

# Fatal shark attacks on divers in Australia, 1960–2017

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## Key words

Diving; Marine animals; Diving incidents; Deaths; Injuries; Spearfishing; Snorkelling

## Abstract

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**Aim:** The aim of this study was to identify the number, location and characteristics associated with fatal shark attacks on divers in Australian waters from 1960 to 2017, inclusive.

**Methods:** Searches were made of the Divers Alert Network Asia-Pacific Diving Mortality Database; the International Shark Attack File website; the Australian Shark Attack File and the Global Shark Attack File to identify cases of fatal shark attacks on divers in Australia. In addition, a systematic search of published medical and sporting literature was conducted to identify relevant reports. The data collected were scrutinised for relevance and duplication.

**Results:** There were 187 recorded attacks on divers, comprising 112 snorkellers, 62 scuba divers and 13 on divers using surface-supplied breathing apparatus. These included 28 verified deaths: 13 involving snorkellers, eight involving scuba divers, and seven divers using surface-supply. The victims' ages ranged from 13–50 years (mean 31 years). All but three were males. The vast majority of attacks were by *Carcharodon carcharias* (Great White Shark).

**Conclusion:** Spearfishing and other seafood collection, as well as diving near fishing activities and/or seals, were identified as major risk factors. However, shark attacks on divers are relatively rare and represent only 3% of diving-related fatalities in Australia over this 57-year period.

## Introduction

When humans partake in activities in or on the sea, it is inevitable that some of these result in interactions with sharks. However, there is a huge imbalance in comparative mortality from these shark-human interactions. It has been estimated that between 63 and 273 million sharks are killed by humans each year.<sup>1</sup> On the other hand, according to the International Shark Attack file (ISAF), there was an average of 77 reported shark attacks on humans annually from 2007 to 2016. These included 61 fatalities, an average of six deaths per year worldwide.<sup>2</sup>

The ISAF defines unprovoked attacks as incidents where an attack on a live human occurs in the shark's natural habitat with no human provocation of the shark. Provoked attacks occur when a human initiates contact with a shark and include situations where a diver is bitten after grabbing a shark, feeding a shark, attacks while spearfishing, unhooking a shark from a line or removing one from a net. The ISAF data indicate that there were 238 unprovoked attacks on divers (i.e., snorkellers, scuba divers and divers using surface supplied breathing apparatus) worldwide from 1960 to 2015. It does not publish the number of provoked attacks.<sup>2</sup>

The aim of this study was to determine the number, location and characteristics of fatal shark attacks (provoked or

unprovoked) on divers in Australia from 1960 to 2017 inclusive.

## Methodology

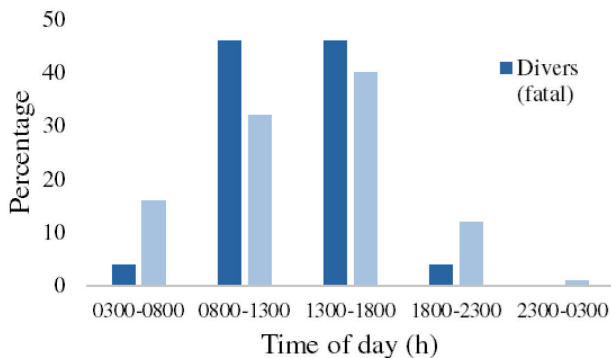
Searches were made of a variety of databases which were likely to include relevant data on Australian shark attacks. These were:

- the Divers Alert Network Asia-Pacific (DAN AP) Diving Mortality Database which incorporates data from Project Stickybeak from 1965 to 2000, and subsequent data collected by DAN AP;<sup>3</sup>
- the International Shark Attack file (ISAF) website;<sup>2</sup>
- the Australian Shark Attack File (ASAF)<sup>4</sup> (additional data was also provided by the ASAF);
- the Global Shark Attack File (GSAF).<sup>5</sup>

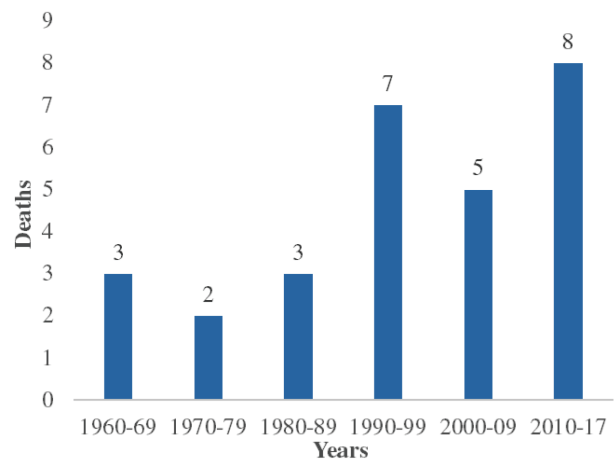
In addition, a systematic search of published literature for all dates up to and including July 2018 was conducted using Medline Complete, CINAHL Complete, Health Source (Nursing/Academic edition) and SPORTDiscus with Full Text. The search terms were: scuba or “*compressed air*” or “*compressed gas*” or snorkel\* or div\* AND shark AND death\* or fatalit\* or mortalit\* AND Australia. The data collected were scrutinised for relevance and duplication and compiled into a single list of diving-related fatalities from shark attacks.

**Figure 1**

Time of day of 28 fatal shark attacks on divers compared with 138 general shark attacks incidents, expressed as percentages<sup>5</sup>

**Figure 2**

Frequency of fatal shark attacks on divers by decade, 1960–2017 (final number is for only eight years)



## Results

The data revealed a total of 562 recorded shark attacks in Australia from 1960 to 2017, inclusive. One hundred and eighty-seven of these were attacks on divers, comprising 112 snorkellers, 62 scuba divers and 13 on divers using surface-supplied breathing apparatus (SSBA). These included 28 verified deaths: 13 involving snorkellers, eight involving scuba divers, and seven divers using SSBA (Table 1). The number of reported shark attacks on both divers and non-divers in Australia increased from 6.5 per year in 1990–2000, to 15 per year from 2001–10, with an average of 11 deaths per decade over this 20-year period.<sup>6</sup> As shown in Figure 1, shark attack-related deaths in divers have risen from three per decade in the 1960s, to eight over the last seven years (Figure 1). The mean (SD) age of the fatality victims was 31 (11) years (range 13–50 y). Only three were females, two being scuba divers. Nineteen of these deaths occurred in South Australia (10) and Western Australia (nine), with the remaining nine spread across Tasmania (four), Queensland (three), New South Wales (two) and none in the Northern Territory and Victoria.

The attacking sharks were sighted or otherwise positively identified in 21 (75%) of the fatal incidents. The species identified were *Carcharodon carcharias* (Great White Shark,  $n = 18$ ), *Galeocerdo cuvier* (Tiger Shark,  $n = 2$ ) and *Carcharhinus leucas* (Bull Shark,  $n = 1$ ). A Great White Shark was implicated as the very probable attacker in another three incidents on the basis of location, size and/or bite marks.

Twenty-one of the 28 divers killed were involved in seafood collection; predominantly spearfishing ( $n = 9$ ), abalone collection ( $n = 5$ ) and scallop collection ( $n = 4$ ). Six attacks occurred near seal colonies, and at least three others occurred in areas with nearby fishing.

Although shark attacks can occur at any time,<sup>6</sup> all of the fatal attacks on divers occurred in daylight with most

incidents in early to mid-afternoon (Figure 2). There was no obvious pattern in the month of the year, or sea and weather conditions. There were spikes in June and December but the numbers are too small for meaningful interpretation; for each of the four quarters of the year there were eight, six, seven and seven deaths, respectively. The bodies of 11 of the victims were never found, although in all of these, the attack was witnessed.

Of the 187 recorded attacks on divers, most of the 28 deaths involved males who were spearfishing or otherwise collecting seafood. The vast majority of the fatal attacks occurred in temperate waters, and between 0800 h and 1800 h, reflective of when most diving is conducted. In the vast majority of incidents, the attacking shark was identified as a *C. carcharias*.

## Discussion

### SPEAR FISHING AND SEAFOOD COLLECTION

In the Australian shark attack database, a shark attack on a diver while spearfishing and other seafood collecting while diving is categorised as a ‘provoked attack’, as the diver is impacting the shark’s behaviour. There is no doubt that such activities increase the likelihood of a diver being attacked, evidenced by the fact that over three quarters of the victims were involved in such activities. Diving near to where fishing is being conducted increases the risk, especially if burley is being used, as this will attract and excite nearby sharks. One spearfisherman was wearing a bait pouch attached to his weight belt, a practice that is obviously highly provocative and strongly discouraged.

### DIVING NEAR SEALS

Seals are a regular food source for large sharks, especially when seal pups are present, so diving near seal colonies is

**Table 1**

Characteristics of 28 fatal shark attacks on divers in Australia; \* distant; NR – not reported; US – unsighted; UK – unknown; GWS – Great White Shark; US-GWS – unsighted but probably GWS; SC – scuba; SN – snorkel; SS – surface supply

| Year | Mode | Month | Time | State | Gender | Age | Activity        | Buddy | Shark  | Contributing factors?          | Conditions                        |
|------|------|-------|------|-------|--------|-----|-----------------|-------|--------|--------------------------------|-----------------------------------|
| 1960 | SN   | Jan   | 1530 | NSW   | M      | 13  | Spearfishing    | NR    | Bull   | Spearing                       | Calm, poor visibility             |
| 1962 | SN   | Dec   | 1430 | SA    | M      | 16  | Spearfishing    | NR    | GWS    | Spearing                       | Poor visibility (4 m)             |
| 1967 | SN   | Aug   | 1100 | WA    | M      | 24  | Spearfishing    | Yes   | GWS    | Spearing; seal colony          | NR                                |
| 1974 | SS   | Jan   | pm   | SA    | M      | 26  | Abalone         | No    | GWS    | Seals nearby; seafood          | NR                                |
| 1975 | SS   | Jul   | 1300 | TAS   | M      | 37  | Abalone         | No    | US-GWS | Seals nearby; seafood          | Calm, dark water                  |
| 1982 | SN   | Feb   | NR   | TAS   | M      | 32  | Spearfishing    | No    | GWS    | Spearing; cleaning fish        | Calm                              |
| 1985 | SN   | Mar   | 1230 | SA    | F      | 33  | Scallops        | Yes   | GWS    | Scallops; offal in area        | Calm, clear                       |
| 1987 | SC   | Sep   | am   | SA    | M      | 47  | Scallops        | No    | US-GWS | Fish, dolphins; scallops       | Moderate smooth sea               |
| 1990 | SN   | Apr   | NR   | QLD   | M      | 37  | Trocas          | No    | US     | Unknown                        | NR                                |
| 1991 | SC   | Sep   | 1500 | SA    | M      | 19  | Sightseeing     | Yes   | GWS    | Unknown                        | Poor visibility (3 m)             |
| 1993 | SC   | Jun   | 0930 | NSW   | M      | 31  | Sightseeing     | Yes   | GWS    | Unknown; fish running          | Calm, clear (10 m)                |
| 1993 | SC   | Jun   | 1055 | TAS   | F      | 34  | Sightseeing     | Yes   | GWS    | Seal colony; abalone           | Calm, clear                       |
| 1993 | SS   | Nov   | 1515 | WA    | M      | 28  | Pearl farm      | Yes*  | Tiger  | Pearls                         | Calm, no current, poor visibility |
| 1995 | SS   | Sep   | 1500 | WA    | M      | 29  | Abalone         | No    | GWS    | Abalone; seals; whale calves   | Rough, poor visibility            |
| 1998 | SN   | Jun   | 1400 | SA    | M      | 26  | Abalone         | Yes   | GWS    | Seal colony; abalone           | NR                                |
| 2002 | SS   | Apr   | 1240 | SA    | M      | 23  | Scallops        | Yes   | GWS    | Scallops                       | Clear                             |
| 2004 | SN   | Dec   | 1300 | QLD   | M      | 38  | Spearfishing    | No    | US     | Spearing; wearing bait pouch   | NR                                |
| 2005 | SN   | Mar   | 1400 | WA    | M      | 26  | Sightseeing     | Yes   | GWS    | Fishing nearby?                | NR                                |
| 2005 | SC   | Aug   | 1610 | SA    | M      | 23  | Cuttlefish eggs | Yes   | GWS    | Cuttlefish eggs; burley nearby | NR                                |

Table 1 continued

| Year | Mode | Month | Time | State | Gender | Age | Activity     | Buddy | Shark | Contributing factors?      | Conditions              |
|------|------|-------|------|-------|--------|-----|--------------|-------|-------|----------------------------|-------------------------|
| 2008 | SN   | Dec   | 0700 | WA    | M      | 51  | Crabs        | Yes   | GWS   | Crab collecting?           | Calm, clear             |
| 2011 | SS   | Feb   | 1820 | SA    | M      | 50  | Abalone      | No    | NR    | Abalone                    | NR                      |
| 2011 | SC   | Oct   | 1325 | WA    | M      | 32  | Spearfishing | No    | GWS   | Spearing                   | NR                      |
| 2012 | SC   | Mar   | 0930 | WA    | M      | 33  | Sightseeing  | Yes   | GWS   | Nearby fishing?            | Choppy, poor visibility |
| 2014 | SN   | Feb   | 1200 | SA    | M      | 28  | Spearfishing | Yes   | GWS   | Spearing                   | Choppy, clear           |
| 2014 | SN   | Dec   | am   | QLD   | M      | 18  | Spearfishing | No    | US    | Spearing                   | Calm, clear             |
| 2014 | SN   | Dec   | 1130 | WA    | M      | 17  | Spearfishing | Yes   | Tiger | Spearing, baiting          | NR                      |
| 2015 | SS   | Jul   | 1000 | TAS   | M      | 46  | Scallops     | No    | GWS   | Scalloping, fishing nearby | NR                      |
| 2016 | SC   | Jun   | 1130 | WA    | F      | 50  | Sightseeing  | Yes   | GWS   | Fishing nearby?            | NR                      |

more risky (There is an old adage that “*a diver is the slowest seal*”). The Australian unprovoked shark attack data indicate that “*swimming, surfing or diving near seals or seal colonies has the highest rate of severe injury and fatalities*”.<sup>6</sup> The provocation of hunting seafood near seals would add to this inherent risk.

#### TEMPORAL AND LOCATIONAL PATTERNS AND SHARK SPECIES

The fatal attacks in temperate waters were associated with *C. carcharias*. Attacks by Great White Sharks in more tropical waters are rare, and most fatal attacks in warmer waters involve *G. cuvier*.<sup>6</sup> Although a broad variety of shark species are known to attack humans, from 1990 to 2010, only three species of sharks were identified as responsible for fatalities during general aquatic activities in Australia – *C. carcharias*, *G. cuvier* and *C. leucas*.<sup>6</sup> This is consistent with these data on diving-related fatalities.

#### BUDDY SITUATION

The presence or absence of a buddy did not appear to influence the likelihood or the ultimate outcome of these severe and fatal attacks. As shown in [Table 1](#), more than half of the fatality victims were with a buddy at the time of the attack. However, it is very likely that the presence of a buddy has enhanced the rescue of some victims of non-fatal attacks. All divers are encouraged to undergo training in first aid, including the management of severe bleeding. The use of a tourniquet in the event of amputation has recently been re-introduced in first aid guidelines.<sup>7</sup>

#### RISK

The main reason for the increase in fatal shark attacks in recent decades appears to be the rise in population and greater participation in aquatic activities in general, including in more isolated locations.<sup>6</sup> It undoubtedly also reflects the increase in diving-related activity since 1960, and a more recent resurgence in spearfishing as a recreation. However, it has also been argued that the rise in attacks by *C. carcharias* along some Australian coastlines may be associated with the whale migration season and an increase in the numbers of migrating whales.<sup>8,9</sup>

It is almost impossible to determine the absolute risk of being attacked by a shark while diving owing to the difficulty of determining an accurate denominator for the number of dives. One report for Western Australia estimated the risk of a fatal shark attack while diving using scuba or SSBA to be less than one in three million dives.<sup>10</sup> Australian divers have been estimated to have conducted an average of 1.55 million scuba dives each year from 2001–2010, inclusive and there was only one fatal shark attack on a scuba diver during this period.<sup>11</sup> Whatever the actual risk may be, it is extremely small and far lower than what many in the community

perceive it to be. Current DAN AP diving fatality data reveal that death from shark attack represents only approximately 3% (28/926) of recorded Australian diving-related fatalities from 1960 to 2017 inclusive.<sup>3</sup> In many places, divers seek out and enjoy their interactions with a variety of sharks, the vast majority of which are uneventful. However, even small sharks can sometimes be dangerous when provoked and divers should never be complacent about a shark's presence.

## LIMITATIONS

It is possible that some shark attack-related fatalities in divers were not recorded in the available databases and so not included here. In addition, two cases that were recorded in one of the databases as diving-related were excluded due to insufficient available evidence to confirm that the victims were in fact diving.

## Conclusion

Shark attacks on divers are relatively rare, representing approximately 3% of diving-related fatalities in Australia over more than half a century. Most of the victims were relatively young males who were attacked by Great White Sharks. Spearfishing and other seafood collection, as well as diving near fishing activities and/or seals, were identified as major risk factors. Therefore, to reduce risk, divers should avoid collecting seafood in areas known to be frequented by large sharks, avoid diving near seal colonies or where there is fishing activity, especially if burley is likely being used to attract fish.

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