were on antidepressants at the time they died, with one of them also taking amphetamines, and an anti-seizure medication. Other medications known to cause malignant dysrhythmias in combination with alcohol are not commonly tested for.

Fatality Summary

Intitial analysis of these preliminary data for the first year of collection suggest that more in-depth information is needed on a case by case basis for accurate and consistent reporting. The data does suggest several possible hypotheses for the cause of some of these deaths.

1. A disproportionate number of these deaths may be caused by medical conditions, such as coronary artery disease, especially in the older male population.

2. The lack of scuba certification by a recognized training agency appears to lead to a high probability for death.

3. Diving alone or without the benefit of a dive buddy during scuba activity decreases the chance for survival when an unexpected underwater event occurs and assistance is required.

In future reports, DAN will continue to look very closely at these hypotheses and other questions that may come from fatality reporting and analysis.

8.0 Introduction to Dive Accidents

Divers Alert Network (DAN) celebrated its tenth anniversary in 1990. DAN's mission has evolved from its original purpose of assisting injured divers, to compiling and analyzing diving statistics in order to learn more about what causes diving accidents and how to prevent them. 1989 proved to be the most fruitful year in terms of information gathering. Five hundred and sixty cases were received for analysis by DAN. Divers Alert Network receives accident reporting forms from two main sources: hyperbaric treatment facilities and injured divers. Most of the reports received by DAN involve Americans or citizens of other countries diving in locations that Americans frequent, however, reports are received from various places around the world. A copy of the *DAN Dive Accident Reporting Form* and *DAN Fatality Worksheet* are provided in appendices A and B.

Accident forms received by DAN are reviewed by medical personnel for completeness and consistency. They are then followed up for a maximum period of three months or until residual symptoms are resolved. The completed record is then entered into the *DAN Diving Accident Database* and analyzed. Appendix C has a list of severity codes DAN uses to classify symptoms.

There were 678 cases reported treated in 1989 compared to 553 in 1988. This represents a 23 percent increase in reported treatments for 1989. This increase is consistent with the increases reported by some regions of the country. The majority of the increased treatments have come from popular dive regions which have been well reported in past years. The southwest DAN region containing California reported an increase of 77 percent in cases treated. The southeast DAN region with Florida had a 14 percent increase in treatments, and the Caribbean basin reported a 26 percent increase in total cases treated. Also, Hawaii reported an overall increase of 61 percent in 1989. It is apparent that these areas represent some of the most popular dive locations in the northern hemisphere. This increase may represent the increasing popularity of scuba, or that more diving is occurring at these popular locations.

General Information

The collection of injury statistics presented in the *1989 Report on Diving Accidents and Fatalities* attempts to shed light on the often uncertain causes of scuba diving related injury and death. DAN uses this yearly report in addition to articles and seminars throughout the year to educate the diving public. It is DAN's hope that increased education will lead to increased diving safety awareness.

Research and education are key to preventing diving accidents. With this in mind, DAN is expanding its services to better serve the diver. DAN has made its hotline more accessible, trained more medical staff to answer non-emergency questions, enlarged its educational programs, and stepped up its research efforts to make diving as safe as possible.

Technical Information

In 1989, DAN collected information on 560 injured divers. From these divers, 391 accident forms were completed and verified. These completed reports were used as the basis for this 1989 annual report. The *DAN Dive Accident Reporting Form* has 71 different questions, and includes such information as age, sex, dive profile, level of certification, and current health. DAN has looked for significant correlations between these data, and common statistical terms are used to describe the central tendencies of our sample population, in this case, injured divers.

In some tables, the total doesn't equal the sample population of 391 for 1989. This is because divers fill out their own form. On some questions they might not remember what they did pre-dive, and thus would leave it blank. This creates what is called a "null field" in the database and is responsible for the "no response" or "frequency missing" footnote. However, DAN has endeavored to follow up as completely as possible with each diver.

9.0 Diver Characteristics

This section lists epidemiological information on the population of injured divers. As of yet, we can not compare injured divers to a normal population. Future studies will give us this capability. For now, however, these are known characteristics for the data on injured scuba divers.

Age

The mean age of 1989 injured divers was 34 years, with the range being 13-63 and the median being 33. Numerically there was an increase in every age category except the 10-14 year-olds. Percentagewise, only the 15-19 and the 55-59 year-old age groups showed a notable increase from the 1988 figures. The 15-19 year-olds nearly doubled while the 55-59 year-olds quadrupled. The 25-29 year-olds and the 30-34 year-olds represented 46 percent of the entire injured population. Table 9.1 lists the age distribution.

Table 9.1 Age Distribution of 1989 Accident Cases

Age	Frequency	Percent	Males	Females
10-14	1	0.3	1	0
15-19	11	2.8	8	3
20-24	32	8.2	22	10
25-29	94	24.0	71	23
30-34	86	22.0	64	22
35-39	57	14.6	45	12
40-44	48	12.3	34	14
45-49	29	7.4	20	9
50-54	17	4.3	10	7
55-59	11	2.8	9	2
60-64	5	1.3	5	0
TOTALS	**391**	**100.0**	**289**	**102**

Sex

In 1989, women had 26 percent of the total diving accidents, however, the number of women who were injured rose from 58 in 1988 to 102 in 1989, which is almost double the number from 1988. Yet, the actual percentage increase from 1988 is 4 percent. This slight increase may be due to better

accident collection and follow-up, or perhaps that more women are now diving. Table 9.2 shows the gender of the 1989 diving injuries.

Table 9.2 Sex of 1989 Accident Cases

Sex	Frequency	Percent
Female Divers	102	26.1
Male Divers	289	73.9
TOTAL	**391**	**100.0**

Certification Level

Fifty-two percent of the 1989 divers held beginning level certification or were in the process of being certified (student, basic, or open water). Forty-five percent were trained at advanced levels with three percent listing other or unknown, as shown in table 9.3. It should be noted that the diver listing commercial certification was diving recreationally at the time of his injury.

Table 9.3 Certification Level of 1989 Accident Cases

Certification	Male	Female	Totals	Percent
Student	6	6	12	3.07
Basic	22	8	30	7.67
Open Water	115	47	162	41.43
Advanced	81	28	109	27.88
Divemaster	22	2	24	6.14
Instructor	32	9	41	10.49
Commercial	1	0	1	0.26
Other	4	2	6	1.53
Unknown	6	0	6	1.53
TOTALS	**289**	**102**	**391**	**100.00**

Table 9.4 Diver Experience by Sex

Male	Total Dives							
Years Diving	0-20	21-40	41-60	61-80	81-100	101-120	120+	TOTALS
0-1	19	8	4	5	0	0	1	37
2-3	5	5	12	3	5	1	6	37
4-5	3	7	3	4	7	1	17	42
6-7	0	0	3	1	1	0	13	18
8-9	1	2	0	1	1	0	13	18
10-11	0	1	0	0	1	0	19	21
12-13	1	1	0	0	2	0	15	19
14-15	0	0	1	1	0	0	12	14
16-17	0	0	1	1	0	1	5	8
18-19	0	0	0	0	0	0	9	9
20+	1	0	1	0	1	0	24	27
TOTALS	30	24	25	16	18	3	134	250

Frequency missing = 39

Female								
0-1	13	6	2	0	0	0	0	21
2-3	3	9	0	0	3	0	6	21
4-5	2	1	2	0	3	1	2	11
6-7	0	0	0	0	0	0	1	1
8-9	0	0	1	0	0	0	7	8
10-11	1	0	0	0	0	0	2	3
12-13	0	0	0	0	0	0	1	1
14-15	0	0	0	0	0	0	2	2
16-17	0	0	0	0	0	0	0	0
18-19	0	0	0	0	0	0	1	1
20+	0	0	0	0	0	0	1	1
TOTALS	19	16	5	0	6	1	23	70

Frequency missing = 32

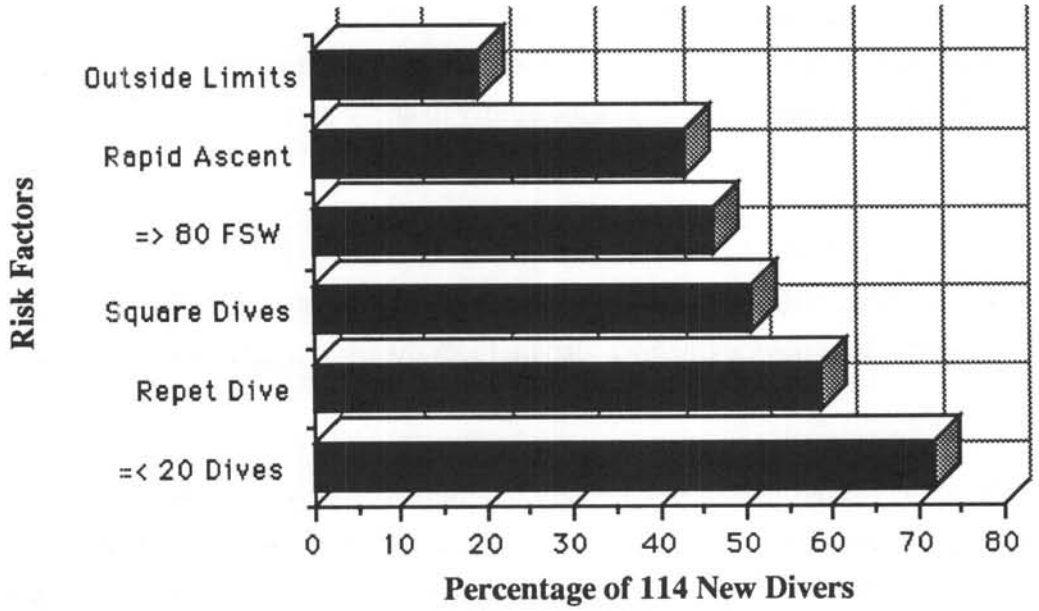
Experience

There is not necessarily a correlation between the number of years diving and individual experience. Although a diver might have been certified for 10 years, they could have made 20 dives or just two dives per year. A diver may make more than 20 dives in their first year, but this doesn't mean they are experienced. The essential quality of experience is the ability to apply previously learned skills to new underwater situations.

For the purpose of research, we have established a minimum level of experience as two years of diving *and* more than 20 total dives. That is, if a diver has made twenty dives or less, they are placed into the novice category. This novice category also includes divers with less than two years of diving experience.

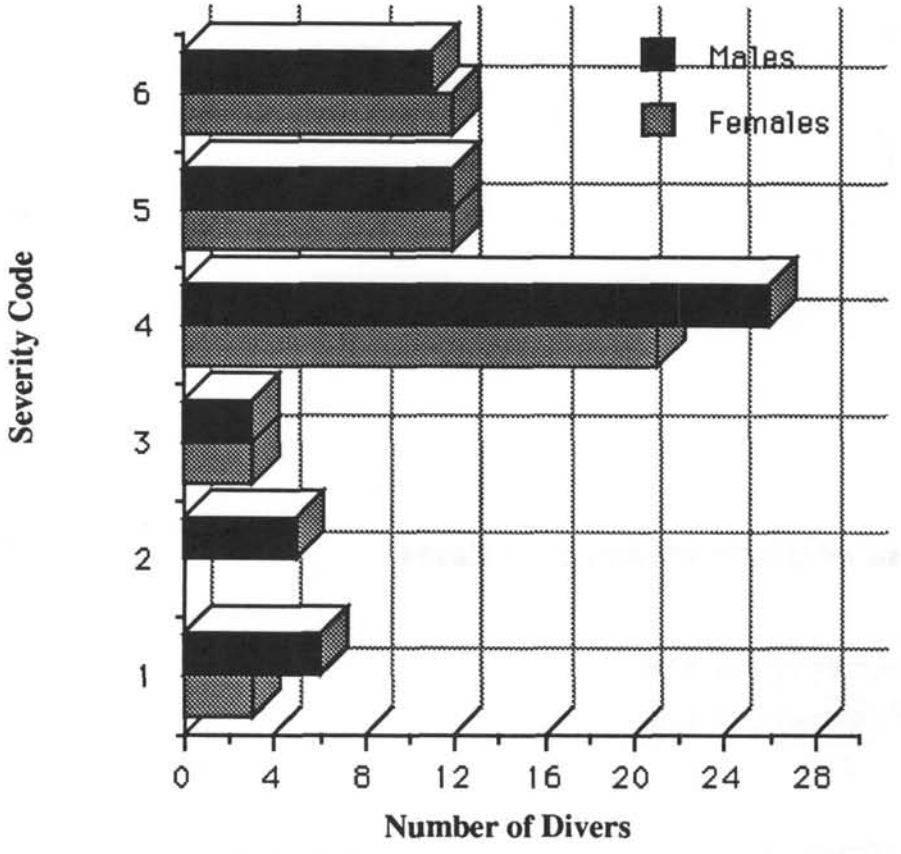
Thirty-three percent (129 of 391) of the 1989 injured divers fall into this category. Eighty-four percent (31 of 37) of the divers with buoyancy control problems fall into this category of novice diver. Fifty-two percent (13 of 25) of the out-of-air situations and 53 percent (60 of 114) of the rapid ascents were also associated with novice divers. Table 9.4 gives the number of dives by sex and years diving.

Graph 9.5 New Diver Profile Traits



In the 1989 data set, 114 divers had less than two years of diving experience. Of the 114 divers, 72 percent (82 of 114) had made 20 dives or less. Fifty-nine percent of the 114 were doing repetitive diving, and 51 percent were doing square dives. Forty-six percent (53 of 114) of the new divers were diving at eighty feet or deeper. Of the 114 new divers, 43 percent had a rapid ascent. Graph 9.5 shows the character traits of diving being done by new divers on the dive they were injured. The extent to which these traits contributed to their lack of experience is not known, but similar traits are found in more experienced divers.

Graph 9.6 New Divers With Less than Two Years of Experience



For Severity Code see appendix C.

Eighty-two percent of the 114 new divers had a severity code of 4 or greater. Codes 4, 5, and 6 represent the most severe symptoms. These codes are used to indicate probable spinal cord DCS. Graph 9.6 shows the severity code of the 114 new divers by male and female. Appendix C has a listing of DAN's severity coding system.

Fitness to Dive

Physical fitness is reported by the individual diver. Of the 391 injured divers in 1989, 360 replied they were fit and 29 replied they weren't fit. Table 9.7 shows the breakdown by sex. Additionally, 65 percent of males (188 of 289) and 74 percent of females (75 of 102) stated that they exercised weekly.

Table 9.7 Physical Fitness* of the 1989 Accident Cases

Sex	Fit	Not Fit
Male	270	19
Female	90	10
TOTALS	**360**	**29**

**As reported by diver.*
No response = 2

Table 9.8 Medication Use of the 1989 Accident Cases

Prescription Use		Nonprescription Use	
Frequency	Percent	Frequency	Percent
93	25	25	8

No Response = 17 *No Response = 66*

Of the 391 injured divers, 25 percent (93 of 374) indicated that they were taking a prescription drug at the time of their accident. Eight percent (25 of 325) responded that they were using a non-prescription drug. Table 9.8 shows the frequency of medication use. Frequently used nonprescription medications were decongestants for ears or sinuses, and antihistamines to prevent seasickness.

Table 9.9 Current* Medical History by Disease Severity Code**

	Severity						
Frequency	**1**	**2**	**3**	**4**	**5**	**6**	**TOTALS**
Chest-lung	0	0	1	3	2	3	**9**
Asthma	0	0	0	3	3	0	**6**
Chest-heart	1	1	0	3	1	2	**8**
GI/Abdomen	1	1	1	5	1	0	**9**
Spine/Back	2	2	2	10	5	2	**23**
Limb/joint DCS	0	0	0	1	0	0	**1**
Circulation	1	0	0	1	1	0	**3**
Neurologic	0	0	0	3	0	0	**3**
Musculoskeletal	2	5	1	3	2	1	**14**
Eye	0	1	0	1	1	0	**3**
Emotional	0	1	0	2	3	0	**6**
Other	0	5	4	11	14	5	**39**
None	40	31	17	102	58	34	**282**
TOTALS	**47**	**47**	**26**	**148**	**91**	**47**	**406***

* *A person may suffer from more than one concurrent problem.*

** *For Disease Severity Code see appendix C.*

Twenty-three people listed that they had a problem with their back or spine within two months of their accident. Preliminary research is being done to try and establish whether or not a history of back or spinal problems is a consideration in susceptibility to spinal cord DCS. Fourteen people listed a problem with their musculoskeletal system within the past two months and nine people listed a problem with their gastrointestinal tract or abdomen. Diving with current symptomatic health problems and the occurrence of familiar post-dive symptoms may be confused by the diver or diagnostician for decompression sickness or another illness. Seventy-two percent of all divers were diving without a recent health problem. Table 9.9 lists medical problems within two months of the injury.

Table 9.10 Past* Health Illness by Disease Severity Code

	Severity						
Frequency	**1**	**2**	**3**	**4**	**5**	**6**	**TOTALS**
Chest-lung	1	2	1	4	0	6	**14**
Asthma	1	0	0	11	4	0	**16**
Chest-heart	1	2	0	4	2	2	**11**
GI/Abdomen	7	8	3	17	5	5	**45**
Brain	0	0	0	1	1	0	**2**
Spine/Back	5	3	2	17	9	3	**39**
Limb/joint DCS	1	1	1	4	1	0	**8**
Circulation	1	0	0	0	4	1	**6**
Neurologic	0	1	0	1	0	1	**3**
Musculoskeletal	7	8	2	16	14	3	**50**
Eye	0	1	0	4	2	1	**8**
Emotional	1	1	0	0	1	0	**3**
Other	7	14	5	21	20	4	**71**
None	22	15	13	63	43	28	**184**
TOTALS	**54**	**56**	**27**	**163**	**106**	**54**	**460***

**A person can have more than one concurrent illness.*

Fifty people listed that they had problems with their musculoskeletal system in the past (more than two months previously). Forty-five listed a problem with their gastrointestinal tract or abdomen, and thirty-nine listed a problem with their spine or back. Table 9.10 shows past illnesses by severity.

Table 9.11 Alcohol Use of 1989 Accident Cases

Time of use	Number of divers
Night before	160
Pre-dive	7
Between dives	9
Post-dive	61
None	189
TOTAL	**426***

** Some divers engage in drinking in more than one category.*

Fifty-two percent of the injured divers reported having imbibed alcohol at some time within twenty-four hours of their dive. Table 9.11 shows when the alcohol was consumed. No differentiation is made for the number of drinks a diver may have had.

Table 9.12 Pre-dive Alcohol Use of 1989 Accident Cases

	# of Drinks							
Severity	**1**	**2**	**3**	**4**	**5**	**6**	**>=7**	**TOTALS**
1	5	7	3	3	1			**19**
2	4	3	3	3		2	1	**16**
3	1	4		1		2		**8**
4	18	12	7	7	5	3	5	**57**
5	8	14	6	5		4	3	**40**
6	3	9	5	4		2	1	**24**
TOTALS	**39**	**49**	**24**	**23**	**6**	**13**	**10**	**164***

** Refers to last episode of drinking.*

Table 9.12 shows more alcohol use among the higher severity codes.

Table 9.13 Smoking History of 1989 Accident Cases

Smoke	Frequency	Percent
Present	60	15.3%
In Past	97	24.8%
Never	234	59.8%
TOTAL	**391**	**100.0%**

Table 9.13 indicates that close to 60 percent of the 1989 accident population had never smoked in their life. Almost 25 percent had smoked in the past, and 15 percent presently smoke. It is difficult to determine what role, if any, smoking had in these cases.

Table 9.14 Nausea, Hangover, Diarrhea, and Recreational Drug Use

Sex	Nausea	Hangover	Diarrhea	Drug Use
Male	9	4	10	5
Female	8	4	3	1
TOTALS	**17**	**8**	**13**	**6**

Frequency missing = 7

Table 9.14 indicates conditions which represent potential problems because the diver may be dehydrated, and the ability to perform tasks may be decreased. Six people listed using recreational drugs sometime during their dive trip.

Table 9.15 DCS Symptoms Prior to Last Dive

Male	35 of 282
Female	25 of 99
TOTAL	**60 of 381**

Frequency missing = 10

Table 9.15 indicates that sixty people listed having dived while having some symptom later associated with decompression sickness.

Table 9.16 Lack of Sleep and/or Fatigue Prior to Last Dive

Male	86 of 286
Female	39 of 99
TOTAL	**125 of 385**

Frequency Missing = 6

Table 9.16 indicates that 125 people were fatigued or had a lack of sleep prior to the dive in which they were injured.

Table 9.17 Strenuous Exercise

Sex	Prior to Dive	During Dive	After Dive
Male	50	86	32
Female	19	22	7
TOTAL	**69**	**108**	**39**

Frequency Missing = *12* *8* *22*

Table 9.17 indicates sixty-nine people had some strenuous activity before diving. One hundred and eight reported some strenuous activity during the dive, and 39 exercised after diving.

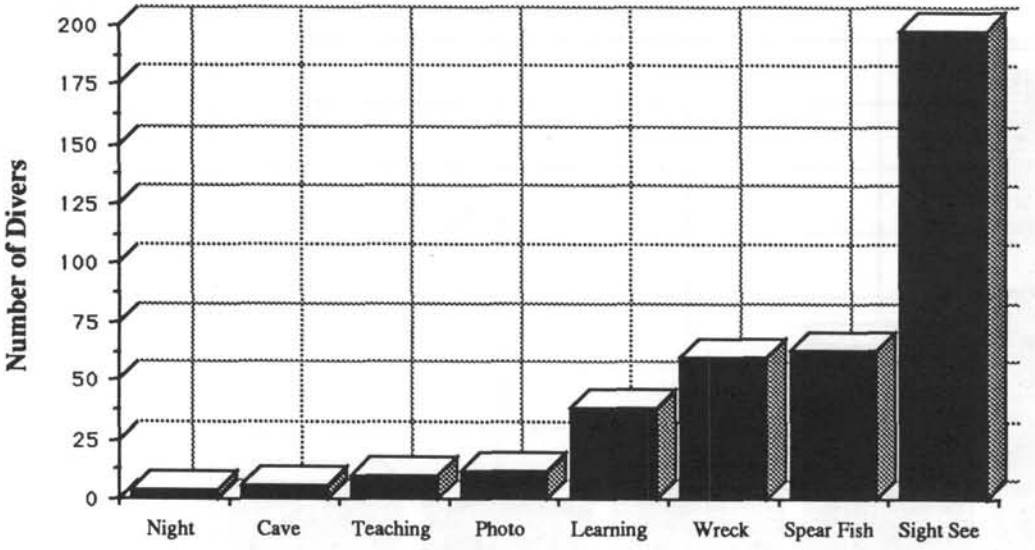
Table 9.18 Type of Water Environment

Type	Frequency	Percent
Freshwater	49	12.5%
Saltwater	342	87.5%
TOTAL	**391**	**100.0%**

Table 9.18 indicates forty-nine divers were diving in freshwater at the time of their accident. Three hundred and forty-two were diving in saltwater when their accident occurred.

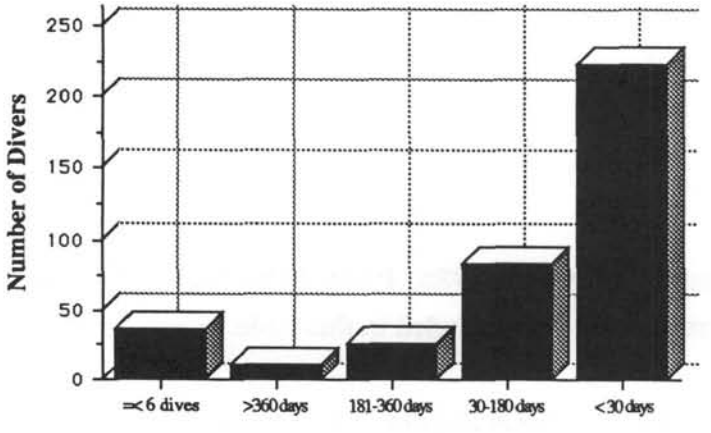
10.0 Dive Profile

Graph 10.1 Primary Dive Activity



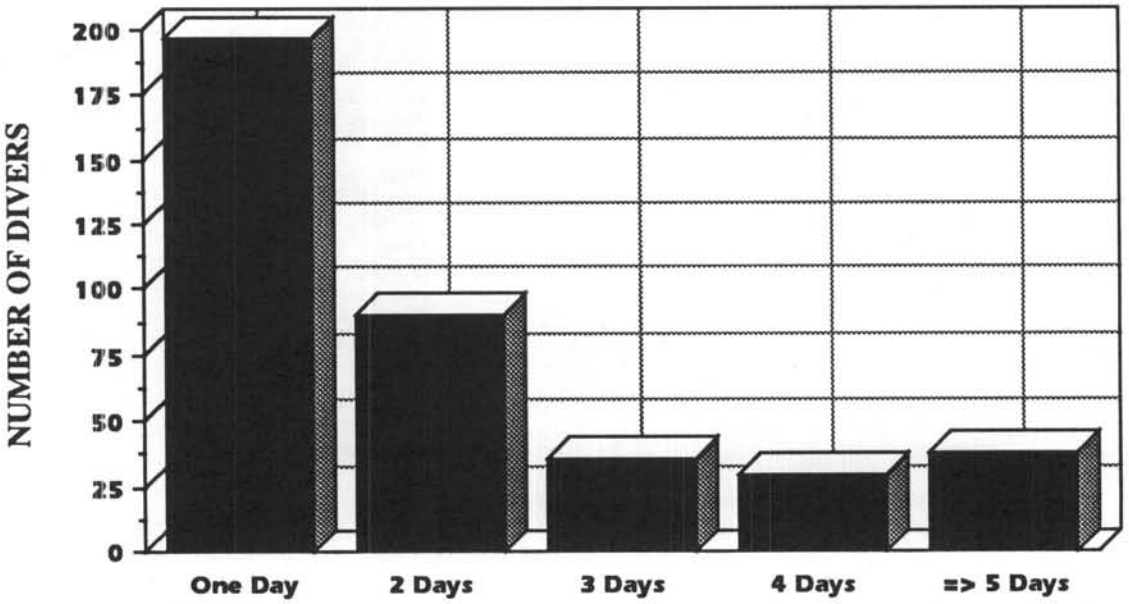
Graph 10.1 indicates 51 percent of the divers were primarily sight-seeing. Sixteen percent of the divers were spearfishing and 15 percent were wreck diving. The remaining 18 percent were doing different types of diving such as: night, cave, teaching, photo, and learning.

Graph 10.2 Days Since Last Safe Dive



Graph 10.2 indicates that the majority of dive injuries occurred in divers who had been diving within the last 30 days. The breakdown for the frequency of diving in 1989 is similiar to the results found in the 1988 report. Uncertified divers (=< 6 dives) were not included elsewhere in this graph.

Graph 10.3 Number of Days Diving



Graph 10.3 illustrates the breakdown of the days of diving in a series. It shows that approximately 50 percent of all accidents occurred on the first day of diving. This may represent a number of possible dive accident causes such as: lack of experience, lack of physical fitness, lack of preparation, or excessive diving in a single day.

Dive Location

Table 10.4 lists the location of the reported treated injuries since 1986. It should be noted that all reported DCS/AGE injuries, including those not treated, are also included in this table.

Table 10.5 lists the location of 1989 accidents by state and DAN Region. It also breaks down these injuries by diagnosis. Tables 10.6 and 10.7 show the location of 1989 accidents by state and country respectively.

Table 10.4 Total Reported Cases

	Regions							
1986	**SW**	**NW**	**MW**	**GU**	**PA+**	**NE**	**SE****	**TOTALS**
DCS-I		6	2	1			68	77
DCS-II	69*	11	13	8	7	33	133	274*
AGE	28	2				10	41	81
No DX reported					25		97	122
No Treatment++	3					1	4	8
TOTALS	100	19	15	9	32	44	343	562
1987								
DCS-I	15	4	2	15		30	61	127
DCS-II	58*	25	12	20		26	199	340*
AGE	20	4	2	6		6	59	97
No DX reported					38			38
No Treatment++	2					3	17	22
TOTALS	95	33	16	41	38	65	336	624
1988								
DCS-I	14	9	11	13		22	68	137
DCS-II	43	27	10	25		32	151	288
AGE	25	6	2	1		10	38	82
DCS-AGE combined	1			4			5	10
No DX reported					36			36
No Treatment++		3		1	1	2	5	12
TOTALS	83	45	23	44	37	66	267	565
1989								
DCS-I	48	12	18	11		14	78	181
DCS-II	64	15	17	29		47	156	328
AGE	35	3	3	1		4	65	111
No DX reported					58			58
No Treatment++								
TOTALS	147	30	38	41	58	65	299	678

* *Represents DCS types I and II cases combined.*

** *SE includes Caribbean basin.*

\+ *Hawaii only reports number of cases treated.*

++ *No Treatment represents cases with no treatment, refused treatment, or spontaneous resolution.*

Table 10.5 Total Cases Treated and Reported in 1989 by DAN Regional Coordinators

Southwest Region	DCS-I	DCS-II	AGE	TOTALS
Arizona	1	1	0	2
California	47	61	34	142
Utah	0	2	1	3
TOTALS	48	64	35	147
Northwest Region				
Alaska	0	1	0	1
Oregon	8	0	0	8
Washington	4	14	3	21
TOTALS	12	15	3	30
Midwest Region				
Illinois	2	5	0	7
Indiana	1	0	2	3
Kentucky	2	1	0	3
Michigan	7	4	0	11
Minnesota	2	3	0	5
Ohio	3	1	0	4
Wisconsin	1	3	1	5
TOTALS	18	17	3	38
Gulf Region				
Arkansas	0	2	0	2
Colorado	0	7	0	7
Louisiana	4	5	1	10
Missouri	1	0	0	1
Texas	6	15	0	21
TOTALS	11	29	1	41
Pacific Region				
Hawaii*				58
TOTAL				58

**Hawaii only reports number of cases treated.*

Northeast Region	DCS-I	DCS-II	AGE	TOTALS
Connecticut	1	1	1	**3**
Maine	3	6	1	**10**
Maryland	2	13	0	**15**
New York	2	9	2	**13**
Pennsylvania	6	17	0	**23**
Virginia	0	1	0	**1**
TOTALS	**14**	**47**	**4**	**65**
Southeast Region				
Alabama	0	5	1	**6**
Florida	48	75	38	**161**
Georgia	4	3	2	**9**
North Carolina	1	9	0	**10**
South Carolina	0	4	0	**4**
Tennessee	1	0	1	**2**
TOTALS	**54**	**96**	**42**	**192**
Caribbean Basin				
Bahamas	3	4	0	**7**
Barbados	2	8	1	**11**
Belize	1	1	0	**2**
Bonaire	1	1	0	**2**
Cayman	1	13	2	**16**
Curacao	0	1	0	**1**
Honduras	0	1	0	**1**
Jamaica	0	1	3	**4**
Mexico	9	5	10	**24**
Micronesia	0	4	2	**6**
Panama	0	1	0	**1**
Puerto Rico	0	3	0	**3**
St. Thomas	7	14	5	**26**
Turks & Caicos	0	3	0	**3**
TOTALS	**24**	**60**	**23**	**107**

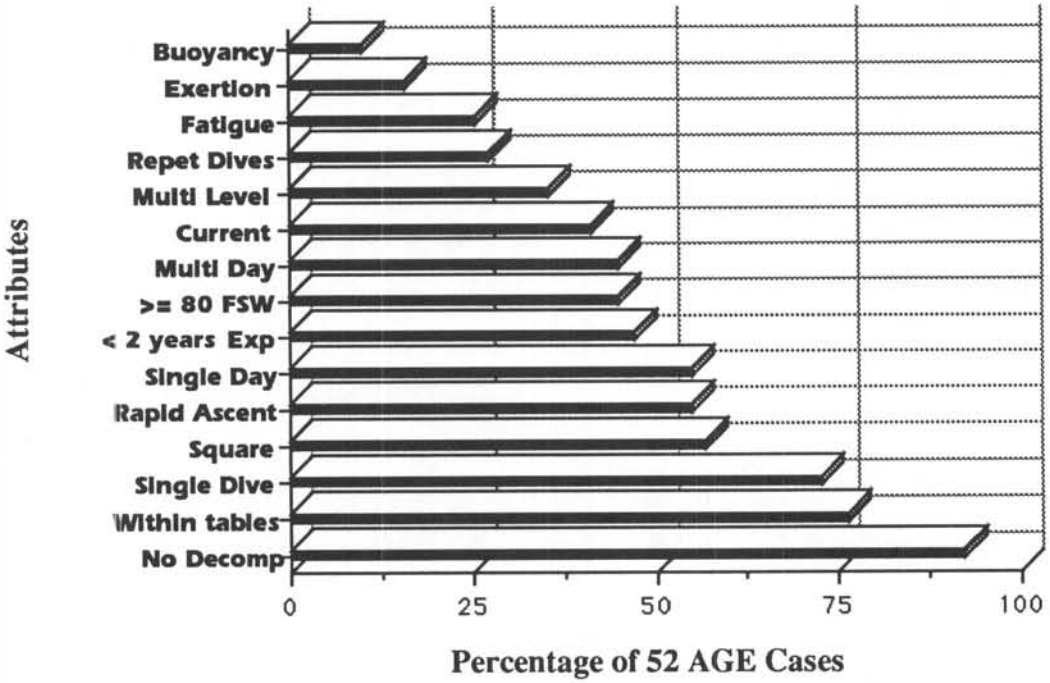
Table 10.6 Accidents by State

State	Frequency	Percent
Alabama	1	0.4%
Arizona	1	0.4%
Arkansas	1	0.4%
Connecticut	1	0.4%
Kentucky	1	0.4%
Lousiana	1	0.4%
Maryland	1	0.4%
Missouri	1	0.4%
Pennsylvania	1	0.4%
Utah	1	0.4%
Virginia	1	0.4%
Wyoming	1	0.4%
Maine	2	0.7%
Massachusetts	2	0.7%
New Hampshire	2	0.7%
Ohio	2	0.7%
Wisconsin	2	0.7%
Minnesota	3	1.1%
Oregon	3	1.1%
Georgia	4	1.5%
Hawaii	4	1.5%
Texas	4	1.5%
New York	8	3.0%
Michigan	9	3.3%
North Carolina	10	3.7%
Washington	14	5.2%
New Jersey	16	5.9%
California	55	20.3%
Florida	119	43.9%
TOTAL	**271**	**100.0%**

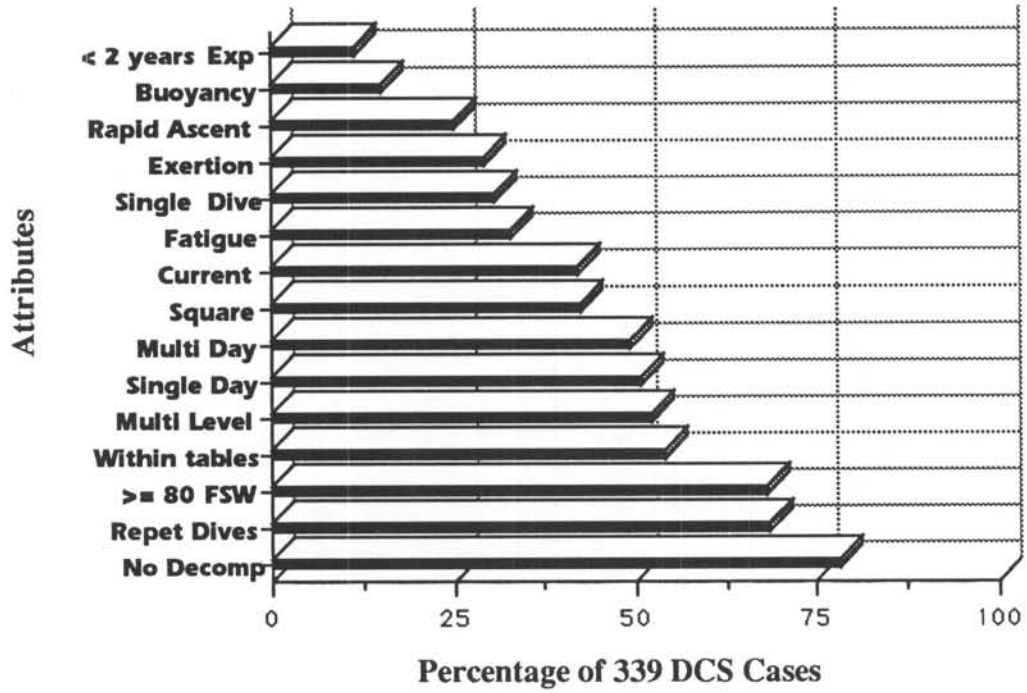
Table 10.7 Accidents by Country

Country	Frequency	Percent
Australia	1	0.3%
Cocos Islands	1	0.3%
Grenada	1	0.3%
Guam	1	0.3%
Indonesia	1	0.3%
Micronesia	1	0.3%
Philippines	1	0.3%
Puerto Rico	1	0.3%
Tobago	1	0.3%
Truk	1	0.3%
Canada	2	0.5%
Honduras	2	0.5%
Bonaire	3	0.8%
West Indies	3	0.8%
Antilles	4	1.0%
Belize	4	1.0%
British Virgin Islands	5	1.3%
Palau	5	1.3%
Turks and Caicos	5	1.3%
Barbados	6	1.5%
U.S. Virgin Islands	7	1.8%
Caymans	13	3.3%
Bahamas	18	4.6%
Mexico	30	7.7%
USA	271	69.3%
Other	3	0.8%
TOTAL	**391**	**100.0%**

Graph 10.8 AGE Dive Attributes



Graph 10.9 DCS Dive Attributes



Dive attributes or diver preferences are shown in graphs 10.8 and 10.9. They are listed in order of frequency. The most common attributes in DCS cases for the last three years have been no decompression diving, ranging from 71 to 90 percent, and diving equal to or greater than 80 feet, which has remained relatively stable at approximately 70 percent yearly. Repetitive diving has also remained consistent at approximately 63 percent. The greatest changes have been in multiple and single day diving. Although there was 18 percent more multiple than single day diving in 1987, by 1989 there was two percent more single than multiple day diving (51 versus 49 percent).

Most AGE cases seem to be the result of a no decompression, single day, and single square dive. Depths of 80 feet or greater have been associated with about 45 percent of all AGE cases each year. Rapid ascent is commonly associated with AGE by the diving public, and it has been reported in approximately 50 percent of all AGE cases from 1987 to 1989.

Table 10.10 Equipment Problems

Equipment	Frequency	DCS	AGE
Regulator	14	9	5
BC Vest	10	10	0
Weight Belt	2	1	1
Dry Suit	2	1	1
DC Computer	6	4	2
Inflator Hose	3	2	1
Contaminated Air	1	0	1
Unfamiliar Equipment	10	8	2
Timing	1	1	0
TOTALS	**49**	**36**	**13**

Computer diving has become very popular with recreational diving and thousands of units are being used today. Fifteen percent of divers in the 1987 accident report were using computers compared to 31 percent in 1988. In 1989, 32 percent of all injured divers were using computers.

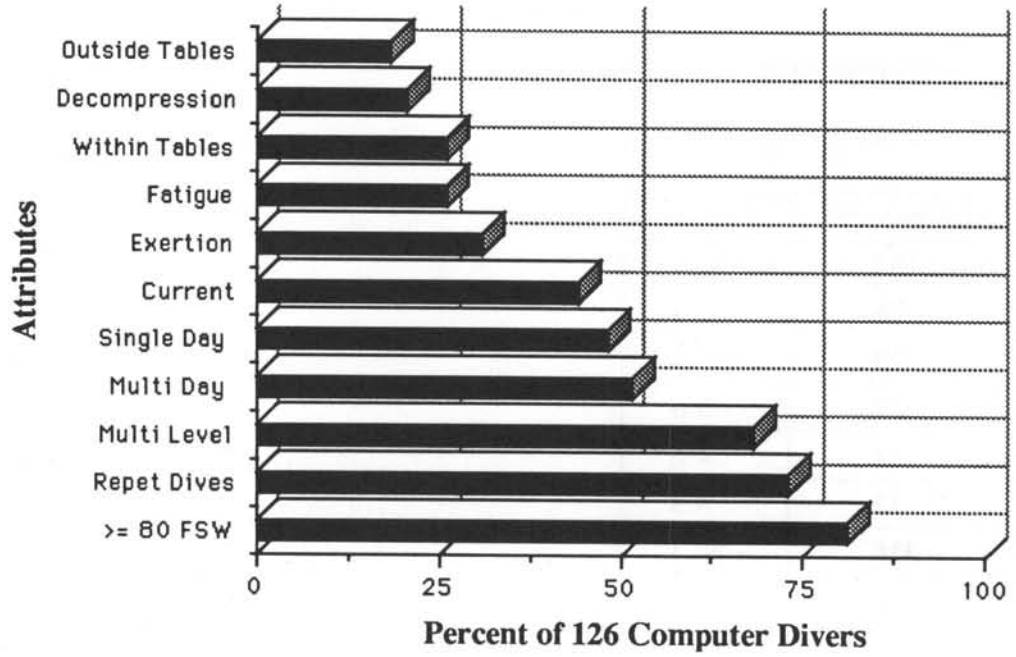
Table 10.11 demonstrates a comparison between computer assisted divers and those who use a dive table to calculate their profiles. The US Navy Table is still a standard decompression table, and is the only table used in this comparison. Computer divers are more likely to begin their dive at 80 feet or greater than table users and do more multi-level and repetitive diving than table users. These diver preferences are allowed within the functioning of decompression computers. Divers may very well select themselves out of table use because they prefer this style of diving. There is seemingly very little difference between single and multiple day diving among table and computer users. Since dive times are calculated differently for table and computer dive limits, no comparisons were made for this analysis.

Table 10.11 Table vs. Computer Diving

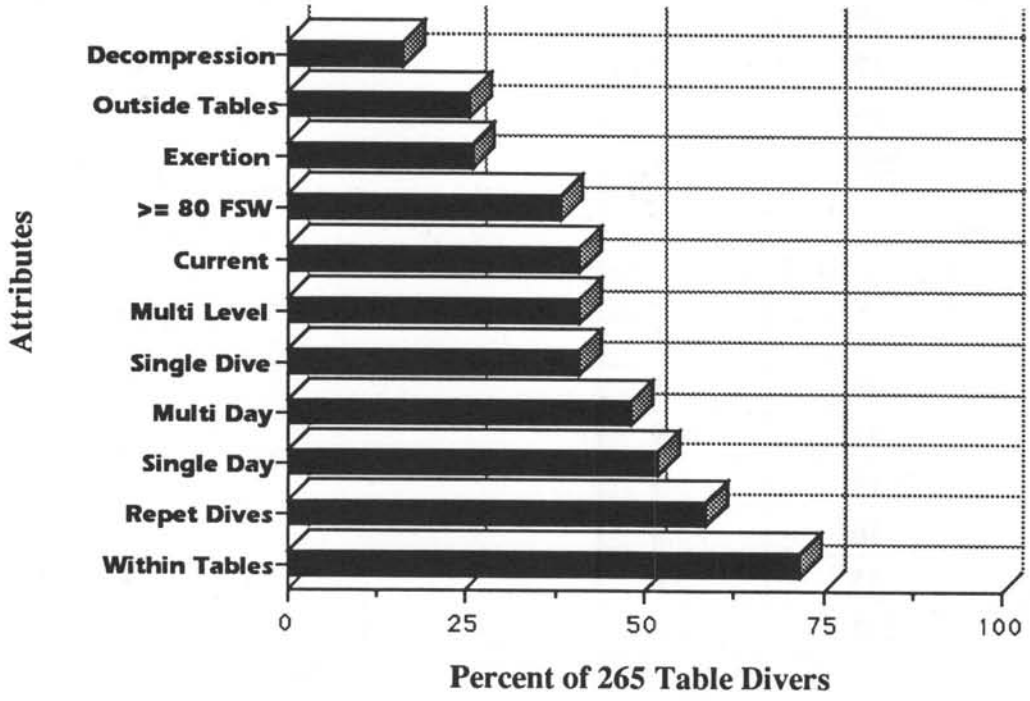
	1989		1988	
	US Navy	Computer	US Navy	Computer
>= 80 fsw	38.5%	81.0%	67.0%	81.0%
Square	53.2%	28.6%	61.0%	42.0%
Multi day	48.3%	52.4%	48.0%	55.0%
Repet	58.5%	73.0%	57.0%	81.0%
Single day	51.7%	47.6%	52.0%	45.0%
	n = 265	*n = 126*	*n = 184*	*n = 84*

Dive attributes for table and computer divers are evaluated in graphs 10.12 and 10.13. Direct attribute comparisons may be done using these data.

Graph 10.12 Attributes of Computer Divers



Graph 10.13 Attributes of Table Divers



11.0 Symptoms

Symptom recognition is important for accurate diagnosis and symptom reporting. The most common symptoms are shown in order of frequency, beginning with the first injury through the sixth.

Table 11.1 Top Injury Symptoms

First Injury		
Symptom	**Frequency**	**Percent**
Pain	154	39.4
Numbness	76	19.4
Headache	29	7.4
Extreme fatigue	22	5.6
Dizziness	18	4.6
Weakness	17	4.3
TOTAL	**316**	**80.7**
Frequency Missing = 0		
Second Injury		
Numbness	99	27.3
Pain	74	20.4
Weakness	37	10.2
Dizziness	19	5.2
Headache	17	4.7
Extreme fatigue	15	4.1
TOTAL	**261**	**71.9**
Frequency Missing = 29		
Third Injury		
Numbness	61	20.1
Pain	59	19.5
Weakness	33	10.9
Dizziness	18	5.9
Extreme fatigue	16	5.3
Headache	15	5.0
TOTAL	**202**	**66.7**

Frequency Missing = 88

Fourth Injury		
Symptom	**Frequency**	**Percent**
Numbness	37	17.6
Pain	31	14.8
Weakness	17	8.1
Nausea	17	8.1
Extreme fatigue	16	7.6
Dizziness	15	7.1
TOTAL	**133**	**63.3**
Frequency Missing = 181		
Fifth Injury		
Numbness	23	17.2
Pain	21	15.7
Nausea	13	9.7
Dizziness	11	8.2
Extreme fatigue	8	6.0
Headache	7	5.2
Difficulty walking	7	5.2
TOTAL	**90**	**67.2**
Frequency Missing = 257		
Sixth Injury		
Numbness	16	20.3
Difficulty walking	11	13.9
Pain	10	12.7
Extreme fatigue	4	5.1
Headache	4	5.1
Muscle twitch	4	5.1
Weakness	4	5.1
TOTAL	**53**	**67.3**

Frequency Missing = 312

A complete list of first and second symptoms are shown in table 11.2. Although pain is the most common symptom, many other symptoms may also indicate decompression illness.

Table 11.2 1989 Injury Symptoms

	First Symptom		Second Symptom	
Symptom	Frequency	Percent	Frequency	Percent
Pain	154	39.4	74	20.4
Numbness	76	19.4	99	27.3
Headache	29	7.4	17	4.7
Extr fatigue	22	5.6	15	4.1
Dizziness	18	4.6	19	5.2
Weakness	17	4.3	37	10.2
Other	12	3.1	9	2.5
Diff breathing	11	2.8	11	3.0
Nausea	10	2.6	10	2.8
Unconsciousness	10	2.6	7	1.9
Itching	9	2.3	3	0.8
Visual disturbance	5	1.3	5	1.4
Paralysis	2	0.5	4	1.1
Bowel problem	2	0.5	1	0.3
Personality change	2	0.5	4	1.1
Diff walking	2	0.5	7	1.9
Reflex changes	2	0.5	1	0.3
Semi-conscious	2	0.5	3	0.8
Restless	2	0.5	8	2.2
Muscle twitching	1	0.3	6	1.7
Rash	1	0.3	6	1.7
Ear ringing	1	0.3	1	0.3
Decreased skin sensation	1	0.3	12	3.3
Bladder problem	0	0.0	2	0.6
Convulsions	0	0.0	1	0.3
TOTALS	**391**	**100.0**	**362**	**100.0**

No response = 29

Table 11.3 DAN Disease Severity Code

Severity Code	Frequency	Percent
1	47	12.0
2	46	11.8
3	25	6.4
4	141	36.1
5	86	22.0
6	46	11.8
TOTAL	**391**	**100.0**

DAN uses a coding system to rate dive injuries based solely on the severity of the diver symptoms. The most severe symptoms are represented by a code of six, and the least severe symptoms are rated a code one (see appendix C). Seventy percent of the 1989 injured divers had a severity code of four or higher.

Table 11.4 1989 Unblinded Disease Diagnosis

Final Diagnosis	Frequency	Percent
DCS I	88	22.5
DCS II	251	64.5
Air Embolism	52	13.0
TOTAL	**391**	**100.0**

Table 11.4 shows the traditional diagnosis attributed to diver symptoms. This diagnosis is not made only on the basis of the symptom. The rater, in most cases a physician, has other data about the diver, such as symptom onset time. Therefore, this diagnosis process is called unblinded.

Table 11.5 Present Severity Code vs. Previous Dive Injury Diagnosis by Sex

Male				
Severity	AGE	DCS	Barotrauma	None
1	0	8	1	28
2	0	8	1	32
3	0	3	0	14
4	0	9	2	89
5	1	9	0	54
6	0	0	1	25
TOTALS	**1**	**37**	**5**	**242**

No response = 5
One case had two previous accidents.

Female				
Severity	AGE	DCS	Barotrauma	None
1	0	0	1	8
2	0	0	0	6
3	0	1	0	6
4	1	5	0	33
5	0	1	0	20
6	0	1	2	17
TOTALS	**1**	**8**	**3**	**90**

Twelve percent of females and 15 percent of males had a previous dive accident. Pulmonary barotrauma was less common in this small group. There is no particular pattern in the distribution of these repeat dive injuries.

Table 11.6 Age by Disease Severity and Sex

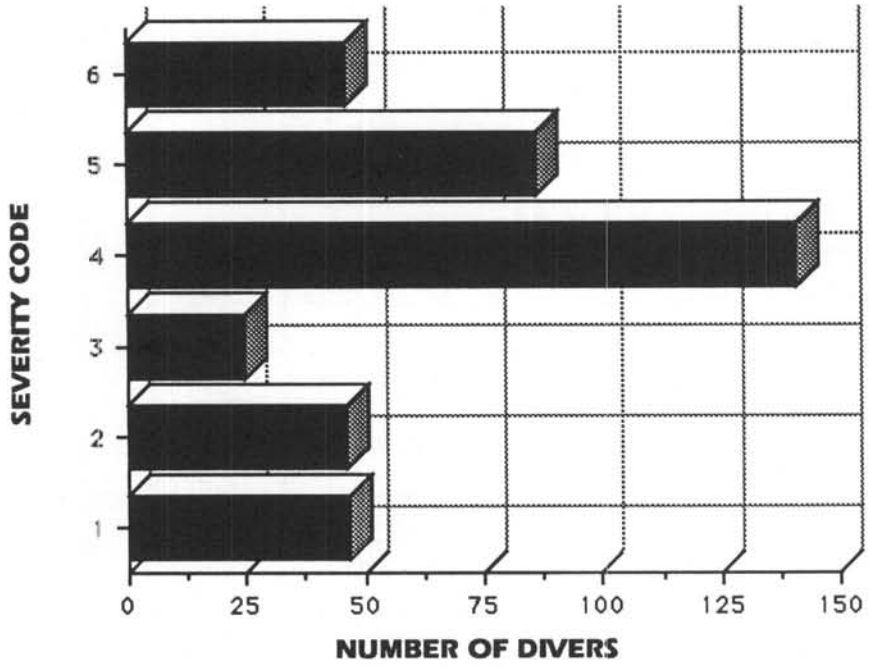
Male							
Age	1	2	3	4	5	6	TOTALS
10-14	0	0	1	0	0	0	1
15-19	2	0	1	2	1	0	6
20-24	2	0	1	11	4	3	21
25-29	7	7	3	25	21	6	69
30-34	8	10	6	19	13	3	59
35-39	8	3	2	17	7	7	44
40-44	6	6	3	6	7	4	32
45-49	1	2	0	12	4	1	20
50-54	4	1	0	2	3	0	10
55-59	0	3	0	3	2	0	8
60-64	0	4	0	0	0	1	5
TOTALS	38	36	17	97	62	25	275

Frequency Missing = 14

Female							
Age	1	2	3	4	5	6	TOTALS
10-14	0	0	0	0	0	0	0
15-19	0	0	1	1	0	0	2
20-24	2	0	0	4	3	1	10
25-29	1	3	1	8	5	5	23
30-34	1	1	2	9	5	4	22
35-39	1	0	0	6	2	2	11
40-44	3	1	1	4	3	1	13
45-49	0	1	1	1	2	4	9
50-54	1	0	0	2	1	1	5
55-59	0	0	0	2	0	0	2
60-64	0	0	0	0	0	0	0
TOTALS	9	6	6	37	21	18	97

Frequency Missing = 5

Graph 11.7 Severity Code vs. Occurrence



The above graph demonstrates the breakdown of injury severity. There is no clear reason for why most injuries occur in the more severe codes. This trend is also evident in the 1987 and 1988 data.

12.0 Treatment

Section 12.0 deals with some of the problems commonly found in the recreational dive population regarding treatment. Perhaps because symptoms can be very subtle and mistaken for other illnesses, or divers use denial to delay calling, 50 percent of the divers DAN reports on waited for greater than 12 hours or more to call for assistance. Additionally, 16 percent continued to dive after developing the first symptom of decompression illness.

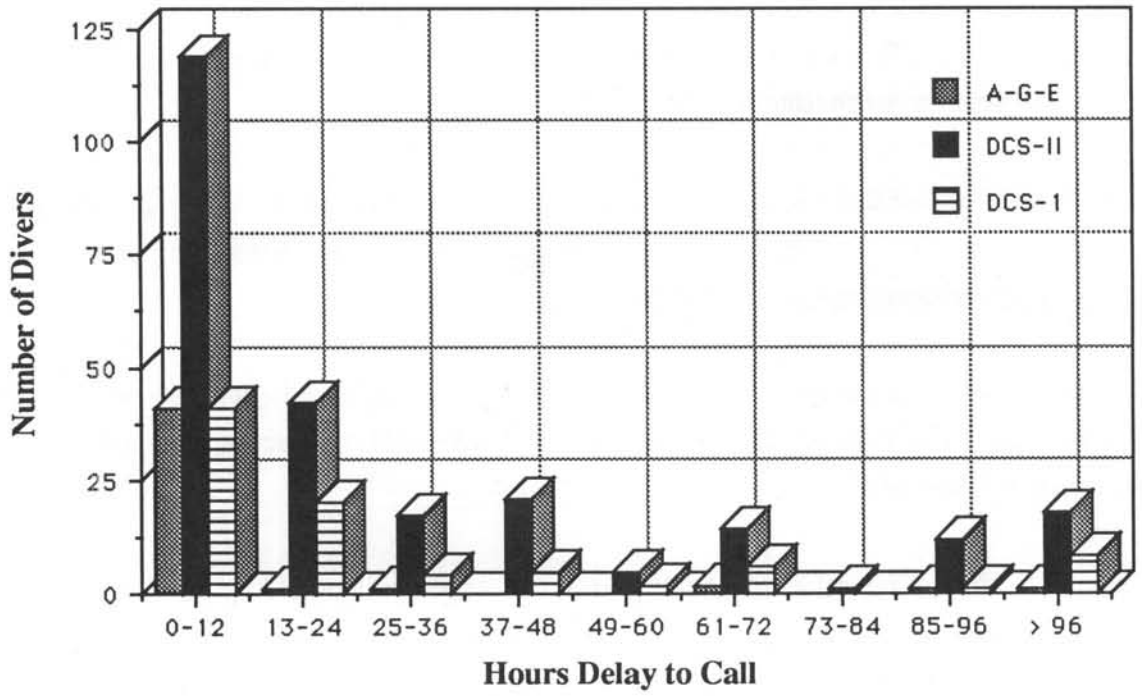
Graph 12.1 shows the length of time (in hours) divers wait to contact assistance. Graph 12.2 demonstrates who divers are initially contacting for information and assistance. DAN emergency and information lines play a vital role in diver assistance.

First aid use in the field is shown in graph 12.3. Although the use of oral fluids, for first aid after the dive, has increased from 17 to 25 percent since 1987, the first aid use of oxygen has dropped from 36 to 33 percent in that same time period.

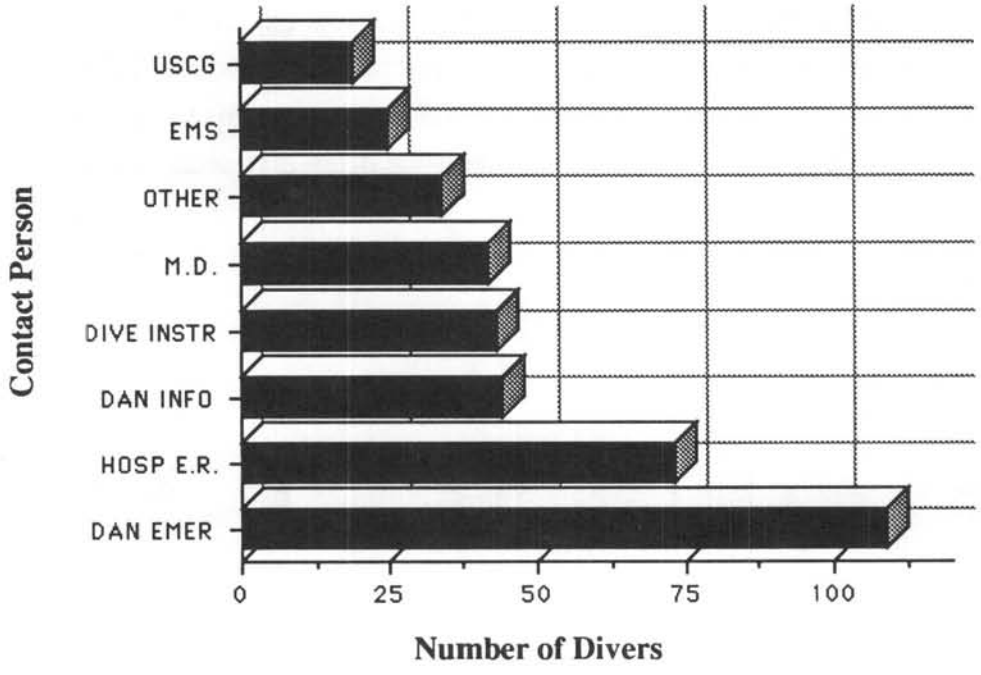
Graph 12.4 shows the time (in hours) from symptom onset to recompression. Graph 12.5 shows the residual symptoms by severity code. Refer to appendix C for the severity codes. Codes 4-6 have the most severe symptoms. Seventy percent of the 1989 accident population had symptoms with severity codes between 4-6.

Graph 12.6 shows the number of divers that had post-treatment residuals. Symptoms of decompression illness can persist when appropriate hyperbaric therapy is not recieved, but this can also occur when treatment is obtained by the diver. Forty-six percent of all injured divers had residual symptoms. Three months after the accident DAN stops following up on injuries. At this point, 18 percent of all divers still were experiencing residuals. This may be due to the delay in treatment or the overall severity of the injury.

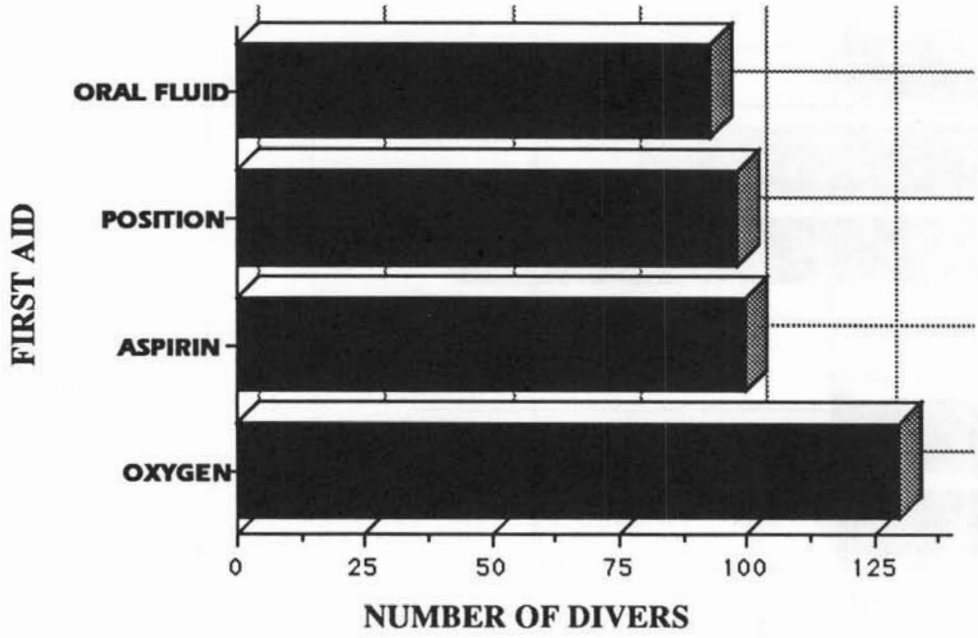
Graph 12.1 Delay to Calling for Assistance



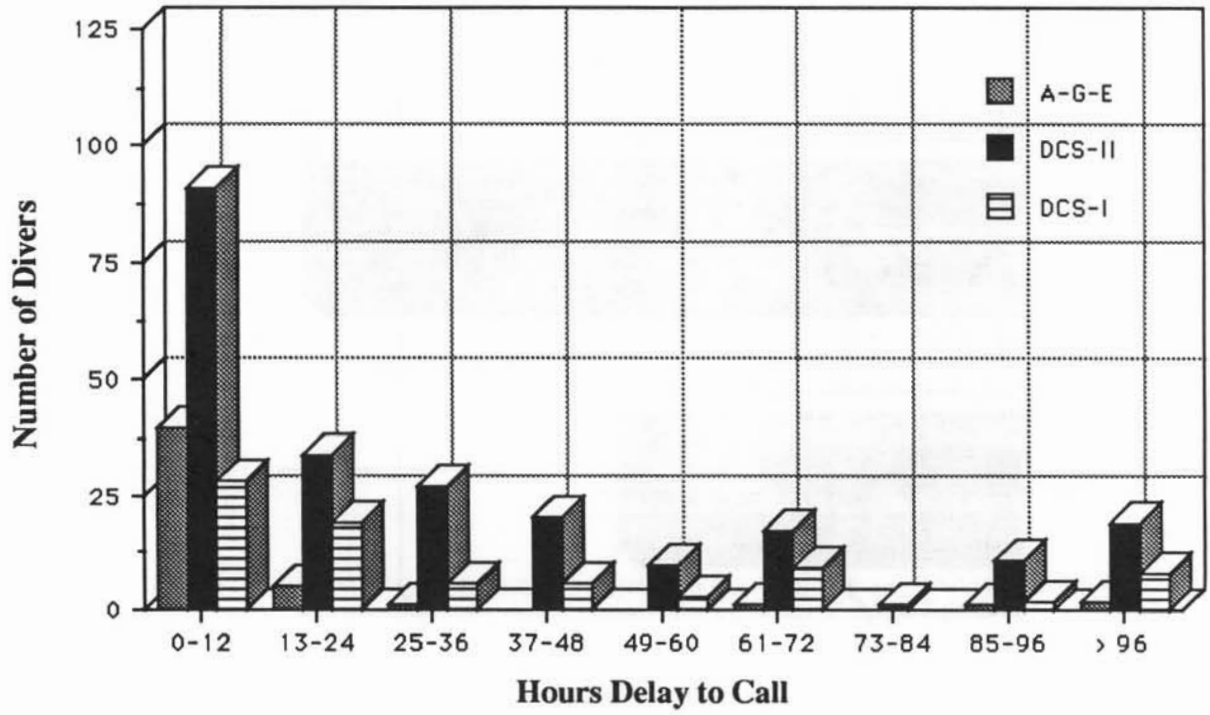
Graph 12.2 First Contact for Assistance



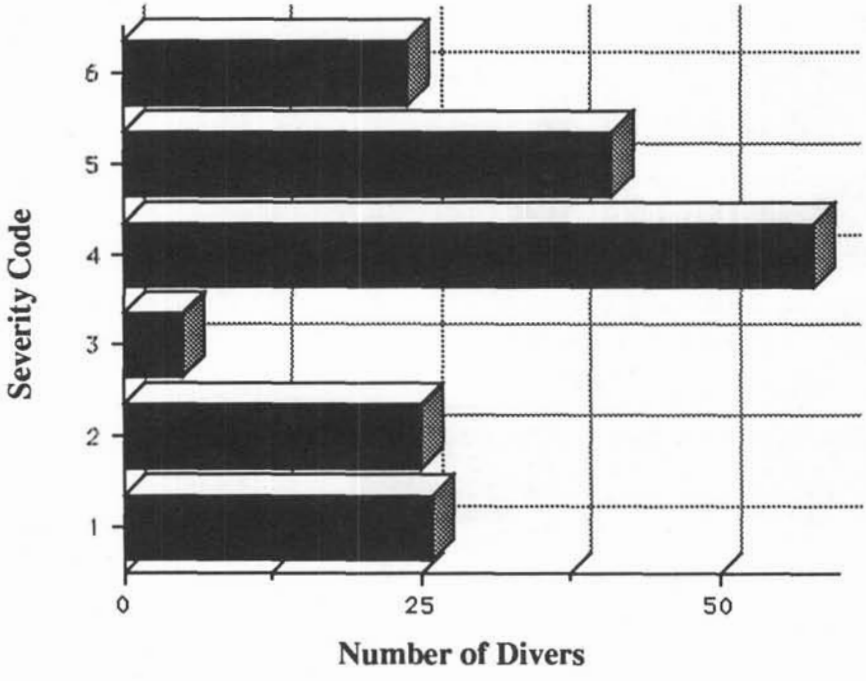
Graph 12.3 First Aid Used



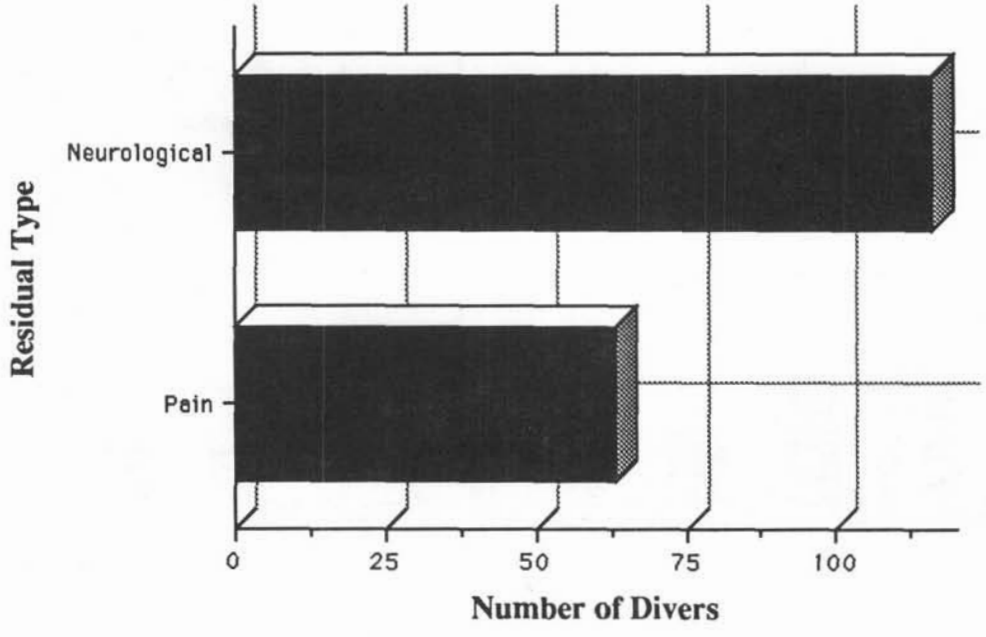
Graph 12.4 Delay to Recompression



Graph 12.5 Residual Symptoms by Severity Code



Graph 12.6 Post-Treatment Residuals



Accident Summary

This is DAN's third annual *Report on Diving Accidents*, however, this year we have expanded our report to include diving fatalities.

Scuba diving continues to be popular among men and women of all ages. From these accident and fatality cases, there are trends which can be consistently identified from previous years.

For example, divers who lack adequate experience and underwater skills seem to be undertaking dive situations they are not yet prepared to handle, resulting in rapid ascents, buoyancy problems, and out-of-air situations. More experienced divers may continue diving despite current or past health problems which have the potential to contribute to dive injuries or limit the diver's ability to perform adequately in the water.

Additionally, recreational divers continue to dive with decompression illness symptoms and delay calling for assistance. The general lack of symptom recognition may be, in part, responsible for this behavior. The wide variety of possible symptom presentations adds to the divers' indecision to seek treatment once symptoms occur.

The most consistent findings associated with decompression illness are: diving at 80 feet or greater, repetitive diving, and no-decompression diving. These are not, however, considered *true* risk factors because they only pertain to the *injured* population. DAN will continue to follow up its prospective study of non-injured divers throughout 1991.

With the results gained from this prospective study and the annual accident reports, more information will be available to enable DAN to learn the causes of diving-related problems and how to avoid them in the future.

DAN DIVE ACCIDENT REPORTING FORM

BOX 3823 • DUKE UNIVERSITY MEDICAL CENTER
DURHAM, NORTH CAROLINA 27710
Information Mon.–Fri. 9–5 (E.T.) (919) 684–2948
Emergencies Only (919) 684–8111

DATE & TIME OF ACCIDENT
MONTH/DAY/YEAR
Time _____ AM PM

IS THIS A FATALITY REPORT?
☐ YES ☐ NO

For DAN Office Use Only
CASE
SEVERITY CODE
BMI

1. PATIENT NAME LAST FIRST MI

2. OCCUPATION

3. ADDRESS STREET CITY ST ZIP

4. PATIENT PHONE (HOME) - -

5. PATIENT PHONE (WORK) - -

6. COUNTRY (IF NOT USA)

7. AGE YRS

8. SEX M or F

9. HEIGHT FT IN

10. WEIGHT LBS.

11. CERTIFYING AGENCY
A - PADI
B - NAUI
C - NASDS
D - YMCA
E - SSI
F - Other
G - None

12. CERTIFICATION LEVEL
A - Basic
B - Open Water
C - Advanced
D - Divemaster
E - Instructor
F - Commercial
G - Other
H - None
I - Student

13. DAN MEMBER?
Y - Yes
N - No

14. YEARS DIVING YEARS MONTHS

15. NUMBER OF DIVES MADE Total; Previous 12 months

16. PREVIOUS DIVE ACCIDENTS
A - Possible DCS
B - DCS
C - AGE
D - Pul. barotrauma
E - None

17. CURRENT MEDICATIONS
Y or N
Prescription
Non-prescription
List _____

18. CIGARETTE USE
A - Presently
B - In past
C - Never
Years Smoking
Packs per day

19. PREVIOUS MAJOR ILLNESSES/ SURGERY
(Provide up to 3 responses)
A - Chest-lung
B - Asthma
C - Chest-heart
D - Gastrointestinal/Abdomen
E - Brain
F - Spine/Back
G - Limb or joint of DCS site
H - Circulation/Blood
I - Neurologic/Nervous system
J - Muscle/Skeleton system
K - Eye
L - Mental/Emotional
M - Other _____
N - None

Past:
A - 2-6 months
B - 7-12 months
C - 1-3 years
D - 2-5 years
E - 6+ years

List and describe specific problems:

20. CURRENT HEALTH PROBLEMS WITHIN PREVIOUS 2 MONTH
(Provide up to 3 responses)
A - Chest-lung
B - Asthma
C - Chest-heart
D - Gastrointestinal/Abdomen
E - Brain
F - Spine/Back
G - Limb or joint of DCS site
H - Circulation/Blood
I - Neurologic/Nervous system
J - Muscle/Skeleton system
K - Eye
L - Mental/Emotional
M - Other _____
N - None

List and describe specific problems or additional current medications

PLEASE ATTACH SEPARATE SHEET FOR ADDITIONAL INFORMATION OR NARRATIVE.

I understand that the information in this form will be used for research purposes only, and that all personal information will be kept strictly **confidential**. I also understand that the Divers Alert Network may need to contact me in the future for clarification of information provided on this form.

_____
Patient Signature

DIVE ACCIDENT

21. PURPOSE OF DIVE
- A - Pleasure
- B - Work/Labor

22. DIVE ACTIVITY (up to 2 responses)
- A - Wreck
- B - Cave
- C - Night
- D - Photography
- E - Under Instruction
- F - Providing Instruction
- G - Spearfishing/ Game collecting
- H - Sightseeing

23. ENVIRONMENT
- A - Freshwater
- B - Saltwater

24. ALTITUDE OF DIVE
- A - Sea Level
- B - > Sea Level but < 1000 ft.
- C - > 1000 ft.

25. Was this dive or dive series typical of your normal type of diving?
- Y - Yes
- N - No

IF NO, Explain _____

26. DIVER'S PERCEPTION OF TEMPERATURE
- A - Cold
- B - Hot
- C - Comfortable

27. CURRENT STRENGTH
- A - Strong
- B - Moderate
- C - Mild
- D - None

28. AIR SUPPLY
- A - Scuba Air
- B - Surface Supply Air
- C - Mixed gas
- D - None/Breath-hold dive

29. AIR CONSUMPTION
- A - Ran low
- B - Out of air
- C - Not a problem
- D - Buddy breathing (not octopus)

30. BUOYANCY PROBLEM
- Y - Yes
- N - No

31. RAPID ASCENT
- Y - Yes
- N - No

32. WITHIN LIMITS-Y or N
- Tables (which table _____)
- or
- Computer (type _____)

33. TYPE OF SUIT
- A - Wet
- B - Partial Wet
- C - Dry
- D - Lycra
- E - Swim

34. EQUIPMENT USED ON DIVE: (please check all that apply)
- Depth gauge
- Timing device/watch
- Buoyancy vest
- BC Inflator hose in use
- Decompression computer

35. EQUIPMENT MALFUNCTION:
- A - None
- B - Regulator
- C - BC Vest
- D - Weight belt
- E - Dry suit
- F - DC Computer
- G - Inflator hose
- H - Contaminated air supply
- I - Equipment was not familiar to you.
- J - Other

Reason: _____

36. TYPE OF DIVE
- Y - Yes
- N - No

Single

Repetitive

37. WOMEN, PLEASE RESPOND (up to 2 responses)

When the accident occurred, were you:
- A - Menstruating
- B - On birth control medication
- C - Pregnant
- D - None of the above

38. DIVE LOCATION:

State, Province, or Island: _____

Country or nearest country: _____

39. How long ago was your last Dive Trip/Series?

Circle one: Days Weeks Months

40. STRENUOUS EXCERCISE
- Y - Yes
- N - No

24 hours predive

During dive

6 hours postdive

41. PREDIVE HEALTH
- A - Nausea/ vomiting
- B - Hangover
- C - Diarrhea
- D - Other
- E - No Problem

42. ALCOHOL

Please check:

	Number of drinks, beers, or wine
None	
Night Before	
Predive	
Between Dives	
Post Dive	

43. RECREATIONAL DRUG USE

Prior to, between, or after dive
- Y - Yes
- N - No

44. Do you consider yourself physically fit?
- Y - Yes
- N - No

Do you excercise on a weekly basis? (Y or N)

Days per week

45. FATIGUE OR LACK OF SLEEP PRIOR TO DIVE?
- Y - Yes
- N - No

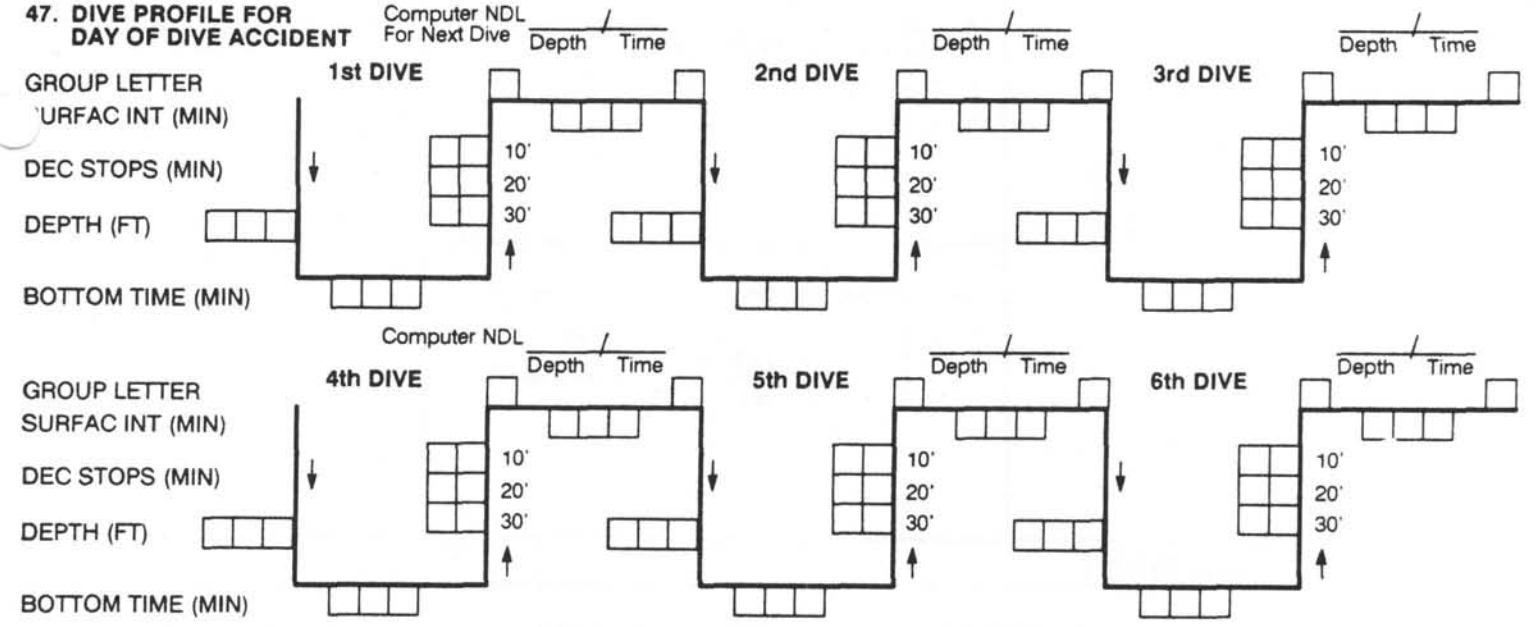
46. DIVE SERIES

Please fill in all that apply up to and including your last dive. If you skipped a day please leave that day blank.

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
Total # of dives							
Any night dive? (How many)							
Any symptoms? (Yor N)							
A - All no stop dive(s) B - Any safety stop C - Any dive requiring decompression stops							
A - Multilevel (time divided) B - Square							
Deepest Dive (ft.)							

DIVE ACCIDENT (cont.)

47. DIVE PROFILE FOR DAY OF DIVE ACCIDENT



PRE-CHAMBER INFORMATION

48. INITIAL CONTACT WAS:

- A - DAN Emergency
- B - DAN Non-emergency
- C - Hospital emergency room
- D - Emergency medical service
- E - US Coast Guard
- F - Physician
- G - Dive instructor/shop
- H - Other: _____

49. Total delay from symptom onset to contacting DAN or other medical help:

HOURS or DAYS

50. FLYING OR INCREASED ELEVATION AFTER DIVING AND PRIOR TO TREATMENT?

- A - Commercial airliner
- B - Unpressurized aircraft
- C - Med Evac Flight
- D - Mountain elevation
- E - Does not apply

Hours post dive (flew or went into elevation)

elevation (in feet)

51. SIGNS & SYMPTONS

1st Symptom, 2nd Symptom, 3rd Symptom, 4th Symptom, 5th Symptom, 6th Symptom

- A - Pain
- B - Rash
- C - Itching
- D - Weakness
- E - Numbness/Tingling
- F - Dizziness/Vertigo
- G - Semi-consciousness
- H - Unconsciousness
- I - Restlessness
- J - Extreme fatigue
- K - Visual disturbance
- L - Speech disturbance
- M - **Headache**
- N - Paralysis
- O - Difficulty breathing
- P - Nausea/Vomiting
- Q - Hemoptosis/coughing blood from lungs
- R - Muscle twitching
- S - Convulsions
- T - Hearing loss
- U - Ringing ears
- V - Decreased skin sensation
- W - Bladder problem
- X - Bowel problem
- Y - Personality change
- Z - Difficulty walking/ standing
- 1 - Reflex change
- 2 - Other: _____

52. LOCATION: Block A = location of symptom
Then please check (✓)
L = Left R = Right B = Bilateral/Both Sides

1st Symptom, 2nd Symptom, 3rd Symptom, 4th Symptom, 5th Symptom, 6th Symptom

A L R B

- A - Head
- B - Face
- C - Sinus
- D - Eyes
- E - Ears
- F - Neck
- G - Shoulder
- H - Entire arm
- I - Upper arm
- J - Elbow
- K - Forearm
- L - Wrist
- M - Hand
- N - Fingers
- O - Chest
- P - Back
- Q - Upper back
- R - Lower back
- S - Abdomen
- T - Buttock
- U - Groin
- V - Hip
- W - Entire leg
- X - Thigh
- Y - Knee
- Z - Calf
- 1 - Shin
- 2 - Ankle
- 3 - Foot
- 4 - Toes
- 5 - Trunk
- 6 - Generalized
- 7 - Other: _____

53. SYMPTOM ONSET:

	HOURS	MINUTES	or	BEFORE SURFACING FROM DIVE
1st Symptom				
2nd Symptom				
3rd Symptom				
4th Symptom				
5th Symptom				
6th Symptom				

54. ANY OF THE SYMPTOMS FROM #51 PRIOR TO THE LAST DIVE?

Y - Yes
N - No

If yes, which symptoms?

1st, 2nd, 3rd, 4th, 5th, 6th

Other

Explain: _____

55. FIRST AID ADMINISTERED BEFORE HOSPITAL OR CHAMBER HELP WAS RECEIVED?

Y - Yes
N - No

- Oxygen
- Aspirin
- Oral fluids
- Head down position/ Trendelenburg

If oxygen was received was delivery by:

- A - Demand valve
- B - Freeflow valve
- C - Don't know

PRE-CHAMBER INFORMATION (cont.)

56. HOSPITAL TREATMENT ADMINISTERED

(Please check all that apply):

- ☐ None
- ☐ Oral fluids
- ☐ IV fluids
- ☐ Oxygen
- ☐ Steroids
- ☐ Anticoagulant
- ☐ Aspirin
- ☐ Other medication

_____

_____

57. RELIEF BEFORE CHAMBER TREATMENT?

☐
A - Complete
B - Partial
C - Temporary
D - None

59. PRE-CHAMBER RELIEF OCCURRED:

☐
A - Without first aid or medical care
B - Following first aid
C - Following pre-chamber hospital care
D - No relief occurred

58. IF ANY RELIEF OCCURRED, WHICH SYMPTOMS FROM #51 ABOVE?
(Please check):

- 1st ☐
- 2nd ☐
- 3rd ☐
- 4th ☐
- 5th ☐
- 6th ☐

CHAMBER TREATMENT

60. CHAMBER TREATMENT FACILITY LOCATION

CITY

STATE COUNTRY

Date & Time of Treatment

MONTH/DAY/YEAR

Time _____ AM PM

Name of hyperbaric facility:

Treating doctor

Form Completed By

_____

61. TYPE OF CHAMBER
(please check)

Initial Treatment	Retreatment Chamber
☐ Monoplace	☐ Monoplace
☐ Dualplace	☐ Dualplace
☐ Multiplace	☐ Multiplace
☐ No chamber treatment given	

62. TOTAL DELAY FROM SYMPTOM ONSET TO RECOMPRESSION

HOURS or DAYS

63. INITIAL TREATMENT

☐
A - USN TT4
B - USN TT5
C - USN TT6
D - USN TT6A
E - HART Protocol
F - KINDWALL Protocol
G - 45 fsw 90 min
H - 33 fsw 120 min
I - Other

_____

_____

64. TABLE EXTENSIONS REQUIRED?

☐
Y - Yes
N - No

66. RETREATMENT GIVEN
(Provide up to 3 responses)

TABLE	NUMBER OF TREATMENTS
☐	☐
☐	☐
☐	☐

A - USN TT4
B - USN TT5
C - USN TT6
D - USN TT6A
E - HART Protocol
F - KINDWALL Protocol
G - 45 fsw 90 min
H - 33 fsw 120 min
I - Other

_____

67. RELIEF AFTER HYPERBARIC THERAPY COMPLETED?

☐
A - Complete
B - Partial
C - Temporary
D - Hyperbaric therapy not completed
E - None

68. RESIDUAL SYMPTOMS AFTER HYPERBARIC THERAPY COMPLETED?

☐
A - Pain only
B - Neurologic
C - Hyperbaric therapy not completed
D - None

65. RELIEF AFTER INITIAL TREATMENT OF SYMPTOMS FROM # 51?

- 1st ☐
- 2nd ☐
- 3rd ☐
- 4th ☐
- 5th ☐
- 6th ☐

Please indicate:
A - Complete
B - Partial
C - Temporary
D - None

69. DURATION OF RESIDUAL SYMPTOMS

(Circle one)

☐
DAYS
WEEKS
MONTHS

70. FINAL DIAGNOSIS:

☐
A - DCS I
B - DCS II
C - Air Embolism
D - Pulmonary Barotrauma
O - Other

_____

_____

_____

I WOULD LIKE TO RECEIVE DAN INFORMATION.

☐
Y - Yes
N - No

DIVERS ALERT NETWORK
FATALITY WORKSHEET

DAN Case Number _____ ME Case Number _____

DIVER PROFILE

Name _____ Date of Birth _____ Race _____

Occupation _____ S.S. Number _____ Marital Status _____

Date of Death _____ Time (24 Hour Clock) _____ First Contact _____

Age _____ Sex _____ Height _____ Weight _____

Certified ____ Years Diving ____ Certification level _____

Total number of dives made _____ Dives in last 12 months _____ Experience Level _____

DIVE CONDITIONS

Location _____ New dive site _____ Altitude _____ (ft)

Water environment _____ Water temp _____ Current _____ Water depth _____

Visibility _____ Wave height _____ Amount of surge ____ Bottom type _____

Weather condition _____ Entry _____ Air consumption _____ *

Number in dive group _____ Buddy separation ____ Tender _____ Type of Suit _____

Dive Activity _____ Specialty Certified _____

DIVER HEALTH

Fatigue _____ Alcohol _____ Drugs _____ Physically Fit _____

Mental Status _____ Pre-dive Health _____ Previous dive accidents _____

Undiagnosed health problems _____ Previous major illness _____

Current health problems _____ Prescription medications _____

Non-prescription medication _____

EQUIPMENT AND OTHER DIVE PROBLEMS

Equipment problems _____ Problem 1 _____ Problem 2 _____

Air Supply _____ (scuba, surface, etc.) Entanglement _____ Trapped _____

Rapid ascent _____ Buoyancy problem _____ Nitrogen narcosis _____

Infrequent diver _____ Weight belt _____ lbs/kg Dropped _____

* Air consumption: Out of air, Low on air, no problem

DIVE PROFILE

Single dive _____ Decompression diving _____ Last dive trip/series _____

Using a computer? _____ Type of computer _____

Depth 1: _____(ft) Bottom Time 1: _____ (min) Surface interval 1: _____

Depth 2: _____(ft) Bottom Time 2: _____ (min) Surface interval 2: _____

Depth 3: _____(ft) Bottom Time 3: _____ (min) Surface interval 3: _____

RECOVERY/FIRST AID

Was event witnessed _____ How long into dive did the problem occur? _____ (minutes)

Where _____(descent, bottom, ascent) What depth _____(fsw)

Immediate Search _____ After _____ (days) _____(hours) _____ (minutes)

Body Recovered _____ After _____ (days) _____(hours) _____ (minutes)

USCG Assistance _____ Medivac _____

CPR done _____ Oxygen available _____ Oxygen administered _____

Signs diver knew s/he was in distress _____

Place death registered _____(City, County) _____ (State)

AUTOPSY FINDINGS—SOURCES OF INFORMATION

Source 1_____ Source 2_____ Source 3_____

Primary cause of death _____ Secondary cause _____

Heart_____g Liver_____g Left Lung_____g Right Lung_____g

Gallbladder_____g Spleen_____g Right kidney_____g Left kidney _____g

Brain_____g

Scenario Narrative:

DIAGNOSIS CODING FOR DISEASE SEVERITY
BLINDED DIAGNOSIS

CODE = 0		ASYMPTOMATIC	
CODE = 1	**DCS-I**	**LOCATION***	**SIDE**
PAIN		G,H,I,J,K,L,M,N,U,V,W,X,Y,Z.	ANY
RASH		ANY	ANY
ITCHING		ANY	ANY
CODE = 2	**DCS-II**	**LOCATION***	**SIDE**
PAIN		F,D,Q,R,S,T,4,5.	ANY
NUMB/TINGLE		ANY	L/R
RESTLESS		ANY	ANY
HEADACHE		ANY	ANY
SKIN-SENSATION		ANY	L/R
MUSCLE-TWITCH		ANY	ANY
CODE = 3	**DCS-II**	**LOCATION***	**SIDE**
RINGING EARS		ANY	ANY
DIZZINESS		ANY	ANY
PAIN		O	ANY
FATIGUE		ANY	ANY
REFLEX		ANY	ANY
CODE = 4	**DCS-II**	**LOCATION**	**SIDE**
WEAKNESS		ANY	L/R
NUMB/TINGLE		ANY	BOTH
BREATHING		ANY	ANY
NAS/VOMIT		ANY	ANY
HEARING LOSS		ANY	ANY
SKIN-SENSATION		ANY	BOTH
PERSONALITY		ANY	ANY
WALK/STANDING		ANY	ANY
CODE = 5	**DCS-II**	**LOCATION**	**SIDE**
VISUAL-DIS		ANY	ANY
SPEECH-DIS		ANY	ANY
WEAKNESS		ANY	BOTH
PARALYSIS		ANY	BOTH
BLADDER		ANY	ANY
BOWEL		ANY	ANY
CODE = 6	**A-G-E**	**LOCATION**	**SIDE**
SEMI-CONSCIOUS		ANY	ANY
UNCONSCIOUS		ANY	ANY
PARALYSIS		ANY	L/R
CONVULSIONS		ANY	ANY

*Location of symptom is used in differential diagnosis and refers to question #52 on the DAN Dive Accident Reporting Form in appendix A.

NOTES