

BSAC INCIDENT REPORT

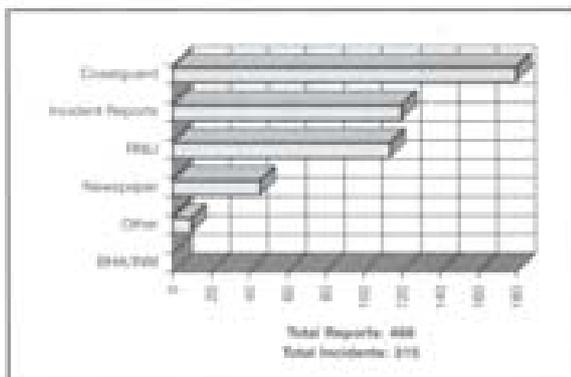
Brian Cumming, NDC Safety Adviser

"Good morning. In my report to you today, I plan to present to you three things: -

- A review of the statistics - how many incidents reported, what types, who reported them, etc.
- An overview and analysis of the year's incidents - trying to draw out the key points.
- Lastly a number of safety awards for individuals who have, by their actions, singled themselves out for special recognition.

But, before I do start, I need to explain the criteria that are used to determine which incidents are included in our report. Basically the data refers only to incidents that occur in the UK, and this means all incidents, not just those involving BSAC members. We are the governing body for sports diving in the UK and hence it is our responsibility to record and analyse data for all UK sports diving incidents. As for overseas incidents, we do receive information on them, but we only record and publish those incidents relating to BSAC members, and although these are not generally counted in the numbers you will find all of the information in the incident report.

Also important to note is that our incident year runs from the beginning of October to the end of September in the following year, so this report deals with the period from October 95 to September this year. By the way, just in case you have not discovered it, a copy of the Incident Report is included in every delegate's wallet. With those issues dealt with, let me start with the statistics.



We have had a total of 315 incidents reported in the 1996 incident year. This is a 10% reduction from the number recorded in 1995, and 1995 in turn showed a 9% reduction from 1994. It is difficult to be certain that this is a true indication of increasing safety, as there are several other factors that could also be affecting the numbers, but it is clearly a trend in the right direction.

This graph indicates the number of reports from the various sources.

As you can see and might expect, the greatest number come from the Coastguard (this is quite proper since the Coastguard should be your first point of reference in all coastal incidents). My grateful thanks go to Phil Wren, who is with us today, and who pulled out all the stops to get me the information in time to be included in this report.

Our own reporting system provided the next greatest source of information, closely followed by the RNLI, and again my thanks go to Mike Vlasto of the RNLI for his support. Newspapers provide a smaller, but important source of information and detail, although I think that we should treat some of it with caution, as I shall illustrate later.

Finally there is a small amount of information supplied by other sources, for example Stoney Cove, and my thanks go to them for their input. These numbers add up to more than the total number of incidents because, very often I received reports from several sources on the same incident.

The British Hyperbaric Association and the Institute of Naval Medicine were able to provide us with some summary data, but the constraints of medical confidentiality make it impossible for them to provide reports on specific incidents. I will cover this information later, but once again I would like to express my thanks to them for their valuable input.

Our analysis of incidents categorises them into 7 groups, and here you can see the breakdown by those groups for UK incidents. As you can see: -

- 16 resulted in fatalities
- 77 involved decompression illness
- 32 involved injury or illness
- 98 involved boat and/or surface incidents
- 24 involved ascents
- 25 involved other diving technique problems
- 19 involved equipment
- 4 were classed as miscellaneous

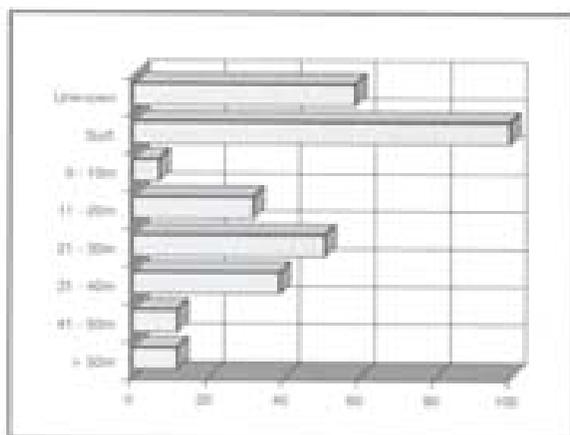
This graph shows the distribution of incidents by month, and the picture is quite typical of the normal pattern: most incidents occurring in the spring/summer period with a big step up at Easter.

Divers' need for Coastguard, Helicopter and RNLI assistance show similar pictures, and this graph shows the total use of the rescue agencies over the incident year: -

187 incidents involving the Coastguard
70 incidents involving helicopters
60 incidents involving Lifeboat launches

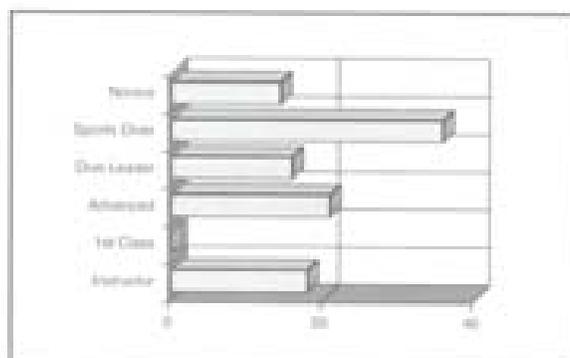
To finish the statistical theme, I have two more graphs to show. Firstly the depth range at which these incidents occurred.

As you can see, of those where the depth is known, most are at the surface and these include divers at the surface, boating incidents and incidents that occurred out of the water.

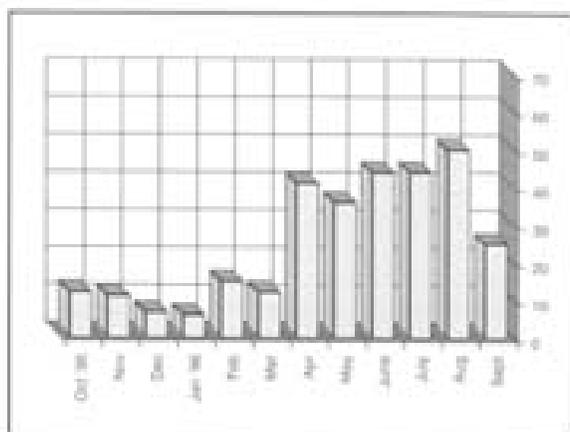


The in-water incidents show a predominance of occurrences in the 21 to 30 metre range, and my guess is not that this is an especially dangerous depth range, but much more likely that this is the most popular diving depth range.

There are only 10 incidents in the 'barry range', of over 50 metres (air divers), and this is almost half those recorded last year, let's hope that this trend (if that's what it is) continues.



My last graph in this group looks at the qualifications of those involved, and it only includes those for whom that information is known or relevant. I am not really sure what to conclude from this, since the data must be strongly affected by the numbers of divers in each category, and that factor is ignored in this chart. In the future I will try to include this parameter.

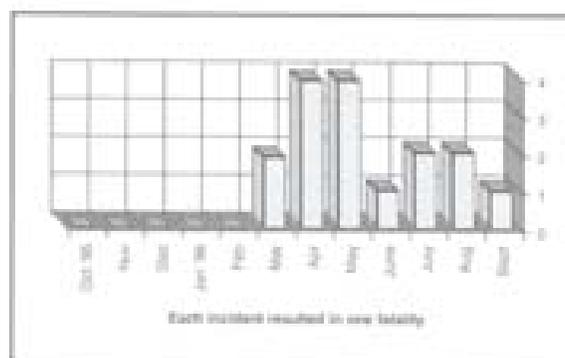


I am however sure of one thing, being a 1st Class Diver does not make you immune from problems.

Sadly, this year 16 people have lost their lives whilst engaged in sports diving activities in the UK. Whilst this number is typical of the average that history suggest that we can expect, each represents a tragic occurrence, bring great sadness to all of those involved.

Of the 16 deaths, 7 involved the loss of BSAC members, and this year conforms to the "normal" historical pattern.

The next graph looks at the distribution of all UK fatalities by month. If anything, it shows a bias towards the early part of the year, and bears out one of my thoughts about these incidents, namely that people are perhaps pushing themselves too hard at the beginning of the season, when the water is still cold, and without giving themselves a chance to work up to diving fitness and competence.



As you will see, I have tried, where possible, to assign one single prime cause to each incident, when we look at the fatalities the following issues emerge: -

Sadly, in this most important of all groups, in 50% of the cases, there simply is not enough information to be able to make a judgement on the key issue that caused the problem. In many ways this is not a surprise, since these are the only cases in which it is not possible to gain the opinion of the casualty.

3 of the year's fatalities involved individuals with prior medical conditions where it is probable that the additional stresses involved in diving precipitated an acute medical concern that lead to their deaths. Some of these problems were known and the individuals were clearly taking a risk, but this is not so in all cases. For example, in one incident, a diver took a medical examination, was given a clean bill of health then suffered a fatal heart attack whilst diving, two weeks later.

Also worthy of note is that 3 cases involved divers who were apparently diving alone. This is particularly relevant when there is presently much discussion about the merits and risks of solo diving. It can not be claimed that all of these divers would have survived if they had been diving with a buddy, but it is important to note that just under 1/5th of the fatalities involved solo divers, and it is certain that this is a much higher fraction than the number of solo dives that are conducted.

Whilst on this subject, you can read in the report of a number of incidents where divers became unconscious underwater, and

were safely recovered to the surface by attentive buddies. It is almost certain that these would have added to the fatalities if these divers had been diving alone. As it is, because of their positive outcomes, they feature as relatively minor incidents, and could easily pass unnoticed.

The second category of incidents involves incidents of Decompression Illness, and as I showed earlier, this is our second biggest category.

My analysis of the 77 incidents breaks down in the following way: -

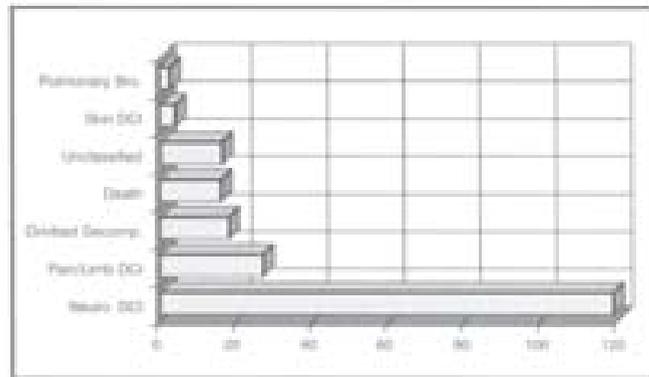
Again the biggest single group (40%) are those for which there is simply not enough information to be able to make a decision on the prime causal factor. Very often this is because the only report that we have is from the Coastguard, and by its nature it only deals with the management of a sick diver, and does not go into the causes.

Just under a quarter involve cases of DCI that seem to be inexplicable, in other words the dive profile would not have been expected to precipitate a problem. These could be cases where PFCs have been present, or simply the fact that no table or computer can guarantee freedom from a problem. However, I suspect that a large number involve a much simpler explanation, and that is that the truth is being stretched when the incident is reported. The reason for this comment lies in statement made to me by a representative of the BHA. It appears that the experience of the chamber operators is that as they spend time with a patient, during the often long process of decompression treatment, the truth slowly emerges, and the casualty often admits to features of the dive that clearly relate to the problem, and that were omitted or distorted in the report of the incident. Human nature is such that few of us like to admit our mistakes.

The next group, again just under a quarter, involves cases of DCI where some clear 'rule' of safe diving practice has been broken. Typical factors are rapid ascents, missed stops, and incorrect repeat dives. The following quotes from the incident report illustrate this group incidents:-

- *After an initial dive to 18m which included 12 mins of training stops. A diver re-entered the water alone to free a stuck anchor. Freeing the anchor caused exertion, and the diver surfaced rapidly from 15m, out of breath. At the surface the diver was distressed. Recompression treatment resolved the problem.*
- *A diver received a spinal bend causing loss of function of left leg. The incident involved a dive to 62m, the rescue of an unconscious diver, and a rapid ascent. A full recovery is reported.*
- *Two divers completed a dive to 30m for a bottom time of 35 mins, having experienced difficulty recovering the shot, which delayed their ascent. The dive computers of these divers required differing amounts and depths of decompression. The computer of one cleared, but the other still required 5 mins stops when the divers surface due to low air and being over due. At the surface one of the divers complained of 'pins and needles' in his hands and was put on oxygen. He was flown to a recompression chamber and treated for 2 hours.*
- *Following a dive to 42m for 24 mins, a diver made a rapid ascent, with no stops, and was subsequently recompressed.*

Some people do far more exciting diving than I do!



At this point I would like to look at the data provided by the INM on behalf of the BHA. As I stated earlier, confidentiality issue prevent the publication of too much detail, but this graph shows a revealing breakdown of DCI incidents by type, as you can see the biggest category, by far, involve serious cases of neurological DCI, and this backs up a verbal comment that was made to me by a representative of the BHA where it was stated that divers are not taking DCI seriously enough, apparently 25% of all cases treated result in significant unresolved problems for the casualty.

The next category of incidents involves injury and illness, and as you might imagine include a wide variety of problems.

The biggest single group in this category can only be described as bad luck! Situations where it is difficult to see how the problem could have been foreseen or avoided. The following examples illustrate the sorts of occurrence:-

- *De-kitting after a dive. A diver was lowering a combined 12M and pony cylinder to the ground when a clip on the stabjacket broke allowing the set to fall onto his big toe. The casualty was taken to hospital where a double fracture of the toe was diagnosed.*
- *Two fully kitted divers were walking towards the entry point for a dive. Their route included a series of steps which were blocked by a group of young children. In trying to negotiate this obstacle, one of the divers fell and broke his leg.*
- *During a training session in a pool with a maximum depth of 4m a trainee experienced difficulty clearing his ears during a descent. They ascended a little, the ear cleared and the session continued. Six days later, whilst under going a diving medical, it was discovered that this diver had a perforated eardrum.*

The last group of any significance involved a number of very similar incidents where divers have been injured by being struck by their buddy rolling or jumping into the water on top of them.

Divers were struck on the head and arms, very often by the buddy's cylinder. These potentially are very serious events, and are totally avoidable.

The next category of incident and the biggest single group with 98 incidents reported involve surface and boating incidents.

Of these, the major cause is a lack of, or poor servicing, leading to engine failure and divers stranded at sea. If the failure occurs whilst divers are in the water, it is very likely that lost divers will be the consequence. These two quotes from the incident report are typical.

- *A local ferry picked up two divers when they became separated from their RIB after it had broken down.*
- *Seven divers in three groups were diving at the same time, each group with an SMB. Whilst the divers were underwater, the engine of the dive boat stalled twice and the second time the Cox was unable to restart it. Eventually it was restarted but by this time the Cox had lost sight of the SMBs. After a search, the Coastguard was contacted and an inshore lifeboat launched. All divers were eventually found and returned safely to shore.*

There are many such cases in the report, and the fact that no lives were lost as a result is down to good luck and the skill of the rescue services.

The next, and sizeable grouping involves carelessness from boat-handlers, and good, or should I say bad, examples are:-

- *Two RIBs were together at a dive site waiting for the last pair to surface, when a third boat appeared. The pair in the water deployed a delayed SMB and ascended. One diver surfaced and the second was just below the surface when the third boat drove over the top of the second diver's bubbles, despite shouted warnings.*
- *Two divers had completed a dive to 30m and were using a lifting bag as a delayed SMB to make their ascent. When they were at 18m a RIB pulling a shot weight towed the shot line through the divers hitting one of the divers with the weight. The SMB was ripped out of their hands and they descended to the seabed.*
- *During an ascent from a wreck, at the final stop, one of a pair of divers noticed fishing weights passing by and was caught by a hook. This diver was dragged towards the surface. Every so often the line went slack and the diver sank down again. The buddy finally managed to cut this diver free, but a rapid ascent was made to just below the surface where buoyancy control was once more established.*

Another group in the 'boat and surface' category can be put down to poor planning, as illustrated by the following:-

- *Four pairs of divers dived in Lubworth Cove from the shore. Three pairs returned into the cove but the fourth pair was carried west by the current and were unable to return. A yacht was requested to pick them up.*
- *A car ferry out of Oban had to take avoiding action for a diver who surfaced in main shipping lane.*
- *Two divers apparently drifted off a shot line to a wreck and were picked up 2.5 miles from the site by another charter boat. They had no surface detection aids available.*

This latter issue comes up repeatedly, and is seemingly a very easy matter to resolve. Divers get separated from their boats for a number of reasons, they are swept away by currents, they are unmarked, or, as we have heard, engine failure often leads

to separation. Once lost, getting found again is the top priority, and this is where self-help is a critical issue.

Increasing your visibility to the searchers is paramount, and there are a number of ways to do this - flares, large inflatable 'sausage buoys', flags, etc. all are effective. I find it astonishing that anyone commits himself or herself to the deep without such a device. If you take nothing more away this weekend, take away the determination to equip yourself and your colleagues with surface detection aids, it is highly likely that at least one person in this room will be floating, lost at sea, remembering my words, before the next DDC.

The fifth category of incidents involves ascents and once again there are a number of common themes. Divers have conducted fast ascents because they have lost their weight belts, because they have been unable to control dry suit buoyancy, and because they have been dragged towards the surface by delayed SMBs and lifting bags. The following cases are typical:-

- *Two divers were filling a lifting bag at a depth of 32m to assist the recovery of a shot. The regulator being used to fill the bag free flowed. The lifting bag became buoyant and although the diver who had been filling it moved back, it carried him to the surface.*
- *One of a pair of divers tied a delayed surface marker buoy line to a wreck and released the buoy, in preparation for their ascent. The line did not seem to run freely. One of the divers detached it from the wreck but it became entangled with fishing line. The line jammed, catching the diver's thumb. Once the line was detached, the diver was pulled rapidly to the surface since the buoy had not reached the surface. A buddy line attached the divers to each other and hence both were carried to the surface. Their computers indicated that 5 mins stops had been missed.*
- *Two divers ascending from a no-stop dive to 35m intended to conduct a safety stop of 3 mins at 6m. However one of the pair was unable to release air from his drysuit wrist dump, and he ascended buoyantly to the surface, his buddy went with him. The thermal underwear is thought to have become mucked up and to have prevented effective dumping of air.*
- *After a dive of 24 mins to a maximum depth of 39m, a dive trio commenced their ascent. One of the divers lost control of his buoyancy due to unfamiliarity with a new dry suit dump valve, and ascended directly to the surface missing all planned stops.*
- *Two trainee divers were swimming close to the sea bed in 15m water when the weight belt of one of them became detached and dropped to the bottom and was lost in the silt. This diver alerted the instructor who tried to assist. Despite dumping air, and with the trainee upside down and flailing downwards, the pair made a buoyant ascent.*

Clearly most of these incidents could have been avoided by the application of more care, attention, and/or more practice with the equipment.

The next category of incidents involves problems associated with diving technique, and in this group poor planning features strongly -

- Two CG teams were tasked to search for two overdue divers. No dive plan had been logged anywhere. They had actually been caught in traffic (not at sea) !!!
- Two divers stayed too long at depth, were unable to relocate the shot line for ascent (it had been removed) and had trouble using a delayed SMB. Stops were correctly conducted at 6m, but at the 3m stop one diver was almost out of air and used the alternative air source of the other diver. When they surfaced they had missed 3 mins of stops at 3m, although they did have some air remaining.

Once again fundamental principles of diving practice had been overlooked and problems resulted.

The last category involves equipment problems, and two issues dominate this category of incident; poor or missing servicing and regulator free flows, probably due to cold water. The following extracts illustrate typical incidents:

- A diver's regulator mouthpiece 'came apart' underwater. She swam 7m to her buddy and snatched his regulator, displacing his mask. The buddy used his octopus regulator and adjusted his mask. The defective regulator was then found to be serviceable and the dive continued for a further 30 mins.
- One of a pair of divers experience a violent free flow from their regulator as they descended. A second regulator attached to a second cylinder was used, and since the pair were unable to stop the free flow the first cylinder was turned off.
- Subsequent examination indicated that this regulator had not received a recommended upgrade, and a mechanical failure had occurred.
- 4 mins into a dive, at 17m depth, the regulator of one of a pair of divers started to free flow. Attempts to rectify this underwater were made but these failed and the diver made a rapid ascent to the surface. Icing of the first stage was found to be the cause of the problem.

This latter incident was at fresh water site in March.

The message is clear, ensure that all servicing is correctly carried out, and take precautions against regulator free flow when operating in cold water.

Whilst on the subject of servicing, the following incident illustrates the need to ensure that correct servicing procedures are followed.

- The pillar valve of a diving cylinder exploded from the cylinder during filling. Extensive structural damage was caused and the operator received severe arm and ear injuries. The cylinder thread was 1/4" BSP and, incorrectly, a new valve had been fitted which had an M25x2 thread. The new valve had been fitted by the owner under what have been described as DIY conditions.

In this incident the pillar valve and attached compressor hose passed through a partition wall, a 6 square metre section of the roof of the building was blown into an adjacent garden, and the action of the pillar valve being ejected from the cylinder stripped out the thread causing a shrapnel effect which caused severe lacerations to the arms of the operator. The operator

was just moving forward to turn off the supply valve when the explosion occurred, a fraction of a second later and a fatality may well have resulted.

Before I leave the issue of equipment I must share one last incident with you, not because it is in anyway typical, if anything it is just the reverse. As divers we are all aware of the potential of a diving cylinder explosion, and we all take precautions to avoid the possibility. But the reality is that this is an extremely rare occurrence, fortunately! In my diving career, I have never come across such an instance. As a mechanical engineer, my view has always been that they are most probably designed with very large safety factors, and I have always been quite happy with that probability. But when you stop and think what is going on when a cylinder is charged it can be quite sobering. Typically you might have a 5Kw motor working away for 10 minutes to compress the air into the cylinder, at a modest 20% efficiency that is enough energy to lift the average family car several stories into the air. Ask yourself what happens if you get all of that energy back in one go!

If you are lucky you get showered with rust and water, a dislocated shoulder, badly bruised, a ringing in the ears, and a large laundry bill. In this instance the two divers were very lucky, the cylinder was only a 3 litre cylinder and it was immersed in a water-bath when it exploded. The cylinder had been correctly serviced and inspected, and the amount of internal corrosion present is a surprise to all those involved and has so far not been satisfactorily explained. The cylinder is currently being metallurgically examined.

Whilst I am considering the unusual, I thought that you might like to hear of some of the things that made me smile as I read through the incidents.

Firstly, I said earlier that we should treat some of the press reports with caution, well here is a good example from that widely read journal the Cornishman -

"... Coastguard were called to the scene after the 29 year old man suffered a buoyant descent from 18 metres and recovered later after being placed in a decompression chamber"

Presumably they were flown to the decompression chamber in a submarine.

We often here the comment that one should use dive computers with caution since it is the diver not the computer that gets bent. Well in one case this situation seems to have been reversed. The report describes a particularly difficult ascent where an attentive dive leader successfully completed a difficult lift on an over weight and struggling dive buddy. The effect was a much faster than desired ascent, and the report includes the wonderful lines

"Fortunately neither Diver A nor Diver B suffered any ill effects from the incident - although Diver B's computer wasn't too happy"

One report describes how 'A large vessel came very close to a group diving a wreck. Two boats took up a position between the vessel and the divers. The vessel failed to respond to radio calls. It turned away at a range of 100m.'

The report concludes with the dry comment

"In the heat of the moment the white flares carried on board were overlooked

- Next time we open fire"

As I mused over these incidents I was struck by a couple of conclusions:-

Firstly, most of these incidents could have involved anyone of us. Sure there have been a number of really stupid incidents that I hope everyone here would have avoided, but in general, most of them could have been anyone of us. If we are honest we have all cut corners in our diving and generally we get away with it, but every so often the luck runs out.

Secondly, several years ago I remember listening to a former NDD or Incidents Advisor describing the concept of an 'Incidents Pit'. The idea was that of a progressively steepening hole into which you would graph as an incident developed and worsened, the deeper you went the more difficult it was to get out. At the time I thought that this was a rather unhelpful model of the situation since I could not see how to use it to avoid problems. Having read through over 300 reports I can now fully understand the thinking that went into the concept, perhaps I didn't listen well enough at the time.

The facts are that we all place our selves at higher than normal risk every time we dive, and things do regularly go wrong. Usually we are able to correct the situation, but every so often the toast lands jam side down, and a serious situation quickly develops. I think that an important message of the Incident Pit model is that we are all used to taking risk in every day life, and we are used to managing the consequences. We drive cars, sometimes they break down, and when they do we are inconvenienced, but rarely are we placed at serious risk as a

result. Generally the situation is not serious, nor close to being serious. I believe that we tend to transfer our every day experience of risk management to the diving situation, without realising that the slope is very much steeper, steeper because we are in an alien environment. And that is before things start going wrong.

Boat engine failures are not the same as car engine failure, arriving late at a planned stop is not the same as arriving late for a meeting, and in the real world we have an inexhaustible supply of commodity that we have the most immediate need for - air. All of this may seem very obvious, but I think that we become so skilled at coping with everyday life that we fail to realise that the rules are much tougher on or under the sea. We allow ourselves to be lulled into a very false sense of security.

In summary let me leave with a thought. If we could do just five things better:-

- thorough and timely equipment servicing
- take more care over dive planning
- build up slowly - don't push yourself too far too fast
- encourage more care from our boathandlers
- ensure that we stay inside the recommended limits for safe dive profiles
- we could cut our incidents by up 50%!

Finally let me thank you for your attention, and for all of the reports that you have submitted."

BSAC SAFETY AWARDS

Brian Cumming then introduced the BSAC Safety Awards and Bob Boler, the National Diving Officer, made the presentations.

"My final duty today leaves me with very mixed feelings. The BSAC makes Annual Awards that recognize special efforts made by divers towards the safety of others. This year our awards recognize four separate events, and sadly, the first two deal with two of the year's fatalities.

In May this year, Alf Fisher was descending a shot line to a depth of 24m. At 24m Alf indicated to his buddy that he wanted to ascend. An ascent was started during which Alf lapsed into unconsciousness. His buddy brought him safely to the surface, where Alf's son, Terry, was the first to the scene, and took charge of the rescue management. Swiftly, Alf was recovered into the boat and resuscitation actions were started. After a while the rescue services arrived and he was flown to hospital. Sadly, Alf did not recover. He had followed all the recommendations and had had a recent medical, but he succumbed to a heart attack.

Rescue professionals at the incident praised the actions of all of those involved and singled out Terry Fisher, the casualties son, for special mention, for his courageous and professional attempts to save his father. The BSAC would like to recognize the efforts of **Terry Fisher** with the **Alan Broadhurst Award**.

For their parts in the same rescue attempt, BSAC Safety Awards go to **Andy Dymond, Mark Palmer and Paul Thomas**.

In the second case, also in May, Daniel Collins was diving in 13m of water when he indicated to his buddy a problem with his regulator and made a swift ascent to the surface. His buddy quickly followed and found Daniel at the surface, unconscious and with his drysuit over inflated. Daniel was recovered into a boat and brought to the shore. Resuscitation attempts were made, and so successful were they in these attempts that a pulse and spontaneous respiration returned. Daniel was flown to a recompression chamber and then taken to hospital. Sadly Daniel did not recover.

The rescue services expressed their astonishment at the professionalism and persistence of all those involved. Although these attempts did not save Daniel, they did allow organ donation to take place, which would not otherwise have been possible.

In recognition of their efforts BSAC Safety Awards go to **Peter Stansfield, Amanda Ovale, Mike Doherty, Mick Wilson, Dave Ramage, Steve Gore, and Phil Douglas**.

In January this year Steve Millard was taking a trainee through a drysuit drill in a pool in 3m of water. Without any warning, the trainee lapsed into unconsciousness, and lost her regulator.