

ANZSOG Case Program

Off the hook: Western Australia's shark cull (A)

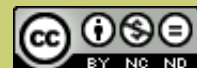
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For Bryn Martin 10 October 2011 began, like most other days, in the sparkling waters of Cottesloe. The sixty-four year old swam out to a pylon about 400 metres from shore, just as he had done for more than a decade. In one direction, the Indian Ocean stretched uninterrupted to the horizon; in the other, locals and visitors were busy enjoying Perth's most popular beach. Amongst those on shore were Martin's wife and family. When he failed to arrive for breakfast as planned, they immediately suspected something was amiss. After more than an hour scanning the area, his wife reported him missing to emergency services. No trace of Bryn Martin could be found, save for a pair of slashed swimming trunks. Witnesses recalled seeing some splashing and a large shadowy shape near where he disappeared. The Western Australian coroner later heard that the damage to his bathing suit was consistent with a shark attack, most likely, a great white.

The incident left local residents and the wider community shaken. Cottesloe was where Ken Crew bled to death on the sand after being attacked by a shark in waist-deep water. Onlookers likened the 2000 incident to a scene from the film *Jaws* and the government issued an immediate but unsuccessful catch-and-kill order.¹ Meanwhile, less than a month prior to Martin's disappearance, twenty-one year old Kyle Burden was attacked by a shark whilst body-boarding in the Margaret River region. In a statement to the media, his mother said: 'There is no real explanation for the randomness of Mother Nature and there is no blame.'²

This case was written by Marinella Padula, Australia and New Zealand School of Government for Dr George Argyrous as a basis for class discussion rather than to illustrate either effective or ineffective handling of a managerial situation. It has been prepared from published materials.

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¹ Neff, C. 'The Jaws Effect: How movie narratives are used to influence policy responses to shark bites in Western Australia', *Australian Journal of Political Science*, 2015, 50:1, pp.114-127.

² Rickard, L. 'Our hearts are all breaking together' *WA today*, 6 September 2011.

Yet the deaths of Burden and Martin were not the last of 2011 and soon, these tragic deaths would look less like isolated events and more like a troubling pattern. Martin's disappearance was quickly followed by another casualty bringing the toll to three. In 2012, sharks claimed two more lives in Western Australian waters, followed by the death of surfer Chris Boyd in 2013 (*Exhibit A*). This prompted the state government to undertake a drum line trial with the aim of capturing large sharks near popular beaches.

Attack statistics

For more than 30 years, the Australian Shark Attack File (ASAF), maintained by Taronga Zoo in New South Wales (NSW), collated and analysed statistics on all known shark attacks and attempts in Australian waters. ASAF usually focused on 'unprovoked' incidents, excluding events where the victim initiated contact with a shark or was engaged in commercial fishing.

A 2011 paper by ASAF Coordinator John G West examined Australian shark attack data and found that over the last 50 years there had been an average of one shark-related fatality per annum, although the frequency of attacks had risen during the past two decades (*Exhibit B*). This was attributed, in the main, to a burgeoning human population (up from 8.3 million in 1950 to 17 million in 1990 to 22.7 million in 2011³) and increased beach visitation. Other possible contributors to altered migratory habits and/or population levels amongst sharks included rising sea temperatures, changes to commercial shark fishing, and increasing humpback whale, seal and sea lion populations. The International Shark Attack File (ISAF), which compiled data from around the world, also found that the number of reported attacks had increased over the 20 years to 2010.

West reported that there were approximately 100 million visits to Australia's 12,000 beaches per year and a growing enthusiasm for water-based recreation.⁴ Estimates from Surf Life Saving Western Australia (SLSWA) told a similar story; during 2006/2007, SLSWA recorded just over 1.2 million visits to patrolled beaches, that figure had risen to almost 3.9 million in 2012/2013.⁵ Of recreational water users, surfers were most prone to shark attacks, along with deep-sea swimmers and divers. Attacks could occur at any time but were more common during daylight hours in summer. Geographically, the majority of attacks (including non-fatal) from 1990-2010 occurred in NSW and Queensland, outside major population centres along the east coast.⁶

Although identification was not always possible or accurate, just three species accounted for the bulk of incidents: tiger sharks, bull sharks and great white sharks (*Exhibit C*). From 1990-2009, these three species had been responsible for all known fatalities in Australia. Globally, bull and tiger sharks were implicated in most attacks, though the less common great whites had the highest casualty rate.⁷ The majority of fatal shark attacks involved sharks larger than 3 metres in length. About three-quarters of shark attacks in Australia resulted in some form of injury.⁸

Almost 12% of Australian shark attacks over the past two decades proved fatal, which was comparable to the global casualty rate of just over 10%.⁹ Although attacks were on the rise, shark-related fatalities had been in decline across the world during the 20th century, partly due to improvements in emergency medicine, infection control and transport. According to ISAF figures, the

³ 'Population increase since 1900' Australian Shark Attack File, www.taronga.org.au, accessed: August 2014

⁴ West, J.G. 'Changing patterns of shark attacks in Australian waters' *Marine and Freshwater Research*, 2011, Vol. 62, p. 751.

⁵ 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2104, p.9.

⁶ West, J.G. 'Changing patterns of shark attacks in Australian waters' *Marine and Freshwater Research*, 2011, Vol. 62, pp. 745-750.

⁷ 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, p.40.

⁸ West, J.G. 'Changing patterns of shark attacks in Australian waters' *Marine and Freshwater Research*, 2011, Vol. 62, p. 749.

⁹ West, J.G. 'Changing patterns of shark attacks in Australian waters' *Marine and Freshwater Research*, 2011, Vol. 62, p. 748.

USA, Australia and South Africa were the world's shark-attack hotspots, particularly Florida which was the global leader.¹⁰ Yet, despite smaller populations, the number of Australian and South African fatalities regularly exceeded US losses.

Over the past century, the number of shark-related fatalities in Western Australia (WA) had been quite variable, ranging from 0-5 per decade.¹¹ From the late 1960s to the early 1990s, no shark-related deaths were recorded. However, the past decade (2004-2014) had seen an average of one fatality per year – accounting for half of the 20 deaths in WA since 1914 and easily outstripping losses in the rest of Australia.¹² During the same period, there was an average of 4 non-fatal incidents per annum.¹³ Great whites had been implicated most frequently in WA shark fatalities; attacks also occurred over a much broader geographic region compared to other states. After 2011-2012, WA had the dubious honour of being the world's shark fatality capital.

Changing tack: The drum line trial

Boyd's death triggered a decisive shift in policy. Within weeks, Western Australia's Premier and Member for Cottesloe, Colin Barnett, and Fisheries Minister Troy Buswell announced a new strategy to combat the risk of shark attack (*Exhibit D*). Existing measures such as research, education and surveillance would be boosted with extra resources. However, from late January 2014 they would also be supplemented by a drum line trial around Perth and the state's south-west. Drum lines, which are long floating lines with baited hooks designed to attract nearby sharks (*Exhibit E*) were already used on an ad hoc basis (see Culling and other mitigation strategies). This time they would be deployed 24-7 at selected beaches for a three-month period. As part of the trial, the government would:

- Set baited drum lines to catch target (tiger, great white or bull sharks > 3m) one kilometre from shore.
- Deploy vessels to monitor drum lines from 6am to 6pm each day.
- Tag and release target sharks less than 3m long and release non-target animals, if possible.
- Destroy target sharks > 3m and badly injured animals, and dispose of all carcasses offshore.¹⁴

Up to 36 drum lines would be installed at nine city beaches; an initial four beaches in the south-west Margaret River region would also be equipped with up to 36 drum lines (*Exhibit F*). Other beaches would be added as necessary. Drum lines would utilise extra-large hooks, specially chosen to reduce the risk of catching non-target species. The trial was part of a planned 4-year, \$22 million Shark Hazard Mitigation Program which included almost \$4 million in research funds (*Exhibit D*). Sharksmart (www.sharksmart.com.au) was set up to explain the measures, alert the public to sightings and advise on risk-reduction. Depending on the results of the initial trial, the government would seek to extend the drum line policy to 2017. Said Barnett:

We are aware of the risks sharks pose to our beach users and the Western Australian way of life and we are implementing strategies to reduce these risks. But whatever the State Government does to try to minimise the risk there are still no guarantees, it is very important for Western Australian ocean users to always be aware of the risks of entering the water and to take responsibility for themselves.¹⁵

¹⁰ 'ISAF Statistics for the World Locations with the Highest Shark Attack Activity (2004-2013)' International Shark Attack File, <https://www.flmnh.ufl.edu/fish/sharks/statistics/statsw.htm> accessed: August, 2014.

¹¹ Data from www.sharkattackfile.info, includes suspected fatalities and provoked incidents. Accessed: September 2014.

¹² 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, p.9.

¹³ *ibid*.

¹⁴ Adapted from 'New measures to combat WA shark risks' Media Statement, Government of Western Australia, www.mediastatements.wa.gov.au 10 December 2013, Accessed: September 2013.

¹⁵ *ibid*

The government claimed that the trial was necessary in the interests of public safety. Its secondary goals were to preserve the public's enjoyment of coastal areas and to protect tourism – reasons outlined in the WA Government's application to the Federal Government for an exemption to the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) which protected great white sharks (*Exhibit G*). Commonwealth Environment Minister Greg Hunt agreed, granting the exemption on 10 January 2014. The WA Government sought the exemption despite rejecting a very similar program in 2011¹⁶ and an August 2012 report for the WA Department of Fisheries (DoF) which advised against the use of shark nets and drum lines on the basis that the environmental impact would likely be too high. Shark populations across the world were under threat due to overfishing but great whites were particularly vulnerable. CSIRO research suggested that there could be as few as 700 breeding age adults in south-western Australia (*Exhibit G*). Despite the shark's ability to inspire terror amongst beachgoers, still relatively little was understood about its habits and migration patterns. The Fisheries report also failed to find much empirical evidence to back anecdotal reports that shark attacks had an adverse economic impact on affected regions.¹⁷ It did, however, suggest that control programs could negatively affect ecotourism operations.

Prior to launching the trial, the government did obtain advice from the Research Division of DoF. In his report, DoF's Dr Rick Fletcher concluded that the trial posed a 'negligible' risk to the population levels of target and non-target species, with the possible exception of dusky whaler sharks where the risk was considered low-to-moderate.¹⁸ The DoF report also determined that the south-west's great white shark population likely consisted of 'a few to several thousand' individuals.¹⁹ Overall the department predicted that the trial would result in a catch of:

- Fewer than 10 great white sharks 3m+. (Up to 20 would still be considered acceptable.)
- Between 10 and 20 tiger sharks 3m+. (Most tiger sharks caught would be under 3m; many would be released alive. It would take at least several hundred tiger sharks to have a noticeable impact on population levels.)
- Zero or close to no bull sharks. (The trial zone was outside their typical habitat.)²⁰

These estimates were based on information from a variety of sources including Queensland data on bycatch (animals from non-target species), commercial fisheries, recorded sightings and capture rates from research operations. Other stakeholders, including universities, SLSWA and sports clubs were also consulted for advice on program design and implementation. Conservation groups were excluded on the basis that their opposition to culling was well documented. The WA Environment Protection Authority decided against making an assessment, reasoning that the trial was temporary, likely to have limited impact and that the authority would have ample opportunity to assess the trial, if extended.

In terms of program management, the trial would be overseen by the Department of Premier and Cabinet, which was to issue tenders for drum line monitoring, manage contracts and evaluate results. DoF, which was responsible for the development, management and protection of sustainable aquatic resources, would continue to house the Shark Response Unit. Created in late-2011, the Unit's role

¹⁶ Kempster, R. 'A great day for Western Australia's sharks and for public safety' *The Conversation*, www.theconversation.com 16 November 2011, Accessed: November 2014.

¹⁷ McPhee, D.P. 'Likely Effectiveness of Netting or Other Capture Programs as a Shark Hazard Mitigation Strategy under Western Australian Conditions' Department of Fisheries, Western Australia, Occasional Publication No. 108, August 2012, p.10.

¹⁸ Fletcher, R. 'Research Advice on the Proposed Shark Mitigation Strategy using drum lines for January to April 2014' Department of Fisheries, Government of Western Australia, 28 February 2014.

¹⁹ *ibid.*

²⁰ *ibid.*

was to research shark populations and movements, coordinate the response to an attack, and provide information to water users.

Culling and other mitigation strategies

Temporary or permanent drum lines were only one of many methods that authorities in shark-prone areas employed to prevent attacks. They typically ranged from passive interventions such as surveillance and education programs, to much more direct measures, including swimming enclosures²¹ and shark nets. Many areas, of course, employed a combination of methods. In Australia, shark nets and/or drum lines were used in NSW and Queensland and had been for many decades, though they were not widely deployed elsewhere.

The purpose of culling was to decrease the probability of attack by reducing local shark numbers. In Queensland and NSW, mesh nets measuring approximately 6m high and up to approximately 190m long were submerged in near-shore waters parallel to beaches close to major population and tourist centres. Unlike enclosures, however, they did not act as a complete barrier. Beaches in Queensland were also protected by a series of drum lines. During 2013, the Queensland program (across 40 beaches) captured just over 340 tiger, bull and great white sharks, the vast majority of which were under 3m.²²

Both programs were deemed successful by their respective governments and unlikely to be repealed. Of the two, the year-round Queensland program was considered more effective than the seasonal NSW program. Since their introduction (1937 in NSW, 1962 in Queensland) there had only been two fatal attacks at protected beaches (one in NSW and one in Queensland²³). A 2006 Queensland Department of Primary Industries and Fisheries report found a sizeable drop in shark-related incidents across the state post-1962 which included non-fatal encounters (*Exhibit H*). However, a 2009 Southern Cross University report on the Queensland shark control program found that bycatch made up, on average, 45% of the program's total haul (*Exhibit I*). Drum lines, however, were less likely to trap non-target species than nets.

Results from overseas culling programs were mixed and comparisons difficult. Differences in oceanography, climate, and population levels could all impact results. Reports indicated a substantial decline in shark attacks in Durban, South Africa, after the introduction of shark nets and drum lines.²⁴ Recife, Brazil, also saw a fall in attacks after deploying long lines²⁵ and drum lines in 2004.²⁶ However, authorities there also banned surfing in protected areas. Meanwhile, Hawaii discontinued its shark cull (which involved methods including long lines) on the basis that it had made no difference to the number of attacks.²⁷

²¹ A number of beaches in Australia and overseas were fitted with bathing enclosures, small-mesh nets that cut off designated areas completely. Entanglements were less of an issue, however, they were vulnerable to strong waves and it was not practical to shut off large, exposed stretches of coastline, which limited their use.

²² Data from 'Shark Control Program: Shark Catch Statistics' Queensland Government Data, <https://data.qld.gov.au> Accessed: October, 2014.

²³ Weymes, M. 'Fatal shark attack at Byron Bay reignites debate about the use of shark nets along the coastline' *Gold Coast Bulletin*, 10 September 2014.

²⁴ 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, p.50

²⁵ Long lines were composed of a four kilometre line fitted with 100 hooks.

²⁶ *opcit.*

²⁷ 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, p.50

Table 1: Summary comparison of shark culling programs²⁸

Location	Approach	Duration	Outcomes
Queensland, Australia	Shark nets; drum lines	From 1962-	Significant reduction in attacks; only one fatality post-1962
New South Wales, Australia	Shark nets	From 1937- (3 year hiatus during WW2)	One fatality per year 1900-1936 (avg); one fatality post-1937
Durban, South Africa	Shark nets; drum lines	From 1952-	90% annual reduction in attacks
Recife, Brazil	Long lines, drum lines	From 2004-	97% reduction in attacks between 2004-2011
Hawai'i, United States of America	Long lines, drum lines, shark nets	1959-1995	No impact on attacks
La Reunion	Drum lines; increased shark fishing	From 2013-	N/A
Dunedin, New Zealand	Shark nets	1969-2011	Four attacks 1964-1968; one attack in 1973

Sometimes, episodic shark culls were launched in specific areas when large sharks were spotted near beaches or after serious attacks. In November 2012, as a direct response to the recent spate of shark deaths, the WA Government announced changes to its 'imminent threat' guidelines which permitted DoF officers to capture sharks suspected of a fatal attack in state waters (usually within three nautical miles of shore). These were amended to include situations where sharks with a 'history of attacking people' were sighted within one kilometre of popular beaches.²⁹ Commonly termed 'catch-and-kill' orders, DoF officers or approved contractors would deploy drum lines until target sharks were caught or left the area. 'Catch-and-kill' orders were generally issued by the Director-General of DoF, in this case Stuart Smith, preferably in consultation with the Director-General of the Department of Environment and Conservations as well as the Director-General of the Department of Premier and Cabinet.

However, targeted culls presented a number of drawbacks. Catching the creature responsible was difficult at best. There was also no well-defined relationship between the number of sharks in an area and likelihood of attack. Furthermore, there was little to suggest sharks deliberately targeted humans (*Exhibit J*) or that 'man-eaters' were any more inclined to seek human prey in future. An internal review written by a DoF official after the policy was introduced reportedly raised similar concerns:

There is abundant evidence to prove that not all sharks, even those known to be dangerous, are...about to attack just because they are in the immediate area/vicinity where people are present...This again makes the policy subject to criticism. Given the response times, the lack of success so far due to the operational restrictions applied and the largely false expectations that the policy creates, it will in most, if not all cases, result in failure.³⁰

²⁸ 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, p.50

²⁹ 'Shark Hazard Mitigation Decision Sheet' Department of Fisheries, Government of Western Australia, 23 November 2012.

³⁰ Wahlquist, C. 'WA shark cull: 'imminent threat' criteria scrapped in favour of 'serious threat' *The Guardian*, www.theguardian.com, Published: 24 December 2014, Accessed: March 2015.

The review also noted that the term 'imminent' and the criteria used were problematic because they 'made inaction possible'. Moreover, 'In every order so far approved, I don't think any of them met the criteria,' it said.³¹ The DoF instead suggested that limited hunting of white sharks would be 'more cost effective and reduce the available time that this controversial issue is in the public arena'.³²

Although reassuring, surveillance methods were not especially reliable. A report for the NSW Department of Primary Industries found that aerial patrols were inefficient and expensive, spotting only one shark for every 100km flown.³³ Surveillance operations (land, water or air-based) were very resource-intensive and not realistic for most WA beaches most of the year, although shark spotters were deployed at popular beaches during peak periods. The WA Government, along with other state governments, was exploring or expanding the use of new technology (such as drones, electronic shark tags and wearable deterrents) but these tools were not yet sufficiently viable.

Culling methods had long been controversial. Marine scientists noted that declines in shark fatalities had occurred in areas with and without nets and drum lines. Moreover, in many places, the downward trend preceded protective efforts. Scientists also cited environmental/animal welfare concerns, particularly the impact of removing important apex predators from marine ecosystems. These led many researchers to conclude the best way to reduce the risk of shark attack, for the time being at least, was public education. Amongst them was Sydney University academic Christopher Neff whose research into the politics of shark control led him to conclude that government responses in Australia were driven by an outdated, movie-led paradigm of sharks as relentless and calculating killers. This was compounded by a natural underlying fear of sharks, sensationalist reportage and the tendency to describe every encounter as an 'attack'. Said Neff:

There is no evidence that shark hunts reduce attacks. Research shows these responses are political, symbolically reducing public perceptions of risk rather than the actual risk. At the core of this reaction are two elements: the pressure on any government to respond after tragic and unexplainable events; and the familiarity of the 'rogue shark' theory...The true answer is that sharks are not in WA or Sydney looking for people, and the only place to find a 'rogue shark' is in Hollywood.³⁴

For Neff, encouraging beachgoers to modify their conduct (such as by avoiding swimming alone) whilst monitoring the environment (for example watching for schools of fish) was a much more empirically valid and cost-effective way of addressing the small but disconcerting risk of shark attack.

Public opinion: Save. Our. Sharks.

Swift and vociferous condemnation followed announcement of the policy. The Green Party launched legal action to stop the cull while more than 100 marine scientists expressed their disagreement in an open letter to the government.³⁵ Polling suggested that the majority of people opposed the trial. Almost 80% of the 2,619 participants in a December 2013 *WA today* online poll were against the policy.³⁶ In late January 2014, a poll by UMR research, found that 83% of the 500 Australians surveyed hadn't changed their beach-going habits; 82% opposed killing sharks and believed that people entered the water at their own risk.³⁷ Western Australian respondents were somewhat more concerned, with 22% stating that they had curtailed their beach activities somewhat.³⁸ No mention was made of how frequently they normally visited beaches or what kind of activities they pursued.

³¹ *ibid.*

³² *ibid.*

³³ AAP 'Aerial shark spotting inefficient: report' www.sbs.com.au, Published: 30 December 2013, Accessed: March 2015.

³⁴ Neff, C. 'Shark hunts a Hollywood response to real horror' *Sydney Morning Herald*, 25 October 2011.

³⁵ '100+ Shark Experts Oppose WA Shark Cull Policy in Open Letter' Support Our Sharks, www.supportoursharks.com, 23 December 2013.

³⁶ AAP 'WA shark policy a 'cull by another name' *WA today*, 10 December 2013.

³⁷ Dorling, P. '80% opposed to shark cull' *Sydney Morning Herald*, 28 January 2014.

³⁸ *ibid.*

Elsewhere however, earlier surveys of NSW and South Australian beachgoers suggested that although shark attack was a serious concern, choice of beach was little influenced by protection measures.³⁹

The issue was taken up widely across social media, particularly Facebook and Twitter, resulting in thousands of memes, posts and tweets (*Exhibit K*). Many highlighted the relative rarity of shark attacks. The Support Our Sharks Facebook page, an offshoot of a shark conservation advocacy group, garnered tens of thousands of supporters; pro-cull pages by contrast, such as West Aussies Support Shark Cull struggled to get more than several hundred.⁴⁰ Anti-cull sentiment translated into real-world activism when some 4000 people rallied at Cottesloe Beach to protest the policy on 3 January 2014 (*Exhibit L*); similar demonstrations occurred around Australia.⁴¹ The Government denied the policy constituted a 'cull' while the Premier claimed that a 'silent majority' of West Australians supported the trial.⁴² According to the Government, fear of harassment or violent reprisals from conservationists was preventing more vocal assent. Death threats saw one company withdraw from offering services in the south-west. The Perth drum line contract was awarded to DoF, in part because private companies were reluctant to tender. Amongst the few willing to express approval for drum lines publicly were surfers and other marine sports enthusiasts, particularly those from the south-west. Though nowhere near a unanimous position, there was demonstrable concern about the presence of sharks. Margaret River surfer Dave Macaulay shared his anxieties in an interview with a surfing magazine:

I was considering leaving (the West). I've got four kids that all surf. I'm not worried about it myself, but I am worried for them. My daughter was actually there the day of the last attack (which killed Chris Boyd) and ran up to help. All the kids were surfing on the day. She was rattled by that. It's not something you want your daughter to see. She was keen to move to the East and she's been there for a couple of months now. It was pretty quiet there at Lefties (where Boyd was killed) for a couple of weeks but it's pretty much back to normal now.⁴³

Said another: 'They (sharks) shouldn't be protected any more. It seems like there are plenty of them now and lives have been lost because of it. Taking some of them out of the system would mean surfing and diving and swimming would be a lot safer. I think most surfers in WA would agree with me. Some conservationists might not agree, but you have to look at the big picture and the rising number of attacks and encounters.'⁴⁴ By contrast, some Perth scuba divers feared that baited drum lines would attract more sharks to their favourite spots, though the government insisted that they would only draw sharks already in the vicinity.⁴⁵

The trial was scheduled to commence in late January 2014, though environmental activists promised to disrupt it by freeing entangled sharks and removing bait.

³⁹ Crossley, M., Collins, C.M., Sutton, S. G. and Huvaneers, C. 'Public Perception and Understanding of Shark Attack Mitigation Measures in Australia', *Human Dimensions of Wildlife: An International Journal*, 19:2, 154-165, DOI: 10.1080/10871209.2014.844289

⁴⁰ Source: Facebook, www.facebook.com Accessed: November 2014.

⁴¹ 'Thousands protest against WA shark policies' ABC News, www.abc.net.au/news, Published: 6 January 2014, Accessed: November 2014.

⁴² Robertson, K. 'Premier Colin Barnett says silent majority support WA shark cull' Perth Now, www.perthnow.com.au 13 February 2014, Accessed: November 2014.

⁴³ Smith, J. 'What some WA surfers think about shark culling' *Stab Magazine*, www.stabmag.com 10 February 2014, Accessed: March 2015.

⁴⁴ *ibid.*

⁴⁵ Milman, O. 'West coast shark cull sparks fears of more attacks on swimmers' *The Guardian*, 8 January 2014.

Exhibit A: Shark fatalities Western Australia 2011-2013⁴⁶

September 4, 2011:

Kyle James Burden (21) is killed while on his body board at Bunker Bay, near Dunsborough.

October 10, 2011:

Bryn Martin (64) is likely taken by a great white shark whilst swimming at Cottesloe Beach.

Oct 22, 2011:

US tourist George Thomas Wainwright (32) dies after being bitten by a great white shark while diving off Rottnest Island.

March 31, 2012:

Peter Kurmann (33) is attacked while diving off Stratham Beach, near Busselton.

July 14, 2012:

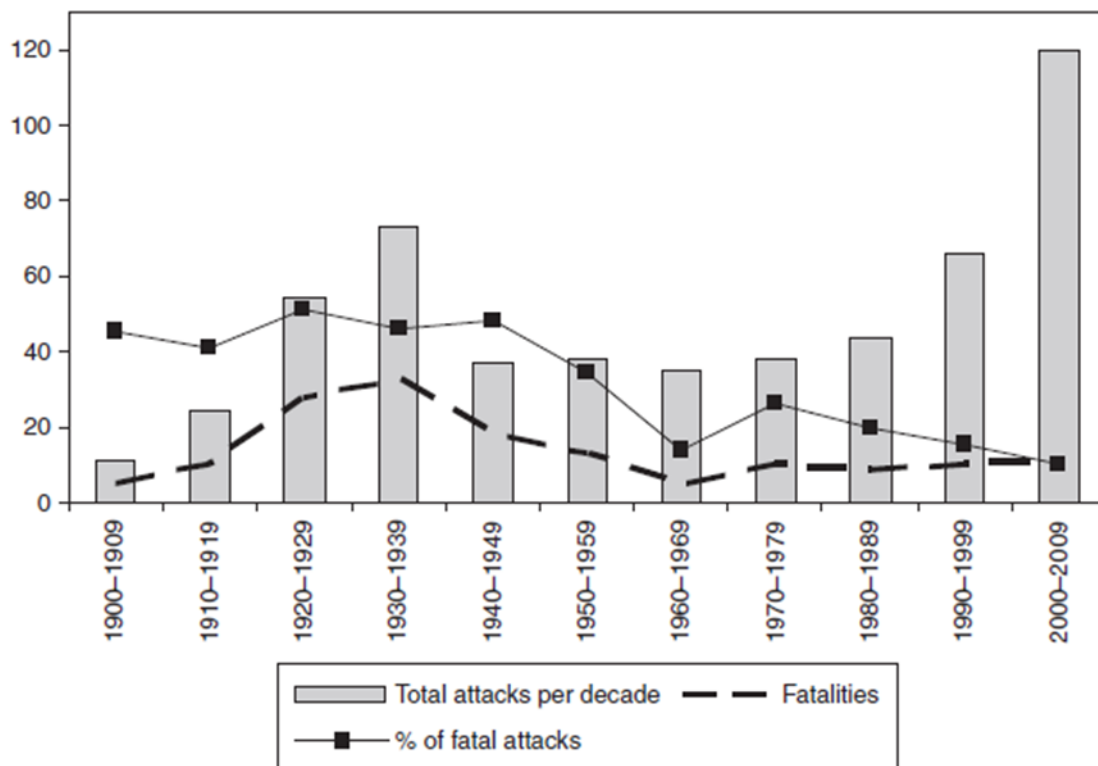
Surfer Ben Linden (24) is killed by a great white shark off Wedge Island, north of Perth.

23 November 2013:

Chris Boyd (35) is attacked by a shark, believed to be a great white, while surfing near Gracetown.

⁴⁶ 'Timeline of shark attacks on WA beaches' *WA today*, 20 July 2012.

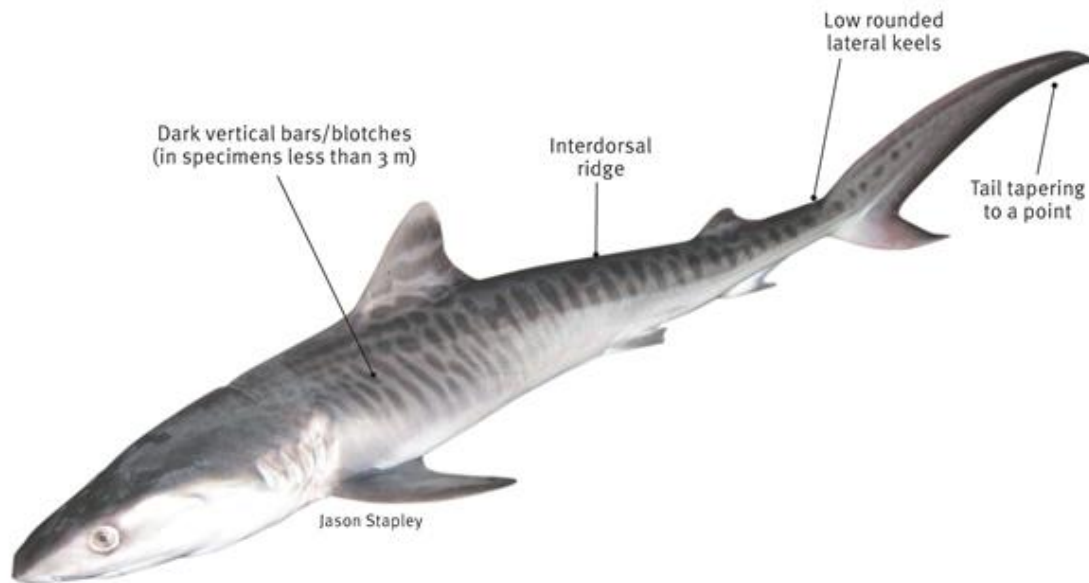
Exhibit B: Shark attacks and fatalities per decade in Australia, 1900-2009



Source: West, J.G. 'Changing patterns of shark attacks in Australian waters' Marine and Freshwater Research, 2011, Vol. 62, pp. 744-754.

Exhibit C: Australia's most lethal sharks

Tiger shark



Scientific name: *Galeocerdo Cuvier*.

Family: Whaler

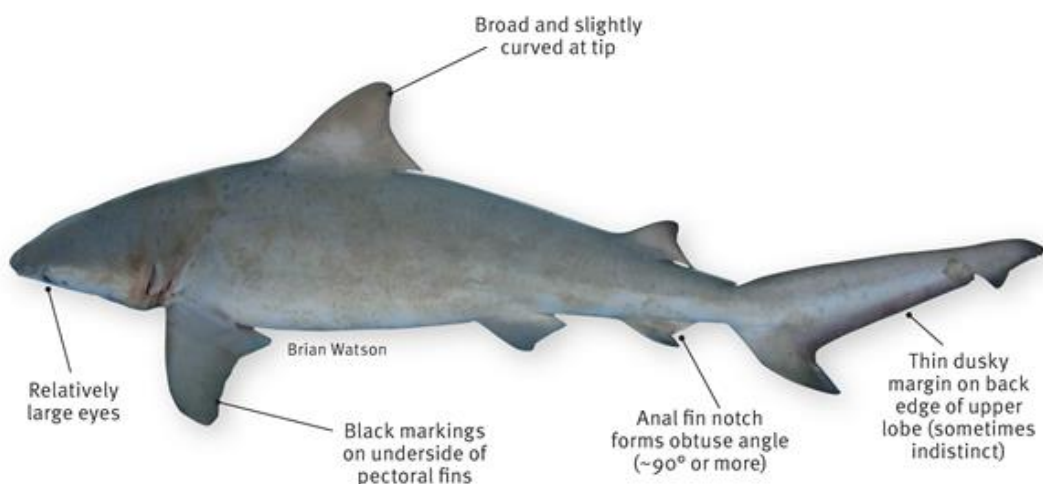
Description:

- large stout whaler
- ranges from pale to dark grey or blue-grey
- bold dark markings in juveniles become vertical bars, which fade in larger specimens
- distinguished by a long tapered tail and uniquely cockscomb shaped teeth.

Size: 50 to 600 cm.

Distribution: Found in inshore/offshore areas, mostly in tropical to sub-tropical waters. In WA, they could be found from the southern tip of the western coast to the Northern Territory border.

Bull shark



Scientific name: *Carcharhinus leucas*.

Family: Whalers (Carcharhinidae)

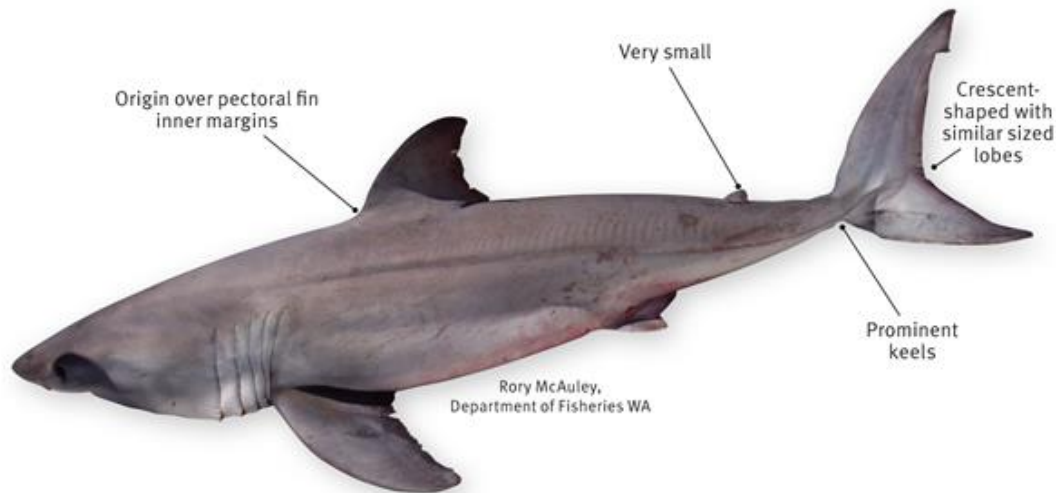
Other names: River whaler, freshwater whaler, Swan River whaler, Zambezi shark.

Frequent misidentifications: Pigeye shark (*C. amboinensis*).

Size: 55 to at least 340 cm.

Distribution: Inshore, including in estuaries and rivers, and offshore, in predominantly tropical to sub-tropical regions. In WA, found as far south as Perth but mostly confined to the Swan and Canning River estuaries.

Great white shark



Scientific name: *Carcharodon carcharias*.

Family: Mackerel sharks

Other names: great white shark, white death, white pointer.

Frequent misidentifications: Juveniles have slender teeth and so may be confused with shortfin mako (*I. oxyrinchus*).

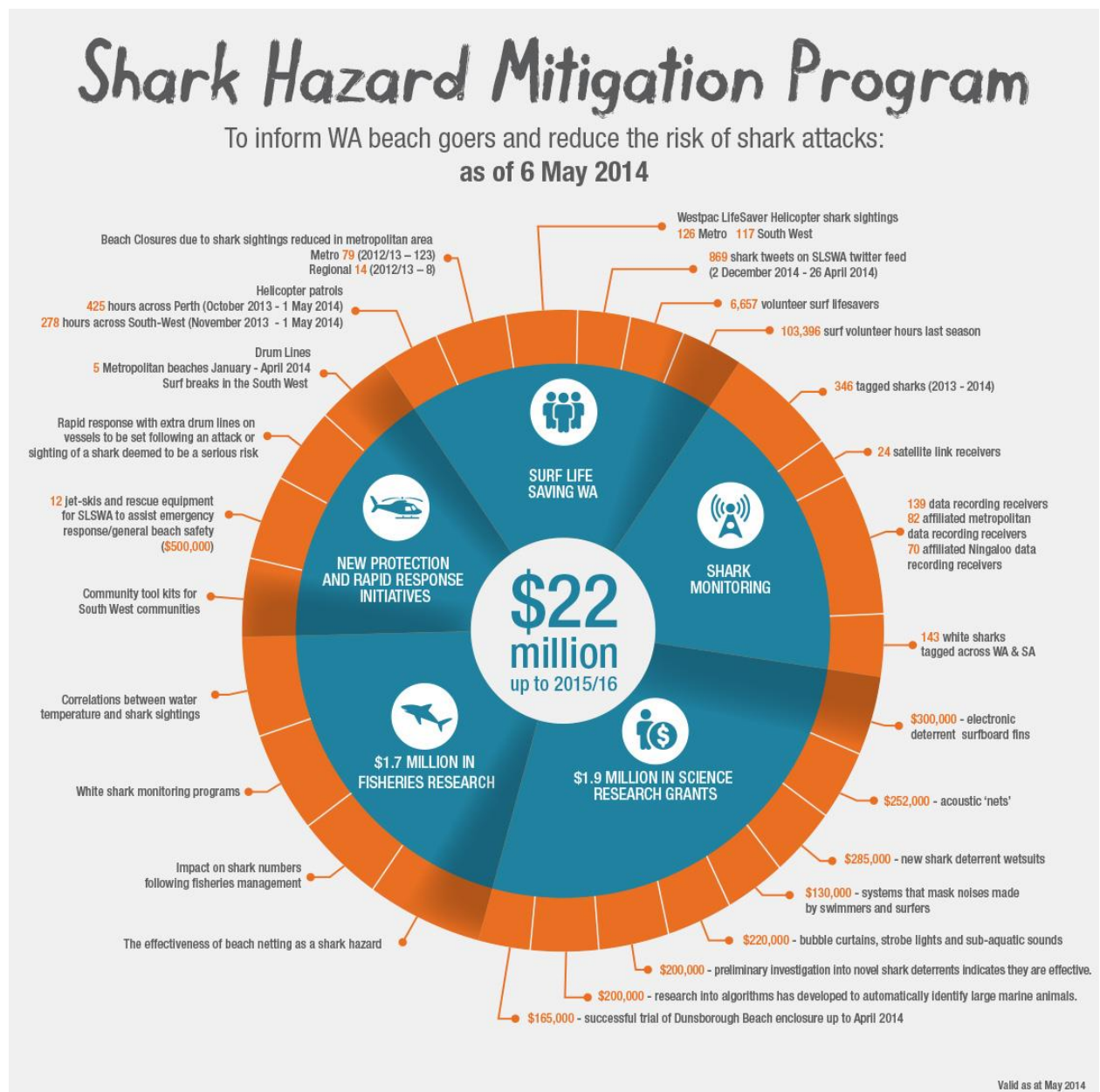
Size: 130 to 600 cm.

Distribution: Inshore/offshore areas in mostly temperate to subtropical waters across Australia. In WA, they typically inhabit areas from the mid-west coast to the South Australian border.

Protected species

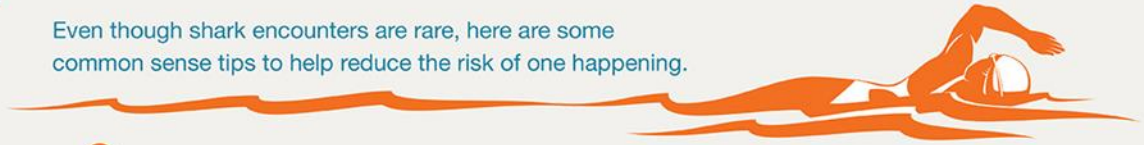
Source: Adapted from: 'Species Identification Guide', Department of Agriculture, Fisheries and Forestry, Queensland Government, <http://www.daff.qld.gov.au/fisheries/species-identification/shark-identification-guide> Accessed: November 2014.

Exhibit D: Western Australia Shark Hazard Mitigation Program





Even though shark encounters are rare, here are some common sense tips to help reduce the risk of one happening.



S

earch sharksmart.com.au before heading to the beach.

Search our website for information or download the beachsafe app for recent sightings. Help other beach goers by reporting shark sightings on 9442 8600.

M

ake sure you swim between the flags.

Or, stay close to shore and avoid deep channels or areas with steep drop-offs nearby.

A

void hazardous waters.

Never swim in places where human or animal waste enters the water. Also, avoid throwing fish waste overboard near swimming beaches and don't remain in the water with bleeding wounds. If spear fishing, it's not smart to carry dead or bleeding fish attached to you and be sure to remove all speared fish from the water quickly.

R

ecognise the danger signs.

Keep away from large schools of fish, seals or wildlife behaving erratically.

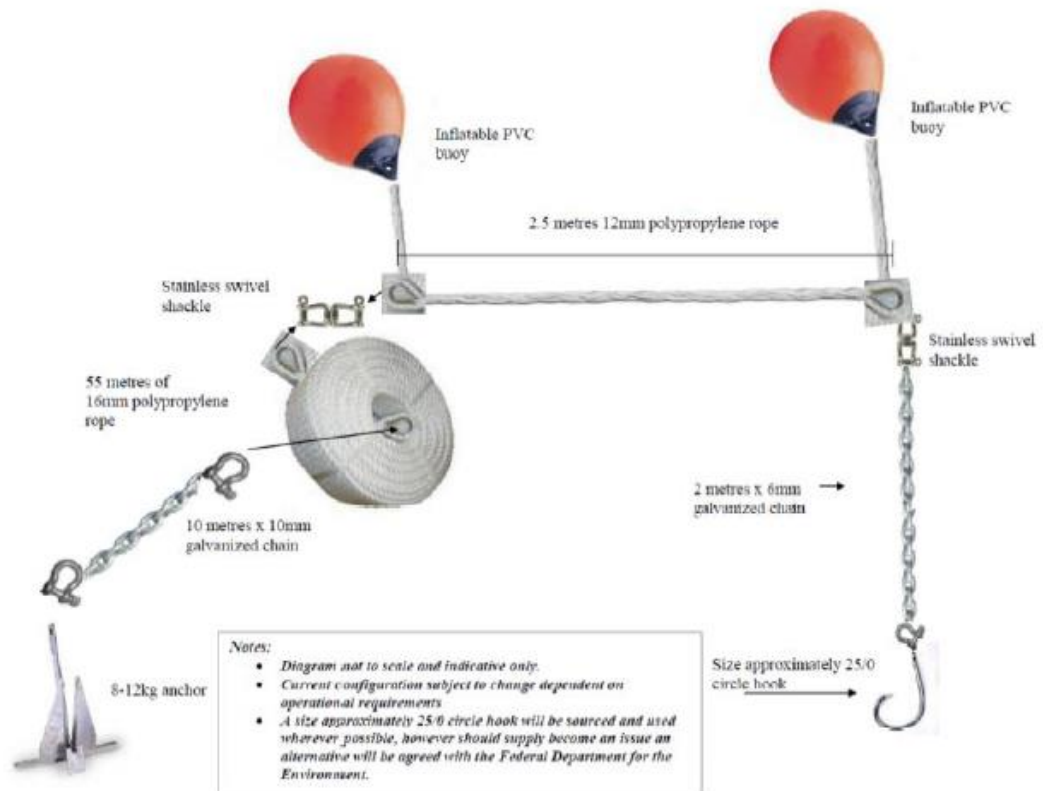
T

ake a mate with you.

Swim, dive or surf with a buddy.

Source: SharkSmart www.sharksmart.com.au Accessed: November 2014.

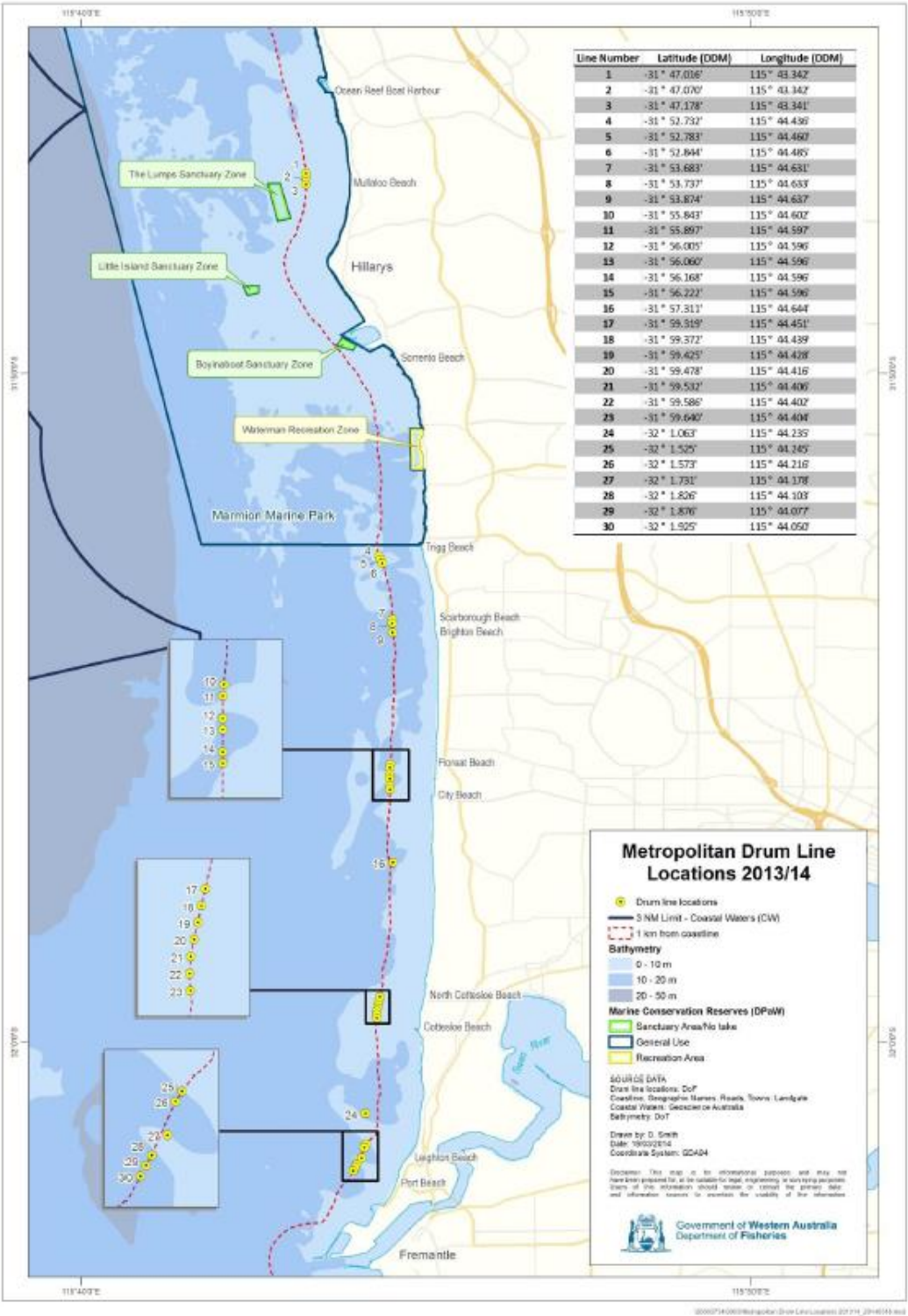
Exhibit E: Basic drum line configuration



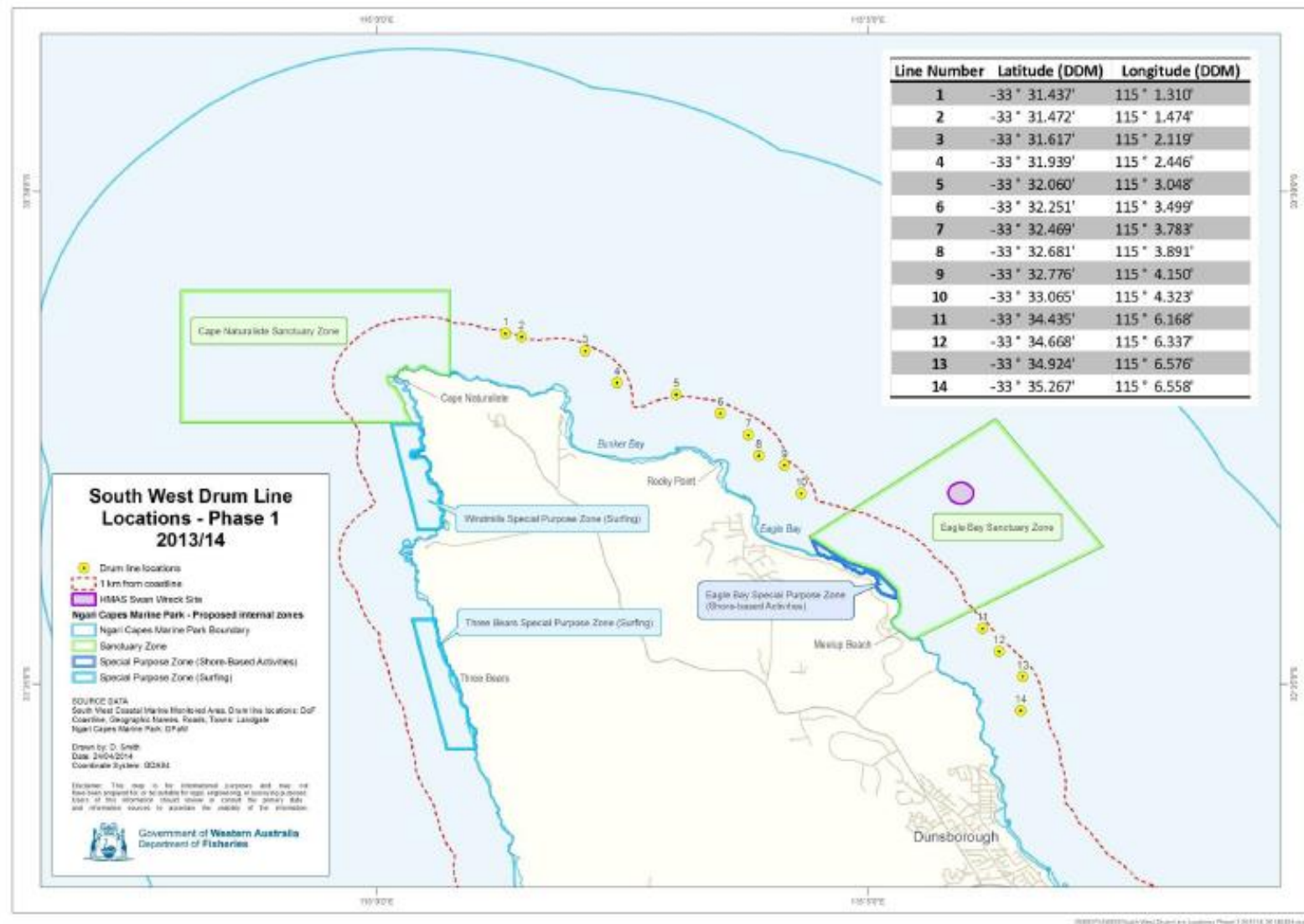
Source: 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014.

Exhibit F: Drum line locations

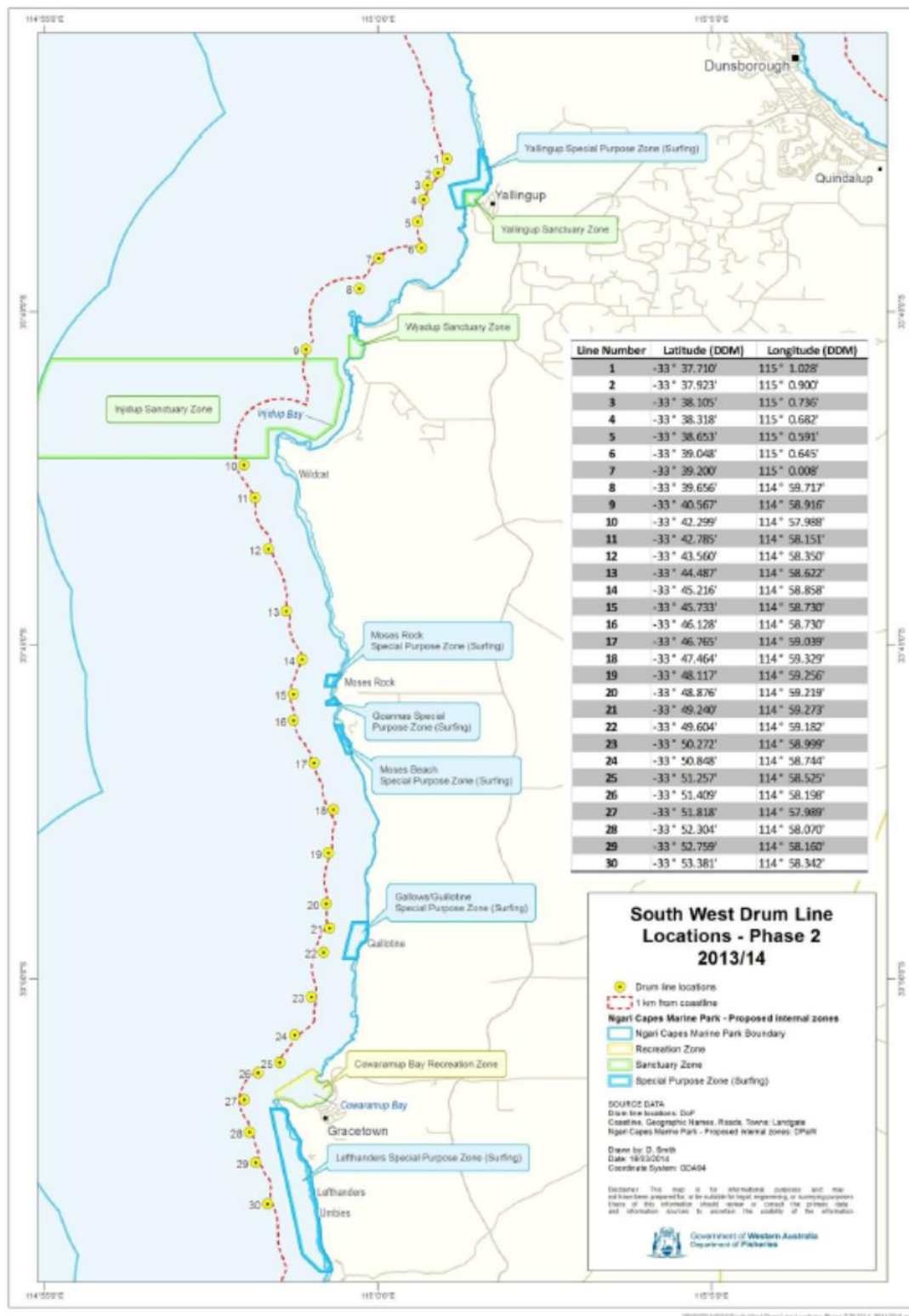
13. Metropolitan drum line locations 2013/14



14. South west drum line locations 2013/14: Phase 1



15. South west drum line locations 2013/14: Phase 2



Source: 'Shark Hazard Mitigation Drum Line Program 2013/14: Review' Department of the Premier and Cabinet, Government of Western Australia, Perth, June 2014, pp.77-79.

Exhibit G: Species in peril

Although calculating and monitoring shark numbers is challenging, researchers have concluded that more than a quarter of shark and ray species around the world are at risk of extinction, mostly due to overfishing.⁴⁷ This was particularly concerning for biologists and environmentalists, since large sharks often take more than a decade to reach sexual maturity and reproduce in comparatively small numbers. As top of the food chain, sharks play an important role in maintaining the health of marine ecosystems. Thanks to conservation efforts, certain shark species appeared to be holding or growing but for threatened species, even small losses could have a serious impact.

In Australia, most shark species can be caught for commercial or recreational purposes. However several species, including the great white shark, are listed as 'threatened' under the federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and subject to special protections.⁴⁸ National recovery plans were in place to preserve and bolster numbers; great whites were also protected by state legislation and international conventions. The Commonwealth Department of the Environment noted the high level of uncertainty around great white numbers and movements, including a lack of reliable metrics to make accurate assessments.⁴⁹ However, a 2012 University of Queensland-CSIRO study concluded that there were possibly as few as 700 breeding-age great white sharks in south-western Australia – a figure that left the population vulnerable to adverse advents and lack of genetic diversity.⁵⁰ They also found DNA evidence to suggest that west-coast great whites existed largely separately from east-coast populations.

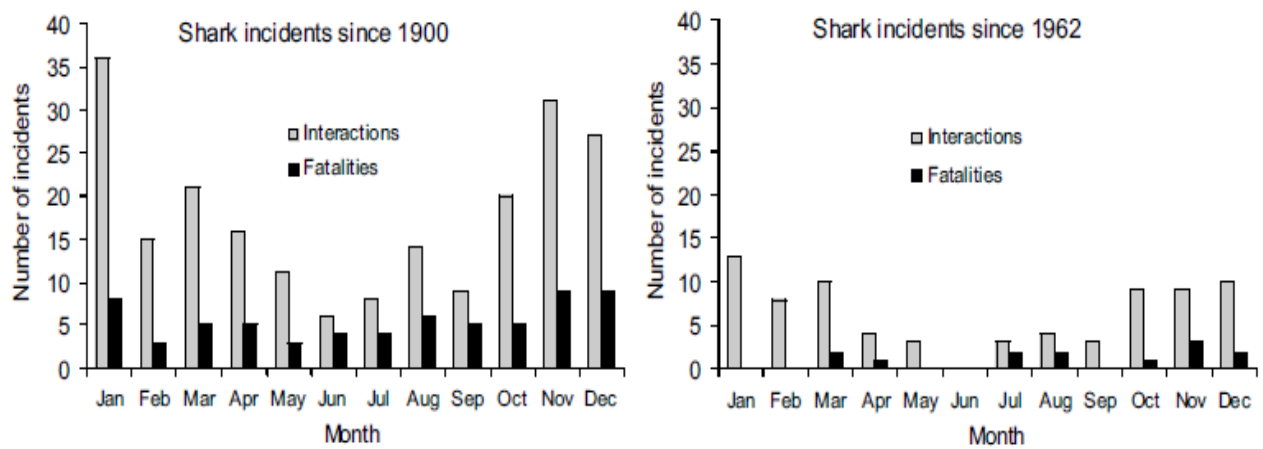
⁴⁷ Dulvy, N. et al 'Extinction risk and conservation of the world's sharks and rays' *eLife* 2014;3:e00590, 21 January, 2014, DOI: <http://dx.doi.org/10.7554/eLife.00590#sthash.o3DO2b0u.dpuf> Accessed: October, 2014.

⁴⁸ 'Sharks in Australian Waters' Department of the Environment, Australian Government, <http://www.environment.gov.au/marine/marine-species/sharks> Accessed: September, 2014.

⁴⁹ 'Carcharodon carcharias — Great White Shark' Species Profile and Threats Database, Department of the Environment, Australian Government, 2015, Accessed: April 2015.

⁵⁰ Blower DC, Pandolfi JM, Bruce BD, Gomez-Cabrera MdC, Ovenden JR 'Population genetics of Australian white sharks reveals fine-scale spatial structure, transoceanic dispersal events and low effective population sizes'. *Marine Ecology Progress Series*, 2012, Vol. 455:229-244.

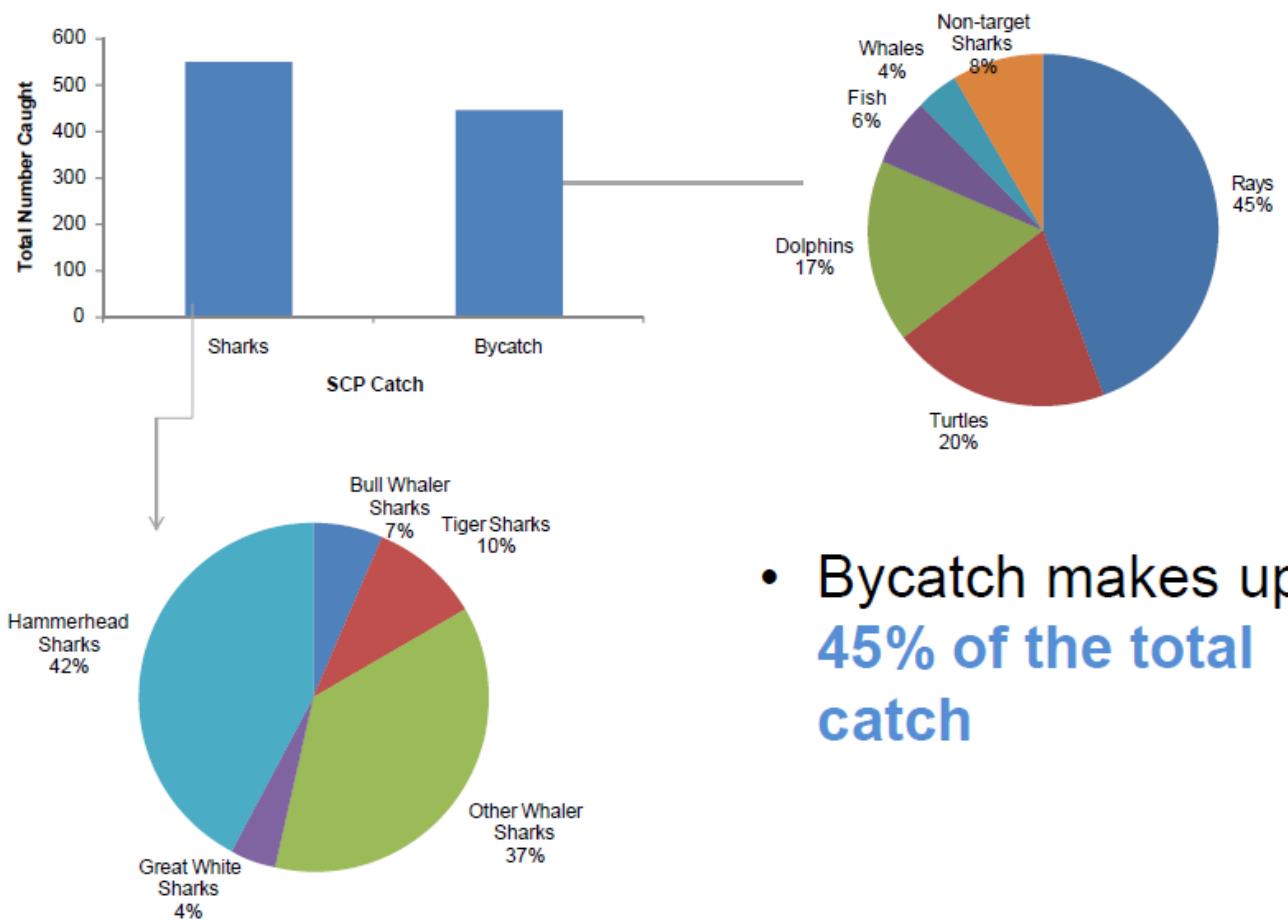
Exhibit H: Number of human fatalities and interactions* with sharks in Queensland before and after introduction of shark control methods in 1962



*'Interactions' range from minor shark contact to severe injuries.

Source: 'A Report into the Queensland Shark Safety Program' Department of Primary Industries and Fisheries, State of Queensland, March 2006, p.11.

Exhibit I: Bycatch composition Queensland 2000-2008



Source: Jackson, C. 'The Shark Control Program on the Gold Coast: Analysing trends of species catch in the Gold Coast Shark Control Program, Queensland from 2000-2008' Presentation to NSW Department of Primary Industries, April 2009. http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0008/280448/SCP_GC_Jackson09.pdf

Exhibit J: Shark habits and habitats

Sharks are apex marine predators with deep prehistoric roots: fossil evidence dates back more than 400 million years.⁵¹ Sharks are found along the entire Australian coastline, with 70 species considered endemic.⁵² Though they typically prefer shallow coastal waters, some sharks (including bull sharks) can tolerate extended periods in freshwater. Still relatively little is understood about their migratory habits – even within the same species, individuals can differ. Some great white sharks, for example, have been tracked travelling as far as South Africa to Australia.⁵³ Scientists believe that these patterns are largely dictated by food availability and reproductive cycles.⁵⁴ As such, local populations vary in size and stability, according to prevailing conditions and human activity such as fishing.

Their speed, power and keen senses make sharks one of the most fearsome and brutally efficient hunters in the natural world. Sharks can smell prey and detect movement at least several hundred metres away, though their vision is comparatively less acute. According to ISAF, most attacks occurred in near-shore waters where sharks were feeding.⁵⁵ Most large sharks have a preferred diet of fish, squid and marine mammals. Serious incidents within 30 metres of shore, however, were very uncommon. ISAF identified several types of unprovoked attacks, the most common being ‘hit and run’ attacks where a shark strikes without warning, then immediately releases its victim. Scientists believed that these incidents were most probably curiosity or cases of mistaken identity (often due to poor visibility). Indeed, there was evidence to suggest that sharks and humans were frequently in close proximity without incident,⁵⁶ even notoriously aggressive shark species.⁵⁷

⁵¹ ‘Shark Fossils’ Ichthyology Department, Florida Museum of Natural History, www.flmnh.ufl.edu Accessed: October 2104.

⁵² ‘Sharks in Australian Waters’ Department of the Environment, Australian Government, <http://www.environment.gov.au/marine/marine-species/sharks> Accessed: August 2014.

⁵³ ‘Great White Shark’ Smithsonian National Museum of Natural History, <http://ocean.si.edu/great-white-shark> Accessed: July 2014.

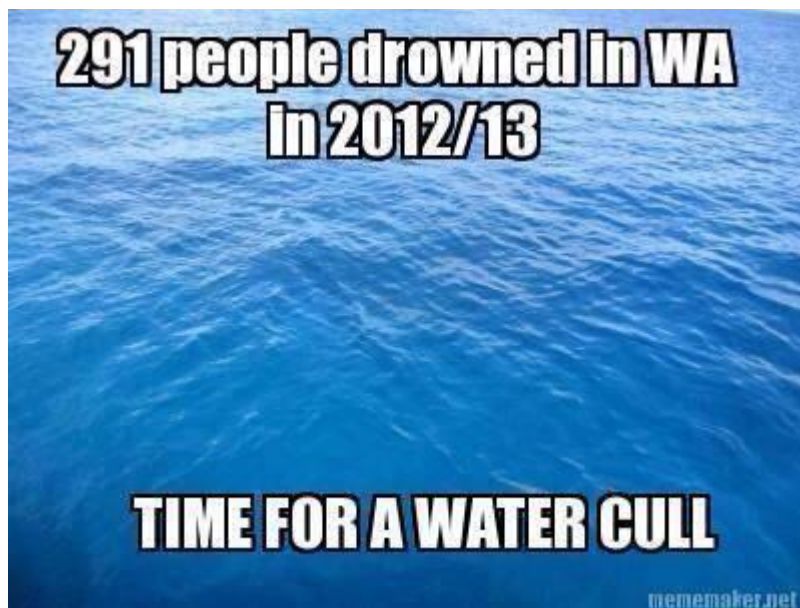
⁵⁴ Tobin, B. ‘Sharks’ Australian Institute of Marine Science <http://www.aims.gov.au/docs/projectnet/sharks-01.html> Accessed: October, 2014.

⁵⁵ ‘How, when and where sharks attack’ International Shark Attack File, Department of Ichthyology, Florida Museum of Natural History, www.flmnh.ufl.edu/fish/sharks/attacks/howwhen.htm Accessed: September 2014.

⁵⁶ Gibbs, L. and Warren, A. ‘The WA government remains committed to the shark cull plan but research shows that most surfers, divers and other ocean users don’t want the cull to continue.’ www.sbs.com.au, Published: 30 April 2014, Accessed: April 2015.

⁵⁷ ‘Map of shark movements on Australia Day prove animals share the busy waterway’ *The Daily Telegraph*, 25 August 2011.

Exhibit K: Shark cull internet memes



Source: Twitter, www.twitter.com, Accessed: November 2014.



Source: Greenpeace, www.greenpeace.org/australia, Accessed: August 2014.

Exhibit L: Shark cull protest images



Source: 'WA Government standing by shark cull despite 4,000-strong protest at Cottesloe Beach' ABC News, www.abc.net.au/news, 6 January 2014, Accessed: November 2014.



Source: 'Thousands protest WA's government shark strategy' SBS News, www.sbs.net.au/news, 4 January 2014, Accessed: September 2014.