

British Sub-Aqua Club

A review of the nature of diving
in the United Kingdom
and of UK diving fatalities
in the period
1st Jan 1998 to 31st Dec 2009

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Outline

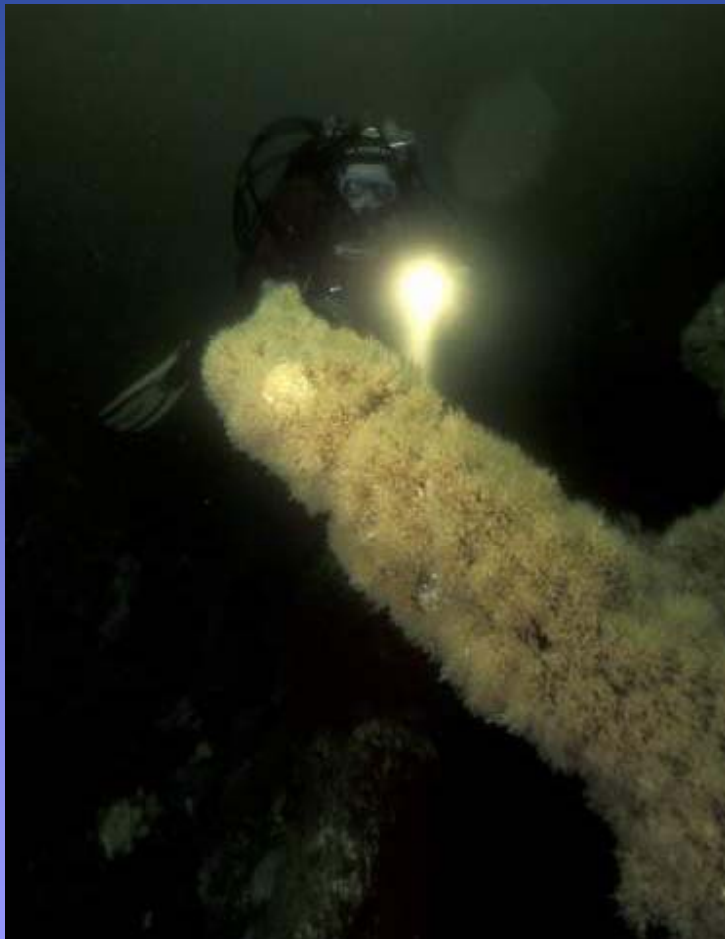
- The nature of UK diving
- Diving organisations in the UK
- Diver training in the UK
- The UK dive survey
- Diving incident data – scope of analysis
- Fatal incident analysis
- Summary and conclusions

The nature of UK diving

- 11,000 mile coastline
- 1,000 plus islands
- 44,000 shipwrecks
- <70 miles to the coast
- Sea, lakes, quarries, rivers, lochs, caves



The nature of UK diving



Depths from
0 to 80m plus are
readily available
both at sea and in
some inland sites

The nature of UK diving

Sea temperature

4°C (39°F) to 18°C (64°F)

Inland waters may freeze in
winter

Most divers use drysuits
throughout the year



The nature of UK diving



Underwater visibility can vary
from 30m to zero

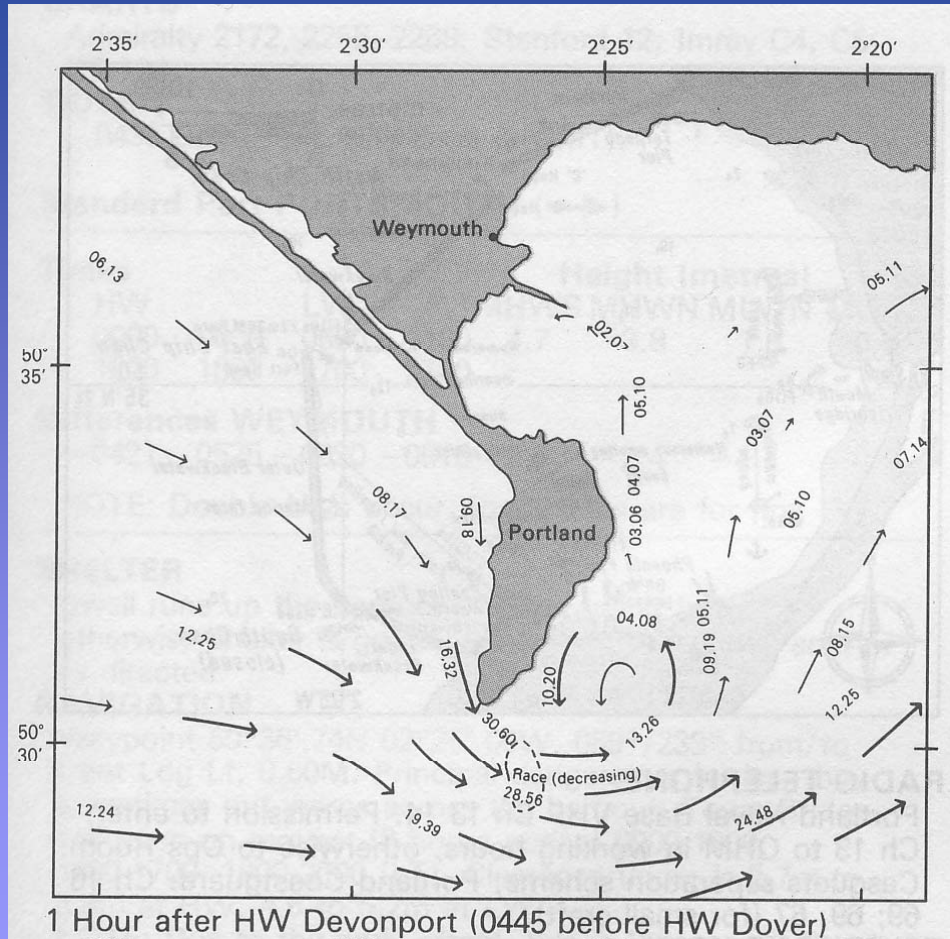
The nature of UK diving

Surface conditions can range
from flat calm (rare) to
totally impossible
(not so rare)

Coastal geography means that
some shelter is often available
but sea-sickness is a frequent
problem



The nature of UK diving



Tidal ranges up to 15m

Tidal streams up to 10 knots are possible but rare

Tidal streams of 5 knots are common

Planning for slack water is usually required

Diving organisations in the UK

BSAC is the governing body for the sport in the UK

- Diving club with 35,000 members (UK and overseas)
- Largely volunteer run
- Small HQ staff (employed)
- Nationally set standards
- Branch based – branches organise their own programmes
- National coaching and instructor training structure
- Commercial schools and overseas franchises

Other UK based training agencies

Club based – SAA, SSAC, CFT

Commercial – PADI, SSI, IANTD, TDI, ANDI, ITDA etc.

UK diver training

In many parts of the world divers dive in large groups of buddy pairs led and supervised by an experienced dive guide. UK conditions generally do not allow this approach

UK diving usually is based upon dive pairs who are sufficiently well trained to be able to conduct the dive by themselves

At the surface there will be an experienced diver who manages the whole event and ensures that appropriate backup support is available

UK diver training

The minimum skill level for each diver in a buddy pair must include:-

- Good basic diving skills
- Buddy rescue skills
- Leadership skills
- Navigational skills

UK diver training

Typical Club / Branch based training:-

- Weekly pool and lecture sessions
- Indoor training during the winter period
- 1 to 1 instruction in practical sessions
- Instructors are qualified nationally
- Instructors are volunteers
- Experienced divers organise diving trips
- Experienced divers support diver development
- Branches provide a social environment
- Training at a slower pace

UK diver training

Commercial training:-

- Steady growth in commercial training since the 80s
- Initially a US based training approach caused some problems in UK diving conditions
- Attractive to people who are 'time poor'
- Attractive to people preparing for a holiday diving trip overseas

BSAC diving incident report

- Published annually since 1965
- Available free of charge from BSAC
www.bsac.com/incidents
- Covers all UK sports diving incidents (all affiliations)
- Covers overseas incidents involving BSAC members
- Information gleaned from many sources
 - BSAC incident report form
 - MCA - Coastguard
 - RNLI – Lifeboat
 - Reports from managed dive sites
 - Free-form and internet
 - Press reports
- Lessons learned are promulgated to all divers & used to guide BSAC training programme development
- 99.99% certain that all fatal incidents are captured
- A representative sample of non-fatal incidents



BSAC 'Safe Diving' booklet

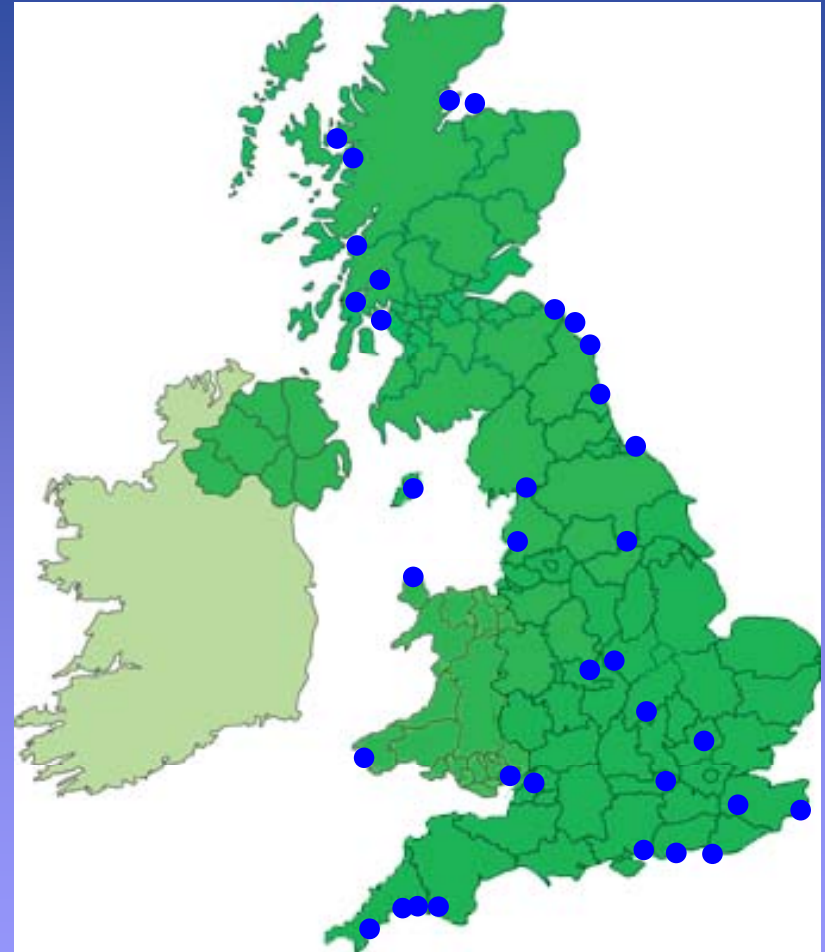


- For many years BSAC has published a booklet called 'Safe Diving'
- Regularly updated, this booklet encapsulates the Club's collective experience and distils it into specific advice and guidance on all aspects of diving safety
- Findings from the incident report are fed into this booklet
- 'Safe Diving' is available, free of charge, to all

www.bsac.com/safediving

UK diving survey

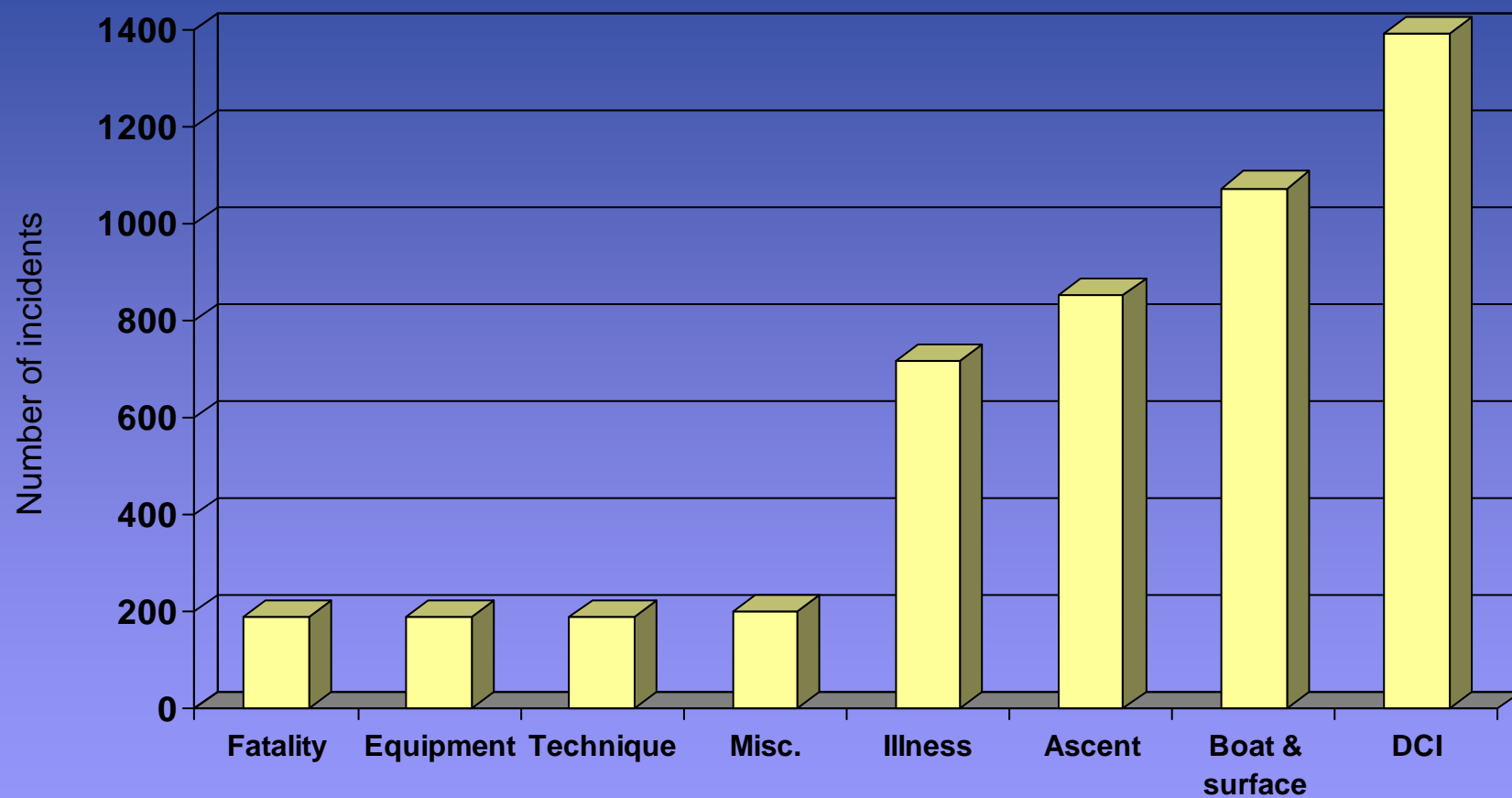
- Survey conducted over a weekend in 2007
- To develop a background understanding of the nature of UK diving and UK divers
- 35 dive sites
- 1,000 respondents
- Backed up by surveys at conferences, dive show and dive shops
- Used to put diving incidents into context



UK diving incidents

- The current database contains information back to 1997
- This analysis covers the period 1st Jan 1998 to 31st Dec 2009
- 4,799 incidents recorded in the database in this 12 year period
- First level categorisation:-
 1. Fatalities
 2. Decompression illness (DCI)
 3. Surface and boating
 4. Ascent
 5. Technique
 6. Equipment
 7. Illness (other than DCI)
 8. Miscellaneous

UK diving incidents



UK fatalities

- Between 1st Jan 1998 and 31st Dec 2009
- 187 fatal incidents
- 10 incidents involving double fatalities
- 197 fatalities in total

UK fatalities analysis

- Insufficient information with 57 of the 197 fatalities
 - No surviving witness
 - Solo divers
 - Separation
 - Double fatalities
 - Insufficient information reported
 - More recent reports – information some times takes time to filter through
- 140 incidents analysed

UK fatalities analysis

Primary causal factor	Occurrence	Frequency
Non-diving medical problem	38	27.1%
Rebreather use	15	10.7%
Equipment problem	13	9.1%
Out of gas	12	8.6%
Inadequate pre-dive checks/brief	12	8.6%
Inexperience	10	7.1%
Buoyancy – diver light	10	7.1%
Buoyancy – diver heavy	8	5.7%
Narcosis	5	3.6%
Tangled (rope, debris)	5	3.6%
Trapped in wreck	5	3.6%
Other trauma	3	2.1%
Other rapid ascent	1	0.7%
DCI	1	0.7%
Unconsciousness	1	0.7%
Separation	1	0.7%
Total	140	100%

UK fatalities analysis

Non-diving medical problems

38 cases

- 27 confirmed
- 11 presumed
- Mainly heart attacks but also strokes
- 2 cases involved snorkel divers – uncertain if these were trained 'divers' or just casual participants

UK fatalities analysis

Rebreathers

15 cases

- 11 cases of diver error – entering the water without correctly switching the system on
- 4 cases of equipment problems – ‘failed diaphragm’, ‘oxygen leakage’, ‘oxygen surge’ and ‘home made’
- 5 cases where the rebreather was not implicated

27 of the total of 197 fatalities (14%) involved a diver who was using a rebreather

Our survey showed that only 4% of dives were conducted using a rebreather in 2007

UK fatalities analysis

Equipment problems

13 cases

- Excludes rebreathers
- 3 cases of regulator free flow
- 3 cases of regulator fault and cessation of gas supply
- 2 cases of weightbelt failing to release
- 2 cases of BCD failure
 - 1 inlet valve stuck open, 1 inlet valve stuck closed
- 1 case direct feed hose failure
- 1 case of over reading cylinder pressure gauge leading to unexpected 'out of gas'
- 1 case of an oversized semi-drysuit causing the diver to become very cold

UK fatalities analysis

Out of gas

12 cases

- Often followed by a failed attempt to use a secondary gas source
- Loss of buoyancy often occurred (sometimes due to the inability to inflate a BCD or drysuit)
- 2 cases involved divers re-entering the water after a dive, with low gas supplies, to recover lost equipment

36 of the 140 cases involved divers running out of breathing gas, although in many cases this was a secondary or tertiary factor

UK fatalities analysis

Inadequate pre-dive briefing/checks 12 cases

- 7 cases involved incorrect equipment set up that was not found until the diver was in the water
 - Direct feed hose not connected
 - Gas supply not turned on
- 3 cases involved divers entering the water unknowingly using their pony regulator
- 1 double fatality where divers entered the water and encountered difficult and unexpected conditions – the inquest report stated that their 'dive brief was inadequate'

UK fatalities analysis

Inexperience

10 cases

- 3 cases involved an instructor with 2 or more trainees
 - 2 cases involved trainees struggling with their gas supplies
 - 1 case involved a trainee who became tangled in line
- 1 case involved a diver on their first UK dive, their first drysuit dive and in rough sea conditions
- Relatively trivial incidents that led to fatalities
 - Water in mask, water in mouthpiece, difficulty clearing ears
- Mainly divers under instruction who, if they had been in more benign conditions (depth, visibility, water movement etc), would probably have survived

UK fatalities analysis

Buoyancy – diver too light

10 cases

- 4 cases involved divers losing control of their drysuits and making rapid ascents (3 inverted)
- 2 cases involved weights
 - 1 case of lost weights and 1 case of diving without weights
- 2 cases involved simply poor buoyancy control
- 1 case involved problems with a delayed SMB
- 1 case involved a diver with a heavy weight attached to his upper harness which inflated his drysuit

6 of these cases resulted in death through a pressure related injury

UK fatalities analysis

Buoyancy – diver too heavy

8 cases

- 4 cases involved divers who sank rapidly at the beginning or during a dive and became separated
- 2 cases involved divers who had completed their dives but then sank from the surface
- 1 case involved a diver who surfaced rapidly and then sank when returning to his intended stop depth
- 1 case involved a diver who was sinking and whose buddy had to lift him with the casualty's drysuit

25 of the 140 fatalities involved this factor.

In many cases a troubled diver got to the surface or close to the surface only to sink back down again and be lost

UK fatalities analysis

Nitrogen narcosis

5 cases

- All air divers
- Depths 60m, 60m, 57m, 55m and 51m
- 3 cases involved divers failing to follow planned depth and time constraints
- 1 case involved a diver becoming confused and unable to deal with a tangled rope
- 1 case involved a diver who lost consciousness

UK fatalities analysis

Tangled

5 cases

- 2 cases involved divers who became tangled in delayed SMB lines
- 2 cases involved divers who became tangled in lines laid on the bottom (one was a solo cave diver)
- 1 case involved a diver who became tangled in a shotline

UK fatalities analysis

Trapped in shipwreck

5 cases

- 4 cases (including one double fatality) involved divers who became lost inside a shipwreck and were unable to find their way out before their gas supplies were exhausted
- Reduced visibility inside the wreck due to the divers' presence was a major factor
- It is believed that none of these divers were using guidelines
- 1 case involved a diver who became stuck in a narrow section of a wreck

UK fatalities analysis

Other trauma (non-pressure related) 3 cases

- 1 case involved a diver whose head struck a rock in rough sea conditions
- 1 case involved a diver who was struck on the head by a boat's propeller
- 1 case involved a diver who fell under a trailer whilst a boat was being recovered (arguably not a diving fatality)

UK fatalities analysis

Rapid ascent

1 case

- Diver made a rapid ascent to the surface, signalled distress and then sank

Decompression illness

1 case

- Diver suffered a pulmonary embolism after an apparently normal dive

Unconsciousness

1 case

- Diver lost consciousness in a swimming pool while undergoing drysuit training

UK fatalities analysis

Separation

1 case

- This case involved two divers who surfaced from their dive and found themselves separated from their boat. They were in rough water for 70 min before they were located, one of the pair drowned before rescue

Separation (usually underwater) occurred in 55 of the 140 cases (39%), almost always as the result of some prior perturbing event.

Avoidance of separation must be a key factor in the reduction of fatal incidents

Exacerbating factors

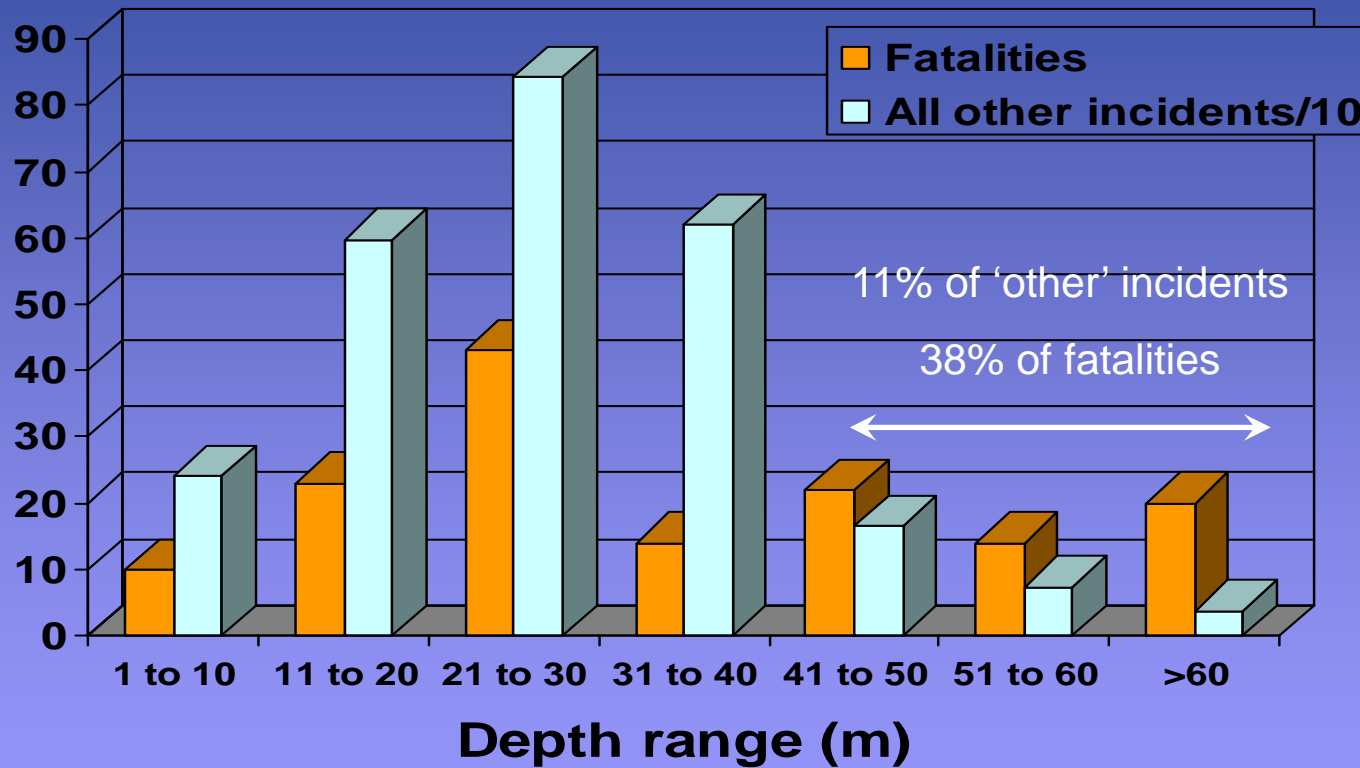
Non-pair diving

- 26 of the 197 fatalities (13%) involved solo divers
- 38 of the 197 fatalities (19%) involved divers in groups of three or more. Very often with divers under instruction

28 of these 38 cases involved a separation (74%)
Cases of separation in the total population of 197 fatalities is 40%

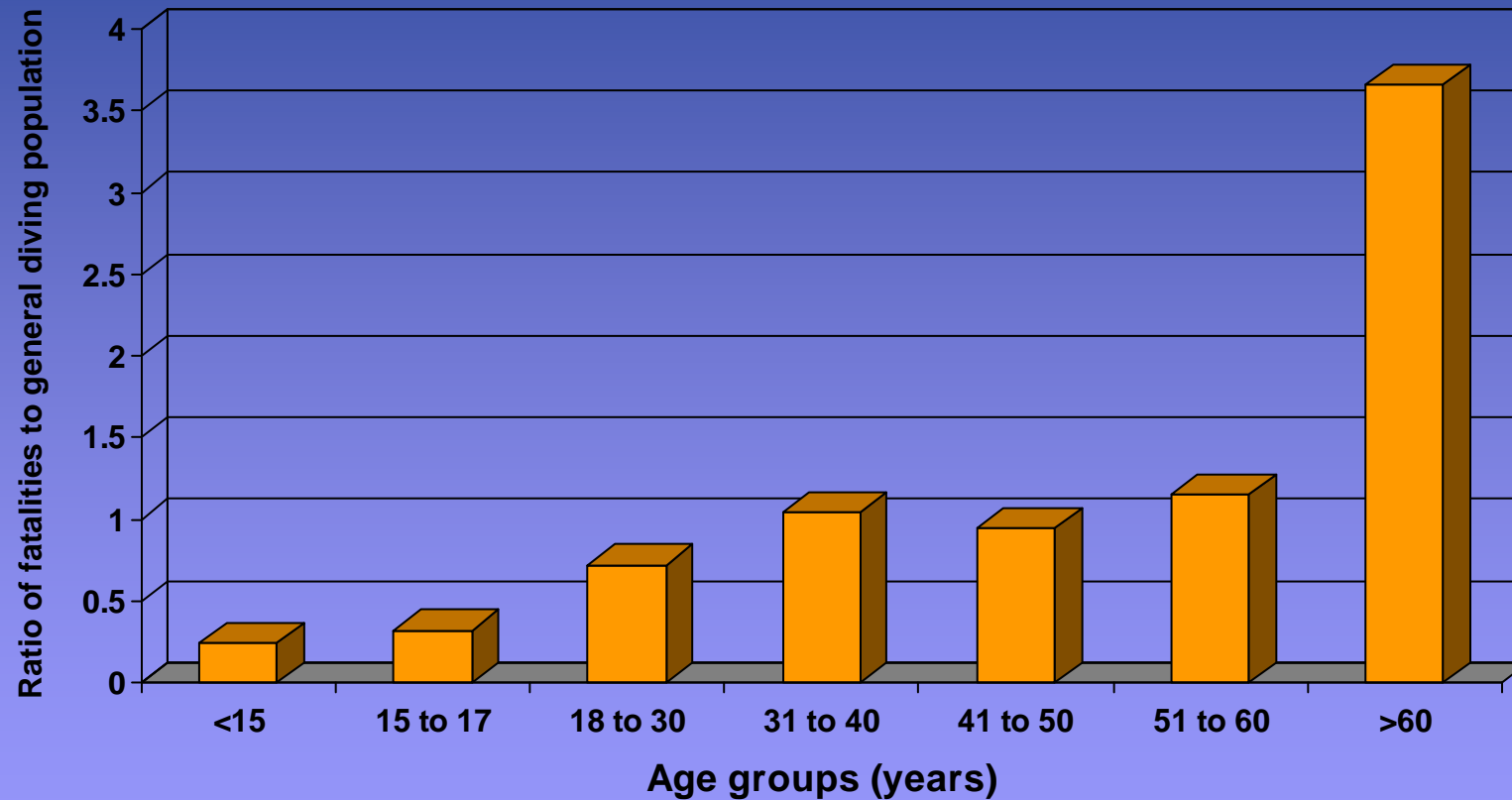
Exacerbating factors

Depth



Exacerbating factors

Age



Exacerbating factors

Club vs non-Club diving



Exacerbating factors

Club vs non-Club diving

- No commercial pressure on speed of training
- No commercial pressure on the size of training group
- Continuous availability of experienced support beyond the basic training phase
 - Experienced divers manage the dives
 - Inexperienced divers dive with experienced divers
 - Experienced divers are on hand to point out incipient problems and how to avoid them
 - Experienced divers are immediately available to provide rapid and effective assistance if required
 - Inexperienced divers can learn through 'osmosis' as well as formal training

Conclusions

- 27% of fatalities were due to 'non-diving related' medical events
- Over 70% of diving fatalities were potentially avoidable
 - 29% related to inadequate pre-dive preparation
 - 18% related to inadequate dive monitoring
 - 16% related to inadequate diving skills
 - 9% related to divers who were in situations beyond their current level of capability
- If divers had paid attention to these basic issues then it is most probable that another 140 UK divers would be alive today

