

# Review of scuba diving fatalities and decompression illness in Australia

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## Key words

Diving deaths, scuba diving, diving accidents, decompression illness, decompression sickness, data, epidemiology

## Abstract

(Lippmann J. Review of scuba diving fatalities and decompression illness in Australia. *Diving and Hyperbaric Medicine*. 2008; 38: 71-8.)

**Introduction:** Recreational scuba diving is a popular activity in Australia, especially around the Great Barrier Reef. Despite efforts by the industry and various governments to reduce the risk, there remains substantial morbidity and mortality as a result of diving. The aim of this study was to estimate the historical and current risk of death and decompression illness associated with scuba diving in Australia.

**Method:** Data were collected through comprehensive internet searches of various journals and electronic databases using appropriate general and medical search engines, hand searches of relevant journals, searches of the DAN Asia-Pacific dive fatality and decompression illness databases, and consultation with various recompression facilities, and diver certification agencies and dive industry bodies.

**Results and Conclusions:** There were 566 diving fatalities reported between 1972 and 2006, of which 290 divers were using scuba. In addition, a total of 3,558 divers were treated for decompression illness in Australian chambers during 1995–2007 financial years. Using recent surveys of scuba diving activity, it can be estimated that there were in excess of 1.75 million scuba dives conducted in Australia in 2006. On the basis of the available data, the mortality rate in scuba divers in Australia can be estimated to be 0.57 per 100,000 dives during 2002–2006. Similarly, the incidence of decompression illness during that period in Australia was 10.74 per 100,000 dives or lower. There has been no significant increase in the annual number of scuba diving fatalities from 1972 to 2006.

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## Introduction

Scuba diving is an exhilarating recreational activity, undertaken around much of the Australian coastline by both Australians and international tourists. Although there are anecdotal reports of people snorkelling in Australia since at least the 1920s, the scuba diving industry began to emerge here in the 1960s. As diving is conducted in a potentially hostile environment there are some inherent risks. Many of these risks can be reduced by factors such as adequate education and training, ensuring adequate fitness and health for diving, appropriate supervision, appropriate and functional equipment, and common sense. However, there is still substantial morbidity and mortality as a result of diving, despite efforts by the industry and various governments to reduce this.

Historically, participants were mainly experienced breath-hold divers who were generally comfortable in the water and who possessed reasonably sound water survival skills. However, as the broader community has become more aware of the beauty of the underwater world and training has been targeted at a broader subset of the population, there has been an increase in the number of divers with relatively poor aquatic skills and sometimes poor fitness and health. In addition, some of the earlier, now ageing, divers who have continued diving have developed medical conditions that may render diving less safe. Unless this is carefully managed by appropriate and adequate participant screening, training, supervision and accident management systems, it can be a

recipe for unnecessary morbidity and mortality.

The aim of this study was to estimate the historical and current risk of death and decompression illness associated with scuba diving in Australia by collating and reviewing the available data on scuba diving fatalities, non-fatal decompression illness (DCI) and total scuba diving activity over the period 1972–2006.

## Method

As part of its ongoing research into, and reporting of, general diving fatalities in Australia and elsewhere in the Asia-Pacific region, DAN Asia-Pacific obtained ethical approval from Human Research Ethics Committee, Department of Justice, Government of Victoria, Australia to access and report on data included in the National Coronial Information System (NCIS).

## DIVING ACTIVITY

Diving activity data from Australia were obtained through hand searches of the South Pacific Underwater Medical Society (SPUMS) journals, consultation with recompression facilities and diving industry bodies and internet searches as indicated in Table 1. In addition, internet searches were conducted to find relevant sporting activity surveys and reports. Finally, the major diver certification agencies in Australia were approached to provide diver certification numbers for 2007.

## DIVING FATALITIES

A comprehensive search was made of the two available resources, including hand searching of the reports of 'Project Stickybeak' from 1972 to 2002.<sup>1-6</sup> This project has aimed to provide insights into the causes of scuba diving and snorkelling accidents to improve diving safety. The other major source interrogated was the DAN Asia-Pacific dive fatality database for scuba diving fatalities occurring between 2003 and 2006. DAN Asia-Pacific has continued and expanded the work of Project Stickybeak to create a regional database of diving fatalities. Finally, internet searches were conducted as indicated in Table 1.

Annual fatality rates were analysed using Poisson distribution models to examine any trends that may have occurred. The fatality rate was assumed to be either constant, or to follow a trend that was linearly or exponentially increasing with time.

## DECOMPRESSION ILLNESS

Annual decompression illness treatment data for Australia were collected through direct liaison with various recompression centres within Australia and by hand searches of the Hyperbaric Technicians and Nurses Association Annual Reports for the relevant periods.

## MORBIDITY AND MORTALITY DATA FROM OTHER COUNTRIES

Comparative diving morbidity and mortality data were sought via hand searches of relevant reports, liaison with reporting bodies, and internet searches on major search engines as indicated in Table 1.

## Results

### THE DIVING POPULATION

The search resulted in eight sources of information from Australia on diving activity that were deemed suitable

for this study. One was a prospective estimate of cylinder fills,<sup>7</sup> one was a prospective survey of dive operators,<sup>8</sup> three were retrospective surveys from dive operators, instructors and training agencies,<sup>9-11</sup> one was a retrospective survey of tourists<sup>12</sup> and two arose from regular retrospective population surveys.<sup>13,14</sup>

### Certifications

The first national study of the Australian scuba diving industry, published in 1989, reported that there were 50,550 new scuba divers certified in 1988.<sup>9</sup> By 1991, this figure had risen to 54,153.<sup>8</sup> However, in 2007, it had dropped to around 48,000 (personal communications from the PADI, SSI, NAUI, SDI dive training agencies, 2008.)

### Dives conducted

The Victorian dive industry representative body (DIVA) conducted a survey of cylinder filling stations over a one-year period from July 1993 to June 1994. The data collection was prospective, and each station was asked to record each time a cylinder was filled. The authors estimated that there were approximately 77,706 tank fills during that 12-month period.<sup>7</sup> Accounting for divers who had their tanks filled privately, it was reported that around 80,000 scuba dives were performed in Victorian waters that year.

A survey conducted in Queensland in 1994 asked operators who held permits to conduct diving activities on the Great Barrier Reef (GBR) to complete a form estimating the number of scuba dives performed through their operation during that period.<sup>11</sup> It was estimated that approximately 1.3 million scuba dives were conducted on the GBR in 1994. This estimate was reasonably consistent with an earlier report that estimated that approximately one million recreational scuba dives were conducted in Queensland in 1991.<sup>8</sup>

A recent report presented the findings of a survey of the diving activities of overnight visitors to Queensland between April 2006 and March 2007. It was estimated that around 1.2 million international and domestic overnight visitors undertook scuba diving and snorkelling activities while in Queensland. Of these, 345,000 (comprising an estimated 143,000 domestic visitors and 202,000 international visitors) went scuba diving.<sup>12</sup> The authors of this report estimated that a minimum of approximately 1.2 million scuba dives were conducted throughout Queensland over that period. This figure is exclusive of local residents who went diving and did not stay in a hotel.

There is relatively little information about the number of people who participate in diving activities in parts of Australia other than Queensland and Victoria, where the reports discussed above were produced. However, the annual Participation in Exercise, Recreation and Sport (ERASS) reports, which survey exercise involvement in people over

**Table 1**

### Key words and databases used for internet searches

Key words:	Scuba diving / diving / sport* activity or survey*, Australia diving / scuba diving + morbidity, mortality, death*, fatalit* Decompression sickness / decompression illness and incidence or rate, diving death* or incident* or accident* scuba diving / diving / snorkelling and death* or accident
Databases:	PubMed, Medline, Embase, CINAHL, sportDISCUS, Google, Google Scholar, Alta Vista, Yahoo, Dogpile

15 years of age, indicated a participation rate of 0.5% for scuba diving in both 2005 and 2006.<sup>13,14</sup> In these surveys, the estimated number of people who scuba dived in 2005 was 86,800 (95% confidence interval 64,636–108,964), and 78,300 (95% confidence interval 57,190–99,410) in 2006.

The ERASS reports also estimated that the mean number of scuba dives conducted by the diving group was 12 in 2005 and 12.1 in 2006.<sup>13,14</sup> This indicates an annual dive estimate of 1,041,600 in 2005, and 947,430 in 2006 for Australian residents; the average over the two years being 994,515 dives. Confidence intervals could not be determined for this estimate as the raw data could not be accessed. If we assume that:

- the ERASS two-year average for the number of dives done by Australian residents is a reasonable estimate;
  - the Queensland estimate of dives by international tourists (750,000) is reasonable and was similar over recent preceding years;
  - we can ignore diving tourists to other States, of whom there are relatively few compared with Queensland;
- we can estimate that around 1.75 million scuba dives were conducted in Australia in 2006 (i.e., approximately one million by residents and 750,000 by international tourists). These dives were undertaken by approximately 280,000 divers.

**DIVING FATALITIES**

The search indicated that there were a total of 566 recorded diving fatalities between 1972 and 2006. This includes all of the main diving modalities, i.e., scuba, snorkelling, surface-supplied (hookah) and rebreather (Table 2). The data for 2002 onwards is provisional as it is likely that some additional cases will be added, especially in the later years as it can take several years before all fatality data are received for a particular year. Figure 1 shows the number of currently recorded Australian diving fatalities (all modes) per year from 1972 to 2006 (DAN A-P, unpublished data; <sup>1-6</sup>).

Table 3 compares the average number of diving fatalities from all modes of diving with scuba diving fatalities per decade, or part thereof. The trend models for scuba diving fatalities suggest a slowly increasing trend from an average of 7.0 fatalities per year in 1972 to an average of 9.6 fatalities per year in 2006. However, the trend terms were

**Table 2**  
**Mode of diving for dive fatalities**

Scuba	290
Snorkel	194
Hookah	62
Rebreather	6
Unknown	14
<b>Total</b>	<b>566</b>

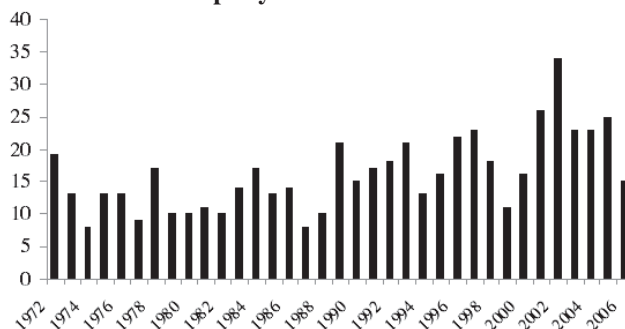
**Table 3**  
**Average Australian diving fatalities per period (all modes and scuba)**

Years	All modes	Scuba
1972–79	12.6	6.8
1980–89	12.8	7.9
1990–99	18.4	9.2
2000–06	23.0	9.1

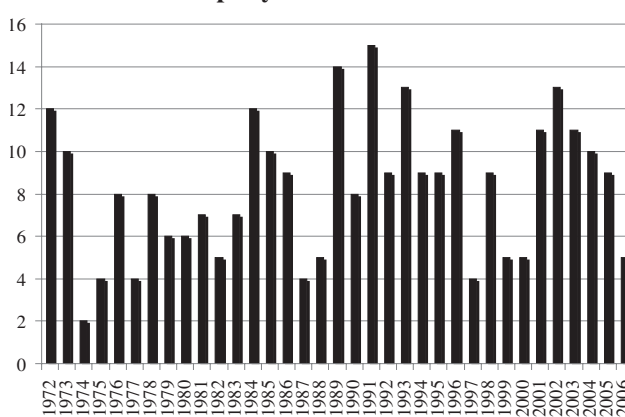
not statistically significant (likelihood ratio test for the slope term in Poisson loglinear regression,  $P = 0.12$ ). The data are consistent with a model in which fatality rates are constant: annual fatalities are Poisson-distributed, with a mean of 8.26 fatalities per year. The model that assumes a constant mean fatality rate passed a goodness-of-fit test (chi-squared goodness-of-fit test based on residual deviance,  $P = 0.08$ ) and a test of overdispersion (Dean-Lawless overdispersion index  $T_b = 1.2$ ). The suggestion of increasing fatality rate in the trend models may be caused by a recent spate of fatalities (2001–2004).

Figure 2 shows the number of scuba diving fatalities per year from 1972 to 2006.

**Figure 1**  
**Number of diving fatalities (all modes) in Australia per year 1972–2006**



**Figure 2**  
**Number of Australian scuba diving fatalities per year 1972–2006**



**Figure 3**  
**Scuba diving fatalities in Australian States and the Northern Territory 2002–06**



Figure 3 shows the number of recorded diving fatalities in various Australian States and Territories between 2002 and 2006 inclusive.

*Estimating the risk of fatality in scuba diving*

Between 2002 and 2006 there was an average of 10 scuba-related fatalities per year in Australia (DAN A-P, unpublished data; <sup>6</sup>) Working on the basis of 1.75 million scuba dives conducted in Australia in 2006 (and assuming that this is typical for the past few years), and using the average annual number of scuba fatalities of ten, a scuba fatality rate of 0.57 per 100,000 dives (or approximately 3.57 per 100,000 divers) over that period can be estimated.

To further investigate differences within Australia, the 1993 and 1994 surveys from Victoria and Queensland respectively were used to provide the denominator to estimate the scuba fatality rate in these States at that time.<sup>7,11</sup> The five-year averages of scuba diving deaths in Victoria and Queensland 1992–96 were 2 and 6.4 respectively.<sup>1,2</sup> If one assumes that the diving activity in these States over the five-year period was similar to the years surveyed, fatality rates of 2.5 per 100,000 dives for Victoria and 0.49 per 100,000 dives for Queensland can be estimated for that period.

*Global risk estimates for scuba diving fatalities*

Table 4 shows some other published scuba diving fatality rates from elsewhere in the world.

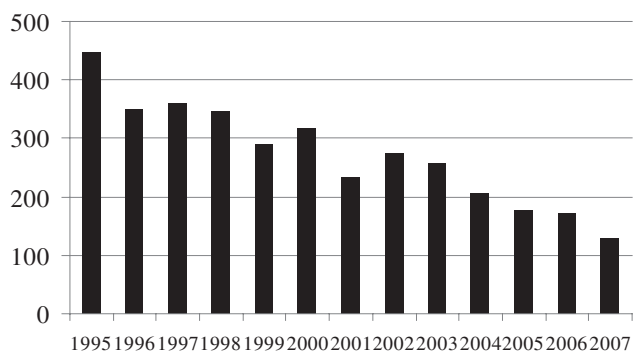
**DECOMPRESSION ILLNESS**

The search indicated a total of 3,558 divers treated for DCI in Australian chambers from the financial years 1995 to 2007 (Figure 4; DAN A-P, unpublished data).<sup>21</sup> A decline in the number of divers treated for DCI is clearly evident. This is the case in all States and Territories (excluding Australia Capital Territory where divers are not treated for DCI; Figure 5). This decline is most prominent in Queensland. Between 1995 and 2007 Queensland had the highest percentage of DCI cases, followed by Victoria and New South Wales (Figure 6).

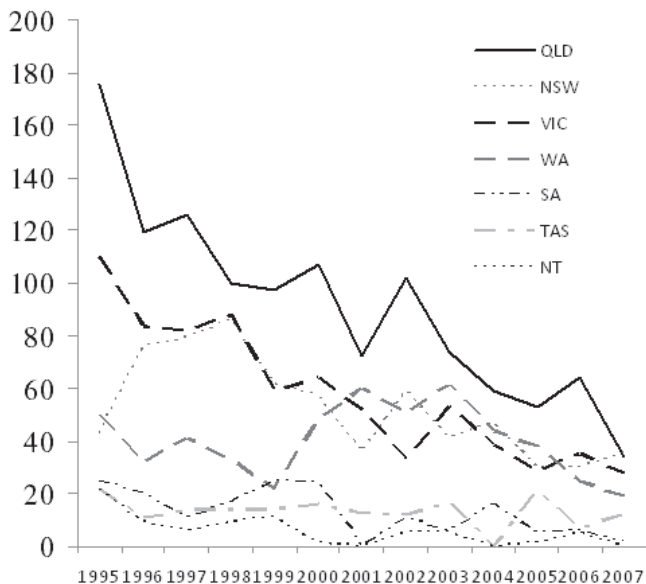
**Table 4**  
**Global risk estimates for scuba diving fatalities**

Location	Method	Rate per 100,000 dives
BC, Canada <sup>15</sup>	Data evolved from a 14-month prospective survey of cylinder fills in British Columbia. Fatality and DCI incidence rates were calculated based on 146,291 reported air fills; 3 deaths over the period	2.05
United Kingdom <sup>16</sup>	Based on 16 reported fatalities in 2006 and an estimate of approximately 2 million dives from a retrospective water sports activity survey, <sup>17</sup> as well as estimates from the British Sub-Aqua Club (Cumming B, personal communication, 2008)	0.80
DAN America members (worldwide, mainly in USA) <sup>18</sup>	Retrospective review of insurance records of DAN America members who died in a dive accidents 1997–2004	11–18
Okinawa, Japan <sup>19</sup>	Retrospective survey of tank fills and review of mortality in divers in the US military community in Okinawa 1989–95	1.3
Stoney Cove, UK <sup>20</sup>	Retrospective survey of divers at Stoney Cove, a large inland diving site based in a flooded quarry, the A&E records at the local hospital and local coronial records	2.9 (N.B. rate is per 100,000 divers)

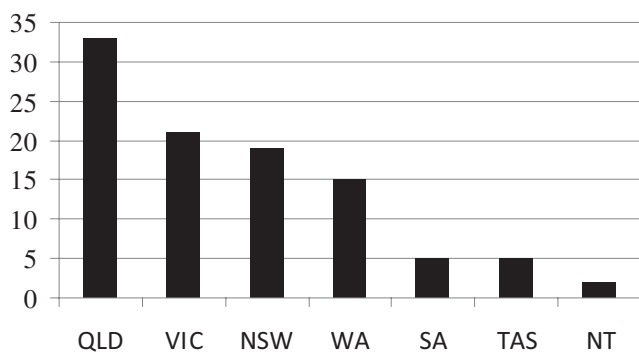
**Figure 4**  
**Divers treated for decompression illness in Australia**  
**1995–2007**



**Figure 5**  
**% DCI for various States and Territories**



**Figure 6**  
**DCI treatment by Australian State and Territory**  
**1995–2007**



*Estimating the risk of decompression illness*

In Australia, between 2002 and 2006, an average of 188 divers were treated for DCI each year. Using the basis of 1.75 million scuba dives Australia-wide, an estimated rate of DCI of 10.74 per 100,000 dives (or approximately 67 per 100,000 divers) for Australia during that period can be calculated. Similarly, in Queensland, between 2002 and 2006 the five-year average of divers treated for DCI was 56.5 (DAN A-P, unpublished data). A conservative estimate of the number of dives conducted in each of these years would be in the vicinity of one million, a figure equal to or considerably lower than early surveys and substantially lower than that projected by the most recent survey (of 1.2 million).<sup>8,10,12</sup> On this basis, the DCI incidence rate in Queensland can be conservatively estimated to be 5.65 per 100,000 dives.

*Earlier risk estimates for DCI from Australia and elsewhere*

**Australia:** For comparison, earlier reports on decompression illness rates in Australia include reports from Victoria, Queensland and from Dunsborough in southern Western Australia. As discussed earlier there were an estimated 80,000 dives conducted in Victoria during 1993–94.<sup>9</sup> In that same period 80 divers were treated for DCI at the local chamber, yielding an incidence rate of 100 per 100,000 dives for that year (DAN A-P, unpublished data). Similarly, based on the reported 1.3 million dives conducted in Queensland waters in 1994,<sup>11</sup> and the fact that 130 divers were treated for DCS in Queensland that year (DAN A-P, unpublished data), a DCI incidence rate of 10 per 100,000 dives can be estimated.

The *HMAS Swan* was sunk in 30 metres of sea water off the southern Western Australian coast in late 1997. Over the following almost three-year period, there were a documented 27,000 dives conducted through a single dive operator on the wreck. These resulted in eight known cases of DCI, an incidence rate of 30 per 100,000 dives (DAN A-P, unpublished data).

**International:** Table 5 shows some other published rates of decompression illness from elsewhere in the world.

**Discussion**

**DIVING ACTIVITY**

It has always been a challenge to obtain reliable estimates of the risk of diving in various places. Because of established reporting systems in Australia, it is possible to determine with reasonable accuracy the annual number of diving fatalities or divers treated for decompression illness. However, the most elusive statistic has been a reliable estimate of the number of dives conducted, the required denominator on which to base an estimate of risk. The dive industry experienced a boom



**Table 5**  
**Global risk estimates for decompression illness**

Location	Method	Rate per 100,000 dives
Mainly Caribbean but also Scapa Flow, Scotland (combined data) <sup>18</sup>	Prospective data collected by DAN America as part of Project Dive Exploration (PDE) study between 1998 and 2004	0–50
Mainly Caribbean <sup>18</sup>	Prospective data collected by DAN America as part of PDE; warm-water divers mainly from the Caribbean; 2001–2004, based on 94,012 recorded dives	19
Scapa Flow, Scotland <sup>18</sup>	Prospective data collected by DAN America as part of PDE at Scapa Flow in Scotland 2001–2004, based on 10,096 dives	188
Caribbean <sup>22</sup>	Prospective survey of 77,680 dives from a cruise ship in the Caribbean from March 1989 to March 1990. 10 reported cases of DCI	12.87
Osezaki, Japan <sup>23</sup>	Prospective 1996–2001 survey of Japanese divers in the Osezaki area. Based on 2,975 respondents who performed a total of 1,140,653 dives with 60 individuals reporting cases of DCI	5.26
BC, Canada <sup>15</sup>	14-month prospective survey of cylinder fills in British Columbia. DCI incidence rates were calculated based on 146,291 reported air fills; 14 cases of DCI over the period	9.57
United Kingdom <sup>17</sup>	Using estimate of 2 million dives from retrospective water sports activity survey for 2006 and treatment data indicating that 105 divers were treated for DCI that year	5.25
Okinawa, Japan <sup>19</sup>	Retrospective survey of tank fills and review of mortality in divers in the US military community in Okinawa 1989–95	13.4
Stoney Cove, UK <sup>20</sup>	Retrospective survey of divers at Stoney Cove, a large inland diving site based in a flooded quarry, the A&E records at the local hospital and local coronial records	3.9 (N.B. rate is per 100,000 divers)

in the mid-1980s to mid-1990s but is generally believed to have declined overall since that time due to economic conditions, competition from other recreational activities and some well-publicised adverse incidents. However, open-water certification numbers appear not to have fallen substantially and, according to the available surveys, scuba diving activity in Queensland appears to be similar in 2006 to what it was in 1994. Despite this, diving activity may well have reduced in certain areas (such as Victoria and South Australia) and increased in others (such as northern Western Australia).

There are several issues of concern with the recent report of tourist activity in Queensland.<sup>12</sup> The first is that the sample size for domestic tourists who dived was very small and,

therefore, is likely to be unreliable. In addition, there appear to have been few divers under training sampled in this survey and, given that this represents a substantial proportion of the diving activity in Queensland, this may have led to an under-representation of the amount of diver training activity. In addition, even at their upper 95% confidence limits, the ERASS national estimates are substantially lower than the estimate of domestic tourists (143,000) who dived in Queensland in the following year, creating concern about the reliability of the various estimates.<sup>12–14</sup>

Considering the increasing dive tourism to some coastal regions in Western Australia, and the possible underestimation of the diving in Queensland due to sampling inadequacies (especially in the case of Australian tourists), the author

believes that the figure of 1.75 million scuba dives estimated in this report may well be conservative and that the actual number of dives may have been closer to two million. However, this is conjecture and not supported by the evidence available at the time of writing.

#### FATALITIES

As can be seen from Table 2, approximately 51% of the dive-related fatalities between 1972 and 2006 involved scuba divers and 34% were snorkelling. It should be noted that many of the 11% of divers who were using surface-supplied breathing apparatus (hookah) may not have been diving recreationally. It appears from Figure 1 that there has been a trend of increasing annual numbers of combined diving fatalities from all modalities. This is supported by the data in Table 3, which indicate that the number of annual combined diving fatalities has almost doubled over the last three decades. It appears that there has been a substantial increase in snorkel-related deaths and this will be the subject of a future report. However, such a trend is not so apparent for scuba fatalities alone (as indicated in Table 3) and was not statistically significant.

The large proportion of fatalities in Queensland, as indicated in Figure 2, is likely to be reflective of the far greater diving activity in that State and not indicative of a higher risk of a diving accident in Queensland. In fact, according to this study, the risk of death in Queensland (0.49 deaths per 100,000 dives) is substantially lower than in Victoria (2.5 deaths per 100,000 dives). It is likely that this five-fold difference is largely due to different diving conditions (cold versus tropical), but may also reflect different diving patterns and possibly an effect of regulation of the diving industry in Queensland.

Table 4 indicates that the estimated scuba diving fatality rate for Australia as a whole is below most of the estimates shown for other countries. This may be due to several factors, such as variations in dive conditions and possibly better controlled diving in Australia as a whole, or in parts of Australia. The Canadian and general UK data evolved from predominantly cold-water diving, which is generally more demanding and is likely to lead to a higher accident rate.<sup>15,16</sup> The exception to this is Stoney Cove where the water is also relatively cold but the diving environment is well controlled.<sup>20</sup> The bulk of the diving in Australia is conducted in more temperate or tropical conditions, which are more conducive to safe diving.

#### DECOMPRESSION ILLNESS

From Figure 4 it is obvious that there has been a very substantial reduction in DCI cases treated over the later years. As indicated in Figure 5, this trend is reflected throughout Australia. This declining incidence may be partly due to reduced diving activity. However, it may also be reflective of better diver education and decompression accident prevention strategies, and improved equipment, such as

dive computers that help to control ascent rate. It should be noted that, although the risk of DCI in Queensland has been conservatively calculated above to be 5.65 per 100,000 dives based on an annual activity of one million scuba dives, it is likely that 1.2 million or more dives are conducted in Queensland each year and, on this basis, the risk estimated may be closer to 5 per 100,000 dives or lower.

Interestingly, although it is a common belief that the diving industry in Victoria is smaller than in NSW (this belief being reflected in the ERASS Surveys<sup>13,14</sup>), Figure 6 indicates that more divers have been treated in Victoria. This could be the result of the more demanding diving conditions in Victoria, easier accessibility to a chamber, possibly lower diagnostic thresholds for treatment at the Victorian hyperbaric facility at that time (Millar I, personal communication, 2008) and possibly, in the later years, some divers from northern NSW being treated at the chamber in Brisbane, Queensland. When comparing DCI rates in Victoria and Queensland, the ten-fold difference is, again, likely to be largely due to the colder and more challenging dive conditions in Victoria.

Of interest, at the time the reported data were collected from the *HMAS Swan* in Western Australia, the typical dive profile consisted of two dives separated by a surface interval of one hour.<sup>22</sup> Concerned about the high rate of DCI and in an attempt to reduce this, the dive operator increased the surface interval to two hours. There have subsequently been very few DCI cases resulting from dives on the wreck since then.

Whilst the incidence of dive fatalities in Australia compares favorably with some international data, this is not necessarily the case with reported DCI incidents for Australia as a whole. However, it is likely that the rate of DCI in Queensland compares favorably with other destinations. It should be noted that in the survey from Canada, only 65% of shops surveyed responded to the survey. Therefore, the real accident rate would be lower than that stated because some dives were unaccounted for.<sup>15</sup> In addition, the authors of the DAN America report pointed out that this rate was derived from a limited population sample and cannot necessarily be extrapolated to the diving population as a whole.<sup>18</sup> DAN America members, with an average age of around forty-six years (Orr D, personal communication, 2008) may not be typical of the diving population.

#### Conclusions

Scuba diving is a sport participated in regularly by an estimated 80,000 Australian residents, and possibly in excess of 200,000 foreign visitors to Australia every year. There are approximately 50,000 new scuba divers trained in Australia annually.

Based on some recent sports and diving surveys it can be estimated that in excess of 1.75 million scuba dives were conducted in Australia in 2006. In addition, it is likely that

more than 2 million snorkel dives are conducted annually around the Australian coastline.

The annual number of scuba diving fatalities has increased slightly over the past two decades but not to a statistically significant degree. Based on currently available surveys, the mortality rate in scuba divers in Australia can be estimated to be 0.57 per 100,000 dives or less.

The number of reported cases of decompression illness in divers in Australia has fallen considerably over the past decade and, based on the latest available diving activity surveys, the Australia-wide DCI incidence rate can be estimated to be 10.74 per 100,000 dives.

### Conflict of interest

John Lippmann is the Executive Director of Divers Alert Network (DAN) Asia-Pacific. DAN is involved in the collection and reporting of dive accident data and provides evacuation cover and dive injury insurance to recreational divers.

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### Acknowledgements

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### References

- 1 Walker D. *Report on Australian diving deaths 1972-1993*. Melbourne: JL Publications; 1998.
- 2 Walker D. *Report on Australian diving deaths 1994-1998*. Melbourne: Divers Alert Network Asia-Pacific; 2002.
- 3 Walker D. Provisional report on diving-related fatalities in Australian waters 1999. *SPUMS J.* 2005; 35: 183-94.
- 4 Walker D. Provisional report on diving-related fatalities in Australian waters 2000. *Diving and Hyperbaric Medicine.* 2006; 36: 62-71.
- 5 Walker D. Provisional report on diving-related fatalities in Australian waters 2001. *Diving and Hyperbaric Medicine.* 2006; 36: 122-38.
- 6 Walker D. Provisional report on diving-related fatalities in Australian waters 2002. *Diving and Hyperbaric Medicine.* 2008; 38: 8-28.
- 7 McDonald W. Victorian air fill survey 1993-1994. *SPUMS J.* 1994; 24: 194-6.
- 8 Wilks J. Calculating diver numbers: Critical information for scuba safety and marketing programs. *SPUMS J.* 1993; 23: 11-4.
- 9 Esguerra R, Ashbolt L Callenbach P. *Report on a study of the Australian diving industry*. Lindfield: Diving Industry and Travel Association of Australia; 1989.
- 10 Wilks J, Knight J, Lippmann J, editors. *Scuba safety in Australia*. Melbourne: J.L. Publications; 1993. Pref i.
- 11 Windsor D. A study into the number of dives conducted on the Great Barrier Reef in 1994. *SPUMS J.* 1996; 26: 72-4.
- 12 *Queensland scuba diving and snorkelling report – visitor activities and characteristics*. Queensland Government; 2007 (internal report only).
- 13 Standing Committee on Recreation and Sport 2006. *Participation in exercise, recreation and sport. Annual report 2005*. Canberra: Australian Sports Commission SCORS; 2006.
- 14 Standing Committee on Recreation and Sport 2007. *Participation in exercise, recreation and sport. Annual report 2006*. Canberra: Australian Sports Commission SCORS; 2007.
- 15 Ladd G Stepan V, Stevens L. The Abacus Project: establishing the risk of recreational scuba death and decompression illness. *SPUMS J.* 2002; 32: 124-8.
- 16 Cumming B. NDC Diving Incidents Report 2006. British Sub-Aqua Club. Available online: <<http://www.bsac.org/page/805/incident-report-2006.htm>>. Accessed 17 June 2008.
- 17 *Watersports and leisure participation survey 2006*. Guildford Surrey: Arkenford; 2007.
- 18 *Annual diving report, 2006*. Durham, NC: Divers Alert Network; 2007.
- 19 Arness MK. Scuba decompression illness and diving fatalities in an overseas military community. *Aviat Space Environ Med.* 1997; 68: 325-33.
- 20 Hart AJ, White SA, Conboy PJ, Bodiwala G, Quinton D. Open water scuba diving at Leicester: five years' experience. *J Accid Emerg Med.* 1999; 16: 198-200.
- 21 Gilliam B. Evaluation of DCS incidence of multi-day repetitive diving for 77,680 sports dives. In: Lang MA, Vann RD, editors. *Proceedings of the Repetitive Diving Workshop*. Cost Mesa, CA: American Academy of Underwater Sciences; 1992. p. 15-24.
- 22 Australasian hyperbaric treatment data. In: *Proceedings of the Annual Scientific Meetings of the Hyperbaric Technicians and Nurses Association, 1995–2007*. Annual reports available from: the Editor, *Offgassing*, The Journal of the Hyperbaric Technicians and Nurses Association Inc, <[HTNAJournal@bigpond.com](mailto:HTNAJournal@bigpond.com)>
- 23 Nakayama H, Shibayama M, Yamani N, Togawa S, Takahashi M, Mano Y. Decompression sickness and recreational scuba divers. *Emerg Med J.* 2003; 20: 332-4.

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