The Senate

Environment and Communications References Committee

Shark mitigation and deterrent measures

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Abbreviations

AIASA	Abalone Industry Association of South Australia
AIMS	Australian Institute of Marine Science
ALC	NSW Young Lawyers Animal Law Committee
AMCS	Australian Marine Conservation Society
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoEE	Department of the Environment and Energy
DPI	New South Wales Department of Primary Industries
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
FAO	Food and Agriculture Organization of the United Nations
FRDC	Fisheries Research and Development Corporation
HSI	Humane Society International
IFAW	International Fund for Animal Welfare
IPOA–Sharks	United Nations International Plan of Action for the Conservation and Management of Sharks
IUCN	International Union for the Conservation of Nature
R&D	Research and development
SCEC	Sunshine Coast Environment Council
Shark-plan 2	*National Plan of Action for the Conservation and Management of Sharks 2012*

SLSC	Surf lifesaving club
SMART	Shark Management Alert in Real Time
SMP	Shark meshing program
TCSA	Taronga Conservation Society Australia
TSSC	Threatened Species Scientific Committee
UAV	Unmanned aerial vehicle

List of recommendations

Recommendation 1

8.19 The committee recommends that the New South Wales and Queensland Governments:

- **immediately replace lethal drum lines with SMART drum lines; and**
- **phase out shark meshing programs and increase funding and support for the development and implementation of a wide range of non-lethal shark mitigation and deterrent measures.**

8.20 The committee further recommends that the Australian Government pursue this recommendation at a future Meeting of Environment Ministers.

Recommendation 2

8.28 The committee recommends that, while state government lethal shark control programs remain in place, management arrangements for these programs should include more effective and transparent catch monitoring with the objective of improving understanding of the efficacy of lethal measures for public safety and the effects of the measures on the populations of marine species.

Recommendation 3

8.29 The committee recommends that the Australian Government:

- **establish a publicly accessible national database of target and non-target species interactions with shark control measures; and**
- **require the Department of the Environment and Energy to use this information to prepare and publish an annual assessment of the impacts of lethal shark control measures on target and non-target marine species.**

Recommendation 4

8.30 The committee recommends that state governments review and regularly audit the quality of the data collected on target and non-target species interactions with shark control measures.

Recommendation 5

8.37 The committee recommends that the Australian Government establish a review into the effectiveness of shark research and, following the review, commit to providing funding on a long-term basis for research areas that are considered likely to significantly contribute to improved knowledge about effective shark mitigation and deterrent measures.

Recommendation 6

8.38 The committee recommends that the Australian Government review the funding provided to CSIRO to enable CSIRO to:

- **undertake ongoing data collection and monitoring to support the determination of white shark population trends;**
- **develop a predictive model of shark abundance and location; and**
- **undertake a social survey to determine how the behaviour of water users has changed in response to the recent human–shark interactions.**

8.39 The committee further recommends that the Australian Government seek advice from CSIRO as to whether research can be undertaken to address anecdotal evidence presented to the committee on the potential risk that certain ocean-based activities, such as the use of teaser baits in cage diving, crayfish pots and trophy hunting, might increase the risk of human–shark interactions. The Australian Government should review the funding provided for marine science research to enable CSIRO (or another research institution) to conduct the research CSIRO advises could be undertaken.

Recommendation 7

8.42 The committee recommends that the Australian Government initiate discussions with state and Northern Territory governments regarding the clinical information collected about shark bite incidents to enable subsequent expert analysis of shark behaviour.

Recommendation 8

8.46 The committee recommends that the Australian Government match funding provided by state governments in support of the development of new and emerging shark mitigation and deterrent measures.

Recommendation 9

8.52 The committee recommends that the Australian Government develop a process to ensure products marketed as personal shark deterrent devices are independently verified as being fit-for-purpose.

Recommendation 10

8.53 The committee recommends that the Minister for the Environment and Energy and relevant state governments work with key stakeholder groups, such as national surfing organisations, to encourage water users to take all reasonable steps to reduce the probability of being involved in a shark bite incident, including by endorsing the use of independently verified personal deterrent devices.

Recommendation 11

8.55 The committee recommends that the Western Australian Government's trial rebate program for independently verified personal deterrent devices be made ongoing in Western Australia and adopted by other relevant state governments.

8.56 The committee further recommends that relevant state governments consider developing programs for subsidising independently verified personal deterrent devices for occasional surfers at beaches associated with the risk of dangerous shark encounters.

Recommendation 12

8.62 The committee recommends that the Australian Government hold a National Shark Summit of shark experts.

Recommendation 13

8.63 The committee recommends that the Australian Government establish a National Shark Stakeholder Working Group comprising key stakeholders in shark management policies. The principal function of the Working Group would be to further the objective of ending lethal shark control programs by developing strategies and facilitating information sharing about the effective use of non-lethal measures.

Recommendation 14

8.68 The committee recommends that the National Shark Stakeholder Working Group review the adequacy of information available to beachgoers regarding the risk presented by sharks, such as signage at beaches and how real-time information provided through shark alert apps can be made available at beaches.

Recommendation 15

8.69 The committee recommends that the Australian Government, working with relevant state governments, develop a program to provide grants for specialised trauma kits at venues near beaches associated with the risk of human–shark encounters.

Recommendation 16

8.70 The committee recommends that relevant state governments review the water safety education programs and education about sharks generally that is provided in schools (particularly schools in coastal areas), with a view to enhancing the education provided on reducing the risk of shark interactions and improving knowledge about shark behaviour and the ecological value of sharks.

8.71 As part of these reviews, the committee recommends that state governments consider the role that relevant community and scientific organisations with expertise in human–shark encounters could have in supporting the delivery of such programs.

Recommendation 17

8.72 The committee recommends that the National Shark Stakeholder Working Group review the various social media accounts and apps that distribute real-time information about shark sightings and warnings about the risk of shark activity to consider whether an integrated national database and app should be established.

Recommendation 18

8.74 The committee recommends that the New South Wales Department of Primary Industries improve its consultation and communication with animal rescue groups regarding marine wildlife caught in or injured by lethal shark control measures.

Recommendation 19

8.80 In light of the repeated use of section 158 exemptions for lethal shark control programs, the committee recommends that the next independent review of the *Environment Protection and Biodiversity Conservation Act 1999* carefully consider whether section 158 is operating as intended. In particular, the committee recommends that the independent review consider:

- **whether the matters the Minister may consider in determining the national interest should be limited; and**
- **whether section 158 should be amended to prohibit the repeated granting of exemptions for the same controlled action or any other controlled action of a similar nature.**

Recommendation 20

8.81 The committee recommends that the Minister for the Environment and Energy refrain from granting exemptions under section 158 of the *Environment Protection and Biodiversity Conservation Act 1999* for matters relating to shark control programs until after the operation of section 158 has been reviewed in accordance with Recommendation 19.

Chapter 1

Introduction

1.1 The waters around Australia contain many species of sharks. Although most species are not dangerous to humans, in a number of tragic cases people who encounter those that are have suffered serious injuries or been killed. These encounters, or concerns about the potential for them, have led to the implementation of measures intended to promote public safety, some of which are designed to be lethal to sharks but can also result in the unwanted capture of other marine life. Although lethal measures are in place in certain parts of the country, Australian governments have, over many years, contributed to global conservation efforts in response to concerns about declining shark populations. Australia is party to international agreements that seek to ensure shark populations are managed sustainably and some shark species are protected under Commonwealth law.

1.2 Essentially, this inquiry examines the effectiveness of the lethal and non-lethal measures taken in Australia to protect the public from dangerous species of sharks. In doing so, the committee explores how the public safety measures, shark conservation efforts and Commonwealth environmental law interact; considers whether the current arrangements represent the most desirable and effective response; and looks to the future to understand developments that may improve public safety significantly without harming the marine environment.

Referral

1.3 On 30 November 2016, the Senate referred the following matter to the Environment and Communications References Committee for inquiry and report:

> The efficacy and regulation of shark mitigation and deterrent measures, with particular reference to:
>
> (a) research into shark numbers, behaviour and habitat;
>
> (b) the regulation of mitigation and deterrent measures under the *Environment Protection and Biodiversity Conservation Act 1999*, including exemptions from a controlled action under section 158;
>
> (c) the range of mitigation and deterrent measures currently in use;
>
> (d) emerging mitigation and deterrent measures;
>
> (e) bycatch from mitigation and deterrent measures;
>
> (f) alternatives to currently employed mitigation and deterrent measures, including education;
>
> (g) the impact of shark attacks on tourism and related industries; and
>
> (h) any other relevant matters.[1]

1 *Journals of the Senate*, 2016–17, no. 22 (30 November 2016), pp. 710–11.

1.4 The committee was initially required to report by 30 June 2017. However, on 19 June 2017, the Senate granted an extension of time to report until 29 November 2017.[2] On 28 November 2017, the reporting date was extended further to 12 December 2017.[3]

Conduct of the inquiry

1.5 In accordance with its usual practice, the committee advertised the inquiry on its website and wrote to relevant individuals and organisations inviting submissions. The date for receipt of submissions was 3 March 2017.

1.6 The committee received 78 submissions, which are listed at Appendix 1. In addition to the detailed submissions, a form letter from 223 individuals was received and published.

1.7 The committee held ten public hearings for this inquiry, as follows:

- Sydney, 16 March 2017 and 17 March 2017;
- Perth, 20 April 2017 and 28 July 2017;
- Byron Bay, 2 May 2017;
- Brisbane, 31 July 2017;
- Cairns, 29 August 2017;
- Townsville, 30 August 2017; and
- Canberra, 20 October 2017 and 14 November 2017.

1.8 A list of witnesses who appeared at the hearings is at Appendix 2.

1.9 The public submissions and transcripts of evidence are available on the committee's website at www.aph.gov.au/senate_ec.

Acknowledgement

1.10 The committee thanks all of the individuals, organisations and Commonwealth government departments and agencies that contributed to the inquiry.

1.11 The committee is particularly grateful to the individuals personally affected by shark bite incidents who were prepared to discuss their experiences with the committee at the public hearings. These individuals included: Mr Dale Carr, who was bitten in August 2015; Mr Rick Gerring, whose brother died in May 2016 as the result of a shark attack; and Dr Sharon Burden, whose 21-year-old son died in a shark attack in 2011. The committee also received evidence from individuals involved in the response to shark bites.

2 *Journals of the Senate*, 2016–17, no. 45 (19 June 2017), p. 1472.

3 *Journals of the Senate*, 28 November 2017, p. 2312.

1.12 As this inquiry examined issues involving matters of both Commonwealth and state government responsibility, the committee sought and received evidence from certain state governments. This included written evidence from the Queensland and South Australian governments, and the then Premier of Western Australia, the Hon Colin Barnett. Evidence was also given at a public hearing by the Hon David Kelly MLA, Western Australian Minister for Fisheries, and officers of his department. The committee wishes to record its appreciation to these state governments for the assistance provided during this inquiry.

Structure of the report

1.13 This report comprises eight chapters, as follows:

- Chapter 1—this chapter has outlined introductory matters regarding the referral and conduct of the inquiry. The remaining sections of the chapter provide background information about sharks in Australian waters and the legal framework that applies to shark protection and conservation.
- Chapter 2 considers the frequency of human–shark interactions in Australian waters. The chapter also explores various other matters, such as public awareness and fear of sharks, and the available evidence about the impact of shark bites on regional tourism.
- Chapter 3 presents an overview of existing shark mitigation and deterrent measures used in Australia, including both non-lethal measures (such as surf lifesaving and aerial surveillance) and the lethal shark control programs operated by some state governments.
- Chapter 4 continues with the discussion of lethal shark control programs by examining the conflicting points of view about whether such programs are effective.
- Chapter 5 examines the Commonwealth's responsibilities with respect to the lethal shark control programs arising under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Chapter 6 addresses the evidence received about new and emerging technologies that may provide beachgoers with more effective protection from dangerous sharks while also minimising any impact on the marine environment.
- Chapter 7 continues on the topic of alternative methods for managing the risk of human–shark interactions by examining evidence received about other approaches that are not necessarily dependent on new technology, such as shark spotting and education programs. The chapter also outlines the evidence received on whether new, emerging or other approaches to shark management are, at this time, able offer reliable protection.
- Chapter 8 contains the committee's conclusions and recommendations.

1.14 In addition, Appendix 3 to the report presents a selection of myths and misconceptions about sharks. These myths were discussed during public hearings and are highlighted in this report as it was argued that they have implications for informed policymaking about sharks.

Shark numbers, species, behaviour and habitat

1.15 The following section provides background information about the types of sharks that can be found in Australian waters.

Overview

1.16 Around 180 species of sharks can be found in Australian waters.[4] Most sharks live in marine environments, however, a small number of species have adapted to freshwater habitats, such as the Northern River shark (*Glyphis garricki*) and speartooth shark (*Glyphis glyphis*) found in northern Australia.[5]

1.17 Sharks comprise around one per cent of all fishes and 'share nearly all the major features of their finned relatives', including the use of gills to extract oxygen from water.[6] The following information published by the Department of the Environment and Energy (DoEE) provides an overview of the feeding habits of sharks in Australian waters:

> Most sharks are predators. Many sharks species become active after dusk and hunt during the night. The majority of sharks feed on other fishes. Large sharks, such as the white shark (*Carcharodon carcharias*) and tiger shark (*Galeocerdo cuvier*), prey on large marine mammals such as seals, sea-lions, dolphins as well as large fishes, turtles and even sea birds.
>
> While some sharks are probably not very selective feeders, certain sharks eat some foods more than others. For example, hammerhead sharks are known for eating stingrays; bull sharks eat other sharks; and smooth dogfish eat crabs and lobsters.[7]

1.18 Not all shark species are dangerous to humans. Available data indicate that the overwhelming majority of shark bites in Australia, including 99 per cent of fatalities, can be attributed to three species of sharks: the white shark (*Carcharodon*

4 Department of the Environment and Energy (DoEE), 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 2 November 2017).

5 DoEE, 'Sharks in Australian waters'.

6 DoEE, 'Sharks in Australian waters'.

7 DoEE, 'Sharks in Australian waters'.

carcharias), tiger shark (*Galeocerdo cuvier*) and bull shark (*Carcharhinus leucas*).[8] Information published by the DoEE suggests that, at present, it is understood that the shark species known to be dangerous to humans do not target humans as prey, instead 'the majority of shark attacks can be attributed to the shark confusing us with its normal prey'.[9]

Population

1.19 Potentially declining shark populations has been a matter of concern for a sustained period, as demonstrated by the 1999 United Nations International Plan of Action for Conservation and Management of Sharks. Concerns about shark numbers and the need for shark conservation follow overexploitation of certain shark species, with their recovery affected by 'slow rates of growth, late age-at-maturity and low fecundity compared with bony fishes'.[10] Globally, sharks are harvested for meat, fins, skin, cartilage and liver, with shark meat and fins used for food, shark skin primarily used for leather, cartilage used for food and in the pharmaceutical industry, and liver 'mostly used to extract oils and other hydrocarbons, which have been used in a wide array of industries throughout history'.[11] Approximately one-quarter of the total number of shark species are threatened with an elevated risk of extinction, largely due to over-fishing, including as bycatch.[12]

1.20 In addition to fishing activity that targets shark species, sharks are also caught as bycatch by fishing efforts directed at other marine species.[13] Shark populations are also vulnerable as a result of recreational fishing, habitat degradation and shark control activities.[14]

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8 Taronga Conservation Society Australia, 'Australian shark attack file: FAQs', https://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file/faqs (accessed 5 December 2016). See also New South Wales Department of Primary Industries (DPI), 'Identifying sharks', www.dpi.nsw.gov.au/fishing/sharks/identifying-sharks (accessed 5 December 2016).

9 DoEE, 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 2 November 2017).

10 Food and Agriculture Organization of the United Nations (FAO), 'Sharks', www.fao.org/ipoa-sharks/background/sharks/en/ (accessed 20 January 2017).

11 FAO, 'Sharks', www.fao.org/ipoa-sharks/background/sharks/en/ (accessed 20 January 2017).

12 Professor Colin Simpfendorfer, *Committee Hansard*, 30 August 2017, pp. 1–2.

13 Department of Agriculture, Fisheries and Forestry, *National Plan of Action for the Conservation and Management of Sharks 2012*, www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/sharks/sharkplan2-final/sharkplan2-action.pdf (accessed 10 January 2017), p. 1.

14 DoEE, 'Sharks in Australian waters'.

1.21 As at October 2017, nine shark species are classified under the EPBC Act as threatened species due to declining populations. In particular, the east coast population of the grey nurse shark (*Carcharias taurus*) and the speartooth shark (*Glyphis glyphis*) are listed as critically endangered species. The white shark is listed as vulnerable.[15]

1.22 In relation to the white shark, it is listed as vulnerable on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.[16] The DoEE advised that is was first listed as vulnerable under Commonwealth legislation in 1997 under the *Endangered Species Protection Act 1992*. This listing was transferred to the EPBC Act's threatened species list in 2001. The DoEE noted that the white shark 'is also provided legislative protection under state and territory legislation throughout its range in coastal waters, and is protected under the Convention on International Trade in Endangered Species and Convention on Migratory Species conventions'.[17]

1.23 Many submitters noted that accurate information about the population of shark species is limited. As noted by CSIRO, there 'are no current reliable estimates of population size in Australian waters for white, bull or tiger sharks'. CSIRO explained that these species have not been the primary focus of commercial fisheries, and the conventional data required to produce reliable estimates 'such as detailed catch records over suitable time periods, is limited, unreliable or non-existent'.[18]

1.24 CSIRO added:

> White sharks have been protected in Australian waters since the late 1990s, but data on their historical and contemporary catch has been poorly recorded and is inadequate for estimating population size or trend. Bull and tiger sharks have not been the focus of targeted research to estimate population size in Australian waters, although analyses of tiger sharks captured in the Queensland Shark Control Program…indicate significant declines in catch rates and average size between 1993 and 2010…[19]

15 DoEE, 'Sharks in Australian waters'.

16 International Union for the Conservation of Nature (IUCN) Red List, '*Carcharodon carcharias*', www.iucnredlist.org/details/3855/0 (accessed 12 July 2017). The IUCN Red List catalogues the global conservation status of animal, fungi and plant species. It seeks to determine the relative risk of extinction and highlight those that are facing a higher risk of global extinction. See IUCN Red List, 'Introduction', www.iucnredlist.org/about/introduction (accessed 12 July 2017).

17 DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), p. 3.

18 CSIRO, *Submission 33*, p. 7.

19 CSIRO, *Submission 33*, p. 7 (citation omitted). See also Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, pp. 2–3.

1.25 The SEA LIFE Trust explained that a lack of information on population status of white sharks is a global problem that is not just limited to Australia. The SEA LIFE Trust submitted:

> The population status in Australia, and globally, is…poorly known owing to a lack of robust abundance indicators. Quantitative stock assessments are not possible. The Great White Shark is, however, uncommon compared to other sharks and evidence (from game fishing, bycatch, shark netting or from observational data) indicates a declining global population.
>
> Evidence suggests that the population may have declined by at least 20% over the last three generations and, in some areas, the species is considered to have declined even more substantially over the same period.[20]

1.26 Regarding white sharks, in 2014 CSIRO and partners in the National Environmental Science Program 'reported the first ever empirical estimate of adult white shark abundance—provisionally 750 to 1,200 adult white sharks for the eastern Australia population'. CSIRO added that subsequent data and refinements to the analysis 'suggest that the figure is more likely to be at the lower end of this scale'.[21] CSIRO further added that the total population of white sharks is likely around ten times the adult population.[22]

1.27 Dr Daniel Bucher and Professor Peter Harrison also referred to the recent estimate of the east coast population of adult white sharks. However, Dr Bucher and Professor Harrison noted that 'there are no estimates for juvenile and sub-adult white sharks, which are the size categories (2.0–3.5 m) generally found in coastal waters and implicated in recent events'. Overall their joint submission concluded that:

> There is…historical evidence of a greater decline in white shark numbers than other shark species and no current evidence supporting a recovery in numbers…Furthermore, it is widely acknowledged that many large shark species (>2 m) are unable to increase their populations rapidly due to life history characteristics such as slow growth, late maturity and low reproduction rates…[23]

1.28 Other submitters also provided reasons supporting the proposition that there has been a long-term decline in the white shark population. Sharksafe Barrier, a South African company that supplies eco-friendly barriers designed to separate humans from sharks (these devices are discussed in Chapter 6), submitted:

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20 SEA LIFE Trust, *Submission 25*, pp. 3–4.

21 CSIRO, *Submission 33*, p. 6.

22 Professor Nic Bax explained that 'if you…look at the simple demographics of white shark—how long they live, how many pups they produce, how frequently the females reproduce—you would come up with an estimate that the total population of sharks would be about 10 times the adult population'. Professor Nic Bax, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 4.

23 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 3 (citations omitted).

> White sharks have long lifespan, slow growth, have low estimated fecundity, and low natural mortality within the marine ecosystem (only orca are known to prey on adult white sharks in areas where the two species overlap). It is therefore believed that increasing conflict with man during the past century is the main cause of population declines of this ancient top-predator.[24]

1.29 Sharksafe Barrier added that there are three key human-related drivers of declining white shark populations: depleted food resources, bioaccumulation of pollutants and lethal beach protection measures.[25]

1.30 Some individuals, however, questioned how assessments about the conservation status of shark species, particularly the white shark, can be made when reliable population information is not available. For example, Mr John Heaton, a resident of the New South Wales north coast, submitted:

> I keep hearing from shark experts and scientists that world-wide, Great White numbers are still low. However the frustrating thing is that no expert, scientist or organisation can say how many Great Whites are actually travelling along the east coast of Australia and/or is that number adequate or not for the marine habitat. Local professional fisher people tell me the ocean off the North Coast of NSW coastline is teeming with sharks, including Great Whites.[26]

1.31 A similar sentiment was expressed by a Western Australian resident:

> Scientists do not know the numbers of great white sharks. Daily WA ocean users see the evidence of increasing numbers and this 'local knowledge' cannot be discounted. Old time fishermen who have fished off our coast all their lives say the ocean off Perth and our south west is now teeming with sharks, including great whites. It is common sense that great white numbers have increased since they became a protected species in 1997. This coincided with an increase in the migrating whale population and the decline of our commercial fishing fleet. The decision to close the Perth fishery was a foolish one because it was an economically efficient way to manage great white numbers.[27]

1.32 Mr Donald Munro remarked that commercial fishers on the east coast suggest that the estimate referred to in paragraph 1.26 'is a mile out'. Mr Munro added:

> It is a little bit hard for me to come to grips with the fact that with today's technology they cannot get a more accurate figure. We could stick a man on the moon in 1969 and bring him back, for God's sake. This is 2017. So it is

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24 Sharksafe Barrier, *Submission 29*, p. 4.

25 Sharksafe Barrier, *Submission 29*, p. 4.

26 Mr John Heaton, *Submission 11*, p. 2.

27 Mrs Rebecca Clough, *Submission 66*, p. 1.

> frustrating, but definitely, categorically I will state that direct information from commercial fishermen particularly…is that the numbers are way up.[28]

1.33 However, scientists involved in shark research and other stakeholders cast doubt on claims regarding significant increases in white shark numbers and explained that there are particular difficulties associated with studying white sharks. For example, in response to the suggestion that coastal waters are 'teeming' with white sharks, Professor Nic Bax, a senior principal research scientist at CSIRO stated:

> …given the life history strategies of the white shark—and you're looking at the life history parameters—it would be hard to imagine that their growth rate could be more than about four per cent a year. So an explosion in that sense, four per cent a year, depending on how you consider a four per cent increase, is the maximum rate of increase we would expect given the shark demographics…And, of course, we have no evidence that it is increasing at four per cent. It could be decreasing at four per cent. We don't know.[29]

1.34 Other submitters also asserted that anecdotes about shark populations are not credible. For example, Humane Society International (HSI) submitted:

> There is a limited amount of data on white shark population numbers, behaviour and habitat preferences. We note that while there have been claims in the media of 'increases' in white shark numbers in Australia, these anecdotal reports have not been verified by scientists who work specifically with the species. Presentations during the 2015 NSW Shark Summit focused on the lack of evidence of any kind of surge in white shark numbers. The Summit addressed the fact that the species continues to be listed under federal law as vulnerable to extinction. It seems that in the case of the white shark, opinion is given credence over evidence.[30]

1.35 Professor Jessica Meeuwig argued that it is 'unlikely that there has been a population boom in white sharks, given their basic, fundamental biology'.[31] After noting that white sharks only start reproducing between 17–20 years of age and 'have one or two offspring every couple years', Professor Meeuwig emphasised that white sharks 'are just not capable of rapid rebound like a herring or a pilchard'.[32]

1.36 Professor Meeuwig added that anecdotal information about increases in shark populations could be linked to an increase in sampling efforts; that is, a greater number of people being in the water results in a higher number of observations.[33]

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28 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 3.

29 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 4.

30 Humane Society International, *Submission 43*, p. 5.

31 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 36.

32 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

33 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

In addition, Professor Bucher commented that the number of observations might be affected as people 'tend to remember the big things, the shocking things'; Professor Bucher added that people will remember when they see a shark but will not 'remember so much how many times [they] did not see a shark'.[34]

1.37 Changes in the areas favoured by sharks could also be resulting in an increased frequency of shark observations. Professor Meeuwig explained that climate change could affect the distribution of animals on which sharks prey, leading to white sharks approaching the coast but not being indicative of an overall increase in the population.[35]

1.38 On the difficulties in studying white sharks, Professor Colin Simpfendorfer told the committee:

> All species can provide challenges. As technology has developed we have become much better at doing it. But some of the challenges are that it is a very big ocean and there is not a huge number of white sharks, for example, out there. So finding them and studying them when you find them is difficult. The other challenge they present is that they move over vast distances. We have white sharks that swim regularly between Australia and New Zealand, for example. When you are moving over that sort of distance, it is a challenge to understand what is going on. Technology also only gives us answers about so many bits and pieces.[36]

1.39 Ms Tooni Mahto from the Australian Marine Conservation Society (AMCS) emphasised the need to consider the migratory nature of species such as white sharks when considering population estimates. Ms Mahto stated:

> White sharks move. They are migratory animals and travel huge distances across the oceans. They are not permanent residents at any location around our coastline. So sporadic anecdotal increases in particular locations are not an indication of a population increase and are more likely the result of changes in prey distribution in their physical environment.[37]

1.40 Nevertheless, given the scientific uncertainty about the white shark population, some submitters questioned how future decisions about categorising the white shark as a listed threatened species under the EPBC Act could be made.[38]

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34 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 50.

35 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

36 Professor Colin Simpfendorfer, *Committee Hansard*, 30 August 2017, p. 3.

37 Ms Tooni Mahto, Senior Marine Campaigner, Australian Marine Conservation Society, *Committee Hansard*, 2 May 2017, p. 53.

38 See Mr John Heaton, *Submission 11*, p. 2.

1.41 Despite advising that the lack of reliable data means it is 'not currently possible to say' if the populations of bull, tiger or white sharks are increasing, decreasing or stable, CSIRO informed the committee that research is underway to develop means for obtaining white shark population estimates. CSIRO explained that it is undertaking research in a partnership under the National Environmental Science Program with the aim of developing, applying and refining 'novel techniques for estimating total population size for white sharks in Australian waters'.[39] CSIRO added that data collected for the 2014 estimate of adult white shark abundance for the eastern Australia population are being 'further developed to give an estimate of total population size' as well as to extract information about the juveniles in the population.[40] The data collected from this process will support the recovery plan for the white shark (which is discussed in Chapter 5).[41]

1.42 CSIRO also noted that data on the incidence and frequency of shark bites 'may not have a direct relationship to local shark abundance and cannot be used as a proxy for shark population trend'.[42] Furthermore, CSIRO added that although the data it is collecting to estimate the white shark population will be 'a highly statistically robust estimate', the data will be an estimate of abundance, not the trend in population.[43]

1.43 Finally, in an answer to a question taken on notice, CSIRO identified the need for additional research to enhance understanding of the current state of shark populations. CSIRO suggested that a focus of this research could be the 'ongoing data collection and monitoring to support the determination of population trends', with this data collection effort to include sampling of white sharks in state government tagging programs as well as white sharks caught in shark control programs and as commercial fisheries bycatch. CSIRO submitted:

> Current research will provide a more precise estimate of when the assessment should be updated and further tested for population trend, but practical reasons would suggest reassessment once about 100 new samples have been collected or after 1–2 years. The majority of tissue samples are being taken as part of the State run tagging programs; these programs are critical for obtaining the necessary data to estimate population size and trend, and will ensure the required number of samples to estimate these parameters are obtained in the shortest possible time.[44]

39 CSIRO, *Submission 33*, p. 1.

40 CSIRO, *Submission 33*, p. 7.

41 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 3.

42 CSIRO, *Submission 33*, p. 10.

43 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 4.

44 CSIRO, Answers to questions on notice, 20 October 2017 (received 24 November 2017), p. 2.

Behaviour and habitat

1.44 CSIRO explained that bull, tiger and white sharks have similar movement patterns in that they 'roam over considerable distances (1000s of km)…and utilise both nearshore and offshore waters as part of their normal habitat'. Regarding white sharks, CSIRO noted that they 'are not permanent residents at any one site' with movements that 'indicate temporary residency at various sites, mixed with periods of long-distance travel that may include common corridors'.[45] Furthermore:

> Research indicates broad-scale movements of white sharks in eastern Australia between Tasmania and central Queensland and between eastern Australia and New Zealand. Movements include multi-year return and occupancy of two known east coast nursery areas (Port Stephens, New South Wales and 90 Mile Beach-Corner Inlet area, Victoria).
>
> Nearshore areas, including surf zones and some estuaries, are common habitat for juvenile white sharks with sporadic areas of temporary residency along the coast likely in response to the distribution of prey.[46]

1.45 CSIRO added that, although Bass Strait is not a barrier to movement, 'the general pattern is for sharks to remain either east or west of Bass Strait'.[47]

1.46 In their joint submission, Dr Daniel Bucher and Professor Peter Harrison provided the following insights into shark behaviour:

> While there is a lack of data on shark behaviour, 'normal' behaviour for sharks is generally considered to be following and hunting prey. These prey are primarily fish, however, depending on the species, sharks also eat a variety of other marine animals (marine mammals, other sharks, sea turtles, squid, crustaceans and seabirds). Food availability is generally driven by seasonal changes in weather patterns, ocean currents and water temperatures. Furthermore, sharks are inquisitive (and opportunistic) animals, and will investigate almost anything in the water column or on the surface…[48]

1.47 The submission continued with observations about the movement patterns of white, tiger and bull sharks:

> Both juvenile white sharks and tiger sharks show a 'hot-spot-highway' style of movement with regular visits to 'preferred' or 'residency' locations as well as wide-ranging patterns of movement…Juvenile white sharks are known to be more common in northern NSW waters in winter when sea

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45 The committee was also advised that 'white sharks are highly specialised endotherms capable of maintaining high metabolic rates in cool temperate areas, and hence they do not follow predicable seasonal patterns of movement'. See Government of South Australia, *Submission 65*, p. 2.

46 CSIRO, *Submission 33*, p. 1.

47 CSIRO, *Submission 33*, p. 7.

48 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 3 (citations omitted).

> surface temperatures are cooler…following schools of large snapper and Australian salmon (and possibly the humpback whale migration), and stopping wherever food is prevalent…Tiger sharks tend to follow seasonal changes in water temperatures, generally moving further into NSW waters during warmer months when sea surface temperatures are higher… Bull sharks occur year-round in NSW waters north of Sydney…Immature animals use rivers and estuaries and mature animals use inshore marine areas, entering estuaries in summer to breed. Broad-scale movements between coastal populations have also been recorded in mature animals…[49]

1.48 Professor Bucher noted that sharks 'will go wherever there is food'. He explained that sharks travel to places:

> …where there is a lot of food and where the ocean temperature and currents, and so on, are just right—it might be a permanent spot; it might be something that comes and goes with the seasons or from year to year…The individuals are constantly moving around, and what we are getting are these little aggregations in different spots at different times.[50]

1.49 Evidence received by the committee also commented on the influence of sharks on the structure of marine ecosystems. Dr Bucher and Professor Harrison submitted that sharks 'are believed to play a key role in the structure and functioning of marine communities, and are a vital component to coastal ecosystem health'. They explained:

> By selectively removing weakened animals from prey populations and scavenging whale carcasses and flood debris, sharks can serve to keep prey population healthy and vigorous. The further decline of shark populations, combined with other anthropogenic pressures in coastal waters (climate change, habitat loss and degradation, pollution), could have dire consequences (economic and environmental) for these highly productive marine systems….[51]

1.50 On the role sharks play in shaping marine ecosystems, Professor Bax commented:

> I think there's a general acceptance in the biological community that large apex predators, like white sharks, are important to the way the ecosystem functions. While I believe it would be true…we don't have the specific information which allows us to say, 'If white sharks were gone this would happy to the ecosystem,' there have been instances, especially in terrestrial areas, with the reintroduction of large predators like wolves in Yellowstone,

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49 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 3 (citations omitted).

50 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 50.

51 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 4 (citation omitted). Similar evidence about the role performed by sharks as apex predators and how they regulate the food chain was provided by Ms Amanda Elizabeth Morgan (see *Committee Hansard*, 28 July 2017, p. 2); Dr Jan-Olaf Meynecke (see *Committee Hansard*, 31 July 2017, p. 11); and Mr Paul O'Dowd, *Committee Hansard*, 29 August 2017, pp. 2–3.

> where their presence changed the behaviour of other animals and changed the whole ecosystem. In Yellowstone national park, it's led to the resurgence of a particular kind of tree and it's led to a change in the landscape because of the presence of this apex predator. It's not just their direct role in predation or feeding; it's how they change the behaviour of other animals in the system.[52]

1.51 When commenting on shark behaviour, some witnesses emphasised that, of the small number of shark species that are considered to be dangerous to humans, those sharks are not considered to preferentially hunt humans as prey. For example, Mr Brendan Donohoe of the Surfrider Foundation Australia commented that sharks 'are not after people'. Mr Donohoe stated:

> …to the best of my knowledge there has never been a shark caught post-attack that has had in its intestines the evidence of involvement in more than one incident. They are not the rogue lion, the rogue this, the rogue that. Shark incidents happen. Sharks have been hunted, and successfully hunted, and found. They have found bits of boards and things when people have been taken, but they have never found bits of board from two different attacks. They are not return hunters. These things are not after people. They are not crocodiles. They do not lie in wait for us. They investigate. From all reports, as sharks, particularly whites, hit maturity and become bigger specimens, they start to change their feedstock from large fish to seals and the like.[53]

1.52 However, other individuals expressed frustration regarding what they consider is a lack of authoritative information about perceived changes in shark behaviour and spikes in regional human–shark encounters. Mr Heaton stated:

> The experts, for whatever reason, cannot give any sort of reason as to why for a two-year period they came close to the shore and encountered or attacked people—whatever terminology you want to use. Why did they come in so close to shore and attack people? Surfers only go about 100 metres off the coastline. Why did the sharks come within 100 metres over that two-year period?[54]

1.53 Generally, it was accepted that further research is necessary to gain a better understanding about sharks, particularly regarding their behaviour, movement and breeding patterns.[55] In particular, CSIRO identified that it might 'be possible to build a predictive model' to better understand shark abundance and location. CSIRO provided

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52 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 9.

53 Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 23.

54 Mr John Heaton, *Committee Hansard*, 2 May 2017, p. 3.

55 See, for example, Ms Amanda Elizabeth Morgan, *Committee Hansard*, 28 July 2017, p. 4; Mr Kent Stannard, Founder and Trustee, Tag For Life, *Committee Hansard*, 31 July 2017, p. 41.

the following explanation of how a predictive model could be developed and the benefits that such a model could provide:

> The NSW DPI, through their tagging program, are amassing a significantly larger data holding on the distribution and movements of white sharks (and other species) than previously available. If the data and modelling can identify a suitable suite of environmental predictors it could be very useful in reducing shark-human interactions. Understanding shark movements to identify behavioural patterns, habitat preferences, and fine-scale residence behaviours of sharks, particularly into highly populated areas, and understanding our ability to detect white shark presence, are key components to understanding human-shark interactions supporting improved management policies and mitigation responses. A continued collaboration with all the States would ensure that collected data are analysed in a consistent way that will support increased precision in estimates of population size, juvenile mortality and trends in adult population size.[56]

1.54 Finally, marine scientists noted that particular aspects of shark behaviour have implications when considering shark deterrent and management measures. Professor Shaun Collin noted that 'not all sharks are the same with respect to how they react to environmental cues'. As a result, Professor Collin commented that deterrent measures may need to be species specific to account for differences between species, such as white sharks being visual specialists, bull sharks relying on electro reception and tiger sharks basing 'most of their behaviour on smell'.[57] Evidence received from interested observers of the marine environment provided further insight into this. Mr Ian Wiese, who undertakes photography using an unmanned aerial vehicle (drone) off the south west coast of Western Australia explained that the bronze whaler sharks he has observed are 'extremely shy…as soon as they became aware of something in the vicinity they would turn away'. Mr Wiese remarked that this species is 'not as dangerous as many people imagine'.[58]

1.55 Professor Meeuwig added that the age of sharks is significant as juvenile sharks are generally more aggressive.[59] Professor Meeuwig indicated that targeting the large, adult sharks has implications for the overall population, as the adult sharks 'are the reproductive engines of these populations'.[60]

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56 CSIRO, Answers to questions on notice, 20 October 2017 (received 24 November 2017), p. 2.

57 Professor Shaun Collin, *Committee Hansard*, 20 April 2017, pp. 37, 38.

58 Mr Ian Wiese, *Committee Hansard*, 28 July 2017, p. 41.

59 Professor Meeuwig referred to behavioural studies to demonstrate this point. In Professor Meewig's words: 'within a population or a species, it is the young animals that are aggressive. It is not the big ones. It is the teenagers who do not understand a V8 engine. They just bang into your cameras and are quick to come in, and the older sharks within the same species—the bigger ones—are sitting there going, "Not too sure about that".' *Committee Hansard*, 20 April 2017, p. 45

60 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 45.

Conservation

1.56 A small number of shark species are protected under Commonwealth legislation due to concern about their declining populations. Australia has also committed to international agreements intended to help conserve and manage sharks to ensure their sustainable use.

The EPBC Act

1.57 The EPBC Act provides a framework for protecting matters of national environmental significance. As noted above, nine species of sharks are classified as 'threatened' under the EPBC Act and are therefore protected. The EPBC Act also protects migratory species, Commonwealth marine areas and the Great Barrier Reef Marine Park.

1.58 The EPBC Act discussed further in Chapter 5.

Bonn Convention

1.59 Australia is a signatory to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), which provides a 'global platform for the conservation and sustainable use of migratory animals and their habitats'.[61] Species listed under the Bonn Convention, such as the white shark, are included in the EPBC Act's list of migratory species.

1.60 The EPBC Act includes offences that are designed to give effect to Australia's obligations under the Convention and various provisions of the EPBC Act stipulate that the minister must not act inconsistently with Australia's obligations under the Bonn Convention.[62]

National Plan of Action for the Conservation and Management of Sharks 2012

1.61 Australia is a signatory to the United Nations International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks), which is a 'voluntary international instrument developed so that nations can take positive action to ensure the conservation and management of sharks, and their long-term sustainable use'.[63]

1.62 In response to the IPOA–Sharks, Australian governments have developed national plans of action for the conservation and management of sharks. The current plan was released in 2012 and is referred to as 'Shark-plan 2'.

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61 Convention on the Conservation of Migratory Species of Wild Animals, 'CMS', www.cms.int/en/legalinstrument/cms (accessed 8 April 2017).

62 *Environment Protection and Biodiversity Conservation Act 1999*, ss. 34E, 37H, 54, 140 and 146L.

63 Department of Agriculture and Water Resources, 'Sharks', www.agriculture.gov.au/fisheries/environment/sharks (accessed 10 January 2017).

1.63 Among other things, Shark-plan 2 identifies as an issue for shark conservation and management the current 'understanding of the effects of shark fishing, control programs for bather protection and management practices on ecosystem structure and function'. Five actions are identified to improve understanding, including 'periodic assessment of the ecological impacts of shark control programs for bather protection'. The Plan classifies this issue as a 'medium-low' priority.[64]

64 Department of Agriculture, Fisheries and Forestry, *National Plan of Action for the Conservation and Management of Sharks 2012*, www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/sharks/sharkplan2-final/sharkplan2-action.pdf (accessed 10 January 2017), p. 16.

Chapter 2

Human–shark interactions

2.1 The previous chapter noted one of the ways that humans interact with sharks, namely by harvesting sharks for meat and other products. The focus of this inquiry, however, is another type of interaction—instances where sharks bite humans without provocation, particularly encounters that result in injuries or fatality.

2.2 In examining this issue, the committee has received evidence from individuals recounting their personal encounters involving sharks, including people who have had a firsthand encounter that resulted in serious injury, accounts from family members of victims of fatal incidents, and other reports of fatalities. The committee was also aware of reports of these encounters published or repeated elsewhere.

2.3 During the course of this inquiry, a tragic shark bite incident occurred. In the days leading up to the committee's first Perth hearing, Laeticia Brouwer, a 17-year-old teenager who was holidaying with her family on the southwest of Western Australia, was surfing when she was bitten by a shark. Laeticia died from her injuries.

2.4 At the committee's hearing, the Chair offered the committee's sincere condolences to Ms Brouwer's family and friends, as well as noting that the committee's thoughts and sympathies are also with all those who responded to or are otherwise affected by this heartbreaking incident. The committee reiterates these sentiments.

2.5 The personal accounts considered by the committee are contained in the written submissions and transcripts of oral evidence taken at public hearings. Although they are referred to at times in this report, it would be difficult to do justice to these accounts in this report. Rather than reviewing extracts of this evidence in a report, it is preferable that readers review these accounts in their entirety.[1] In addition, the committee is mindful that the purpose of its inquiry was to examine the efficacy of shark mitigation and deterrent measures, not responses to specific shark bite incidents.

2.6 This chapter commences the report's examination of encounters between humans and sharks by presenting available statistics on such encounters. Given this inquiry is examining shark mitigation and deterrent measures, the chapter focuses on unprovoked shark encounters, utilising the definition used by Taronga Conservation Society Australia (TCSA) as being 'an incident where a shark is in its natural habitat

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1 The committee received evidence from: Mr Dale Carr, who was bitten in August 2015 off Port Macquarie (see *Submission 26; Committee Hansard*, 2 May 2017, pp. 13–18); Mr Rick Gerring, whose brother Ben died in May 2016 as the result of a shark bite (*Committee Hansard*, 20 April 2017, pp. 46–50); and Dr Sharon Burden, whose 21-year-old son Kyle died in a shark bite incident in 2011 while boogie boarding near Bunker Bay (see *Committee Hansard*, 28 July 2017, pp. 17–33).

and has made a determined attempt to bite a human where that person is not engaged in provocative activities'.[2] This distinguishes unprovoked shark bites from provoked incidents, where a human 'attracts or initiates physical contact with a shark'.[3]

2.7 It is acknowledged, however, that some participants in the public debate about responses to shark bites do not consider the distinction between unprovoked and provoked encounters is useful. For example, Mr Fred Pawle stated:

> …whenever divers, swimmers or beach goers disappear without any warning they are not counted in official shark death statistics, even as potential shark victims and, similarly, people who are in the water to catch or collect seafood are classified as having provoked the shark, which I find illogical. Unless you are there you cannot really say whether or not a shark has been provoked.[4]

2.8 In relation to the 2015 incident where a Tasmanian man who was diving for scallops with his daughter died from shark bite injuries, Mr Pawle commented: 'I do not know why collecting scallops can be classified as provoking a shark'.[5]

2.9 This report does not adopt consistent terminology when referring to human–shark interactions. Instead, terms such as 'interaction', 'encounter', 'bite' and 'attack' are used. Partly, this reflects the differences in the terminology used by witnesses, particularly when discussing the evidence they gave to the committee.

2.10 Although the commonly-used term 'shark attack' is occasionally used in this report and is included in the terms of reference for the inquiry, it is acknowledged that there is some debate about how the use of this term might influence public debate and the direction of policymaking (this issue is discussed at paragraphs 2.26 and 2.66).

Data on the incidence and frequency of shark encounters

2.11 Species of sharks that are considered dangerous to humans have presented a risk to people in coastal and maritime settings since ancient times. The number of people who frequent the ocean and the purposes for which they do so has changed over time, however. Over the course of the 20th century, increasing numbers of people frequented coastal areas for recreational purposes and activities such as surfing and diving became popular. Across Australia, large numbers of people now regularly enter waters that are home to sharks.

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2 Taronga Conservation Society Australia (TCSA), 'Australian shark attack file', http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 2 December 2016).

3 Examples include when a person is bitten after grabbing a shark or while removing a shark from a fishing hook, interactions with spearfishers while spearing fish or the shark, and when a person steps on a shark. TCSA, 'Australian shark attack file'.

4 Mr Fred Pawle, *Committee Hansard*, 31 July 2017, p. 28.

5 Mr Fred Pawle, *Committee Hansard*, 31 July 2017, p. 28.

2.12 When considering the potential for the number of human encounters with sharks to have increased and to continue to increase, the following related factors provide some insight:

- the 'general worldwide trend towards more intense utilisation of coastal marine waters for…[recreational] activities'; and
- increasing population, which in turn leads to increasing numbers of people who use coastal waters for recreational purposes.[6]

2.13 Besides human population growth, other possible explanations for increases in unprovoked shark bite incidents could include 'an increase in abundance of shark species frequently implicated in unprovoked bites, and/or a natural or anthropogenic change in these species habitat use or behaviour'.[7]

2.14 Dr Leah Gibbs argued that 'spikes and declines in incidents are a function of numerous complex social and ecological factors', including shark population dynamics, conditions in the marine environment, human population change, ocean activities engaged in by humans and improvements in emergency response. Dr Gibbs added that these factors, 'many of which are very poorly understood and documented…then interact in very complex ways'.[8]

2.15 It was noted, however, that the frequency of shark incidents has not kept up with the significant increase in Australia's population over several decades. Mr Leon Deschamps explained:

> …in the 1950s, 1960s and 1970s, we were looking at a population of 10 million to 12 million people in Australia. We are now at 24 million people. Those shark attacks haven't doubled. We have doubled the population—a population that is now more involved in water sports, more involved in diving. When you went on a holiday 20 years ago, not every kid had goggles and a snorkel. We do now. We explore the water, thanks to Jacques Cousteau and others. We get out there and get amongst it. We spend more time than ever in the water. That explosion in population does not translate.[9]

2.16 Mr Deschamps also argued that the frequency of shark bites needs to be considered over a long period before it could be assessed whether the frequency of incidents has increased. Mr Deschamps reasoned that, over a 100–150 year timeline, recent figures on shark bites are 'infinitesimal'.[10]

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6 TCSA, 'Australian shark attack file'. This research was referred to by Ms Amanda Elizabeth Morgan during her evidence (see *Committee Hansard*, 28 July 2017, p. 1).

7 D McPhee, 'Unprovoked shark bites: are they becoming more prevalent?', *Coastal Management*, vol. 42, 2014, p. 485.

8 Dr Leah Gibbs, *Committee Hansard*, 31 July 2017, p. 1.

9 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 28.

10 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 28.

2.17 The following paragraphs discuss available data on shark encounters, including fatalities and injuries. Before doing so, however, it is useful to highlight evidence given by Dr Christopher Neff on how he approaches discussions and analysis of data on shark encounters. Dr Neff emphasised that shark bites 'is a highly emotive topic' and '[y]ou are not dealing with data; you are dealing with people's lives'. Dr Neff added:

> In the past decade that I have spent researching this topic and doing a masters and a PhD on the politics of shark attacks, whether it is individuals or communities, they are deeply affected…People are not data points. They are real people whose lives have been affected.[11]

2.18 These sentiments notwithstanding, it is necessary to review data to understand the overall frequency and nature of shark encounters. According to data collected by the TCSA, in the last 50 years there have been 47 fatalities in Australia arising from unprovoked shark bites (an average of 0.9 per year).[12] Data for 2014 to November 2017 is at Table 2.1.

2.19 In addition to the statistics on unprovoked attacks in Table 2.1, provoked attacks between 2014 and 2016 resulted in four fatalities and 22 injuries. For the year 2017 up until 27 October, two provoked incidents (of which one resulted in injury) have been recorded.[13]

2.20 According to the International Shark Attack File, which is managed by the Florida Museum of Natural History, Australia recorded the second highest number of shark attacks between 2005 and 2014 globally, behind the United States of America.[14] Small geographical areas in Australia can also rank highly in international comparisons, particularly when spikes in shark encounters are experienced. The Mayor of Ballina Shire Council remarked that from 8 February 2015 to July 2016, surfers on beaches in Ballina, New South Wales 'were involved in nine per cent of the world's shark attacks and interactions'.[15]

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11 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 1.

12 TCSA, 'Australian shark attack file', http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 2 December 2016).

13 TCSA, 'Australian shark attack file annual report summary', 2014, 2015 and 2016, http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 31 October 2017).

14 Florida Museum of Natural History, 'World locations with the highest shark attack activity', www.flmnh.ufl.edu/fish/isaf/shark-attacks-maps-data/trends/world-highest-attacks/, 11 February 2015 (accessed 5 December 2016).

15 Cr David Wright OAM, Mayor, Ballina Shire Council, *Committee Hansard*, 2 May 2017, p. 19.

Table 2.1: Human–shark encounters, 2014–24 November 2017

State	2014				2015			
	Unprovoked			*Provoked (fatal)*	Unprovoked			*Provoked (fatal)*
	Fatal	*Injured*	*Uninjured*		*Fatal*	*Injured*	*Uninjured*	
NSW	2	1	0	0	1	8	5	0
QLD	0	1	0	1	0	1	3	0
SA	0	2	2	1	0	1	0	0
WA	0	2	0	1	0	2	0	0
VIC	0	0	1	0	0	1	0	0
TAS	0	0	0	0	0	0	0	1
NT	0	0	0	0	0	0	0	0
Total	2	6	3	3	1	14	7	1
	2016				2017 (to 24 November 2017)			
NSW	0	5	3	0	0	4	1	0
QLD	0	2	0	0	0	3	1	0
SA	0	0	0	0	0	0	1	0
WA	2	1	0	0	1	2	3	0
VIC	0	0	0	0	0	1	0	0
TAS	0	0	1	0	0	0	0	0
NT	0	0	0	0	0	0	0	0
Total	2	6	4	0	1	10	6	0

Note: In addition to the fatalities from incidents described as 'provoked', the following numbers of provoked incidents resulting in a person being injured or uninjured were recorded: 2014 = 9; 2015 = 10; 2016 = 9; 2017 (to 24 November 2017) = 2.

Source: Taronga Conservation Society Australia, 'Australian shark attack file annual report summary', 2014, 2015, 2016 and 2017, http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 27 November 2017).

Interpretation and analysis of data

2.21 The available data also suggest that the frequency of shark bites has fluctuated over time, although annual fatality rates appear to have declined compared to the first half of the 20th century. Mr John West, the coordinator of the Australian Shark Attack File, has made the following observations on these trends:

> In the first half of the 20th century, there was an increase in the number of recorded shark attacks, culminating in a peak in the 1930s when there were 74 incidents…The number of attacks then dropped, to stabilise, 35 incidents per decade from the 1940s to the 1970s. Since 1980, the number of reported attacks has increased to 121 incidents in the past decade…There had been a decrease in the average annual fatality rate, which had fallen from a peak of 3.4 year in the 1930s, to an average of 1.1 year for the past two decades.

> The number of fatal attacks relative to the number of total attacks per decade has also decreased over this period, from 45% in the 1930s to 10% in the past decade.[16]

2.22 CSIRO's submission noted that '[a]s in other areas of the world, the overall number of shark attacks has gradually increased over the last few decades in Australian waters'. CSIRO added:

> Various studies have attributed this overall increase to a rise in human population…Some studies note that although the number of attacks has increased the rate of attack (being the number of attacks per time spent by people in the ocean) has decreased…Many different factors contribute to the overall increase in shark attacks that are not related to shark numbers, including human population trends, changes in human population distribution and regional demographics, as well as variations in lifestyle and behaviour of people over time. However, it is important to note that clusters of shark attacks cannot be attributed to increases in human use of the ocean or sudden increases in overall shark population size as neither of these sufficiently change over such short periods of time.[17]

2.23 Similarly, the Fisheries Research and Development Corporation (FRDC) advised that the 'frequency of reported interactions between sharks and humans remains relatively low; however they are becoming more commonplace'. In considering this, however, the FRDC noted that the ability to quantify absolute numbers and identify real trends in human–shark interactions is impeded by 'multiple confounding factors'. In the FRDC's view, the resulting uncertainty 'has likely resulted in widespread conjecture about whether interaction rates are increasing or have remained stable'.[18]

2.24 CSIRO also submitted that it is not the case that shark bites are more likely to occur in locations where shark numbers are high. It explained:

> There are, for example, high human-use areas where white sharks are abundant but where the incidence of shark attack is low. The Western Australia drumline program revealed a significant number of tiger sharks present in coastal waters off Perth, yet no attacks have been attributed to this species in the area since 1925 (Australian Shark Attack file data).[19]

2.25 Dr Leah Gibbs noted that 'people regularly encounter sharks without harm', with a survey of Western Australian ocean users revealing that almost 70 per cent of them had reporting having 'safe interactions with sharks at some point while using the

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16 J West, 'Changing patterns of shark attacks in Australian waters', *Marine and Freshwater Research*, 2011, vol. 62, p. 745.

17 CSIRO, *Submission 33*, p. 10 (citations omitted). See also Professor Nic Bax, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 8.

18 FRDC, *Submission 34*, p. 3.

19 CSIRO, *Submission 33*, p. 10.

ocean'. Accordingly, Dr Gibbs argued that it should not be argued that sharks are inherently dangerous as 'the simple presence of sharks does not present an inevitable danger to people'.[20]

2.26 The term 'shark attack' also attracted comment. Some submitters argued that the term is detrimental to debate about the issue of managing and deterring shark encounters. For example, the NSW Young Lawyers Animal Law Committee argued:

> The term 'shark attack' does not draw any distinction between minor events and fatal incidents. For example, bites from non-threatening sharks like the Wobbegong, which have accounted for 5.5% of all shark attacks in Australia since 1990, are not distinguished from more serious bites by other species of sharks, yet all events are labelled 'shark attacks'. The term 'shark attack' is even used to include events where there is no physical contact with a person.[21]

Risk of encountering a dangerous shark relative to other sources of harm

2.27 In discussing the frequency of human–shark interactions, the TCSA has emphasised that the number of shark encounters 'must be put into perspective', such as by contrasting the number of incidents that occur with the millions of beach visitations that take place each year.[22] The relative infrequency of fatal shark attacks in Australian waters is also noted in information published by the Department of the Environment and Energy (DoEE).[23]

2.28 Submitters and witnesses to this inquiry made other similar observations about the relative degree of risk compared to other activities that can result in death. For example, Sea Shepherd Australia cited TCSA data indicating that, over a person's lifetime the risk of being killed by a shark is one in 292,525, compared to a one in 3362 chance of drowning at the beach.[24]

2.29 Continuing on this topic, representatives of Surf Life Saving Australia informed the committee about its experiences with coastal drowning deaths. Mr Shane Daw, the National Coastal Risk and Safety Manager for Surf Life Saving Australia, advised that over the past 12 months, on a national basis their organisation has 'recorded a 24 per cent increase in coastal drowning deaths on the previous year with 130 coastal drowning deaths'. He continued:

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20 Dr Leah Gibbs, *Committee Hansard*, 31 July 2017, p. 2.

21 NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 10.

22 TCSA, 'Australian shark attack file', http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 2 December 2016).

23 Department of the Environment and Energy (DoEE), 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 2 December 2016).

24 Sea Shepherd Australia, *Submission 57*, pp. 30–31.

> We know that in the past 12 years that we have had 1,190 deaths related to either drowning or shark attacks…We know that 26 of those deaths were as a result of a shark attack, a shark fatality. We further know that, over the 12 years, a total of 265 shark incidents have taken place. Out of those, 26 were fatal, but those non-fatal shark incidents or encounters also included where there was no injury sustained, so it can be an attack to a board or something of that nature. So we do know that has been happening. There have been approximately 22 shark-related incidents on an annual basis and we know from drowning death incidents that there have been, roughly, an average of 97 occurring per year.[25]

2.30 Other comparisons about the relatively low risk of a shark fatality or injury were also made. For example, Ms Natalie Banks from Sea Shepherd Australia noted the higher number of annual road deaths[26]—data published by the Bureau of Infrastructure, Transport and Regional Economics indicate that in 2016 there were 1300 road deaths across Australia.[27] Ms Banks observed:

> Around the world, globally, five to six people die from shark incidents. When we get in a car we do everything we can to minimise the risk. There is a risk to getting in a car. We put a seatbelt on, we do not drive under the influence, we do not speed—all those things. The same could be said of going to interact with a natural, wild marine environment: we do what we can to minimise the risk. It is a very small risk but it is there and we can do more to minimise the risk.[28]

2.31 Mr Daw added that any beachgoer encounters 'a possibility of a shark encounter of some sort, because that is the environment that they live in'. However, he further added that this knowledge:

> …needs to be balanced with the fact that we know, with all due respect, more people will die driving to the beach than will be taken by a shark. We know that in all the aquatic environments around Australia there are approximately 300 drownings every year and we are averaging one to two shark attack deaths a year. So it is a matter of balancing that with an understanding of the potential risk. Probably the issue that we are facing is: how do you do that without being seen to be downplaying or dismissing it?[29]

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25 Mr Shane Daw, National Coastal Risk and Safety Manager, Surf Life Saving Australia, *Committee Hansard*, 16 March 2017, p. 9.

26 Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 13.

27 Bureau of Infrastructure, Transport and Regional Economics, *Road deaths Australia, December 2016*, https://bitre.gov.au/publications/ongoing/rda/files/RDA_Dec_2016.pdf (accessed 15 June 2017).

28 Ms Natalie Banks, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 13.

29 Mr Shane Daw, Surf Life Saving Australia, *Committee Hansard*, 16 March 2017, p. 11.

2.32 Mr Dale Carr, who suffered a shark bite in 2015, noted that for fatal events that do not involve sharks, such as drownings and road accidents, the effects on close family members of the person involved 'are just as compelling as a shark attack'. However, he considers that the public 'become numb' to such reports.[30]

Public awareness and fear of sharks

2.33 The previous section repeated observations made by submitters and witnesses who, while acknowledging that shark-related fatalities are tragic, noted that the risk of injury or death from shark encounters is significantly lower than the risk associated with many other activities, including everyday activities and other recreational ocean-based activities. Discussing this evidence is not intended to downplay the distressing and sometimes tragic nature of shark attacks; rather, it provides context for considering whether, and if so why, there is a heightened public awareness of and interest in sharks. It also provides a starting point for considering how appropriate and effective policies can be developed with the limited resources available for promoting public safety in all aspects of life.

2.34 Associate Professor Daryl McPhee considered the infrequent nature of shark attacks relative to other causes of death when suggesting how to respond to the issue of shark encounters. He stated that 'we should not lose sight of the fact that unprovoked shark bites does cause human fatalities and life changing injuries', with 'obvious flow on effects to friends and families of those bitten'. He added, however, that '[w]e should also not lose sight of the fact that unprovoked shark bite is an extremely infrequent event, and available data clearly demonstrates that drowning at surf beaches represents a much more substantial source of fatalities, and physical injuries from surfing itself are frequent and often serious'. Finally, Associate Professor McPhee noted that even with a 'clear increasing trend' of shark attacks globally and in Australia, 'the probability of an unprovoked bite is still low'.[31]

Primal fear

2.35 Despite the significantly higher number of drowning deaths that occur each year compared to shark-related fatalities, it was hypothesised that shark attacks capture greater interest among the public because of a primal fear humans have of sharks. For example, Mr Shane Daw from Surf Lifesaving Australia explained:

> With sharks there is that primal fear. People are very scared of sharks. They are not afraid of drowning, they are not afraid of getting caught in a rip current and they are not afraid of getting stung by a bee. *Jaws* has a lot to answer for, I guess.[32]

30 Mr Dale Carr, Member, Bite Club; Beyond the Bite, *Committee Hansard*, 2 May 2017, p. 16.

31 Associate Professor Daryl McPhee, *Submission 58*, p. 2.

32 Mr Shane Daw, Surf Life Saving Australia, *Committee Hansard*, 16 March 2017, p. 12.

2.36 Evidence received from Professor Jessica Meeuwig supports this view. Professor Meeuwig commented:

> Professor EO Wilson of Harvard University, perhaps one of the most transformational thinkers about evolutionary biology, famously stated that we are both fearful and fascinated by our monsters. By monsters he meant lions, tigers and indeed sharks. He pointed out that we are fearful because in our lower brains from our deep evolutionary history we understand that we are potentially prey, but we are fascinated because we also understand that by learning about these animals we can avoid being prey. We have this dichotomy, so every time there is an incident with a lion, a tiger, a bear or a shark there is this complete media frenzy, there is a massive amount of discussion and we do not know exactly what to do with it.[33]

2.37 Associate Professor McPhee remarked that people fear 'what is immediate' and 'what we cannot control'. Associate Professor McPhee explained that risks associated with various activities such as driving, consuming alcohol and smoking 'are not fears over an evolutionary period we have been exposed to and respond to'. In developing this point, he remarked that 'a teenager does not necessarily fear smoking because it is not going to kill them today…[y]et getting into the water in an area where there have been shark bites there is potentially an immediate effect, and it will be feared'. Associate Professor McPhee further commented that the risk of shark bite is distinguished from other risks that can be controlled to a greater extent; for example, the risk of death from drowning can be mitigated by becoming a better swimmer. Associate Professor McPhee remarked:

> We cannot mitigate the risk of a shark bite by being a better swimmer or a better surfer. In fact it is the opposite. Become a better swimmer or a better surfer and you would generally spend more time in the water.[34]

2.38 Mr John Heaton noted that the father of an individual who died after a shark attack in Ballina in 2008 told him that every subsequent attack brings back memories of his son's death. Mr Heaton also pointed to a broader issue of surfers struggling to handle shark incidents, even when they are not directly affected:

> For a lot of people, I think the following sums it up: 'After three long months of driving up to my local beach and just staring at the water, I started to understand I was running out of excuses for not going surfing.' My friend…eventually sought help from his local GP, who told him, 'I have never handed out as many referrals to psychologists in my life in such a short amount of time for both male and female surfers.'[35]

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33 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 36.

34 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 36.

35 Mr John Heaton, *Committee Hansard*, 2 May 2017, p. 2.

Effects of popular media and news reporting

2.39 As noted above, it is considered that humans have a primal fear of sharks that makes us more fearful of sharks than other animals or activities that carry a higher risk of death or injury. In addition, it was noted that it is difficult to not be cognisant of the risk of encountering a shark when at the beach. For example, Mr Kim Allen submitted that:

> In Australia, the beach is so much a way of life for so many people, sharks have always been in the back of people's minds.[36]

2.40 Evidence presented to the committee indicates it is widely considered that the depiction of sharks in films which utilise the fear of sharks for entertainment, such as the series *Jaws*, have a negative influence on public views on sharks. For example, Associate Professor McPhee provided the committee with a paper in which he wrote that the *Jaws* movies epitomise the image of sharks in the popular media 'as omniscient killers of humans'.[37]

2.41 Mr Allen advised that the *Jaws* films have been broadcast on television following shark incidents.[38]

2.42 As the previous section demonstrated, many submitters consider statistics reveal a disproportionately high fear of sharks among the public compared to the actual degree of risk involved. In light of this, many witnesses agreed that, due to the need to 'sell papers', much of the media coverage of shark issues in Australia is sensationalised. Accordingly, it is considered that news reporting of shark issues might have a role in encouraging, or at least not challenging, public concerns about beach safety and negative views on shark conservation.[39]

2.43 Humane Society International (HSI) submitted that 'due to the high level of public awareness around sharks and shark bites, and media interest, the resulting shark attack hype has amplified the negative way in which the public and tourists perceive the dangers of sharks'.[40] Similarly, Mr Colin Buxton, a representative of Coolum and

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36 Mr Kim Allen, *Submission 47*, p. 7.

37 D McPhee, 'Unprovoked shark bites: are they becoming more prevalent?', *Coastal Management*, vol. 42, no. 5, 2014, p. 479; provided as Associate Professor Daryl McPhee, *Submission 58*, Attachment 1, p. [4].

38 Mr Kim Allen, *Submission 47*, p. 7.

39 See, for example, Ms Belinda Atkins, Manager, Projects and Programs, Sydney Coastal Councils Group, *Committee Hansard*, 16 March 2017, p. 3; Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 24; Cr Simon Richardson, Mayor, Byron Shire Council, *Committee Hansard*, 2 May 2017, p. 27; Mr Chad Buxton, Marine Scientist and Volunteer, Sunshine Coast Environment Council, *Committee Hansard*, 2 May 2017, p. 72; and Ms Amanda Elizabeth Morgan, *Committee Hansard*, 28 July 2017, p. 5.

40 Humane Society International (HSI), *Submission 43*, pp. 24–25

North Shore Coast Care, who has researched newspaper reporting of shark matters in Queensland over time, stated:

> I suggest that the public, over a long period of time, has been conditioned through media to fear sharks. There are a couple of things that have been consistent in the newspapers that I have read during this research. Shark stories are almost exclusively front-page news. Almost inevitably that is the number one thing, suggesting that sharks sell papers. The other thing is to look at the captions that are used to describe these articles. There were some consistent adjectives used in these captions. Those were 'killer', 'invasion', 'deadly', 'savages', 'horror', 'danger', 'terror' and 'vicious'. This is how we are portraying sharks in the media and that has been consistent over time, so what are we reporting here?[41]

2.44 The argument that consumption of news reporting has influenced negative views about sharks among the public was reinforced by evidence from Dr Christopher Neff. Dr Neff explained that, as part of a survey he conducted into shark bite prevention policies and beach safety, members of the public were asked about the amount of media coverage they had consumed regarding recent shark bite incidents. Dr Neff advised that 'there was a statistical correlation between levels of fear and how much media they had seen'. He added:

> The level of media coverage in both Ballina and WA, specifically, was about 80 per cent. So 80 per cent of all respondents who had a high level of fear had seen a high level of media—between eight and 10 stories…It is having a significantly detrimental impact on the way people view the ocean and how they look at risk. If you hear it 17 times a day then it is going to increase your risk perception.[42]

2.45 Ms Amanda Elizabeth Morgan remarked that people 'are entitled to know what is happening, especially when it happens in their area'; however, in her view the frequency of shark bites is not put into perspective with the reporting 'done in a way that gives the impression that they are more frequent than they are'. In explaining her concerns about the approach taken by the media, Ms Morgan commented on reporting of shark sightings, rather than shark incidents:

> When you use words like 'sharks lurking off WA beaches' it gives the impression that they are doing something wrong or having a sinister demeanour. However, a shark is just swimming in its environment. If you used that same analogy with humans, where they were eating lunch or just walking past something, it would be ridiculous. However, when we put it onto sharks people seem to accept it.[43]

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41 Mr Chad Buxton, Admin Officer/Volunteer, Coolum and North Shore Coast Care, *Committee Hansard*, 31 July 2017, p. 18.

42 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, pp. 3–4.

43 Ms Amanda Elizabeth Morgan, *Committee Hansard*, 28 July 2017, p. 5.

2.46 In addition to the language used in news reporting, submitters were critical of the associated imagery utilised. The Sunshine Coast Environment Council (SCEC) remarked that 'the practice of using stock photos of great white sharks for any shark attack story…is irresponsible and needs to stop'.[44]

2.47 An example that particularly provoked the ire of those who consider media reporting is damaging the public debate about sharks is an image published in the 8 June 2016 edition of *The West Australian*. The image, which dominated the front page, depicted two children being chased by a shark under the headline: 'Will it take this?'. Dr Sharon Burden described this front page as 'reckless and harmful' and evidence of a strategy of publishing 'biased, hyperbole designed to frighten and divide the public rather than informing and providing balanced evidence'.[45]

2.48 The Chief Executive Officer of the Australian Hotels Association (WA), who also commented on that front page, stated:

> In the context of Western Australia, when those images and those types of fear-based images are used, they do not help a rational debate around this issue. I think they exacerbate fear within the community and they lend support to an irrational argument. That type of imagery itself isn't particularly helpful.[46]

2.49 Others approached the role and actions of the media from a different perspective. Mr Andrew Stark, Chief Executive Officer, Surfing Australia, noted that 'a shark attack and being eaten alive is terrible and it is horrific, and the media will always follow it'. Mr Stark suggested that the 'challenge with the media' relates to protecting victims and witnesses of shark attacks, particularly as 'a lot of them will suffer post-traumatic stress disorder, and the victims themselves, if they survive, need to cope with that'.[47]

2.50 Survivors and witnesses of shark attacks, and other individuals in beach communities where shark attacks have occurred, gave evidence that provided revealing insights into this aspect of news reporting. Mr Donald Munro told the committee that, following Tadashi Nakahara's death at Shelly Beach, Ballina in 2015, he was asked to speak to the media on behalf of local surfers. Mr Munro provided the following description of this experience:

> All of a sudden, I had world media focusing on me. In the end, I used to get disgusted with them, and I would say to them, 'If you're going to ask these questions of me, I'm not going to do the interview.' But they would still

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44 Sunshine Coast Environment Council, *Submission 35*, p. 12.

45 Dr Sharon Burden, *Submission 73*, p. 4.

46 Mr Bradley Woods, Chief Executive Officer/Executive Director, Australian Hotels Association (WA), *Committee* Hansard, 28 July 2017, p. 9.

47 Mr Andrew Stark, Chief Executive Officer, Surfing Australia, *Committee Hansard*, 2 May 2017, p. 34.

> ambush me…All they do is feed on the negative side of things. That is what sells media, unfortunately, more than positive things.[48]

2.51 Mr Dale Carr, who survived a shark bite, told the committee that 'what really got me' is the invasion of privacy experienced by people who have suffered a shark bite, people who are supporting someone who has suffered a shark bite, and people in mourning after a fatal shark bite. Mr Carr stated:

> In my situation…I had about three or four 24//7 media outlets out the front of my place while I was in ICU. A bloke was caught in a tree out the front of ward 1 with a long lens trying to take a photograph of me into ward 12. There were six additional security staff at Port Macquarie Hospital.[49]

2.52 Evidence given by Dr Burden indicates that how the media handles shark victims varies and potentially has changed over time. Dr Burden stated:

> On the day after Kyle, I was standing on the beach to talk to the press. I indicated in my statement at that time that the environment needed to be protected and I did not believe in hunting down the shark that had killed Kyle. That was prior to this becoming such a contentious issue. It was well handled by the media at the time. It was respectful. The media at that time treated us with great respect and we were very grateful for that. But I am saddened that over the years it then started to deteriorate—it all went pear-shaped.[50]

2.53 Despite expressing criticism of particular actions by the media, Mr Carr indicated that the media can be influenced to provide more meaningful coverage of shark incidents. He explained:

> Whether this is a reflection of me or not, I do not know, but when I was approached by one of the local television providers, Prime7, I told them I would only do a presentation with their organisation if they showed it over four nights. 'Firstly, you can have the attack story, that is fine.' That has happened. 'Secondly, I want you to talk about what happened afterwards. Thirdly, I want you to show that I was successfully able to go back to the place to thank those who helped me on the beach with their presence of mind. Fourthly, I want you to present, on the fourth night, me back in the water surfing. I want you to show the whole cycle of life of what happens. Don't just give me the same rhetoric of, "This is a shark attack," and then go find someone who supports the view of a producer.[51]

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48 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 6.

49 Mr Dale Carr, *Committee Hansard*, 2 May 2017, pp. 15–16.

50 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, p. 18.

51 Mr Dale Carr, *Committee Hansard*, 2 May 2017, p. 16.

2.54 Others did not accept that media reporting has a negative influence on public views about sharks. For example, in response to questions about sustained newspaper reporting of shark incidents, Mrs Rebecca Clough stated that such coverage 'definitely hasn't contributed to my fear at all…[m]y fear was there from the start'.[52]

2.55 Mr Fred Pawle, who has written extensively on shark bites for *The Australian*, argued that the public 'is becoming very desensitised to shark attacks'. Mr Pawle noted that fatalities become widespread news, however, stories on potential fatalities are, in his view, 'often buried and sometimes even ignored'.[53] Mr Pawle continued:

> People throw around words like 'sensationalist' and just trying to beat up the story. The witness also said that shark stories are only front page news. They are not. The public is being desensitised. I make no apologies for the way tabloid newspapers approach this story and I give credit to the readers knowing that it is a sensational photo. It does instil fear in people but it does not stop people going to the beach and it does not send them out in boats with guns, nets and hooks wanting the kill the things. People are smarter than that.[54]

2.56 Nevertheless, examples of shark incidents that did not result in injury yet received significant media attention can be found, such as an October 2017 story published on the front-page of *The Advertiser*.[55] Likewise, encounters that result in minor injuries, such as the shark bite incident in November 2017 at Avoca Beach on the New South Wales Central Coast, also often receive considerable media attention.[56]

2.57 Some media coverage, however, attracted positive comment or otherwise is worthy of acknowledgement. For example, the Mayor of Ballina Shire Council commended the actions of the local media outlets in the area to shark bite incidents.[57]

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52 Mrs Rebecca Clough, *Committee Hansard*, 28 July 2017, p. 35.

53 Mr Fred Pawle, *Committee Hansard*, 31 July 2017, p. 25.

54 Mr Fred Pawle, *Committee Hansard*, 31 July 2017, p. 26.

55 'It was just like Jaws', *The Advertiser*, 23 October 2017, p. 1; L Walsh and J Pengelley, 'Dad saves teen as 4m shark moves in for kill', *The Advertiser*, 23 October 2017, p. 7. The initial reporting was followed the next day with B Harvey, 'Destroy the rogue shark before it takes a life, says dad who saved daughter', p. 7. An article published the following day also gave prominence to the 'rogue shark theory', which is not supported by scientific evidence (that theory and other myths and misconceptions about sharks are discussed in Appendix 3). However, it is noteworthy that an editorial published in *The Advertiser* observed that it 'is important to remember…that we are living among predators when we enter the sea'. The editorial concluded that white sharks 'deserve our wary respect as we seek to enjoy the water safely'. 'The call to cull', Editorial, *The Advertiser*, 24 October 2017, p. 16.

56 See, for example, J Houghton, 'Punch in the jaws saves doc', *Daily Telegraph*, 14 November 2017, p. 2.

57 Cr David Wright OAM, Mayor, Ballina Shire Council, *Committee Hansard*, 2 May 2017, p. 27

The November 2017 media coverage of members of the Brouwer family of which the committee is aware has also been respectful and is adding value to the public debate.[58]

2.58 To understand better the effects that recent human–shark interactions and media reporting may be having on the behaviour of water users, such as surfers and divers, CSIRO suggested there would be benefit in undertaking a social survey. CSIRO argued that a social survey 'would assist in understanding the broader social impacts of shark attacks on these at-risk user groups and how to improve communication with at-risk water users in the future'.[59]

Social media

2.59 Submitters and witnesses also commented on the implications of social media for the public's perception of the risk presented by sharks. Some of this evidence indicated that social media can be positive for public safety and informing the public about sharks more generally, provided the information made available is accurate. In relation to the distribution of information about shark sightings on social media, Ms Belinda Atkins, who represented the Sydney Coastal Councils Group, stated that:

> I think it is good to have the information out there, as long as it is followed up with an engagement and education component so that, when people know where the incidents are, where the sharks have been sighted, they know what they can do to reduce risk to themselves.[60]

2.60 Ms Atkins added:

> I think social media is also a good way of providing information to the community—not just scare tactics but real information about sharks and their habitat—to really get the community to appreciate sharks and appreciate that they are going into the shark habitat and therefore they should take certain measures against those risks when they do water activities. It is a way that you can get to a lot of people at one given time to spread a specific message, whereas you may not get to a lot of people by other avenues.[61]

2.61 However, other evidence received by the committee highlighted the negative aspects and consequences of social media for public awareness of sharks. For example, Surf Life Saving SA submitted that the distribution of information about shark sightings via social media sites 'at times is inaccurate and the reports are often

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58 See, for example, R Ardon and D Mercer, 'Laeticia's family in plea to save lives of surfers', *West Australian*, 7 November 2017, pp. 4–5.

59 CSIRO, Answers to questions on notice, 20 October 2017 (received 24 November 2017), p. 2.

60 Ms Belinda Atkins, Manager, Projects and Programs, Sydney Coastal Councils Group, *Committee Hansard*, 16 March 2017, p. 3.

61 Ms Belinda Atkins, Sydney Coastal Councils Group, *Committee Hansard*, 16 March 2017, p. 6.

not verified'. Surf Life Saving SA argued that this 'has caused the community to become concerned and sometimes overestimate the danger posed by sharks'.[62]

2.62 Mr Andy Kent from Surf Life Saving NSW described social media as being 'a double-edged sword' for public safety and concerns about shark. He noted that some social media groups that are established enable members of the public to 'post information like "I've seen a shark here"', however, these reports can be of sharks such as bronze whalers, which 'are not a species which we really need to be worried about'.[63]

2.63 Surf Life Saving Australia submitted:

> The concerns held within the community, while valid, need to be balanced with understanding and knowledge. In many instances there is little balanced information relating to shark sightings and interactions, rather an emerging trend of creating fear and alarming people.[64]

2.64 When asked about the utility of distributing information about sharks via social media, Dr Neff responded that such efforts 'cannot be used in isolation'. Dr Neff explained:

> …you cannot say, 'Sharks are monsters, and there are 10 of them outside your beach,' and scare the bejesus out of everyone. You have to tie in your social media campaign with your public education campaign so that you are actually giving meaning to what they are reading, as opposed to elevating concerns and scaring everyone, because that can have a detrimental effect…[65]

2.65 Finally, Surf Life Saving Australia advised that media reporting and the widespread distribution of information on social media about shark encounters has implications for its operations and resources. Its submission explained:

> The organisation is cognisant of public concerns relating to shark interactions. With the growth in social media, live news feeds and a digitally enabled society, the community of today is far more connected than ever before. The awareness of sightings and interactions are far more widely known and available. Surf Life Saving is conscious of this, and, throughout many states this has had a significant impact with a call for increased lifesaving services response and management requirements.[66]

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62 Surf Life Saving SA, *Submission 10*, p. 2. See also Sunshine Coast Environment Council, *Submission 35*, p. 12.

63 Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW; Mr Brent Manieri, Australian Lifeguard Service Manager, Australian Lifeguard Service; Mr Shane Daw, National Coastal Risk and Safety Manager, Surf Life Saving Australia, *Committee Hansard*, 16 March 2017, p. 13.

64 Surf Life Saving Australia, *Submission 16*, p. 1.

65 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 4.

66 Surf Life Saving Australia, *Submission 16*, p. 1.

Use of the term 'shark attack'

2.66 As noted previously, some submitters expressed views on the use of the term 'shark attack'. In relation to media reporting, submitters argued that emotive language should be used less frequently and only when clearly warranted. For example, the SCEC submitted:

> Words used to describe encounters are often emotive. Although underreported in media, most shark encounters are incidental and don't result in death or even injury. SCEC recommends news coverage uses the word 'encounter' instead of 'attack' unless warranted (unprovoked and injurious).[67]

2.67 Dr Neff advised that approximately 75 per cent of people he surveyed (see paragraph 2.43) agreed that the phrase 'shark attack' was 'sensationalised'. Dr Neff advised that he had worked with Dr Bob Hueter from the Mote Marine Laboratory in Florida on new terms that differentiate between incidents that have not resulted in harm from those that resulted in injury or a fatality. Dr Neff explained that a paper he co-authored with Dr Heuter suggested the terms 'shark sighting' and 'shark encounters' would be appropriate for incidents that do not result in injury. The terms 'shark bites' and 'fatal shark bites' could be used for incidents that result in injury or death.[68]

Impacts of incidents and fatalities on tourism and related industries

2.68 As many tourists are drawn to Australia's beaches, the potential damage to the tourism industry arising from unprovoked shark attacks and related concerns for public safety is occasionally cited in support of enhancing mitigation measures. For example, impacts on regional tourism were taken into account by the Environment Minister in his statement of reasons for granting the New South Wales Government an exemption from the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the first north coast shark meshing trial.

2.69 In correspondence to the DoEE about the trial, the New South Wales Department of Primary Industries (DPI) provided information on how shark attacks on the New South Wales north coast could affect tourism activity. DPI explained that over 11 million people visit the north coast each year, and the tourism industry in the area is 'worth more than $3.4 billion annually to the national economy and supports around one in three jobs in the region'. DPI went on to observe that beaches and on-water activities are major contributors to tourist activity in that region:

> …the Ballina-Byron Bay area of NSW is a major national and international recreation and tourism destination, and a gateway to the Gold Coast,

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67 Sunshine Coast Environment Council, *Submission 35*, p. 12.

68 Dr Neff added that these suggested terms were 'adopted by the American Elasmobranch Society, the largest group of shark scientists in the world' and Surf Life Saving Australia. Dr Neff also expects that the terms are being considered by the people responsible for the Australian Shark Attack File. Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 4.

> Queensland and other regional locations. A primary driver of recreation and tourism in this region of Australia are the iconic surf beaches, offering a range of on-water recreation, tourism and sporting opportunities (swimming, surfing, surf schools, kayaking, kite surfing) and on-water events including Gromfest (young surfer competition), ocean swimming events, kite surfing competitions, amongst others.[69]

2.70 The DPI then added:

> The local community have raised concerns about the impact on the economy and tourism-related businesses since the 'spike' in shark attacks occurred…The heightened public media on the most recent shark events is likely to impact on Australia's reputation as a tourism destination, with flow on impacts to the regional and national economy, including jobs and growth. The NSW Government has already received reports of planned on-water events being rescheduled elsewhere from the Ballina-Byron Bay region.[70]

2.71 Accounts of negative economic outcomes following shark-related fatalities and injuries were presented to the committee. This information covered tourism as well as other industries and economic activities which may be linked to tourism, such as those relating to retail and sport.

2.72 Surfing Australia argued that sharks attacks have 'without doubt negatively impacted surfing across sport, recreation and community through participation decline in attack and fatality regions'. It added that a 'serious downturn' has been experienced in 'industries related to surfing included surf retail, manufacturing and surf tourism'. Surfing Australia's submission explained:

> There is strong evidence to show significant down turn of over 20% in participation and revenue of surf schools in the regions where attacks and fatalities have occurred. There is also clear evidence around the down turn in industries related like surf board manufacturing and surf retail. In some cases long term surf shops have been forced to close due to the direct impact of shark issues in their regions and surf board manufactures have indicated significant downturn in board sales in effected areas of up to 50%. Boardriders Clubs in affected areas have seen up to 50% decline in participation due to the shark issue. It is clear that the shark issue is having a serious negative impact in communities around Australia.[71]

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69 Correspondence from Mr Scott Hansen, Director General, New South Wales Department of Primary Industries (DPI), to Mr Matt Cahill, DoEE, dated 14 October 2016, tabled by the DoEE, Supplementary Budget Estimates 2016–17, 21 October 2016.

70 Correspondence from Mr Scott Hansen, DPI, to Mr Matt Cahill, DoEE, dated 14 October 2016.

71 Surfing Australia, *Submission 20*, p. 1. For details of downturns in particular locations, see Mr Andrew Stark, Surfing Australia, *Committee Hansard*, 2 May 2017, pp. 30, 33–34.

2.73 The Ballina Chamber of Commerce advised that a survey of its members conducted in late 2015 indicated that it was 'mainly the tourism based businesses and surf industry businesses recording and experiencing downturns'. Nevertheless, the Chamber noted that 'if there is a part of any area under impact then it will affect everyone'.[72] The Mayor of Ballina Shire Council commented that the 'local tourist trade experienced a very poor 2015 holiday period, and surf-related businesses and accommodation outlets suffered badly.[73]

2.74 The committee also received personal accounts of business confidence being affected by shark-related fatalities and injuries. For example, Mr Don Munro, who is the President of Lennox Head Ballina Boardriders, submitted:

> Unfortunately my observations and advice indicate that impacts both socially and economically are being felt widely, with kids frightened to go in the water, and the thoughts of fewer domestic and international visitors weighing heavily on the minds of local businesses. The key difference in their behaviour being that once we had a respect for the ocean, but now our region has a fear of the ocean.[74]

2.75 Mr Fred Pawle gave similar observations about the social and economic consequences. In his submission, Mr Pawle wrote:

> While in Ballina in November, I was stunned to see the beautiful beaches there deserted on a pleasant, sunny, spring day. It's not just surfers who are abandoning this hot spot of shark sightings and attacks. These beaches were once magnets for hundreds of tourists. The Dunes, a nearby resort that once catered to large school groups and young travellers, has had to redefine itself as a wedding venue. The losses incurred by its owners are significant. The local surf shop, after losing a large proportion of its revenue in the initial downturn, has modified its stock to focus on surf fashion instead of equipment. As a result, a generation of kids in the area (and all around our coastline) who would have otherwise been drawn to the healthy, happy sports of surfing or surf lifesaving are now more easily distracted by less salubrious pursuits.[75]

2.76 Evidence from other countries was also put forward. Global Marine Enclosures submitted that a study in Brazil 'calculated a $20m economic loss in the coastal region of Recife following a shark attack'. Although Global Marine Enclosures acknowledged that a figure on the economic impact of shark attacks in Australia is not

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72 Ballina Chamber of Commerce, *Submission 45*, p. 3.

73 Cr David Wright OAM, Mayor, Ballina Shire Council, *Committee Hansard*, 2 May 2017, p. 19.

74 Mr Don Munro, *Submission 39*, p. 1.

75 Mr Fred Pawle, *Submission 56*, p. 1. This evidence about changes to surf-related businesses shares some similarities with comments made by another witness on job losses in local surfboard manufacturers—see Mr John Heaton, *Committee Hansard*, 2 May 2017, p. 7.

available, it argued that the impact 'is likely to be significant as tourism is the largest economic driver in coastal regions'.[76]

2.77 However, some submitters noted that there is limited evidence demonstrating economic consequences of shark encounters. Associate Professor Daryl McPhee considered that it is 'clearly plausible' that unprovoked encounters could have negative consequences for some businesses in the area where the encounters occurred. Nevertheless, he advised that he is not aware of any economic studies documenting these effects. Associate Professor McPhee reached the same conclusion on potential effects for overall tourism, namely that 'impacts on tourist numbers at a locality are plausible but to my knowledge have not been independently assessed'.[77]

2.78 Other witnesses also commented on the lack of reliable information about the connection between shark bites incidents and overall tourism activity. In response to questioning about statistics on visitor number to Western Australia published by Tourism Research Australia, Mr Bradley Woods, Chief Executive Officer/Executive Director, Australian Hotels Association (WA), stated:

> Yes, there has been growth, but the growth has not been at the same degree as national growth. The national visitation growth, particularly from Chinese visitors to Australia, has been substantially higher than Western Australia. We are not achieving the growth performance that we could be achieving. I'm just referring to the [Tourism Research Australia] research in that sense. Whether it is shark related, I have no evidence that we can find because there's just no work in that space.[78]

2.79 In commenting on how to assess whether shark encounters affect tourism or economic activity more broadly, Associate Professor McPhee added that any 'redistribution of expenditure and activity within and between regional communities' would need to be taken into account as part of a 'credible economic study'. He explained:

> A person is unlikely to cease spending all their money in an area, even if they change their leisure behaviour in response to a series of shark bites. They either substitute their expenditure for other activities in the same area or the same activity in another area (or most likely a combination of both). Economic activity may not be lost – rather it is redistributed. Anecdotal information from Western Australia is that after the series of shark bites in the greater Perth region, the sale of home pools increased, as did the patronage at some public pools. I stress that this is anecdotal information, but it is an example of the types of hypotheses that could be tested through economic studies.[79]

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76 Global Marine Enclosures, *Submission 31*, p. 4.

77 Associate Professor Daryl McPhee, *Submission 58*, p. 6.

78 Mr Bradley Woods, Chief Executive Officer/Executive Director, Australian Hotels Association (WA), *Committee Hansard*, 28 July 2017, p. 13.

79 Associate Professor Daryl McPhee, *Submission 58*, p. 6.

2.80 The submission from the Queensland Government's Department of Agriculture and Fisheries approached the relationship between shark encounters and tourism from a different perspective. It presented the following counterfactual statement which argued that the shark control measures used in the state support tourism, and the absence of those measures would have negative effects for the tourism sector:

> Queensland's beaches are marketed locally and internationally as being safe with regard to shark attack. If Queensland did not maintain a shark control program there would be increased shark activity at popular beaches and possible fatalities with resultant tourist booking cancellations, and other negative economic impacts on regional economies.[80]

2.81 HSI argued, however, that the replacement of lethal shark control measures such as those used by the Queensland Government with non-lethal measures (the various lethal and non-lethal measures are discussed in subsequent chapters) would support the tourism sector. It explained:

> We recognise that tourism may benefit from the restoration of public confidence in beach safety and a reduction in shark attacks. We consider that the implementation of effective non-lethal shark mitigation and deterrence measures would support the tourism industry by achieving these outcomes.[81]

2.82 Others expressed scepticism about or directly challenged claims of negative economic consequences from shark encounters. For example, Sea Shepherd Australia submitted:

> Comments, opinions and beliefs are not independent and are not evidence based. More to the point, there is no source data that supports the assertion that the tourism industry is affected by shark encounters.[82]

2.83 Similarly, the NSW Young Lawyers Animal Law Committee (ALC) argued that 'reports of negative impacts upon the tourism industries in New South Wales, Queensland and Western Australia are frequently anecdotal and are not evidence based'.[83] The ALC's evidence on the impact of shark bites on tourism instead centred on published data. The ALC noted that national figures on inbound tourism published by Tourism Australia indicate an increase in tourist numbers of 8.2 per cent from 2014.[84] On regional effects, the ALC noted 'reports of reductions in wages from retail surf outlets' and 'reductions in membership numbers and financial contributions to

80 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 6.

81 HSI, *Submission 43*, pp. 24–25

82 Sea Shepherd Australia, *Submission 57*, p. 19.

83 NSW Young Lawyers Animal Law Committee, *Submission 61*, pp. 10–11.

84 NSW Young Lawyers Animal Law Committee, *Submission 61*, pp. 10–11. See also Sea Shepherd Australia, *Submission 57*, p. 23.

Surf Life Saving Clubs', but argued that 'there is insufficient evidence of a connection between those reports and shark encounters'.[85]

2.84 One of the examples provided by Sea Shepherd Australia in its submission centred on the fatal shark attack that occurred in September 2014 at Byron Bay. Using information published by Destination NSW, Sea Shepherd argued that for the year ending March 2015, 'domestic and international travel to the Northern Rivers sub-region of the Far North Coast all increased'. Sea Shepherd added:

> Travel to the area also significantly exceeded visits to regional New South Wales as a whole, with domestic overnight travel to the subregion up by 14.3% on the previous year, compared to a 4.1% increase to regional New South Wales. There was also a significant increase in expenditure in the sub-region for the year ending March 2015 across both domestic and international travellers, with domestic overnight travellers spending 13.5% more than the previous year.[86]

2.85 On potential effects on the number of beach visitations, Sea Shepherd Australia argued that the available data 'does not in any way suggest that shark attacks are scaring residents and tourists away from the ocean'; rather, the data indicate that 'beach attendance has ebbed and flowed regardless of the shark control measures and shark encounters'.[87] One of the examples presented by Sea Shepherd Australia indicates that, in Western Australia, beach visitations increased at beaches where fatal shark attacks occurred. Sea Shepherd's submission explained:

> …Bunker Bay, the scene of Kyle Burden's tragic death in November 2011, saw beach attendance increase nearly 34% the next year; from 89,783 in 2011/12 to 119,947 in 2012/13. Margaret River – which experienced a fatal shark attack at nearby Gracetown in August 2010 – saw beach attendance nearly double from 73,592 in 2009/10 to 140,047 in 2010/11. Busselton, which experienced a fatality at nearby Port Geographe Marina in March 2012, likewise saw an increase in beach attendance, more than tripling from 525 in 2011/12 to 1,658 in 2012/13.[88]

2.86 Sea Shepherd Australia added that a survey of New South Wales and South Australian beachgoers conducted by researchers at Flinders University concluded that beachgoers 'don't choose beaches based on whether there are shark attack prevention measures in place'. Instead, 'the landscape/views, and popularity of the beach were the two principal drivers of beach choice'.[89]

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85 NSW Young Lawyers Animal Law Committee, *Submission 61*, pp. 10–11.

86 Sea Shepherd Australia, *Submission 57*, p. 25 (emphasis omitted).

87 Sea Shepherd Australia, *Submission 57*, pp. 23–24.

88 Sea Shepherd Australia, *Submission 57*, p. 23.

89 Sea Shepherd Australia, *Submission 57*, pp. 23–24.

2.87 Evidence given by representatives of Surf Life Saving NSW and the Australian Lifeguard Service also commented on the statistics available on beach visitations at patrolled beaches. They noted that the available data, 'whilst subjective', indicate that since the death of Tadashi Nakahara at Ballina in 2015, there has not been a discernible decrease in beach attendance'. This is 'despite all the, for want of a better word, hysteria that has been portrayed through the media about the region'.[90] It was also noted that overall membership numbers for lifesaving clubs in the area have been steady.[91]

2.88 The above observations notwithstanding, Mr Brett Manieri from the Australian Lifeguard Service added that visitations to certain unpatrolled beaches could have potentially declined. He explained:

> It may be that we are seeing a continuation of not a great varying degree because swimmers and surfers had previously gone to unpatrolled locations. Quite a few of the beaches up there are patrolled locations and they are now moving to those locations and are swimming in the patrolled area and also at the netted location.[92]

2.89 A New South Wales parliamentary committee considered the impact of shark attacks on tourism in a 2016 inquiry. In its report, that committee noted it had 'received no evidence suggesting that tourism or related industries (such as accommodation) had been affected on a state-wide level' by well-publicised shark attacks occurring in state waters.[93] However, at a regional level (the north coast and the mid north coast), the committee suggested the evidence available indicates that a cluster of shark attacks has a temporary impact on the activities that both tourists and residents undertake, and that this can have a consequent impact on local businesses. The committee concluded that further research is needed in this area.[94]

2.90 Other factors relating to any relationship between shark encounters and tourism activity were also put forward in submissions.

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90 Mr Brent Manieri, Australian Lifeguard Service, *Committee Hansard*, 16 March 2017, p. 12

91 Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW; *Committee Hansard*, 16 March 2017, p. 12

92 Mr Manieri referred to individuals living in the north coast of New South Wales who he knows now surf at netted areas. In addition, he noted that surf cameras at Lighthouse Beach, Ballina, indicate that surfers have moved to the netted, northern end of the beach. See Mr Brent Manieri, Australian Lifeguard Service, *Committee Hansard*, 16 March 2017, p. 16.

93 Legislative Assembly Committee on Investment, Industry and Regional Development, Parliament of NSW, *Management of sharks in New South Wales waters*, report 1/56, June 2016, p. 15.

94 Legislative Assembly Committee on Investment, Industry and Regional Development, *Management of sharks in New South Wales waters*, p. 22.

2.91 The Australian Marine Conservation Society (AMCS) argued that there are positive direct links between sharks and tourism, as interested tourists seek to see sharks in their natural environment. More generally, the AMCS argued that the role sharks play in maintaining a healthy marine environment is also beneficial for tourism.[95] The committee was also referred to tourism activity associated with a shark in Florida[96] and, outside of this inquiry, other environmental organisations have also suggested that eco-tourism would 'alter the way sharks are perceived'.[97]

2.92 The Migaloo 2 Foundation, which offers marine educational activities using the yacht *Migaloo 2*, argued that negative effects of tourism from shark encounters can be linked to a mistaken belief in, and promotion of, lethal shark control measures that the Migaloo 2 Foundation consider are ineffective. It submitted:

> The tourism industry has relied on fear and ignorance and active tourist operators to perpetuate the lie that Australia has shark nets so swimmer are safe, yet the current Shark net program does not net in an entire area as many people think. As this lie is exposed both locally and overseas tourist operators will instead need to rely on telling the truth to encourage tourists and people in general to visit their area.[98]

2.93 Finally, some submitters commented on how the distribution of information about shark encounters could affect tourism. Returning to the topic of media reporting on shark encounters discussed previously, HSI submitted that the approach taken to reporting such events 'has not benefited tourism'. HSI argued:

> The view espoused by media outlets is that there is a veritable swarm of sharks sitting off the Australian coast, this is not backed by science. The majority of these fear-mongering articles display a picture of a white shark with jaws open.[99]

2.94 Mr Bradley Woods from Australian Hotels Association (WA) gave similar evidence regarding the impact of media reports that are widely distributed internationally. Mr Woods stated:

> What we are concerned about is that sometimes, when these attacks occur, the international attention and the national attention could portray our beach line and our coastlines as unsafe destinations to the rest of the world. It's difficult, when we're marketing the attractiveness of the state from a tourism perspective, to then be countering the negativity of what are perceived to be unsafe beaches or coasts. Obviously, whilst each of these

95 Australian Marine Conservation Society, *Submission 38*, p. 10.

96 See Mr Tony Isaacson, DiveCareDare, *Committee Hansard*, 31 July 2017, p. 47.

97 Sea Shepherd Australia, 'Alternatives to drum lines and shark nets', www.seashepherd.org.au/apex-harmony/overview/alternatives.html (accessed 7 December 2016).

98 Migaloo 2 Foundation, *Submission 28*, p. 2.

99 HSI, *Submission 43*, p. 24.

> deaths was tragic, in the context of the numbers over the last 17 years it is a balance, and there's a question there of what is realistic.[100]

2.95 It was also suggested that the distribution of information about shark encounters via social media could similarly have negative implications for tourism and beach visitations over a wide geographic area. Surf Life Saving SA explained:

> The example of this is sharks reported a significant distance from shore with community members then declining going to the beach even though there is no threat at that location. Many of these posts are shared overseas and interstate. We believe that this can cause a decline in beach visitation and have a knock on effect to tourism and local businesses.[101]

Anecdotal evidence regarding activities that may increase the risk of dangerous human–shark interactions

2.96 The final section of this chapter discusses anecdotal evidence received during this inquiry suggesting that certain activities may be placing other ocean users at heightened risk of encountering a dangerous shark.

Cage diving tourism

2.97 The activity most frequently referred to by witnesses and submitters is cage diving. Cage diving with white sharks is permitted in the Neptune Islands Group Marine Park in South Australia. The tourist operators use berley to attract sharks to viewing cages.[102]

2.98 Concerns were expressed that cage diving conditions sharks to associate humans with food. For example, the Abalone Industry Association of South Australia (AIASA) submitted that berleying and teasing white sharks is essentially training white sharks that 'people in cages means food'.[103] Although abalone divers use motorised, submersible dive cages to protect themselves from sharks,[104] the AIASA believes the cage diving operations introduce risk. The AIASA explained:

> Our number one concern is the use of teaser baits which sole purpose of use is to lure the shark closer to the thrill seeking tourist divers in the cage hanging from the boat. This thrill seeking is now an expectation of the tourists instilled by the two tourism operators permitted by the State Government. To keep the sharks coming back they are rewarded with

100 Mr Bradley Woods, Chief Executive Officer/Executive Director, Australian Hotels Association (WA), *Committee Hansard*, 28 July 2017, p. 7.

101 Surf Life Saving SA, *Submission 10*, p. 2.

102 Government of South Australia, *Submission 65*, p. 7.

103 Abalone Industry Association of South Australia, *Submission 70*, p. 2.

104 Government of South Australia, *Submission 65*, p. 5; Abalone Industry Association of South Australia, *Submission 70*, p. 1.

> the chunk of meat on a rope lure from time to time. The same way humans have been training animals for 1000s of years.
>
> We believe this practice is leading to [great white sharks] associating people in cages with food. Our work diving operation employs the use of underwater cages to provide protection from [great white sharks]. However our cages cannot be structurally built the same as they must be manoeuvrable and we need to work from them to harvest abalone. We allege that this practice is the reason why we are encountering a younger cohort of aggressive sharks buzzing us while we are working.[105]

2.99 Mr Russell Morey, who is a commercial fisherman in Western Australia, also objected to cage diving. Mr Morey stated:

> Cage diving would probably be the worst thing that has happened with great whites. You couldn't do a worse thing with a wild animal that's a top-end predator—putting humans in the water, in a cage, and feeding the sharks continuously in the same place, for the pleasure of a handful of people, endangering the rest of the people who get in the ocean. I would like to see those people get out of their cages. If there is no reason, if they're not an animal that will attack them, what's the cage for?[106]

2.100 Others, however, suggested that cage diving can be regulated appropriately and ethical, depending on the use of bait. For example, Mr Blair Ranford stated that, in his view, when cage diving is 'done ethically, which is to say, with a very minimal amount of bait et cetera, I don't believe it increases my risk'.[107] Mr Tony Isaacson commented that the use of chumming for cage diving 'is quite controversial'. He suggested that, based on an expedition in which he participated, sharks appeared to have learnt to associate the boat with food. Mr Isaacson added, however, that cage diving can use other techniques, such as playing music, which are effective in attracting sharks.[108]

2.101 CSIRO referred to research conducted at the Neptune Islands which indicated that sharks increased residency for a short amount of time in the area where cage diving occurred. The following explanation of the research project and findings was provided:

> The Neptune Islands consist, largely, of a northern and a southern group of islands. The southern group does not get cage dived very often, so that was used as a control region. In the northern group, cage diving happens on a very regular basis. So we were able to look at differences between those

105 Abalone Industry Association of South Australia, *Submission 70*, p. 1.

106 Mr Russell Morey, *Committee Hansard*, 28 July 2017, p. 51.

107 Mr Ranford added that one of the locations used for cage diving is at a seal colony so 'the sharks are already there'. Mr Ranford stated the sharks are 'not meant to be fed baits, so if it's done well it's actually meant to be safe'. Mr Blair Ranford, *Committee Hansard*, 28 July 2017, pp. 64–65.

108 Mr Tony Isaacson, DiveCareDare, *Committee Hansard*, 31 July 2017, p. 50.

> two groups. They're only 12 kilometres apart, I believe. Yes, we did see some differences and we do have a scientific publication on that…The main finding was that sharks do increase their residency in that area where shark diving is occurring…but it wasn't a substantial increase in time.[109]

2.102 CSIRO subsequently advised that, to date, 'all published research on the effects of shark cage diving tourism on shark behaviour have been ecological in nature'. That is, a specific scientific investigation has not been undertaken into whether sharks are being conditioned to associate vessels and humans with food or to become more aggressive. Nevertheless, CSIRO referred the committee to findings that, based on the information currently available, suggested such responses were unlikely.[110]

2.103 The Government of South Australia submitted that it 'strictly regulates' cage diving activities undertaken in its jurisdiction. Furthermore, the Government submitted that '[t]here is no scientific evidence to suggest that the risk of shark attack to the general public is increased by shark-related tourism activities'.[111] This evidence was supported by CSIRO, which advised that:

> It should be noted that, in the shark cage dive industry, they're fairly well regulated in that they do put out berley to attract sharks to the boat. The berley does not feed the sharks—it's tiny pieces of fish, oil and blood. It may increase the local fish population, but we don't know that. The industry is not permitted to feed the sharks. They do have teaser baits, and they make every effort not to feed the sharks those teaser baits. It's not a case of the industry actively attracting sharks through feeding them.[112]

2.104 Nevertheless, the South Australian Government advised that research in undertaken to monitor shark residency and that management of the cage diving industry would be reviewed 'should scientific evidence arise showing that this activity has created a risk for marine users'.[113]

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109 Russell Bradford, Senior Experimental Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 13.

110 CSIRO, Answers to questions on notice, 20 October 2017 (received 23 November 2017), p. 3. The research referred to by CSIRO is BD Bruce, *A review of cage diving impacts on white shark behaviour and recommendations for research and the industry's management in New Zealand*, Report for the Department of Conservation, New Zealand, 2015.

111 Government of South Australia, *Submission 65*, p. 7.

112 Russell Bradford, CSIRO, *Committee Hansard*, 20 October 2017, p. 14.

113 Government of South Australia, *Submission 65*, p. 7.

Fishing activities

2.105 Various submitters referred to sharks being attracted to fishing-related activities. Crayfishing is one particular type of fishing activity that was commented on. Mr Leon Deschamps remarked that, in his view, 'you would be a madman to surf at a crayfish break that has a bunch of pots on it'. Mr Deschamps added:

> Near berley water, sharks are put into a feeding response. When you do the maths, there are a lot of pots. I have worked as a cray fisherman. As you probably well know, you are putting two to three kilos of bait into each pot. When you magnify that the volume of pots along the Western Australian coastline, that is a lot of bait in a limited amount of water.[114]

2.106 However, Mr Blair Ranford argued that whether crayfishing is linked to the risk of shark bite is unclear at present as scientific evidence on this matter does not exist. Nevertheless, it was suggested that crayfishing activities should be restricted in some areas as a precaution. Mr Ranford stated:

> …in an area I surf in the south-west—Yallingup—it is not uncommon, as we get into September, October, November, to have upwards of 200 crayfish pots only 500 metres offshore from Yallingup main break, one of the main surfing breaks. I've worked on a cray boat in the past. You're looking at an average of one to 1½ kilos per pot. So in this particular area you are looking at probably 250 kilos of bait in the water 500 metres offshore of one of the south-west's premier surf breaks. It's not a case of saying that we're trying to stop crayfishing; we're simply saying that it should, by, I guess, sheer common sense, be excluded from areas that—like the Ngari Capes Marine Park is designated—are set aside as special surfing reserves. I just think having 250 kilos of bait sitting off the back of a popular surf break can't make sense, and it does concern all the surfers.[115]

2.107 Others dismissed the suggestion that crayfishing resulted in higher risk. Mr Morey asserted that the idea that surfers should not surf near crayfish pots because of a heightened risk of sharks is 'complete nonsense'. Mr Morey reasoned that sharks 'only eat mammals, and they eat large fish'. Therefore, Mr Morey argued that the craypots and the small fish used for bait would not be of interest to a white shark.[116]

2.108 Mr Ian Wiese commented on the annual salmon migration that occurs in the waters off the south west of Western Australia in March to April each year. Mr Wiese commented that sharks follow salmon schools, and filming of the area indicated that catch and release recreational fishing attracts sharks. Mr Wiese suggested that this 'creates a dangerous situation that is inadequately understood and managed at present'.

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114 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 29.

115 Mr Blair Ranford, *Committee Hansard*, 28 July 2017, p. 64.

116 Mr Russell Morey, *Committee Hansard*, 28 July 2017, p. 51.

Mr Wiese argued that the processing of salmon on beach should be banned to avoid carcasses being disposed of in the water.[117]

2.109 Finally, this section reports the evidence received by the committee regarding trophy hunting. Mr Deschamps referred to trophy hunting incidents that have occurred at Shark Bay, Western Australia. In describing these incidents, Mr Deschamps advised that it is currently legal to berley up to the renowned Monkey Mia dolphin beach. Mr Deschamps also noted that, as sharks are treated as fish rather than animals for the purposes of animal welfare legislation, sharks can be caught and skull-dragged.[118] Mr Deschamps argued that, in his view, the combination of these factors places people at risk. Mr Deschamps explained:

> At present, trophy hunters can come to our beaches and, thanks to sharks being removed as animals and turned into a fish, there is now no humane treatment laws for sharks. So you can catch a shark and skull-drag it up the beach on your quad bike. It can be a pregnant female with 80 pups in it. You can sit on it and then maybe feel good about pushing it back into the water for your Instagram photo because it swam away. Yes, you will get a thousand Instagram likes but you just maimed an animal. Not only did you maim that animal but you have now created a potential predator. You have created a potential predator on a beach where our tourism industry relies on having a positive relationship with sharks.[119]

2.110 Mr Deschamps referred to a specific incident in Shark Bay, Western Australia, during a recent school holiday period involving a trophy hunter. Mr Deschamps explained how, in his view, the actions of the trophy hunter endangered those nearby:

> You can put berley in where our iconic Monkey Mia dolphins come to—where they bring their babies to the delight of 100,000 people every single year—and drag a shark through the shallows. In the last school holidays, our boat kayak business had a gentleman hire a kayak, take the kayak directly into the channel 150 metres from the Monkey Mia jetty, put a tuna head on, catch a tiger shark and then try to skull drag it into the shallows through swimming school children. That is legal! That is completely okay! Locals ended up cutting the fishing line. Can you imagine what that could do for our tourism industry? Can you imagine what that could do for the RAC Monkey Mia Resort and the millions they have put into renovations had that shark brushed against a child. It would not even need to bite a child. The guy was using gang hooks. It was utterly ludicrous.[120]

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117 Mr Ian Wiese, *Submission 72*, pp. 1–2, 18.

118 Sharks are not covered by Western Australian animal cruelty legislation as they are categorised as fish rather than animals (see *Animal Welfare Act 2002* (WA), s. 5(1)). The taking or unlawful possession of threatened species is protected by *Wildlife Conservation Act 1950* (WA) and, in Commonwealth areas, the EPBC Act.

119 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 29.

120 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 29.

Chapter 3

Responses to shark bite incidents

3.1 People engaging in various types of water-based activities have been involved in shark incidents, including surfers, divers, swimmers and spearfishers. Over many decades, various measures have been put in place to help protect beachgoers from the risk of encountering a dangerous shark. As visiting the beach and beach culture forms an important part of the way of life for many Australians and is a drawcard for domestic and international tourism, spikes in shark encounters can lead to calls for governments to introduce further measures to protect public safety.

3.2 In responding to the risk that people undertaking recreational ocean-based activities may encounter a dangerous shark, measures that are non-lethal to sharks are widely used. In some states, these non-lethal measures are supplemented by devices that are designed to be lethal to sharks are also deployed. This chapter provides an overview of the non-lethal and lethal measures used in Australia.

Non-lethal responses

3.3 Across Australia, several types of public safety measures and programs used are non-lethal to sharks. State governments and not-for-profit organisations generally manage these measures.

3.4 Based on information published by various state governments, shark mitigation and deterrence techniques in Australia involve a range of detection, deterrent and public awareness measures, including:

- lifesavers, sirens at beaches and equipment for surf lifesaving clubs, such as jet skis to chase sharks away and to help facilitate beach closures;
- surveillance, such as beach patrols, fixed surveillance towers and aerial surveillance;
- tagging and tracking of sharks, including real time tracking data of tagged sharks that can enable response agencies to close beaches; and
- community awareness strategies, including websites, social media and mobile apps that disseminate shark alerts.[1]

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1 See, for example, New South Wales Department of Primary Industries (DPI), 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016); DPI, *Report into the NSW Shark Meshing (Bather Protection) Program: Incorporating a review of the existing program and environmental assessment*, March 2009, www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/623400/Report-into-the-NSW-Shark-Meshing-Program.pdf (accessed 5 December 2016); Correspondence from the Hon Colin Barnett MLA, Premier of Western Australia, dated 14 December 2016; Government of South Australia, *Submission 65*.

3.5 In addition to the measures listed above, a variety of new and emerging shark deterrent and mitigation measures are in use or under development. Evidence about the long-established measures are discussed in the following paragraphs; the new and emerging technologies are discussed in Chapter 6.

Patrolled beaches

3.6 One of the principal non-lethal measures for keeping the public safe from sharks highlighted by several submitters and witnesses were the volunteer and local government operated surf lifesaving services. Surf Life Saving NSW and Australian Lifeguard Service NSW submitted that:

> The simplest and most effective safety measure that members of the general public can follow is to only swim at patrolled beaches and swim between the red and yellow flags. This is the best place to swim because lifesavers and lifeguards are able to monitor all risks to maximise the safety of swimmers.[2]

3.7 A representative of Surf Life Saving Western Australia informed the committee that, in a two-year period, their lifesavers issued 258 direct shark warnings to beach users, which resulted in over 4,600 individuals being warned to leave the water. Overall, once information from beach patrols, aerial surveillance, shark tags and public sightings are taken into account, Western Australian lifesavers 'have cleared tens of thousands of beach users where there was an imminent threat in the water'. Evidence given to the committee indicates that the only recent instance of a death at a patrolled beach in Western Australia occurred early in the morning when lifeguards were arriving at the beach and setting up.[3]

3.8 Given the central role of surf lifesaving in public safety at patrolled beaches, it is instructive to examine the procedures in place for responding to shark sightings and human–shark incidents. Surf Life Saving Australia explained that in most states, the process that is followed at a patrolled beach after a shark is sighted involves:

> …the closing of a beach for a period of time with Surf Life Saving assets (helicopters, rescue craft, personnel) allocated to the area to ensure risk is minimised to the community. The water is cleared and surf lifesavers and lifeguards will monitor the area and liaise with Police as required.[4]

2 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, pp. 3–4.

3 Mr Chris Peck, General Manager, Lifesaving and Training, Surf Life Saving Western Australia, *Committee Hansard*, 20 April 2017, pp. 2, 3.

4 Surf Life Saving Australia, *Submission 16*, p. 6.

3.9 Surf Life Saving Queensland explained that its procedures require surf lifesavers to close the beach for 'at least 60 minutes after a confirmed shark sighting, or until the threat has otherwise subsided'.[5] The committee was advised that, in New South Wales, the process varies depending on which organisation is overseeing the beach. Mr Andy Kent from Surf Life Saving NSW explained that:

- council lifeguards will close the beach they monitor in response to any shark sighting for one hour; and
- for beaches patrolled by Surf Life Saving NSW, a risk management approach is used that takes into account where the shark was spotted, the type of shark and who reported it.[6]

3.10 Surf Life Saving NSW and Australian Lifeguard Service NSW advised that, at some patrolled beaches, shark alarms can be sounded to direct people to leave the water when a shark is detected.[7] In addition, they advised that as a result of funding provided by the New South Wales Department of Primary Industries (DPI), Surf Life Saving NSW 'was able to purchase additional shark alarms in priority areas'. Previous funding also enabled Surf Life Saving NSW to ensure every surf lifesaving club in the state was provided with 'a loud hailer and water resistant binoculars'.[8]

3.11 In Western Australia, the committee was informed that observation platforms are being considered 'to give lifesavers a more elevated position from which to do their surveillance'. [9]

3.12 At a club level, additional measures can be taken if required. The Ballina Lighthouse & Lismore Surf Lifesaving Club informed the committee that, following the shark bites in 2015 and 2016, 'the Club conducted a detailed risk assessment of our water activities and introduced a series of new protocols into our beach operations'. In addition to the standard operating procedures developed by Surf Life Saving NSW, the Club:

- undertakes a 'detailed risk assessment of the beach conditions prior to opening of the beach', which examines water clarity, bird activity and bait balls;
- stations a 'patrol member on the adjacent headland with radios and binoculars to gain an improved visual perspective of the water';
- has relocated the water-based activities of junior members to an enclosed portion of the Richmond River estuary; and

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5 Surf Life Saving Queensland, *Submission 2*, p. 1.

6 It was noted that 'public misinformation that is coming through can sometimes be a hurdle for our organisation'. Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW, *Committee Hansard*, 16 March 2017, p. 13.

7 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, pp. 3–4.

8 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, pp. 3–4.

9 Mr Chris Peck, Surf Life Saving Western Australia, *Committee Hansard*, 20 April 2017, p. 6.

- has increased the use of watercraft prior to opening the beach and when the beach is open.[10]

3.13 The essential work undertaken by surf lifesaving clubs across the country was acknowledged in other submissions. For example, in their joint submission, Dr Daniel Bucher and Professor Peter Harrison stated that a surf lifesaving patrolled beach is a measure that, despite being 'often overlooked', has 'resulted in zero fatalities over an extended period of time'. They added that patrolled beaches have another advantage for public safety generally in that they help prevent drownings.[11]

3.14 Despite the long history of successful surf lifesaving activities, however, the resources available for these activities are limited and are dependent on the efforts of volunteers. In particular, there appears to be an expectation gap between the public's understanding of the role of volunteer surf lifesaving organisations and the authority and resources available to those clubs. Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW, explained:

> The biggest cost we have is volunteer time. When an attack occurs or an encounter occurs at a beach…Surf Life Saving, because of either the public's expectation or the media's expectation, the public and the media think we are in charge—which is probably a success of our brand and the role we do—but in actual fact we know we are not. So when we get tasked to an incident—the latest attack was, I think, in Forster, at a very remote beach—the expectation is that Surf Life Saving will respond and man the beaches and put up signs everywhere. The reality is that we do not have the resources to do that.[12]

3.15 Members of the public can also challenge efforts by surf lifesaving organisations to close beaches temporarily in response to shark sightings. Mr Chris Peck from Surf Life Saving Western Australia advised that 'an element of frustration' is evident when beaches are closed due to shark sightings. Mr Peck stated:

> We have seen people come down and want to participate in events and they are unable to or been halfway through an event and participation has had to stop. People become very frustrated and become very angry by that. If I look at the Clever Buoy example at City Beach where that trial was conducted[13] and the number of beach closures, there was a significant amount of angst from the people and that anger was directed at the lifesavers, who were simply delivering the protocols and closing the beach. In that sense, that is disappointing.[14]

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10 Ballina Lighthouse & Lismore SLSC, *Submission 52*, p. 3.

11 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 6.

12 Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW, *Committee Hansard*, 16 March 2017, pp. 15–16.

13 The Clever Buoy technology and trial is discussed in Chapter 6.

14 Mr Chris Peck, Surf Life Saving Western Australia, *Committee Hansard*, 20 April 2017, p. 4.

3.16 The focus of surf lifesaving efforts is also limited to 'between the flags'. Mr Dale Carr, who has survived a shark bite, noted that when assessing conditions, surfers can be drawn outside the patrolled areas. He explained this decision by depicting a surfer asking themselves the following question:

> Where am I going to go for a surf? Am I going to surf between the flags or am I going to surf where it's really cracking hot?[15]

Aerial patrols

3.17 The committee received evidence about aerial patrols of the coastline conducted by fixed wing aircraft and helicopters. It was advised that four aerial patrols dedicated to bather protection currently operate in Australia.[16]

3.18 The Government of South Australia advised that both fixed wing and rotary wing patrols are used in its jurisdiction. The government's submission, which was provided in March 2017, noted that in 2016–17 fixed wing aircraft are expected to have conducted 1060 hours of regular coastal surveillance in two areas: from the northern Adelaide suburbs to Rapid Bay; and from Victor Harbor to the mouth of the Murray River. The aircrafts use at least three personnel, allowing two dedicated observers 'to concentrate on maintaining watch and managing/communicating any sightings'.[17]

3.19 The helicopter patrols are limited to supporting open water aquatic events in the Adelaide metropolitan beaches and the south coast. These patrols are conducted by the Westpac Life Saver Rescue Helicopter (as part of an arrangement with Surf Life Saving SA). Although these patrols are limited in number (18 patrols were undertaken in 2016–17), the government noted that this approach has the additional advantage in that 'the helicopter can be used to actively drive large sharks away from the shore to reduce the immediate risk of interactions with members of the public'.[18]

3.20 The committee also received evidence from the Australian Aerial Patrol, which was formed in 1957. The registered charity patrols part of the New South Wales south coast from southern Sydney to Mollymook.[19]

3.21 Australian Aerial Patrol explained that when a shark is spotted and logged, if swimmers or surfers are nearby a siren and loudspeaker on the aircraft is used to alert them. For beaches with professional or volunteer lifeguards, the spotting can be reported to these lifeguards for further action. In response to sightings of large sharks, Mr Duncan Leadbitter, Director, Australian Aerial Patrol, added that the aircraft

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15 Mr Dale Carr, Member, Bite Club; Beyond the Bite, *Committee Hansard*, 2 May 2017, p. 17.

16 Australian Aerial Patrol, *Submission 6*, p. 9.

17 Government of South Australia, *Submission 65*, p. 4.

18 Government of South Australia, *Submission 65*, p. 4.

19 Australian Aerial Patrol, *Submission 6*, p. 3.

conduct orbits to deter the shark until it has swum away or people have left the water.[20]

3.22 Mr Leadbitter added that the police have been contacted when people do not leave the water and it is considered a shark presents a significant risk. He told the committee:

> On one occasion when people would not get out of the water we called the Federal Police, because it was in Jervis Bay waters, to get somebody down because there were small children with a large shark nearby. That is unusual but shark attacks are not usual anyway.[21]

3.23 An advantage of aerial patrols is that they can cover unpatrolled beaches; for example, Mr Leadbitter observed that 'south of Kiama there are very few patrolled beaches…we very commonly see people surfing or swimming in areas which are a long, long way from the patrolled areas'. Nonetheless, as noted above, aerial patrols can still support public safety efforts at patrolled beaches. Mr Leadbitter stated that the good record of no fatalities between the flags at patrolled beaches 'is why we work in tandem with the beach safety providers'.[22]

3.24 Individuals provided evidence in support of aerial surveillance. In relation to aerial surveillance activities conducted in other parts of New South Wales, Mr John Heaton commented:

> …I can tell you there is nothing more reassuring as seeing a helicopter fly over where you are surfing and not stop & hover above you. I was involved in a surf break evacuation in Dec 2016 when the helicopter hovered above us and then gave the alarm of a shark very close by.[23]

3.25 Noting the low statistical risk of a shark incident, Mr Leadbitter noted that aerial patrols are 'a psychological thing for people'. He explained:

> People want to feel safe at the beach, and they equate the aerial patrol with somebody looking after them. The risk of shark attack is virtually negligible. You really need to get people over the fear. They like to see the planes. It is very simple.[24]

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20 Mr Leadbitter explained that orbits involve 'flying at 150 metres off the ground or off the water and we will keep circling until we are confident that either the shark is spooked and has swum away, which they do, often if the shadow of the aircraft goes over them, or we are confident that people are out of the water'. Mr Duncan Leadbitter, Director, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 19. See also Australian Aerial Patrol, *Submission 6*, p. 8.

21 Mr Duncan Leadbitter, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 19.

22 Mr Duncan Leadbitter, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 18.

23 Mr John Heaton, *Submission 11*, p. 3.

24 Mr Duncan Leadbitter, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 21.

3.26 However, the committee also received evidence arguing that the effectiveness of aerial beach patrols is limited. The Queensland Department of Agriculture and Fisheries referred to an assessment of New South Wales aerial patrols, which 'confirmed that sighting sharks is very difficult from the air', with an overall sighting rate of 17 per cent. The department noted that this 'suggests sharks sighted from aircraft observers can be missed if the water depth is too deep or turbid'. In addition, species of sharks that are known to be potentially dangerous to humans (white, tiger and bull sharks) 'may be near the surf break before being detectable aerially'.[25]

3.27 Similarly, Dr Christopher Neff submitted that the use of aerial surveillance depends on weather conditions, and that 'cloud cover, white caps, sun glare, the type of shark, position of the shark, and size of shark can all affect visibility'.[26]

3.28 Overall, the committee heard divergent views on the utility and future of aerial patrols. Australian Aerial Patrol argued that aerial patrols 'are no less effective at protecting beach goers than other established methods', and called for the Australian Government to investigate the creation of aerial patrols elsewhere in Australia.[27] However, Associate Professor Daryl McPhee expressed the view that '[t]he traditional approach of using people in planes and helicopters to spot sharks is outdated, and will more than likely be replaced with other technologies such as drones'.[28]

3.29 Stakeholder views on the potential for unmanned aerial vehicles to be widely used for shark spotting are discussed in Chapter 6.

Public information

3.30 There are many techniques used to convey information to the public about the risks presented by sharks. This section briefly discusses some of the mechanisms used. Additional proposals to raise awareness and improve the public's understanding of how to keep safe are discussed in Chapters 6 and 7.

3.31 One of the most visible methods is the use of signs at beaches and other waterways to warn about the risk of sharks. For example, temporary signs can be used when a beach is closed because of a shark sighting or to warn of recent sightings.

3.32 Public information campaigns have been developed to inform the public about the risk associated with sharks. For example, Surf Life Saving NSW and Australian Lifeguard Service NSW advised that, in 2015, DPI initiated a state-wide information campaign known as 'SmarkSmart'. The campaign, which was supported by Surf Life

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25 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 5. The research cited is W Robbins, V Peddemors and S Kennelly, *Assessment of shark sighting rates by aerial beach patrols*, New South Wales Department of Primary Industries, 2012.

26 Dr Christopher Neff, *Submission 48*, p. 5.

27 Australian Aerial Patrol, *Submission 6*, p. 2.

28 Associate Professor Daryl McPhee, *Submission 58*, pp. 5–6.

Saving NSW, aimed to 'help the general public be aware of how they can minimize the risk of being in waters where sharks may be present'. Information containing safety tips and advice was distributed to surf lifesaving clubs and coastal accommodation providers in northern New South Wales.[29]

3.33 Separately to the SharkSmart program, Surf Life Saving NSW advised that it has introduced a coastal accommodation network e-newsletter that includes 'surf safety resources and information on safety signs so guests are "beach ready" and know what the different warning signs mean'. Some editions of the newsletter have also contained 'shark management stories' intended to promote awareness.[30]

3.34 Websites and social media apps are also used. Surf Life Saving NSW and Australian Lifeguard Service NSW highlighted the Beachsafe website (www.beachsafe.org.au). This website is managed by Surf Life Saving Australia and includes current information and conditions for every Australian beach. Surf Life Saving NSW added:

> There is information available on the website in 30 languages and the website can direct swimmers to the nearest patrolled beach. Visitors to the website can view fact sheets on rips, bluebottles and other hazards in different languages. Visitors can also download the Beachsafe App on their smartphones, which provides access to patrol locations and hours; and real-time weather and surf conditions, anywhere along the coast.[31]

3.35 As part of the New South Wales SmarkSmart campaign, a SharkSmart mobile app was developed and released. The app provides information and resources to help reduce the risk of shark encounters. Since March 2016, the app has provided users with real-time alerts if a shark tagged with a tracking device (this is discussed in Chapter 6) is near a listening station or if a shark incident recently occurred in the area.[32] This information is also distributed via Twitter. The SmarkSmart website/app is recognised by Surf Life Saving New South Wales as a source of reliable information about shark sightings.[33]

3.36 In Western Australia, the state government operates a SharkSmart public education website (www.sharksmart.com.au). In addition to information to help members of the public to minimise the risk of encountering a shark, the website provides details on shark sightings, including tagged sharks detected by listening stations, sharks spotted by the Westpac Lifesaver Rescue Helicopter Service and shark sightings reported by members of the public. Surf Lifesaving Western Australia also

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29 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, p. 5.

30 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, p. 5.

31 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, p. 5.

32 The Hon Niall Blair MLC, 'Shark smart app upgrade tracks sharks in real-time', *Media release*, 18 March 2016.

33 Mr Andy Kent, Surf Life Saving NSW, *Committee Hansard*, 16 March 2017, p. 13.

distributes information about shark sightings via Twitter; its account has over 46,000 followers. Mr Chris Peck from Surf Life Saving Western Australia described the Twitter account as being 'critical…for locations where patrols or other initiatives are infrequent or not present at all'.[34]

3.37 Some of the positive and negative issues regarding the use of social media to distribute information about sharks spotted were discussed in Chapter 2.

Lethal measures

3.38 Much of the evidence received by the committee on government responses to shark incidents focused on the lethal measures used in Queensland and New South Wales for decades, as well as the measures more recently used in Western Australia.[35]

3.39 This section commences this report's examination of lethal shark control measures by providing background information on:

- the different measures used and how they work;
- the specific lethal shark control programs used or trialled by various state governments; and
- the catch rates and bycatch associated with the use of lethal measures.

3.40 The effectiveness of the lethal shark control measures used in Australia is an issue that attracted significant comment and, accordingly, is discussed in a dedicated chapter (Chapter 4).

Background on lethal measures currently in use

3.41 The two lethal shark measures examined in detail during this inquiry are shark nets (also referred to as shark meshing) and drum lines.

Mesh nets

3.42 Shark nets designed to entangle large sharks have been used in Australia for decades. The general goal of nets is to 'reduce the number of potentially dangerous sharks in particular areas rather than [to] create an impenetrable barrier against shark attack'. That is, the nets do not create an enclosed area that separates bathers from sharks. Rather, the nets are designed 'to catch "resident sharks" and sharks that move

34 Mr Chris Peck, Surf Life Saving Western Australia, *Committee Hansard*, 20 April 2017, p. 2.

35 In addition to the measures in Australia, at least three other parties to the Convention on the Conservation of Migratory Species utilise shark control programs. Countries known to utilise these measures include South Africa, New Zealand (at Dunedin) and Brazil (Recife), although under the Recife program sharks are not intentionally killed; rather, the sharks are tagged and released away from shore. See Department of the Environment and Energy (DoEE), Answers to questions on notice, Senate Environment and Communications Legislation Committee, Budget Estimates 2017–18, No. 75.

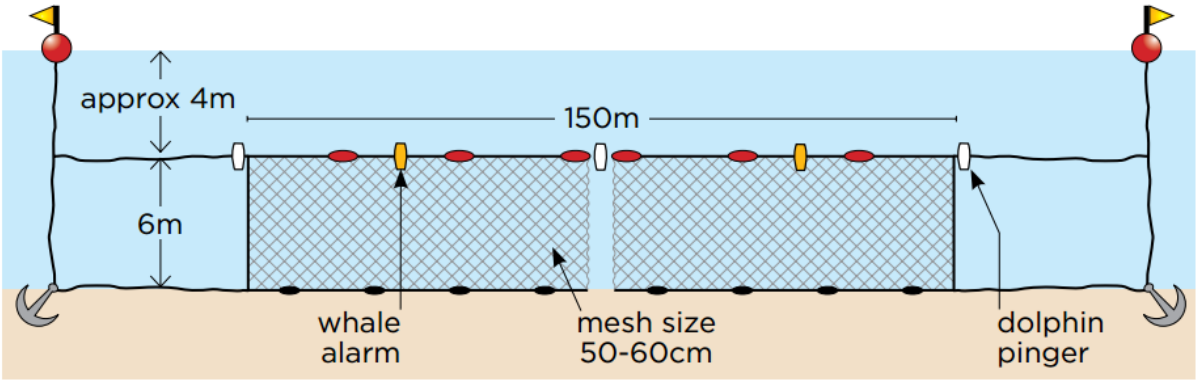
through an area while feeding on bait fish'.[36] The nets feature acoustic warning devices intended to alert dolphins and whales.[37]

3.43 In New South Wales, sunk nets are set within 500 metres of the shore at 51 beaches between 1 September and 30 April each year.[38] The following extract of a 2009 report provides additional detail about how the nets are set:

> The nets are bottom-set on bare sand and held in position using sand anchors weighing between 27 and 30 kg. Nets are required to be set parallel to the beach in waters 10 to 12 m deep (i.e. about 4–6 m below the surface), which generally corresponds to a distance of within 500 m of the beach. This configuration for a net is referred to as a 'set'…although two nets can be set simultaneously to constitute two sets for that beach. The location of a set is determined by the prevailing and forecast wind, seas and currents, but is usually adjacent to the surf clubs and patrolled swimming areas.[39]

3.44 A depiction of a net in operation under the New South Wales north coast trial is at Figure 3.1. In Queensland, the nets are surface-set.[40] An illustration of how shark nets are deployed, based on the Queensland arrangements, is at Figure 3.2.

Figure 3.1: How shark nets operate under the New South Wales North Coast trial



Source: DPI, 'Shark nets for the NSW North Coast', www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/681953/20161207-Shark-Trial-Fact-Sheet-.pdf (accessed 9 February 2017).

36 Queensland Department of Agriculture and Fisheries, 'Shark control equipment and locations' www.daf.qld.gov.au/fisheries/services/shark-control-program/shark-control-equipment-and-locations (accessed 6 December 2016).

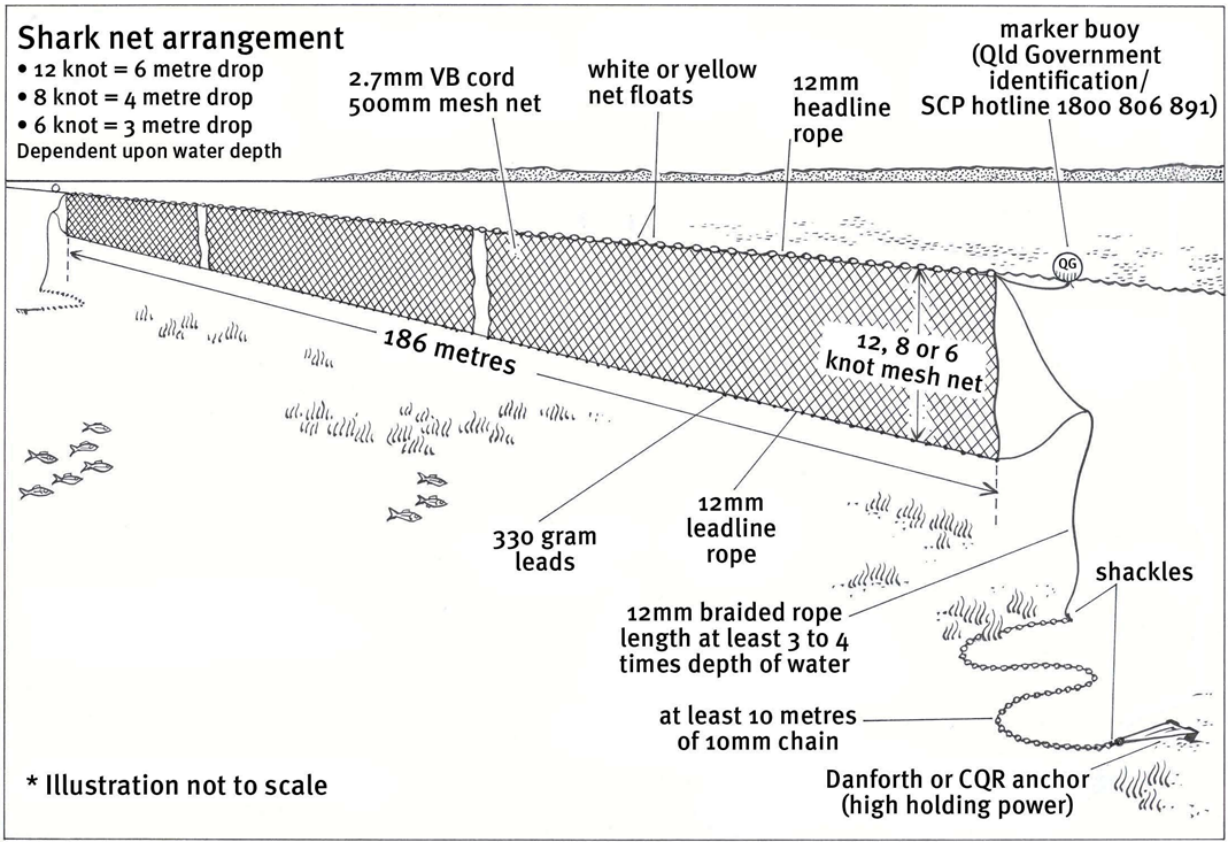
37 DPI, 'Shark Meshing (Bather Protection) Program', www.dpi.nsw.gov.au/fishing/sharks/management/shark-meshing-bather-protection-program (accessed 6 December 2016); Queensland Department of Agriculture and Fisheries, 'Impact on other marine animals', www.daf.qld.gov.au/fisheries/services/shark-control-program/impact-on-other-marine-animals (accessed 6 December 2016).

38 DPI, 'Shark Meshing (Bather Protection) Program'.

39 DPI, *Report into the NSW Shark Meshing (Bather Protection) Program*, March 2009, p. 9.

40 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 2.

Figure 3.2: How shark nets operate under the Queensland Shark Control Program



Source: Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 9.

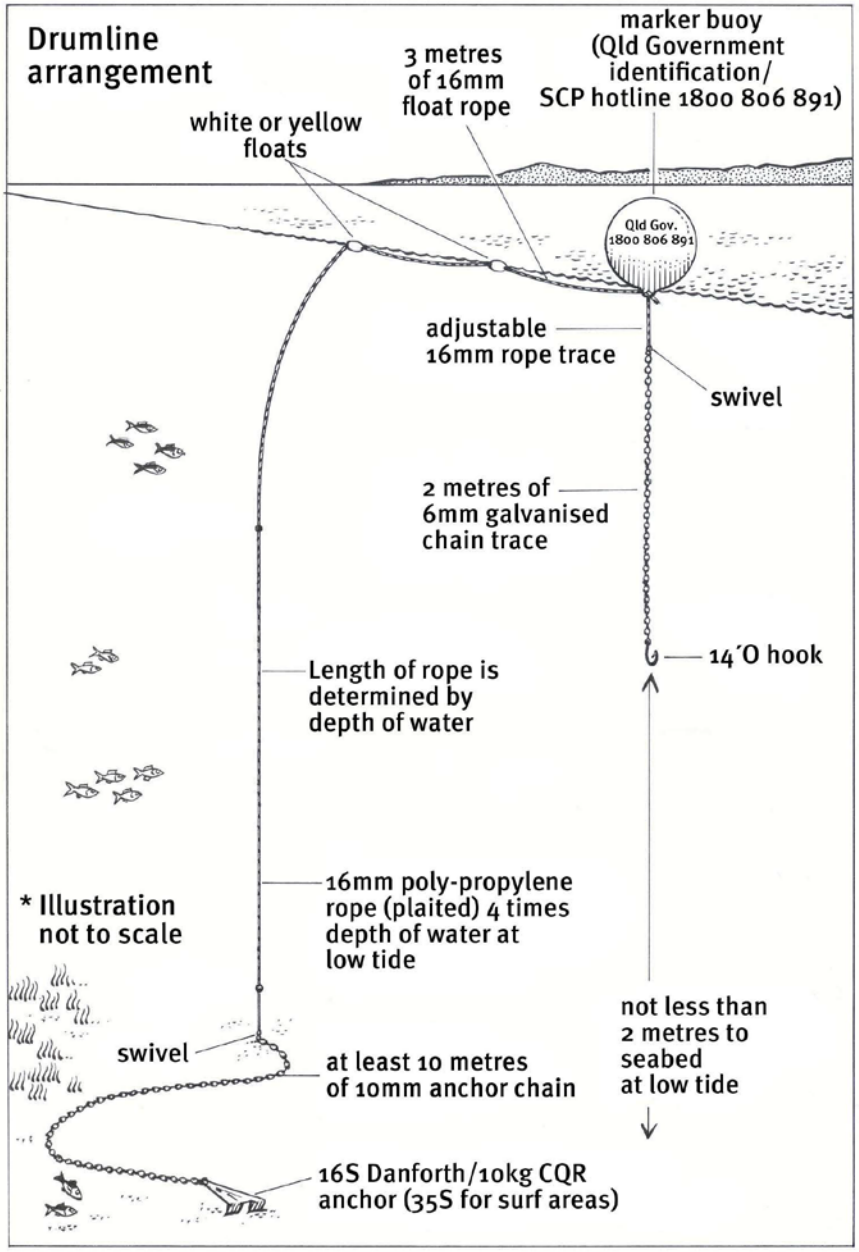
3.45 The nets incur damage during the meshing season. For example, the 2015–16 performance report on the New South Wales program stated that a net was reported missing after a storm event, some nets were believed to be damaged by anchors or entangled after an interaction with a vessel, and others were vandalised. Other damage was also reported, such as nets that were slashed or instances were lines were cut, however, reasons for the damage were not given.[41]

41 DPI, *Shark Meshing (Bather Protection) Program 2015–16 Annual Performance Report*, January 2017, www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/693028/2015-16-SMP-Annual-Performance-Report.pdf (accessed 2 February 2017), pp. 4–5.

Drum lines

3.46 Drum lines use baited hooks to capture actively feeding sharks. The hook is suspended from a plastic float that is anchored to the seabed.[42] Figure 3.3 provides an illustration of how a drum line is set.

Figure 3.3: Use of drum lines under the Queensland Shark Control Program



Source: Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 10.

42 Queensland Department of Agriculture and Fisheries, 'Shark control equipment and locations' www.daf.qld.gov.au/fisheries/services/shark-control-program/shark-control-equipment-and-locations (accessed 6 December 2016).

3.47 Under the Western Australian drum line program, which did not proceed beyond the trial period, the following actions would be taken in response to animals captured by the drum line:

> White, tiger or bull sharks 300 cm Total Length…or greater captured on these drum lines will be destroyed by the contractor using a firearm. Any other captured animals that are not considered to be in a condition to survive will also be destroyed. Deceased sharks (whether destroyed or killed by their capture) will be fitted with uniquely-identified disposal tags and removed to a specified distance offshore and discarded or, where practical, retained for scientific study.
>
> Captured animals that are considered to have a chance of survival will be released as swiftly and carefully as possible after measurement and other basic data are recorded.[43]

3.48 Drum lines that are not intended to kill sharks, but to alert a response team, are in use in New South Wales. These are known as Shark Management Alert in Real Time (SMART) drum lines and are discussed as a new and emerging measure in Chapter 6.

Specific state government shark control programs

3.49 The following paragraphs outline state government programs in place that involve lethal measures for reducing the risk of shark encounters.

New South Wales

3.50 A shark meshing program was introduced in New South Wales in 1937. At present, 51 ocean beaches from Wollongong to Newcastle are netted between 1 September and 30 April each year using sunk nets fitted with acoustic warning devices to alert dolphins and whales.[44] As noted above, the New South Wales Government also uses SMART drum lines, which are discussed in the section on new and emerging technologies in Chapter 6.

3.51 In addition to the long-established measures in place in some parts of New South Wales, in recent years the state government has responded to a spike in shark incidents, including fatalities, with an overarching shark management strategy and trials of both new technologies and lethal measures in other areas.

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43 Western Australian Department of Fisheries, 'Ecological Risk Assessment for the Proposed Western Australian Shark Hazard Mitigation Drum Line Program (2014–2017)', p. 7, in Western Australian Department of the Premier and Cabinet, *Western Australian Shark Hazard Mitigation Drum Line Program 2014–17 Public Environmental Review*, June 2014, Appendix, www.dpc.wa.gov.au/Consultation/Pages/PublicEnvironmentalReview.aspx (accessed 6 December 2016).

44 DPI, 'Shark Meshing (Bather Protection) Program', www.dpi.nsw.gov.au/fishing/sharks/management/shark-meshing-bather-protection-program (accessed 5 December 2016).

3.52 The relevant New South Wales minister has described the spike in shark encounters as follows:

> …since 1 January 2014 there have been 41 interactions with sharks in NSW waters. Of these, 27 were unprovoked , with three resulting in fatalities (one surfer, two ocean swimmers), the most of which occurred in February 2015 in Ballina on the NSW North Coast. Of the remaining 24 interactions, six resulted in serious injuries, 11 in minor injuries and seven with no injuries…Of those 27 unprovoked shark interactions, 14 occurred on the Far North Coast, five in the Mid North Coast, two in the Hunter, one each in the Central Coast, Sydney, and Illawarra and three on the South Coast.[45]

3.53 In October 2015, the New South Wales Government released the *NSW Shark Management Strategy*. The Strategy has three elements: surveillance, detection and deterrence; science and research; and education and community awareness.[46] In total, $16 million was allocated to trials of new technologies, aerial and coastal surveillance, additional research including an expansion of a shark tagging program, and programs intended to improve community education about sharks.[47]

3.54 In response to the spike in shark encounters on the New South Wales north coast, in October 2016 the New South Wales Government announced that it would seek to trial shark meshing on the north coast. On 10 November 2016, the New South Wales Government applied to exempt the north coast shark meshing trial from the requirement to undergo assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).[48] The Minister for the Environment and Energy, the Hon Josh Frydenberg MP, provided an exemption under section 158 of the EPBC Act on 16 November 2016 for a 12-month trial (with mesh nets allowed to operate for up to six months during this period).[49]

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45 The Hon Niall Blair MLC, Correspondence to the Minister for the Environment and Energy, dated 10 November 2016, pp. 1–2; provided as DoEE, *Submission 55*, Attachment 6, pp. 3–4.

46 DPI, 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016).

47 The Hon Niall Blair MLC, 'NSW unveils $16 million world-first shark strategy', *Media release*, 25 October 2015.

48 The New South Wales Government advised that it intended to seek an exemption in a letter to the DoEE dated 1 October 2016. This correspondence was tabled in October 2016 during supplementary budget estimates.

49 Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, 16 November 2016, http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=80454991-88b6-e611-a2f2-005056ba00a8 (accessed 5 December 2016).

3.55 In September 2017, the New South Wales Government announced that it intended to conduct a second shark net trial for the north coast as further data was required 'in order to make a long-term decision on the future of the nets'.[50] On 26 October 2017, the Minister for the Environment and Energy granted a further exemption under section 158 of the EPBC Act for the New South Wales Government to conduct shark net trials over two years from 1 November 2017.[51]

3.56 The use of section 158 exemption for lethal shark control programs is examined in detail in Chapter 5.

Queensland

3.57 Queensland has maintained a shark control program since 1962. The current program uses nets and baited drum lines to protect 85 beaches in the state. The purpose of the program is 'to reduce the possibility of shark attacks on humans in coastal waters of the state adjacent to popular coastal beaches used for bathing'. The Queensland Department of Agriculture and Fisheries submitted that the combination of apparatus used accounts for drum lines being effective at catching tiger sharks, while nets are more effective for catching bull sharks.[52]

3.58 The number of sharks caught under the shark control program between 2010 and 2016 is at Table 3.1. Most sharks are killed; for example, of the 531 sharks caught in 2016, government statistics indicate that only 24 were released alive.[53] Further information about catch rates and bycatch is provided in the next chapter.

Table 3.1: Queensland shark control program catch statistics, 2010 to 2016

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
Number caught	602	700	753	686	586	695	531

Source: Queensland Department of Agriculture and Fisheries, 'Queensland shark control program catch statistics 2001–December 2016' https://data.qld.gov.au/dataset/shark-control-program-shark-catch-statistics/resource/5c6be990-3938-4125-8cca-dac0cd734263 (accessed 30 January 2017).

50 The Hon Niall Blair MLC, 'Second shark net trial for the north coast', *Media release*, 1 September 2017.

51 Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, 26 October 2017, http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=a99fcc21-38c0-e711-b175-005056ba00a8 (accessed 9 November 2017).

52 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 1.

53 Queensland Department of Agriculture and Fisheries, 'Queensland shark control program catch statistics 2001–December 2016', https://data.qld.gov.au/dataset/shark-control-program-shark-catch-statistics/resource/5c6be990-3938-4125-8cca-dac0cd734263 (accessed 30 January 2017).

Western Australia

3.59 The Western Australian Government has had a shark hazard mitigation strategy in place since 2008. The strategy commenced with aerial and beach patrols, with funding subsequently provided for 'research, shark tagging and tracking, an imminent threat policy to fish for a shark, a beach enclosure trial, and development of a Beachsafe app'.[54]

3.60 In December 2013, the Western Australian Government announced that baited drum lines would be set at eight locations in the state. The drum lines were designed to catch large sharks. Sharks deemed to be a threat to water users would be destroyed.[55]

3.61 The Western Australian Government applied to the then Minister for the Environment, the Hon Greg Hunt MP, for an exemption under section 158 of the EPBC Act for up to 72 baited drum lines. An exemption was granted on 10 January 2014 until 30 April 2014.[56]

3.62 The Western Australian Government subsequently proposed that the drum line program would continue for three additional summer seasons, which resulted in the Western Australian Environmental Protection Authority (EPA) initiating a public environmental review process to meet EPBC Act and state requirements for environmental assessment and approval of the program.[57] After considering the environment impacts of the proposal, the EPA announced on 11 September 2014 that it had recommended the proposal should not be implemented.[58]

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54 Government of Western Australia, 'Western Australian Shark Hazard Mitigation', July 2016, www.dpc.wa.gov.au/Publications/Pages/WesternAustraliaSharkHazardMitigation.aspx (accessed 5 December 2016).

55 The Hon Colin Barnett MLA and the Hon Troy Buswell MLA, 'New measures to combat WA shark risks', *Joint media release*, 10 December 2013; The Hon Colin Barnett MLA and the Hon Ken Baston MLC, 'Improving shark safety at popular WA beaches', *Joint media release*, 27 December 2013.

56 See DoEE, 'EPBC Act public notices: The setting of up to seventy two (72) baited drum lines each with a single approximately size 25/0 hook, in Western Australian state waters, and management of those lines', http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=47089832-6c62-e511-b4b8-005056ba00ab (accessed 5 December 2016).

57 Western Australian Department of the Premier and Cabinet, *Review: Western Australia Shark Hazard Mitigation Drum Line Program 2013–14*, June 2014, p. 7.

58 Western Australian Environmental Protection Authority, 'EPA recommends Shark Hazard Mitigation Drum Line proposal should not be implemented', *Media release*, 11 September 2014, www.epa.wa.gov.au/News/mediaStmnts/Pages/EPArecommendsSharkHazardMitigationDrumLineproposalshouldnotbeimplemented.aspx (accessed 5 December 2016).

3.63 The Western Australian Government withdrew the proposal from the EPBC Act assessment process in October 2014.[59]

3.64 Since the EPA's decision, the Western Australian Government has further developed its shark hazard mitigation strategy by adding beach enclosures, extending aerial patrols, updating guidelines for taking sharks posing a serious threat to public safety, and installing watchtowers at Cottesloe Beach.[60] In addition, the government may order that capture gear be set to take a shark posing a serious threat to public safety.[61]

3.65 Following a change in government, in May 2017 the Western Australian Minister for Fisheries announced a new shark mitigation strategy comprising:

- a trial rebate of $200 for independently verified devices purchased by surfers and divers;
- grants for local councils to install Beach Emergency Numbering signs to improve emergency response times; and
- funding for Surf Life Saving WA to use drones to monitor beaches, two additional receivers to detect tagged sharks and funding for an additional beach enclosure (these technologies and measures are discussed in Chapter 6).[62]

Catch rates and bycatch from nets and drum lines

3.66 As mesh nets are a passive fishing activity that is not selective, a wide range of non-target species is caught (these may include rays, dugongs, turtles, fish, cetaceans and grey nurse sharks). Although drum lines catch lower numbers of non-target marine species, advice to the Minister for the Environment from 2005 indicates that large numbers of marine turtles are caught on drum lines.[63]

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59 Government of Western Australia, 'Western Australian Shark Hazard Mitigation', July 2016, www.dpc.wa.gov.au/Publications/Pages/WesternAustraliaSharkHazardMitigation.aspx (accessed 5 December 2016).

60 Government of Western Australia, 'Western Australian Shark Hazard Mitigation', July 2016.

61 See Government of Western Australia, *Guidelines for taking sharks posing a serious threat to public safety*, www.fish.wa.gov.au/Documents/shark_hazard/guidelines_for_taking_sharks_posing_a_serious_threat_to_public_safety.pdf (accessed 7 December 2016).

62 The Hon Dave Kelly MLA, Western Australian Minister for Fisheries, 'A smarter approach to shark mitigation in WA waters', *Media release*, 13 May 2017.

63 DoEE, 'Death or injury to marine species following capture in beach meshing (nets) and drum lines used in Shark Control Programs: Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Key Threatening Processes under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)', 21 March 2015, www.environment.gov.au/biodiversity/threatened/nominations/ineligible-ktp/death-or-injury-to-marine-species (accessed 21 December 2016).

3.67 The Humane Society International totalled the catch and bycatch rates over several decades as follows:

> Between 1975 and 2001, 11,899 sharks, including white sharks, tiger sharks and bull sharks, were killed in nets and drum lines, and over this same period 53,000 other marine animals were killed. Nets and drum lines are also a major contributor to the severe decline of species such as the protected dugong and the grey nurse shark. This is a critically endangered species which is still being captured and killed in numbers too great to sustain the population.[64]

3.68 During the Western Australian drum line trial, 172 sharks were caught. Of these, 163 were tiger sharks, of which 64 were killed (either found dead upon gear retrieval or destroyed). No white sharks were caught. Recorded bycatch during the Western Australian trial comprised nine sharks of non-target species, seven rays and one north-west blowfish.[65]

3.69 During the 2015–16 meshing season in New South Wales, the shark meshing program resulted in 748 marine life interactions (133 interactions with target sharks and 615 interactions with non-target marine life). Of these animals, 51 per cent were released alive.[66] The 2015–16 statistics represent a significant increase on 2014–15, when 189 marine life interactions were reported, including 145 interactions with non-target marine life.[67]

3.70 Over the course of the New South Wales north coast trial of nets conducted between 8 December 2016 to 30 May 2017, 275 animals were caught. Of these, three white sharks, three tiger sharks and three bull sharks were caught. That is, target sharks were three per cent of the total catch. The overall survival rate of all animals caught was 47 per cent.[68]

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64 Ms Jessica Morris, Marine Scientist, Humane Society International, *Committee Hansard*, 17 March 2017, p. 33.

65 Western Australian Department of the Premier and Cabinet, *Western Australian Shark Hazard Mitigation Drum Line Program 2014–17 Public Environmental Review*, June 2014, pp. v, 34–35.

66 DPI, *Shark Meshing (Bather Protection) Program 2015–16 Annual Performance Report*, January 2017, www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/693028/2015-16-SMP-Annual-Performance-Report.pdf (accessed 2 February 2017), p. iii.

67 DPI, *Shark Meshing (Bather Protection) Program 2014–15 Annual Performance Report*, July 2015, p. iii.

68 DPI, *NSW north coast shark-meshing trial final report*, August 2017, p. 30.

3.71 As noted above, under the Queensland program 531 sharks were caught in 2016, of which 24 are recorded as being released alive. Bycatch of 55 non-target species were recorded (ether deceased or released alive).[69] Information published about the Queensland shark control program states that bycatch levels 'are carefully monitored and research is focused on minimising impacts on non-target species'.[70]

3.72 To mitigate bycatch quantities, the Queensland program also seeks to use drum lines instead of nets 'when possible'.[71] The Queensland department advised that in July 2013, the nets used at Cairns were replaced by drum lines to reduce the bycatch of non-target marine animals. The department advised that since this change was made 'there have been zero non-target animals caught in Cairns equipment'. It is also intended that other nets in the Great Barrier Reef Marine Park will be permanently replaced with drum lines, resulting in 'the Great Barrier Reef Marine Park being free from shark nets'. Nets used in Queensland are also surface-set to reduce the amount of bycatch.[72]

3.73 In addition, the committee was advised that advances in acoustic alarm technology has resulted in reductions in bycatch of certain marine mammals. In May 2014, all nets used in the program 'were fitted with a new type of acoustic alarm, which has assisted in a gradual reduction in the number of dolphins caught in the following years'.[73]

3.74 The review of the first New South Wales north coast net trial recommended that research 'should be undertaken to design a net that reduces bycatch'.[74] In response, as part of the second trial, the New South Wales Government will test:

- larger mesh sizes and stronger twine to reduce catch of smaller non-target animals;
- changes to the depth of nets in the water column with the aim of increasing survival of air-breathing fauna (turtle and dolphins); and
- moving nets away from certain areas where the concentration on non-target animals is known to be high.[75]

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69 Queensland Department of Agriculture and Fisheries, 'Shark catch numbers', www.daf.qld.gov.au/fisheries/services/shark-control-program/catch-numbers (accessed 2 February 2017).

70 Queensland Department of Agriculture and Fisheries, 'Shark control program', www.daf.qld.gov.au/fisheries/services/shark-control-program (accessed 2 February 2017).

71 Queensland Department of Agriculture and Fisheries, 'Shark control program'.

72 The Queensland department explained that this followed analysis undertaken in 2013 indicating that there were no significant differences in the shark catch between the two types of nets, however, bottom set nets resulted in more bycatch than top set nets. Queensland Department of Agriculture and Fisheries, *Submission 32*, pp. 2, 7.

73 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 5.

74 DPI, *NSW north coast shark-meshing trial final report*, August 2017, p. 43.

3.75 As the above paragraphs indicate, the government managing a shark control program publishes data on catch and bycatch associated with the program. The committee received some evidence expressing concern about the reliability of the data. Dr Jan-Olaf Meynecke, who is a marine scientist studying dolphins and humpback whales, told the committee that the process for obtaining necessary information based on data released by the Queensland Government is 'unfortunately, quite complicated'. Dr Meynecke also highlighted issues with how the data is recorded and categorised. Dr Meynecke explained:

> There are separate datasets. The way EPA sources some of the incidents is obviously through fisheries but there is also overlap data within the EPA dataset that has to be continuously cleared. I am also aware of incidents that are not being reported, in particular the ones that are near misses, so animals that free themselves. We had at least another three of them in the last two to three weeks on the Gold Coast, so animals do get entangled. There might be even a call-out for rescue but then the animals free themselves. I consider them actually as an incident because we do not know if the animals are injured or stressed and what the long-term impact is. If we are looking at numbers from last year, we can probably talk about 14 entanglements whereas six are properly recorded as entanglements because they had to be freed.[76]

3.76 Stakeholder views on the lethal measures, including the catch rates and amounts of bycatch, are discussed in the following chapter.

75 Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the EPBC Act*, 26 October 2017, p. 15 [paragraph 75]

76 Dr Jan-Olaf Meynecke, *Committee Hansard*, 31 July 2017, p. 10.

Chapter 4

Evidence received about the need for, and effectiveness of, lethal shark control programs

4.1 The preceding chapters largely provide background information about the shark management techniques used in Australia. This chapter begins the report's examination of the evidence received by delving into the issue that is at the heart of the inquiry: whether the lethal shark control programs used in New South Wales and Queensland, and previously proposed for Western Australia, are effective and appropriate public safety measures. The evidence outlined in this chapter provides a foundation for the chapters that follow, including Chapter 5, which consider the exemptions granted to state governments to conduct trials of lethal shark control measures; Chapters 6 and 7, which examines the alternative shark mitigation and deterrence approaches and technologies available; and Chapter 8, which contains the committee's overall conclusions.

4.2 The need for, and effectiveness of, lethal shark control measures attracted significant and passionate debate. Accordingly, this matter is discussed in this chapter at length. The chapter begins by examining views on the extent to which state governments should have a role in protecting members of the public who decide to enter waters where shark populations exist. The chapter then examines the arguments received in favour of the lethal shark control programs, followed by the evidence questioning, or presenting arguments against, lethal shark control programs.

Role of government

4.3 Before examining the evidence received about the effectiveness of lethal shark control measures, it is instructive to consider the evidence put forward regarding whether governments have a legitimate role in providing such measures in the first place.

4.4 It is evident that governments within Australia and globally have taken different approaches in response to shark bites. For example, as this report has identified, lethal shark control programs have been used in New South Wales and Queensland for decades. Lethal measures are also used in South Africa and New Zealand.[1] However, the committee was advised that governments in the United States do not respond to shark bite incidents. Professor Colin Simpfendorfer remarked that the government policy there is 'essentially not do anything in terms of going out and

1 See Department of the Environment and Energy (DoEE), Answers to questions on notice, Senate Environment and Communications Legislation Committee, Budget Estimates 2017–18, No. 75.

trying to catch or reduce populations' as the potential of encountering a dangerous shark is seen as 'an assumed risk'.[2]

4.5 It is evident that significant amounts of public money have been spent on shark control measures and research. A non-exhaustive list of government expenditure on shark matters in recent years is at Table 4.1. The table also notes some private sector and community expenditure that was highlighted during the inquiry.

Table 4.1: List of programs and expenditure relating to sharks, various years

Program/activity	Funding provided/projected
Commonwealth	
National Environmental Science Program funding in relation to shark-specific research	$2.79 million(1)
Expenditure associated with the development of the Shark Recovery Plan	Not available
New South Wales	
Shark Management Strategy	$16 million over five years (including $7.7 million for surveillance, detection and deterrence measures; $7 million for research; and $1.3 million for education and community awareness) (2)
Meshing program	$1.4 million/year (estimate)(3)
Queensland	
Cost of shark control program	$3.3 million/year(4)
Research into behaviour of large sharks (2009)	$125,000 over five years(4)
South Australia	
South Australian Aerial Patrol	$400,000 (2015–16) (3)
South Australia Surf Life Saving Association expenditure on aerial surveillance	Not available(3)
Western Australia	
Beach and aerial surveillance	$12.24 million over 2012–2017(5)
Extended beach patrols in the south west to cover school holiday periods	$2.62 million (2014–15 to 2018–19) (5)

2 Professor Colin Simpfendorfer, *Committee Hansard*, 30 August 2017, p. 8.

Funding to Surf Life Saving WA for jet skis (2012) and a trial of drone surveillance technology (2016)	$1.28 million[5]
Various beach enclosures	$1.2 million by state government,[5] $510,000 by City of Joondalup (plus $40,000/year to maintain) [6]
Drum line trial	$1.28 million (2014)[5]
Serious threat policy	$2.8 million (2012–2020)[5]
Trial of Clever Buoy technology at City Beach (2016–2017)	$500,000[5]
Funding for the Shark Response Unit, SmarkSmart website and BeachSafe app	$4.43 million (2011–2020)[5]
Shark Monitoring Network and shark tagging and tracking	$3.7 million (2013–2020)[5]
Other science and research projects	$3.6 million[5]
Watchtowers at Cottesloe Beach	$175,000[5]
Private and community sectors	
Clever Buoy research and development	$2–3 million[7]
Shark Shield	$10 million over 15 years[8]
Australian Aerial Patrol	$500,000/year[3]

Notes: Date ranges for multi-year funding and future funding commitments is indicated where available. Figures given by third parties are indicative only.

Sources: (1) DoEE, *Submission 55*, pp. 8–9; (2) New South Wales Department of Primary Industries (DPI), "NSW Shark Management Strategy', www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/581694/nsw-shark-management-strategy-factsheet.pdf (accessed 7 November 2017); (3) Australian Aerial Patrol, *Submission 6*, pp. 9, 19; (4) Queensland Department of Agriculture and Fisheries, *Submission 32*, pp. 1, 4; (5) DoEE, *Submission 55*, Attachment 3; (6) Mr Tony Pickard, Mayor, City of Joondalup, *Committee Hansard*, 20 April 2017, pp. 31, 33; (7) Mr Richard Talmage, General Manager, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, p. 44; (8) Mr Lindsay Lyon, Managing Director, Shark Shield, *Committee Hansard*, 20 April 2017, p. 4.

4.6 This section builds on evidence previously noted in this report about the relatively low risk of a person encountering a dangerous shark compared to the risks associated with many other activities that can result in fatalities or injuries. Evidence received about the effects of lethal shark control measures on the marine environment and the cost of the measures is also relevant.

Arguments in favour of government intervention

4.7 State governments themselves have made some of the clearest arguments in support of government action to help reduce the risk of people encountering dangerous sharks while engaging in water-based activities.

4.8 In correspondence provided in December 2016, the then Premier of Western Australia, the Hon Colin Barnett, advised the committee that his government was 'committed to addressing its duty of care to minimise the risk of shark attack'.[3] Similarly, the relevant New South Wales minister has stated that, '[a]lthough no government can guarantee complete safety', the New South Wales Government is 'committed to doing everything it can to ensure the safety of beachgoers, swimmers and surfers'.[4] The Queensland Government considers that the lethal shark control measures it operates are an 'important safety initiative'.[5]

4.9 The extent to which these declarations of government responsibility to minimise the risk presented by sharks rest with the states alone is less clear. The Department of the Environment and Energy submitted:

> It is the responsibility of state and territory governments to focus on public safety and manage the risks to people from sharks in their waters. States and territories are primarily responsible for determining which measures best provide for public safety in their jurisdictions.[6]

4.10 Yet in his correspondence to the Commonwealth Minister for the Environment and Energy, the New South Wales Minister for Primary Industries argued that shark encounters have national implications that necessitate the Commonwealth's attention. The Minister for Primary Industries commented:

> Public safety is a responsibility of all governments. Unprovoked shark interactions are not specific to NSW and are considered a national issue where State and Commonwealth Governments need to work cooperatively to ensure the protection of swimmers and surfers.[7]

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3 Correspondence from the Hon Colin Barnett MLA, Premier of Western Australia, dated 14 December 2016 (published as *Additional Information 1*), p. 2.

4 The Hon Niall Blair MLC, Minister for Primary Industries, and Minister for Lands and Water, *Hansard*, Parliament of New South Wales, Legislative Council, 9 November 2016, pp. 53, 55.

5 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 1.

6 DoEE, *Submission 55*, p. 3.

7 The Hon Niall Blair MLC, News South Wales Minister for Primary Industries; Minister for Lands and Water, correspondence to the Minister for the Environment and Energy, dated 10 November 2016; provided in DoEE, *Submission 55*, Attachment 6, p. 4.

4.11 Individuals and community organisations also commented on the need for government to play a role in public safety regarding sharks.

4.12 Mr Daniel Webber argued that the community, and therefore the government, has a duty to protect children through measures that directly reduce the risk of encountering a shark. Mr Webber argued that, at present, personal deterrents are not suitable for young surfers due to the electric shocks incurred (this is discussed in Chapter 6). Likewise, he argued that education measures have limited benefits due to the risks that teenagers are willing to take. Mr Webber explained:

> Surfing really is an addiction, and any young surfer who finds good waves going unridden will paddle out no matter what the conditions. Besides, teenagers thrive on risk, especially if someone is advising them against an activity. I should also add that younger surfers surf more often and longer than most adults, and smaller boards are more likely to be attacked. So they are a high-risk group.[8]

4.13 In its submission, the Ballina Lighthouse & Lismore Surf Lifesaving Club argued that the government has a role in supporting research that facilitates new technologies for shark deterrence. The Club noted that an additional benefit of government support for the development of these technologies could be the creation of an export industry.[9]

4.14 Mr Andrew Stark, Chief Executive Officer, Surfing Australia, commented that, in his view, the role of government in minimising the risk of a person in the water encountering a dangerous shark should involve a combination of approaches. Mr Stark explained:

> There is not any one particular answer: investment in technology and science, investment in education around the dangers of it, investment in current programs whilst you are working on new programs, investment in surveillance and investment in community consultation. A lot of things are already happening. There is probably more that can happen. It is not a one-key-fits approach. There are certainly a number of different strategies from different stakeholder groups to make sure that this is addressed holistically.[10]

8 Mr Daniel Webber, *Committee Hansard*, 17 March 2017, p. 29. Mr Webber referred to private correspondence with the curator of the Australian Shark Attack File and an academic research paper to support his evidence regarding sharks being more interested in smaller objects.

9 Ballina Lighthouse & Lismore SLSC, *Submission 52*, p. 3.

10 Mr Andrew Stark, Chief Executive Officer, Surfing Australia, *Committee Hansard*, 2 May 2017, p. 34.

Arguments against lethal measures based on the inability of governments to guarantee public safety

4.15 It was widely accepted that governments have a role in promoting the safety of beachgoers. However, some submitters and witnesses argued that it is not possible for governments to ensure a completely safe ocean environment. As governments cannot guarantee public safety, these submitters and witnesses reasoned that governments should not implement or maintain measures that damage the marine environment.

4.16 For example Ms Claudette Rechtorik, Manager, SEA LIFE Trust Australia/New Zealand, argued:

> The government has a role to play in the safety of the beach-going public. However, it is not the role of the government, nor is it even possible, to give the ocean-going community a 100 per cent safe ocean environment. The deployment of shark nets and drum lines is creating not only a false sense of security but one that carries a significant toll for tens of thousands of threatened and endangered marine life. Through multiple surveys in multiple locations, the consistent response from the majority of respondents is that they do not support mechanisms that kill our marine life.[11]

4.17 Ms Jessica Morris, Marine Scientist, Humane Society International (HSI), stated:

> Given the fact that the government can never guarantee public safety in the ocean, we wish to again emphasise that by-catch of protected, harmless and threatened wildlife in Australia's shark control programs is unsustainable and, therefore, should be unacceptable to policymakers.[12]

4.18 Similarly, Australia for Dolphins argued that governments 'cannot ever guarantee public safety in the ocean' and should 'adopt a risk management approach' with an emphasis on non-lethal shark management strategies.[13]

4.19 The Australian Marine Conservation Society (AMCS) acknowledged that human–shark encounters have 'the potential for very significant consequences for individuals, families and friends'. The AMCS also recognised that governments 'can and should implement beach safety mechanisms in relation to shark interactions'. However, the AMCS emphasised that shark interactions 'are still highly rare events' and 'it is not possible to mitigate the risk entirely'. Furthermore, the AMCS argued that there 'is no one perfect solution to keeping sharks and humans completely separated in

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11 Ms Claudette Rechtorik, Manager, SEA LIFE Trust Australia/New Zealand, *Committee Hansard*, 17 March 2017, p. 7.

12 Ms Jessica Morris, Marine Scientist, Humane Society International (HSI), *Committee Hansard*, 17 March 2017, p. 33.

13 Australia for Dolphins, *Submission 4*, p. 5. See also Greenpeace Australia Pacific, *Submission 50*, p. 4.

the marine environment, and there should be no expectation of such'. According to the AMCS, lethal shark control programs 'are doing more damage to the marine environment than providing benefit to ocean users' and is an approach that is 'both archaic and inappropriate'.[14]

Arguments emphasising the need for personal responsibility and a limited role for government

4.20 Several stakeholders who oppose lethal shark control measures asserted that individuals who choose to enter waters where sharks may be present are doing so at their own risk. As a result, these stakeholders reason that there should be a greater expectation that these individuals take personal responsibility for this risk. Accordingly, government actions to alleviate the risk presented by shark bites should be limited.

4.21 For example, Associate Professor Daryl McPhee noted that:

> From the perspective of governments there is a question as to how much a government should intervene, and to what cost, and to what extent, to provide mitigation for people to undertaken a leisure activity of their choosing, when and where they choose. Millions of dollars of taxpayers money is spent annually in response to unprovoked shark bite and its mitigation.[15]

4.22 Associate Professor McPhee asserted that 'individuals need to take greater responsibility for their own safety as the priority, and not rely principally on government'. In support of this view, the associate professor contrasted the programs in place to protect water users from sharks compared to the lack of specific and extensive public safety measures introduced for other leisure activities:

> Using an analogy from the terrestrial environment, a mountain bike rider or a rock climber does not expect a government to make an area 100% safe for those activities. They may expect a government to provide up to date information which facilitates them making a more informed decision, but not active programs to eliminate hazards.[16]

4.23 Associate Professor McPhee added that, in his view, there is a role for government in developing educational material and supporting research needed for 'developing the tools' to respond more effectively to the risk of shark incidents. However, the associate professor emphasised that governments do not need to fund such research in its entirety, particularly as there 'is a lot of commercial interest in this area'. Finally, Associate Professor McPhee suggested that the government could assist in improving the support provided following a shark incident. He explained:

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14 Australian Marine Conservation Society, *Submission 38*, p. 3.

15 Associate Professor Daryl McPhee, *Submission 58*, p. 2 (emphasis omitted).

16 Associate Professor Daryl McPhee, *Submission 58*, p. 3.

> I think there is a significant gap in support for victims, their families and first responders. It is a very acute post-traumatic stress disorder. Certainly the New South Wales government in the last round provided some funding for that area. I think that is an area Commonwealth health services could also look at. I do not know what that would look like, but to me this seems to be a very clear gap where a lot of support could be undertaken.[17]

4.24 Dr Sharon Burden highlighted the need for personal responsibility in relation to undertaking ocean-based recreational activities, with government-backed efforts to promote public safety playing a supplementary role. Dr Burden stated:

> To me, as individuals we play a key role in saying: 'What will I do when I choose a sport that is in the ocean? What personal protective equipment am I prepared to use and purchase? Given all that, the apps available, the information at the beach and the local knowledge I have when I step into the water, have I done everything I possibly can to keep myself safe?'
>
> If then, later, on top of that, you have governments working collaboratively together with surf lifesaving and local organisations to make that beach safer—whether it is through drones, shark spotting towers or whatever it might be—we have layered up the protection from both sides, and that is the best that we can do.[18]

4.25 Sea Shepherd Australia argued that state governments are not responsible for the conduct of marine animals. In comments similar to those expressed by Associate Professor McPhee (see paragraph 4.22), Sea Shepherd contrasted the risk of shark bite with that associated with other leisure activities that can have a higher rate of fatalities but do not trigger the same expectation for government intervention. Sea Shepherd submitted:

> While Sea Shepherd agrees that unprovoked, fatal shark attacks are tragic, traumatic events, the State Government is no more responsible for the actions of surfers and swimmers than it is in protecting hikers and bee-keepers from fatal attacks by bees. Providing an expectation for State Governments to be responsible for the actions of swimmers and surfers is placing massive obligations and excessive burdens on Government authorities.[19]

17 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 39.

18 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, pp. 19.

19 Sea Shepherd Australia, *Submission 57*, pp. 14–15.

4.26 Although Sea Shepherd argued that state governments are not responsible for the actions of surfers and swimmers, it emphasised that governments are subject to legal obligations regarding the protection of the environment, including protected species.[20] Sea Shepherd argued that:

> …the duties on the State imposed by these legal instruments trump any perceived responsibility that the New South Wales, Queensland and Western Australia Governments cite as justification for their shark control programs.[21]

4.27 Evidence given by the Australian Aerial Patrol also indicates that some surfers ignore or are dismissive of the efforts put in place to enhance their safety. As noted in Chapter 2, Mr Duncan Leadbitter explained that when a patrol detects a shark, it conducts orbits until 'the shark is spooked and has swum away…or we are confident that people are out of the water'. Mr Leadbitter informed the committee that:

> Most of the time people will get out of the water. Surfers commonly do not. They will just give us the bird and keep surfing. On my local beach surfers see sharks on a relatively regular basis and most people just ignore them. You give people the chance to get out of the water and…we have on one occasion called the police to try to get people out of the water.[22]

Arguments for maintaining lethal programs

4.28 The principal argument put forward in support of the shark nets and drum lines is the low rate of shark bites that have occurred in the areas featuring lethal measures since those measures were introduced. For example, the Queensland Department of Agriculture and Fisheries submitted that since 1962, when the Queensland shark control program was introduced following multiple fatal shark bites, 'only one fatal shark attack has been recorded at a beach serviced by the program'. The department added that this 'is despite the large increase in the number of people swimming at these beaches over the same period'.[23]

4.29 Similar observations have been made regarding the New South Wales shark meshing program: since the program was introduced, only one fatal shark bite incident has occurred at a meshed beach.[24]

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20 Sea Shepherd Australia, *Submission 57*, p. 15.

21 Sea Shepherd Australia, *Submission 57*, p. 18.

22 Mr Duncan Leadbitter, Director, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 19.

23 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 1. Surf Life Saving Queensland made a similar point: see *Submission 2*, p. 1.

24 DPI, 'Shark Meshing (Bather Protection) Program', www.dpi.nsw.gov.au/fishing/sharks/management/shark-meshing-bather-protection-program (accessed 5 December 2016).

4.30 The submission from the Queensland department responsible for managing the state's shark control program explained that the state government is committed to maintaining the program.[25] The department provided the following reasoning:

> Prior to 1962, regular shark attacks occurred on popular Queensland beaches and made them unsafe for recreation. Since the Government implemented the [shark control program], the number of shark attacks occurring on our beaches has decreased dramatically, with only 29.3 per cent of unprovoked and fatal attacks nation-wide occurring in Queensland.[26]

4.31 Some individuals and organisations agreed that the low rate of incidents at beaches that feature lethal shark control measures demonstrates the success of these programs.

4.32 In support of his conclusion that the lethal measures used in New South Wales have been successful, Mr John Heaton compared available statistics on shark incidents between the shark meshing program area (SMP) from Newcastle to Wollongong and the non-SMP area from Byron Bay and Yamba. He stated that between 1995 to 2015, 25 incidents occurred, comprising encounters that resulted in injuries and encounters that did not. Between September 2014 and October 2016, the Byron Bay–Yamba coastline has experienced 18 encounters, including two fatalities. Mr Heaton argued:

> This is the comparison between a SMP area and a non-SMP area – 25 in 20 years compared to 17 in 2 years. The odds are definitely in a person's favour if you use the ocean between Newcastle to Wollongong. The current SMP provides the many millions of public & tourists a certain level of reassurance. Therefore, it is a question of equality to afford other areas experiencing a high level of shark interaction, the same level of reassurance.[27]

4.33 Mr Heaton explained that he was initially opposed to the proposal to trial shark nets in the New South Wales north coast. However, he changed his mind 'after the continual attacks in 2016 and the "experts" not having a clue for the ongoing shark activity close to the shore'. Mr Heaton explained that he is willing to support any measure 'that will assist to prevent interactions between ocean users and sharks' and that, in his view, the measures should be used in any area that has a high rate of shark incidents.[28] Mr Heaton concluded: 'I make no apology for supporting measures that put human life above marine life'.[29]

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25 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 1.

26 Surf Life Saving Queensland, *Submission 2*, p. 1.

27 Mr John Heaton, *Submission 11*, p. 3. Mr Heaton noted that other measures used in the SMP areas would also assist to minimise the risk of incidents, including the greater resources available for surf lifesaving clubs due to the higher population in the SMP area.

28 Mr John Heaton, *Submission 11*, p. 1.

29 Mr John Heaton, *Submission 11*, p. 3.

4.34 At the committee's Byron Bay hearing, Mr Don Munro argued that, based on catch rates, drum lines in Queensland 'are an effective way of reducing the shark levels' and are 'definitely working'.[30] Similarly, Mr Alan Baldock stated that he is 'a strong believer in drum lines'. Mr Baldock stated:

> If you talk to…a lot of the professional fishermen in the Ballina, Yamba and Evans area, they will all tell you the same thing. The real drum lines[31] will thin them out on the coast so you do not have to be way out in the ocean and you do not have to go and kill hundreds of sharks. They will work just along the coastline. The system is they will hook the shark and kill it. The will let the shark drop to the bottom of the ocean. It will decay and send out a smell for miles and miles, and that is what deters the other sharks. That is how they work. That is why they work on the Gold Coast, and they have been since 1964. If you read the stats, you would know that.[32]

4.35 Mr Fred Pawle argued that the Queensland program has proven that 'nets and drum lines are an effective and cheap way of protecting people while causing minimal disruption to the marine environment'.[33] Mr Pawle stated:

> If a shark is caught in a net or on a drum line, sharks know to stay away. Even scientists acknowledge this. This happened off the Neptune Islands, when some orcas took out a great white. They did not see any more sharks for a month or two, if I am not mistaken. Similarly, off the Farallon Islands in Northern California a few years ago some orcas took out some great whites there, too, and the great whites disappeared. My theory—and, again, I am not a scientist—is that the sharks being caught in nets and drum lines off Queensland are deterring other sharks from coming close.[34]

4.36 Mr Pawle continued:

> I am not proposing the extinction of a species, I am simply questioning the wisdom of sacrificing one of the greatest aspects of life in Australia for the sake of several large, dangerous shark species being able to inhabit our beaches. The Queensland marine ecology has not collapsed as a result of

30 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 9.

31 Mr Baldock is referring to the traditional lethal drum lines, not the SMART drum lines discussed in Chapter 6.

32 Mr Alan Baldock, *Committee Hansard*, 2 May 2017, pp. 10–11. As noted in Chapter 1, however, Professor Shaun Collin advised the committee that 'not all sharks are the same with respect to how they react to environmental cues'; although tiger sharks base 'most of their behaviour on smell', white sharks and bull sharks rely on vision and electro reception respectively. Professor Shaun Collin, *Committee Hansard*, 20 April 2017, pp. 37, 38.

33 Mr Fred Pawle, *Submission 56*, p. 4.

34 Mr Fred Pawle, *Committee Hansard*, 31 July 2017, p. 35.

> more than 50 years of nets and drumlines. Why can't these relatively cheap, effective protective measures be implemented around the country?[35]

4.37 Stakeholders who support the current lethal programs were optimistic that the level of bycatch associated with some of the measures could be reduced. For example, Mr Munro told the committee:

> Certainly no-one I speak to wants to see bycatch. We do not want to see that sort of thing happening at all, but we have to be practical. We are the apex predator. Human life must prevail over all other types of animal or marine life. So we are hopeful—and I am sure it is going to happen—that we will see an initiative or a system put in place where both human and marine life will be protected.[36]

Arguments questioning the effectiveness of, or in opposition to, lethal programs

4.38 The committee received a large number of submissions from individuals and organisations that oppose the use of lethal shark control measures on the following grounds:

- it is considered that the lethal measures are not effective in reducing the risk of encountering a dangerous shark;
- the impact of the measures on the populations of protected shark species (including species that are not considered dangerous to humans);
- the impact of the measures on the populations of other marine species; and
- concerns for the welfare of target and non-target species.

4.39 The following submission extract is an example of the overall argument against lethal measures:

> The management of sharks is a vexed and emotive issue. However…the current lethal measures in place are neither protecting humans from sharks, nor are they protecting marine life. Instead, they create a false sense of security for beach-goers. At the same time they indiscriminately kill thousands of non-target animals.[37]

4.40 This observation from CSIRO is also instructive when considering the effectiveness of lethal shark control measures:

> Although there is little doubt that these devices reduce risk of shark encounter by removing sharks, the actual amount by which risk is reduced has not been assessed. It is clear from research on movement patterns and

35 Mr Fred Pawle, *Submission 56*, p. 5.

36 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 3.

37 Australia for Dolphins, *Submission 4*, p. 1.

> occupancy of beach areas by sharks that the number and frequency of attacks is often a poor indicator of the local abundance of sharks.[38]

4.41 Nevertheless, as Professor Colin Simpfendorfer observed, scrutinising the effectiveness of lethal control measures is challenging as 'we have nothing to compare [them] to'. Professor Simpfendorfer explained:

> There are lots of people who talk about the shark program being effective or not being effective and telling us they have proof one way or the other. The reality is that because we have nothing to compare it to, we don't know what it has done.[39]

4.42 The following paragraphs examine in detail arguments against lethal shark control measures, as well as other evidence received which raises questions about the effectiveness of such measures.

Perceived lack of effectiveness and inadequate information to evaluate effectiveness

4.43 Many submissions and witnesses either argued that lethal shark programs do not provide bathers with significant protection or questioned how reliable assessments about the effectiveness of the programs can be made based on the information that is currently available.

Limited coverage

4.44 An observation about lethal measures made by several stakeholders is that the measures do not prevent all sharks from approaching beaches. That is, mesh nets and drum lines may catch sharks, but these devices do not provide a physical barrier separating humans from sharks.

4.45 As noted in Chapter 3 (and illustrated at Figures 3.1 and 3.2), the nets range from 150 metres to 186 metres in width. The vertical coverage of the nets is also limited; bottom set nets result in a gap between the surface and the top of the net, whereas surface-set nets feature a gap underneath the net to the seafloor. Accordingly, some submitters argued that the relatively small coverage of mesh nets mean that nets cannot provide effective protection. For example, the Ballina Environment Society submitted:

> Shark nets could only be considered a placebo, due to the public perception of protection, as it is not possible for the four 150m nets deployed in Ballina Shire, within 500 metres of the shore to prevent shark attacks.[40]

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38 CSIRO, *Submission 33*, p. 4.

39 Professor Colin Simpfendorfer, *Committee Hansard*, 30 August 2017, p. 6.

40 Ballina Environment Society, *Submission 54*, p. 1.

4.46 The Sunshine Coast Environment Council wrote:

> On a beach kilometres long, a net only 186 metres in length does very little to stop a shark from reaching the beach. Sharks can simply swim around or underneath nets, which questions not only the economic viability of the measure, but the actual purpose of the program as a whole.[41]

4.47 Although the Sunshine Coast Environment Council questioned the ability of nets to provide a safe environment for bathers, it did argue that the nets are effective at 'creating a false sense of security'. The Council commented that this 'is likely due to a lack of education about how shark nets actually work'. In the Council's view, '[i]f the public were to become widely aware that nets are less than 200m in length and only 6m deep, this sense of security would likely fade'.[42]

4.48 In the submission authored by Ms Kathrina Southwell on behalf of Australian Seabird Rescue, Ms Southwell advised:

> Members of the public are often shocked when I have shown them the length of the shark net at Lighthouse Beach. Most people's response is "How is that supposed to protect us from a shark when they can swim over or around the net?"[43]

4.49 Ms Southwell added that many local residents and visitors 'still believe that the net covers the whole length of the beaches and that the sharks cannot get in to where people are swimming and surfing'.[44]

4.50 Available statistics support the argument that nets do not act as a barrier preventing all sharks from approaching beaches. A review of the New South Wales program conducted in 2009 noted that 23 shark encounters had occurred at meshed beaches since the program began.[45] Furthermore, submitters cited reports that 40 per cent of sharks trapped in nets are found on the beach side, meaning that the nets did not provide an area for beachgoers that is clear from sharks.[46]

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41 Sunshine Coast Environment Council, *Submission 35*, p. 5.

42 Sunshine Coast Environment Council, *Submission 35*, p. 6 (emphasis omitted).

43 Australian Seabird Rescue, *Submission 37*, p. 5.

44 Australian Seabird Rescue, *Submission 37*, p. 5.

45 New South Wales Department of Primary Industries, *Report into the NSW Shark Meshing (Bather Protection) Program: Incorporating a review of the existing program and environmental assessment*, March 2009, p. 27.

46 See Australia for Dolphins, *Submission 4*, p. 4 and Sunshine Coast Environment Council, *Submission 35*, p. 5. Professor Daniel Bucher explained that he understands that this figure is based on a South African study and that DPI has advised him there are no similar data for the New South Wales program. *Committee Hansard*, 2 May 2017, p. 46.

4.51 In addition to the evidence expressing scepticism about the effectiveness of mesh nets, evidence suggesting that drum lines also do not guarantee public safety was presented. Sea Shepherd Australia submitted that:

> Since the installation of shark control measures in Queensland, there have been 17 unwanted shark encounters at beaches with drum lines and/or shark nets including a fatality on 7 January 2006 when 21-year-old Sarah Kate Whiley was mauled by up to three bull sharks while swimming in waist-deep water with friends at Amity Point (North Stradbroke Island), despite the eight drum lines installed at the time.[47]

4.52 Associate Professor McPhee stated that:

> In an area where I spend a lot of time, and where I take students, there have been drum lines in place for 30 years and there was a fatal bite there with those drum lines in place. So you can get fatal shark bites right next to shark control equipment.[48]

4.53 The committee also received evidence of cases where dolphins have removed bait from the drum lines, rendering the drum lines ineffective for attracting sharks.[49]

4.54 Although CSIRO noted nets and drum lines do not provide a barrier stopping sharks from approaching beaches, it recognised that, as the devices remove sharks, 'there is little doubt that these devices reduce risk of shark attack'. However, CSIRO added that 'the actual amount by which risk is reduced has not been assessed'.[50] CSIRO's concerns in this area were explained using the following example:

> …if a single white shark was present off Bondi Beach on a particular day and it became entangled in the deployed net, then the risk of encountering a shark on that day, and hence attack risk, has been reduced to zero. If on another day there were 100 white sharks off Bondi Beach and a single shark was again entangled, the risk of encounter has not been significantly diminished despite the same catch rate. What is also unknown is whether any of these sharks were likely to be involved in a shark attack. It is clear from research on movement patterns and occupancy of beach areas that the number and frequency of attacks is a poor indicator of the local abundance of sharks and vice versa.[51]

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47 Sea Shepherd Australia, *Submission 57*, p. 8.

48 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 38.

49 Mr Tony Isaacson, DiveCareDare, *Committee Hansard*, 31 July 2017, p. 50.

50 CSIRO, *Submission 33*, p. 9. A similar point was made by Associate Professor Laurie Laurenson—see *Submission 9*, p. 1.

51 CSIRO, *Submission 33*, p. 9. See also Professor Nic Bax, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 6.

4.55 For many individuals involved in activities associated with a higher-risk of encountering a shark, such as divers, it is evident that lethal measures can be of limited relevance. This is because lethal measures are focused on beaches, whereas these activities take place further away from the coastline. The Western Australian Minister for Fisheries observed:

> It is blindingly obvious in Western Australia that the people who are most at risk are divers and surfers. Putting in place more drum lines, or anything of that nature, is not going to give protection to the people who are most at risk. If you are diving at a reef a kilometre off the coast, you are not going to be protected by a drum line placed at a beach.[52]

Number of dangerous sharks removed

4.56 Despite the logic that devices which reduce the number of sharks reduce the risk of humans encountering dangerous sharks, it was suggested that lethal shark programs could only ever have a limited impact. Mr Brendan Donohoe from Surfrider Foundation Australia argued:

> Taking out a couple of hundred sharks statistically makes no difference at all, and any surfer knows that. When you are out there, you are in their territory.[53]

4.57 The threat to humans posed by the sharks caught by lethal measures was also questioned. A group of academics from the University of Wollongong submitted that most individual animals of the target species caught in the New South Wales meshing program 'are too small to pose a risk to humans'. Furthermore, the species targeted by the program include 'some species that have not been implicated in dangerous encounters with people, such as the broadnose sevengill shark'.[54]

4.58 Other instances where lethal measures are considered not to have been successful include the following:

- The 2014 trial of drum lines in Western Australia was put forward as an example of where lethal measures were not effective at catching white sharks. Ms Jessica Morris, Marine Scientist, HSI, stated that the trial caught 'almost 200 sharks, and none of them were white sharks'.[55]
- Ms Natalie Banks from Sea Shepherd Australia and Professor Jessica Meeuwig referred to a cull in Hawaii of over 4,500 sharks over nearly two

52 The Hon David Kelly MLA, Western Australian Minister for Water, Minister for Fisheries and Minister for Forestry, *Committee Hansard*, 20 April 2017, p. 60.

53 Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 24.

54 Dr Leah Gibbs, Mr Lachlan Fetterplace, Associate Professor Quentin Hanich and Mr Matthew Rees, *Submission 21*, p. 2.

55 Ms Jessica Morris, HSI, *Committee Hansard*, 17 March 2017, p. 35.

> decades. After an evaluation demonstrated did not affect the number of fatalities, it was abandoned in favour of non-lethal measures.[56]

4.59 Under the first New South Wales north coast trial of shark nets, the nets caught nine target sharks, with target sharks representing three per cent of the total catch. These figures can be contrasted with results of the SMART drum lines used in the trial area. SMART drum lines, which are drum lines that are not designed to kill sharks, caught 36 target sharks. This represented 92 per cent of their total catch.[57]

4.60 Other submitters pursued the argument that mesh nets are based on outdated knowledge about shark behaviour and movement patterns. The Migaloo 2 Foundation explained:

> Shark nets were originally deployed around 80 years ago with the idea that short shark nets would deter sharks making that area their home base. Yet now with advanced tagging technology it has been discovered that most of the targeted sharks migrate large areas and wouldn't make that area home even if the nets weren't there.[58]

4.61 Associate Professor Laurie Laurenson, who has undertaken analysis indicating that lethal measures are not effective in reducing the number of shark interactions, submitted that:

> Part of the reason we think that culling is ineffective is because large sharks can travel very large distances in very short periods of time. So for a culling program to be effective, it needs to cull all sharks from a much wider range. That is, the current culling programs cannot protect single beaches without culling sharks from the entire area, with the area defined by how far and how quickly sharks can move (about 100 km per day).[59]

Evidence commenting on the location of lethal measures, incidents at protected beaches and developments since the measures were first introduced

4.62 Some stakeholders also questioned the argument that the low incidence of fatalities at beaches featuring lethal measures since the shark control programs were introduced demonstrate that lethal measures are successful.[60] This reasoning was challenged on several fronts.

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56 Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 11; Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 41.

57 Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, 26 October 2017, http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=a99fcc21-38c0-e711-b175-005056ba00a8 (accessed 9 November 2017), p. 6 [paragraph 26].

58 Migaloo 2 Foundation, *Submission 28*, p. 2.

59 Associate Professor Laurie Laurenson, *Submission 9*, p. 3.

60 For an example of this argument, see paragraph 4.29.

4.63 Regarding the New South Wales program, Dr Christopher Neff stated that the conclusion of one fatality since the nets were introduced in 1937 'fails to acknowledge that shark bite fatalities ended in 1929'. Dr Neff added that the absence of shark bites at beaches that do not feature shark nets should be taken into account, as should the absence of shark bites in the years during World War II when the nets were removed.[61]

4.64 The New South Wales program is chronicled and critiqued in the submission from Sea Shepherd Australia. Among other points made in the submission, Sea Shepherd responded to arguments commonly made in support of lethal measures which are based on the low number of fatalities in locations where the measures are used. Sea Shepherd asserted that these arguments do not explain the shark encounters that have occurred at beaches where lethal measures are in place.[62] Sea Shepherd submitted that:

- excluding fishing-related incidents, 40 shark incidents have occurred at netted beaches, including 24 incidents between September 1992 and the end of 2016—almost one per year;[63] and
- statistics indicate that 'the rate of unwanted shark encounters at the Central Coast's ocean beaches (the most recent location to receive shark nets) has increased since the shark nets have been installed, from 1 incident every 22 years, to 1 incident every 4.4 years'.[64]

4.65 Ms Natalie Banks from Sea Shepherd argued that the low number of fatalities which have occurred at netted beaches in New South Wales should be considered alongside evidence that dangerous shark encounters still take place at those beaches. Ms Banks explained that 46 shark encounters have taken place at netted beaches in New South Wales, with two cases in recent times that 'were very serious and it was only because of blood loss prevention that those people actually survived'. Ms Banks provided similar evidence with respect to the Queensland shark control program:

> In Queensland, where they have drum lines, in 2006 there was a fatality where there was not one or two but three bull sharks that went past eight drum lines at Amity Beach. You have also had 16 encounters in Queensland where there are shark control measures…I think people need to look at the whole story, rather than looking at just elements that suit their argument.[65]

61 Dr Christopher Neff, *Submission 48*, p. 3.

62 Sea Shepherd Australia, *Submission 57*, pp. 12–13.

63 Sea Shepherd Australia, *Submission 57*, pp. 3, 6.

64 Sea Shepherd Australia, *Submission 57*, p. 6 (emphasis omitted).

65 Ms Natalie Banks, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, pp. 12–13.

4.66 Submitters also commented on advances in medical responses, including better knowledge about how to respond to shark bites and improved transportation to hospitals. In addition, other developments that improve beach safety were noted, such as surf lifesaving clubs.[66] Furthermore, the HSI observed that various other activities permitted when lethal control measures were first introduced and which may have attracted sharks nearer to shore are now banned; examples provided included abattoirs discharging offal into the sea and the commercial whaling stations in southern Queensland and at Byron Bay.[67]

4.67 In some locations, lethal devices are not in place year-round—for example, it was noted that shark meshing in New South Wales is only carried out during the peak season (summer). Dr Daniel Bucher and Professor Peter Harrison remarked that improvements in wetsuits mean that a significant number of surfers, are 'in the water year-round, yet remarkably there continues to be no fatal attacks on netted beaches even at these times when the nets are not in the water'.[68]

4.68 It is also considered that comparisons between states with and without lethal shark measures fail to adequately account for differences in the marine environments. Mr Blair Ranford commented:

> Here in Western Australia we see the Queensland culling program held up to be the beacon of light for why it should be brought in here, but I think that ignore some very, very important facts—simply, they are completely different environments that we are talking about. Queensland, traditionally, does not have a history of a large number of great white shark attacks; very much, the majority of it is bull sharks, then, to a lesser degree, tiger sharks, and then, lastly, it is great white sharks in the history of attacks in that area. Bull sharks are far more territorial. Even though they still cover vast areas, they certainly are known to spend a lot more time inshore close to river mouths et cetera, and that is where the majority of their risk comes from. Also, Queensland is a semitropical to tropical environment; it is not an area where great white sharks spend large amounts of time. It is also not an area that has any seal or sea lion populations, which is exactly what we have here in WA. So, to compare the two of them together is really misleading. It doesn't really address the fact that they have two specifically different issues when it relates to shark attacks. For Western Australia it is great white sharks and for Queensland, in a completely different environment, the majority of the time it is bull sharks.[69]

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66 For examples of these arguments, see Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 24; Associate Professor Laurie Laurenson, *Submission 9*, pp. 1–2; and Dr Leah Gibbs, Mr Lachlan Fetterplace, Associate Professor Quentin Hanich and Mr Matthew Rees, *Submission 21*, p. 2;

67 HSI, *Submission 43*, p. 20.

68 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 4.

69 Mr Blair Ranford, *Committee Hansard*, 28 July 2017, p. 64. See also Mr Chad Buxton, Admin Officer/Volunteer, Coolum and North Shore Coast Care, *Committee Hansard*, 31 July 2017, p. 19.

Other observations on evaluating lethal control measures

4.69 Various submitters and witnesses highlighted difficulties in conducting meaningful assessments of lethal control measures. A key issue is the ethical difficulties involved in undertaking research in this area. Associate Professor McPhee commented:

> It is very difficult if not impossible from a range of perspectives, including an ethical perspective, to put together an experiment and conduct it to determine with a high degree of probability what the benefit of shark nets are in terms of actually reducing risk. That would involve putting people deliberately at risk and at a heightened risk without their knowledge. So that is off the table obviously.[70]

4.70 The low number of shark incidents also has implications for statistical analysis. Associate Professor McPhee commented that comparisons between beaches protected by lethal measures and those that are not are 'extremely difficult' because:

> You are comparing zero, zero, zero, one, one, zero, one and two, so you do not get anything that is particularly meaningful from a statistical perspective.[71]

4.71 Likewise, Professor Jessica Meeuwig argued that the effectiveness of lethal measures cannot be considered proven due to the low number of incidents. With reference to the Queensland program, the professor reasoned:

> If you look at where the drum lines are, you see that 83 per cent of the drum lines are in locations where there never ever had been a fatality before they came in…To say, 'Oh, look: since we brought drum lines in there have not been any fatalities,' when there were never any there before is awkward. At Magnetic Island there was one in 1923, and since they brought in a massive number of drum lines, yes, there has not been one, but how do you compare zero and one?[72]

4.72 Dr Leah Gibbs commented that a correlation between a low number of shark bite incidents and the presence of lethal measures 'does not prove causation'. Dr Gibbs added that correlation 'can be very convincing, especially to a poorly informed public', however, in her view, arguments based on correlation overlook various 'quite complex' social, biological and ecological factors.[73]

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70 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 36.

71 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 38.

72 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 40.

73 Dr Leah Gibbs, *Committee Hansard*, 31 July 2017, pp. 3–4.

4.73 CSIRO submitted that it is 'disappointing' that the efficacy of lethal shark control measures on public safety and the effects of these measures on the long-term viability of the white shark population are unclear 'given the decades over which some of these programs have run'.[74] Professor Nic Bax from CSIRO observed:

> …if one was to set up a shark-netting program, a drum-line program, I think…from a scientific view of management…it would be important that there were clear objectives: what was it trying to achieve; and would you know whether it had been successful. Because, if you have no idea about whether what you're proposing is going to be successful or not, or there is no way of measuring that, then it's really just a guess. And so I guess our strong feeling is really that, in these areas where we're trying a very experimental form of management—be it lethal measures of shark removal or non-lethal measures—it's very important to get the information that we can from those activities. And, if there's another Senate inquiry in five years' time, there will be clear information on whether these techniques work or not, and we're not in the same position with different perceptions of how these different techniques work.[75]

4.74 CSIRO suggested that, while shark removal programs continue, the management arrangements for the programs should include 'effective catch monitoring, clear trigger points and decision rules regarding the level of catch for both target and bycatch species'. CSIRO continued that there should be agreed actions in place in response to the trigger points being reached and that all of these management arrangements should be 'linked to defined management objectives'.[76]

4.75 In light of the evidence about the limitations of the lethal shark control programs, the cost of the programs was questioned. Australian Aerial Patrol, which did not express a view on the effectiveness of the program, nevertheless questioned the efficiency of the program compared to other measures such as aerial surveillance. It submitted:

> The shark meshing program costs an estimated $1.4 million per year, involves about 5000 net lifts and takes a very small number of potentially dangerous sharks (about 30 or so). It is thus, incredibly inefficient.[77]

4.76 Professor Meeuwig provided similar criticism of the Western Australian trial. Professor Meeuwig explained that, although the actual figures are not publicly available, her best estimate is that the three month drum line trial which killed

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74 CSIRO, Opening statement, tabled 20 October 2017, p. 1. See also CSIRO, *Submission 33*, pp. 4, 9.

75 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, pp. 6–7.

76 CSIRO, Opening statement, tabled 20 October 2017, p. 1. See also CSIRO, *Submission 33*, pp. 4, 9.

77 Australian Aerial Patrol, *Submission 6*, pp. 18–19.

173 tiger sharks[78] and zero white sharks cost over $1.5 million. Professor Meeuwig concluded that the lethal measures were 'counterproductive' as 'by virtue of spending $1.5 million-ish on that program, we did not spend money on other things' that the professor considered should have received funding instead.[79]

4.77 The current state government minister, the Hon David Kelly MLA, also commented on the expense and limited effectiveness of the Western Australian trial. Among other observations about the trial, the minister noted that in the south-west of the state, an independent contractor 'was paid $5,000 a day and did not catch a single great white shark'.[80]

4.78 Dr Sharon Burden commented that at Bunker Bay, where her son Kyle died, there are no signs indicating previous shark bites and an ongoing risk of shark encounters. When the former Western Australian Government proposed the introduction of lethal shark control measures, Dr Burden explained that her 'immediate frustration' with the proposal is that basic measures such as signage were not implemented. Dr Burden argued:

> To me, when you haven't even done the basics of putting up some information signs that inform—not scare but inform—why are you taking this extreme measure when there is no real evidence that it is going to actually work?[81]

Impact on shark conservation and populations of other species

4.79 Submitters and witnesses highlighted the significant number of target and non-target marine species caught by shark nets and drum lines. For example, Ms Jessica Morris, Marine Scientist, HSI, reported that between 1975 and 2001, the New South Wales and Queensland shark control programs killed 11,899 sharks (including shark species and sizes considered dangerous to humans and those that are not considered dangerous) as well as approximately 53,000 other marine animals.[82]

4.80 As a result of the high numbers of sharks killed, concerns were expressed about the effects of lethal measures on the population of shark species and the efforts in place to conserve certain species.

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78 Professor Meeuwig noted that the tiger shark is 'a species that had not been implicated in any lethal attacks in the region since 1923'.

79 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 36. Similar evidence was provided by Ms Amanda Elizabeth Morgan (see *Committee Hansard*, 28 July 2017, p. 1).

80 The Hon David Kelly MLA, Western Australian Minister for Water, Minister for Fisheries and Minister for Forestry, *Committee Hansard*, 20 April 2017, p. 55.

81 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, pp. 18–19.

82 Ms Jessica Morris, HSI, *Committee Hansard*, 17 March 2017, p. 33.

4.81 Greenpeace noted that the deaths of sharks approaching or of reproductive age 'threaten the reproductive output and recovery of shark species populations'. In addition to the removal of sharks from the population, Greenpeace argued that a male–female population imbalance can be created—it indicated that four female tiger sharks are caught for every one male tiger shark that is caught. Greenpeace submitted that negative effects on population growth due to shark control measures 'will create problems for entire ocean ecosystems by creating an imbalance in population sizes of species consumed by sharks'.[83]

4.82 Submitters noted that the population of the grey nurse shark, which is a critically endangered species, is negatively affected by lethal shark control measures. Ms Jessica Morris, HSI, noted that the grey nurse shark is 'being captured and killed in numbers too great to sustain the population'.[84] The AMCS noted that the recovery plan for the grey nurse shark states that mortalities caused by shark control measures are considered a threat to the recovery of the species.[85]

4.83 The importance of sharks for the health of the overall marine eco-system was also addressed. Mr Jeff Hansen, Managing Director, Sea Shepherd Australia, questioned how seal and whale populations would be kept in check if sharks were killed in the large numbers that would be necessary for lethal measures to guarantee public safety. Mr Hansen remarked:

> Are we going to take control of a natural, wild environment and try to manage that? That is absolute insanity.[86]

4.84 Concerns were also expressed about the level of bycatch and the effects of lethal measures on the populations of other threatened and protected species besides sharks. HSI argued that bycatch from shark control programs is often 'more severe than bycatch associated with Australia's commercial fisheries'. Furthermore, many of the species caught:

> …are listed as threatened with extinction under state and federal laws, and international treaties. Australian state, territory and federal governments are

83 Greenpeace Australia Pacific, *Submission 50*, p. 18.

84 Ms Jessica Morris, HSI, *Committee Hansard*, 17 March 2017, p. 33.

85 Australian Marine Conservation Society, *Submission 38*, p. 8.

86 Mr Jeff Hansen, Managing Director, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 17. Other evidence on the role of sharks in the marine environment was also received. For example, Professor Meeuwig noted that healthy shark populations can help resist crown-of-thorns outbreaks in coral reefs. Professor Meeuwig also referred to recent research that suggests shark populations can help mitigate climate change by keeping populations of animals such as sea turtles in check so they do not overgraze seagrass beds. Professor Meeuwig noted that 'Seagrass beds are one of the highest sequesters of carbon on the planet. If you remove your tiger sharks or reduce their numbers, turtles and dugongs go nuts. They graze on the seagrass, and you lose your blue carbon store'. Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44. The role sharks play in shaping marine ecosystems is also discussed in Chapter 1.

> obliged to protect and promote the recovery of threatened species populations.[87]

4.85 Australia for Dolphins submitted that the 2015–16 annual report on the New South Wales program indicates that 86 per cent of the 748 marine animals caught 'were threatened, protected, or species not intended to be targeted by the shark nets'.[88]

4.86 To illustrate their concerns, submitters commented in detail on the implications of lethal shark control measures for particular non-target protected species. The AMCS provided the following evidence in relation to dugongs:

> Dugongs are classified as vulnerable to extinction by the…[International Union for Conservation of Nature] in response to global declines in population. Northern Australia is regarded as the last remaining global stronghold of this species, with numbers elsewhere having been reduced to small relict populations. As dugongs are long-lived animals with very low reproductive rates, it takes a long time for their populations to recover from declines caused by additional mortality. Even a slight reduction in adult survival due to incidental drowning in nets or other factors could cause a chronic decline in dugong populations. Thus, the 689 dugongs killed in the Queensland shark meshing program over 52 years to 2014 represents a threat to the population of this vulnerable species in that state. As dugongs tend to remain in the one area throughout most of their lives, this mortality is likely to have caused significant local declines in dugong populations.[89]

4.87 The effects of lethal measures on sea turtles were also discussed. The AMCS explained that turtles 'are one of the largest groups of bycatch in the shark control programs', with more than 5000 turtles captured in nets and on drum lines in total to date under the Queensland shark control program. The AMCS added that the recovery plan for marine turtles identifies the Queensland shark control program 'as an issue of concern which should be managed with the intent of reducing mortality'. The AMCS further added that the plan indicates the need 'to significantly reduce the take of green turtles in [shark control programs] and reduce the take of loggerhead turtles to zero'.[90]

4.88 A further group of marine animals that attracted comments in relation to shark control programs is whales. The author of the submission from the Migaloo 2 Foundation informed that committee that:

> During the last 7 years sailing with the humpback whale migration from Byron Bay to Hervey Bay I have heard of many whale entanglements in shark nets. Of these whale entanglements many have resulted in death by

87 HSI, *Submission 43*, p. 3.

88 Australia for Dolphins, *Submission 4*, p. 2.

89 Australian Marine Conservation Society, *Submission 38*, p. 9.

90 Australian Marine Conservation Society, *Submission 38*, p. 9. Further evidence about the impact on sea turtles was given by representatives of Australian Seabird Rescue: see *Committee Hansard*, 2 May 2017, pp. 65–70.

> drowning of both baby and adult humpback whales. Although some entanglements have resulted in the whale being freed on one occasion at least, I can testify that all of the ropes and floatation equipment was not cut off and the whale would most likely have died of exhaustion or starvation as it would not have been able to swim all the way to its feeding ground in the Antarctic as it would have been like swimming with a jumper and gum boots on.[91]

4.89 In addition to the above evidence, the submitter advised they have witnessed a humpback whale entangled in shark net ropes and floatation gear. A photograph was provided in the submission and the submitter reported that the whale 'was forced to stop swimming and rest about every 10 breaths'.[92]

4.90 Dr Jan-Olaf Meynecke provided further evidence about whales being entangled by shark nets off the south east coast of Queensland.[93]

4.91 The International Fund for Animal Welfare (IFAW) submitted that 'at a minimum', nets should be removed during periods of whale breeding and migration. IFAW explained that, for Queensland, this would involve removing nets from the start of June until the end of October, and for New South Wales the end date of the current seasonal removal of nets during winter would need to be extended to October rather than August.[94]

4.92 Some further observations about the implications of shark control measures on marine species are as follows:

- Although they did not support drum lines, some witnesses who oppose lethal measures acknowledged the lower rate of bycatch of non-target species associated with drum lines compared to nets.[95]
- Lethal shark control programs present 'a serious animal welfare problem' because the measures used cause many animals to experience prolonged and painful deaths'.[96]

4.93 Finally, Professor Daniel Bucher responded to the suggestion put forward by some supporters of lethal measures that the measures are appropriate as, regardless of questions about their effectiveness, the deployment of these measures help the public feel safe. Professor Bucher stated:

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91 Migaloo 2 Foundation, *Submission 28*, pp. 1–2.

92 Migaloo 2 Foundation, *Submission 28*, pp. 1–2.

93 See Dr Jan-Olaf Meynecke, *Committee Hansard*, 31 July 2017, pp. 9–10.

94 International Fund for Animal Welfare, *Submission 40*, p. 3.

95 Ms Jessica Morris, HSI, *Committee Hansard*, 17 March 2017, p. 38.

96 HSI, *Submission 43*, p. 3.

> To be honest, I do not think 'it makes people feel good' is a good enough reason to be killing dolphins, turtles and endangered animals. That is not on. I have always made the analogy that, if I wanted to go bushwalking in the Serengeti, would it be reasonable for me to ask the Tanzania government to shoot all the lions? 'Actually, don't shoot them, blow up some cluster bombs; I don't care if you knock off a few giraffes, elephants and zebras in the process, as long as you get a few of those lions, and then I can go walking in safety.' That would be a stupid thing to do. It would be laughed out…But that is effectively what we are doing with nets.[97]

Public opinion about lethal measures has changed

4.94 Some witnesses suggested that lethal measures such as nets are no longer supported by large sections of the community. In examining this evidence, it is important to note that reliably ascertaining community views on matters such as this could be quite difficult. Based on the evidence available to the committee, the level of awareness in the community about how lethal measures operate is also unclear, which has implications for interpreting information put forward measuring public opinion. Some of the evidence presented is also general in nature, or based on limited data. Overall, this evidence provides an interesting perspective, but conclusions are not drawn from it.

4.95 That a wide range of views on shark control measures can be identified is demonstrated by the following comments by Associate Professor Daryl McPhee:

> We are a coastal culture, a beach culture, as a nation, but there are a great diversity of views within that. Even when I look at surfing forums, there are surfers supporting shark culls and surfers opposing them, and there are surfers who, whilst obviously not happy that their fellow surfers and families have been injured, are happy that there are fewer people on their waves, particularly out-of-towners. So we have a very diverse range of views.[98]

4.96 Some of the evidence received questioned specific claims made about public opinion, such as the surveys conducted by the DPI as part of the first north coast trial of nets, and it was suggested that lethal measures were being introduced to satisfy a small group of vocal people.[99] Nevertheless, this section canvasses the DPI surveys while also focusing on broader comments about community views on lethal measures. One such argument put forward by opponents of lethal shark control measures is that these programs are out of step with current community expectations. In describing lethal measures as 'outdated technology that was used to address public fears at the time they were introduced', HSI argued that:

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97 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 46.

98 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 36.

99 Ms Jann Gilbert, *Committee Hansard*, 2 May 2017, p. 59.

> Over the last five decades, the public's ecological awareness and understanding has grown to replace the misplaced fear and hysteria that once came from ignorance. Despite the heavy focus placed by some sections of the media on shark incidents, the community at large understands the importance of protecting our unique marine ecosystems, which include apex predators such as sharks and balancing this with protection for ocean users. This is especially true in areas of high ecological importance and diversity, such as the Great Barrier Reef, where nets and drumlines are still present year round.[100]

4.97 A similar position was held by the AMCS, which included the following statement in its submission:

> Lethal shark control programs are not a solution for shark interactions and the environmental awareness of the beach-going public has shifted in the many decades since the shark cull measures were first imposed in QLD and NSW. Ocean-users are now much more conscious of the need to ensure their safety when visiting our beaches and coasts and also the need to protect the marine environment and marine species such as sharks.[101]

4.98 As part of the first New South Wales north coast trial of shark nets, telephone and online surveys of residents were undertaken to test community attitudes towards the trial. In the report on the trial published in August 2017, results of surveys undertaken before and after the trial were presented. These results indicate that 'overall, Ballina Shire and Evans Head residents were more positive than negative towards the concept of nets in pre- and post-trial telephone interviews'.[102] However, opinions on whether the trial had been successful were influenced significantly by views on bycatch. The report on the first trial commented:

> There was a strong correlation between attitude to bycatch and the perceived success of the trial from the telephoned respondents. Of those who felt bycatches were acceptable, 82% felt that the trial had been a success. In contrast, 65% of the respondents who assessed the bycatch as unacceptable deemed the nets to be unsuccessful.[103]

4.99 The report continued:

> Despite differences in attitudes between residents and non-residents, most stakeholders within both groups were united on the unacceptability of bycatch in terms of the overall success of the trial. Of the sampled residents, 68% of telephone and 60% of online respondents thought that the bycatches in the nets were unacceptable (vs 91% of non-residents). These attitudes appear to reinforce perceptions regarding the overall success of the trial, with more Ballina Shire and Evans Head residents indicating

100 HSI, *Submission 43*, p. 17.

101 Australian Marine Conservation Society, *Submission 38*, pp. 10–11.

102 DPI, *NSW north coast shark-meshing trial final report*, August 2017, p. 42.

103 DPI, *NSW north coast shark-meshing trial final report*, August 2017, p. 26.

> that the nets were unsuccessful rather than successful during telephone interviews (48% vs 37%) and online questionnaires (55% vs 38%). Non-residents were more extreme in their views, with 87% saying that the nets were unsuccessful.[104]

4.100 Mr Leon Deschamps argued that lethal measures are still in use in Australia because of an aversion to change. Mr Deschamps explained:

> I was born and raised in the town that had 800 people in it. It is a small town and it is a small Australian town. One of the things small Australian towns hate is change. I think for the broad community of Australia that goes right through to our innate culture that defines us. We don't like change. We're presently using a 1950s technology, a technology that was introduced when domestic violence was still legal in the home. Times have changed; we have moved on.[105]

4.101 Dr Christopher Neff argued that attempts by government to prevent shark bites 'are not really about preventing shark bites, generally', rather they are 'more about preventing certain frequencies of shark bites in certain locations that produce political penalties'. Dr Neff explained:

> For instance, in New South Wales the political capital upon which shark nets rest is a narrative that there has only been one fatality at a netted beach since 1937. This is absolutely accurate. However, the data omits that there have been 29 shark bites at netted beaches in New South Wales over that same period. The goal is not to stop all shark bites, but rather to stop fatalities and clusters for which the threshold is low and the political penalty might be high.[106]

4.102 Dr Neff advised that the majority of respondents to studies on the public attitude to sharks following shark bite incidents he has conducted consider that no one is to blame for shark bites. The majority of respondents also consider that government should choose non-lethal measures in response and that the primary purposes of lethal measures is not to protect the public, but rather to 'calm the public' and to help tourism. Dr Neff concluded:

> Whatever the committee decides and whatever the states do regarding shark bite prevention, the simple fact is that Australians…get it. They get that these policies do not generally work and that killing sharks is not intended simply to protect the public. I think that shows an underlying level of confidence in government that is shaky and should be concerning to everyone.[107]

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104 DPI, *NSW north coast shark-meshing trial final report*, August 2017, p. 42.

105 Mr Leon Deschamps, *Committee Hansard*, 28 July 2017, p. 27.

106 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 1.

107 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 2.

Chapter 5

Regulation of mitigation and deterrent measures under the *Environment Protection and Biodiversity Conservation Act 1999*

5.1 This chapter focuses on paragraph (b) of the terms of reference for this inquiry: the regulation of mitigation and deterrent measures under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Essentially, this chapter examines the responsibilities with respect to the lethal shark control programs operated by state governments arising from the Commonwealth's principal piece of environmental legislation.

5.2 This chapter:

- outlines the referral, assessment and approval process for actions that are otherwise prohibited by the EPBC Act;
- discusses the limitations of the EPBC Act with respect to state government shark control programs that pre-date the commencement of the EPBC Act; and
- examines evidence received about the exemptions from the EPBC Act referral, assessment and approval process granted to state governments to operate certain shark control measures.

5.3 Some evidence was received which commented on changes to state legislation, such as amendments to the *Fisheries Management Act 1994* (NSW) to facilitate shark management trials in New South Wales by way of a plan of management approved by the relevant minister.[1] This evidence helps to ascertain a full picture of how shark control programs are regulated. However, the committee's deliberations and report focus on matters that are linked to the Commonwealth's legislative powers and responsibilities, in line with the terms of reference for the inquiry and the general remit of a parliamentary committee at the Commonwealth level of government.

Relevance of the EPBC Act in relation to sharks in Australian waters

5.4 Among other objects, the EPBC Act seeks to:

- provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance;
- promote the conservation of biodiversity; and

1 See EDOs of Australia, *Submission 42*, p. 5.

- assist in the co-operative implementation of Australia's international environmental responsibilities.[2]

5.5 The following matters of national environmental significance identified in the EPBC Act are particularly relevant to this inquiry:

- listed threatened species and ecological communities;
- listed migratory species;
- Commonwealth marine areas; and
- the Great Barrier Reef Marine Park.

5.6 Nine species of sharks are listed threatened species under the EPBC Act (see Table 5.1). In addition, Australia is a signatory to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). Species listed in the Bonn Convention, and other conventions relating to migratory species to which Australia is a signatory, are listed migratory species under the EPBC Act. The Department of the Environment and Energy (DoEE) advised that 18 species of sharks and rays are listed as part of the Bonn Convention, including 11 which occur in Australian waters.[3]

Table 5.1: Shark species listed as threatened species under the EPBC Act

Conservation category	Species
Critically endangered	Grey Nurse Shark (*Carcharias taurus*) – East coast population Speartooth Shark (*Glyphis glyphis*)
Endangered	Northern River Shark (*Glyphis garricki*)
Vulnerable	Grey Nurse Shark (*Carcharias taurus*) – West coast population Whale Shark (*Rhincodon typhus*) White Shark (*Carcharodon carcharias*) Dwarf Sawfish, Queensland Sawfish (*Pristis clavata*) Freshwater Sawfish (*Pristis microdon*) Green Sawfish, Dindagubba, Narrowsnout Sawfish (*Pristis zijsron*)

Source: DoEE, 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 28 April 2017).

2 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), ss. 3(1)(a), (c) and (e).

3 These species are as follows: White shark (*Carcharodon carcharias*); basking shark (*Cetorhinus maximus*); narrow sawfish (*Anoxypristis cuspidata*); dwarf sawfish (*Pristis clavata*); green sawfish *(Pristis zijsron*); largetooth sawfish (*Pristis pristis*); reef manta ray (*Manta alfredi*); giant manta ray (*Manta birostris*); pygmy devilray (*Mobula ereegoodootenkee*); Japanese devilray (*Mobula japonica*); and bentfin devilray (*Mobula thurstoni*). Department of the Environment and Energy (DoEE), Answers to questions on notice, 16 March 2017 (received 19 April 2017), p. 7.

Overview of the EPBC Act referral, assessment and approval process

5.7 This section provides a brief overview of the EPBC Act referral, assessment and decision-making processes.[4]

5.8 Under the EPBC Act, a person must not take an action that has, will have, or is likely to have, a significant impact on any matter of national environmental significance without approval from the Minister for the Environment and Energy (the minister) or a decision that approval is not needed. A person who proposes to take such an action must refer that action to the minister. The EPBC Act outlines a process for deciding whether approval of the action is required (Part 7). Actions that the minister considers will have, or are likely to have, a significant impact on a matter of national environmental significance are 'controlled actions' and require an environmental assessment and the minister's approval under Part 9 of the EPBC Act. In deciding whether an action is a controlled action, the minister must consider '[a]ll adverse impacts (if any) that the action has, will have, or is likely to have on each protected matter'.[5]

5.9 Following a decision that a proposed action is a controlled action, the EPBC Act provides for the following levels of assessment:

- accredited assessment (for example, in accordance with a relevant bilateral agreement between the Commonwealth and a state or territory);
- assessment on information provided when the proposed action is referred;
- assessment on preliminary documentation;
- assessment by public environment report; and
- assessment by public inquiry.[6]

5.10 The minister may decide to approve an action, approve an action subject to conditions or not approve the action. In doing so, the minister must consider the impacts of the proposed action on the matters protected by the EPBC Act and other economic and social matters.[7] The minister must take into account:

- the principles of ecologically sustainable development;
- the outcomes of the assessment of the proposed action's impacts;
- referral documentation;

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4 For further detail, refer to the DoEE's submission (*Submission 55*). In particular, Attachment 1 to the submission comprises flow charts that provide a detailed summary of the referral, assessment and decision-making processes.

5 DoEE, *Submission 55*, pp. 4–5.

6 DoEE, *Submission 55*, pp. 4, 9; and 'Environment assessment and approval process', www.environment.gov.au/protection/environment-assessments/assessment-and-approval-process (accessed 2 December 2016).

7 EPBC Act, s. 136(1).

- community and stakeholder comment;
- any other relevant information available on the impacts of the proposed action; and
- relevant comments from other Commonwealth, state and territory ministers, and members of the public (such as information on social and economic factors).[8]

5.11 Furthermore, the DoEE noted that, where species are, have been, or are likely to be impacted by a proposed action, the minister must have regard to additional factors when making their decision. Among others factors, the minister must:

- have regard to the approved conservation advices for the particular species;
- not act inconsistently with Australia's obligations under the Biodiversity Convention, the Bonn Convention, the Apia Convention and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and
- not act inconsistently with a recovery plan or threat abatement plan.[9]

Interaction between the EPBC Act and existing shark control programs

5.12 In considering the implications of the EPBC Act for shark control programs operated by state governments, and by extension, the role of the Commonwealth in relation to oversight of these programs, several aspects of the EPBC Act are significant. This section examines:

- the exemptions provided under the EPBC Act for prior authorisations and lawful continuing use of land, sea or seabird prior to the commencement of the EPBC Act;
- the meaning of 'significant' in relation to the EPBC Act's terminology of 'a significant impact on any matter of national environmental significance';
- the development of recovery plans and listing of key threatening process; and
- assessment arrangements, including bilateral agreements between the Commonwealth and the states.

8 The minister may also take into account the environmental history of the individual or company proposing to take the action, including in the case of companies the environmental histories of their executive officers, their parent companies and the executive officers of their parent companies. The minister must not consider any matters that they are not required or permitted to consider under Division 1 of Part 9. See EPBC Act, Part 9, Division 1, Subdivision B; DoEE, 'Environment assessment and approval process', www.environment.gov.au/protection/environment-assessments/assessment-and-approval-process (accessed 2 December 2016); and *Submission 55*, p. 5.

9 DoEE, *Submission 55*, p. 5.

5.13 In addition, section 158 of the EPBC Act enables the minister to exempt a person proposing to take an action from the Act's referral, assessment and/or approval requirements. This provision is addressed in a separate section later in this chapter.

Exemptions for prior authorisation and continuing use

5.14 The EPBC Act came into effect on 16 July 2000. Under sections 43A and 43B of the Act, actions that were legally authorised before that date (under Commonwealth, state or territory law), and lawful continuations of use of land, sea or seabed that were occurring immediately before that date, are exempted from the EPBC Act's assessment and approval provisions.[10]

5.15 These provisions of the EPBC Act are significant for the long-running lethal shark control programs in New South Wales (first introduced in 1937) and Queensland (commenced 1962). Both jurisdictions consider their actions are covered by the continuing use exemption provided by section 43B of the EPBC Act.[11]

5.16 The EDOs of Australia submitted that, as a result of the continuing use exemption provided under section 43B of the EPBC Act, these established state government shark control programs 'have not been subject to assessment under modern environmental standards'. The EDOs of Australia's submission argued that the 'current state of knowledge in relation to the importance of sharks in the marine environment and the environmental harm caused by these activities', means that continued reliance on these exemptions is 'inappropriate'. Accordingly, the EDOs of Australia concluded that the historical shark control programs should be subject to a 'full environmental assessment that considers both the environmental impact and alternative beach safety measures'.[12]

5.17 Although section 43B of the EPBC Act provides for a continuing use exemption, there are limits to the scope of this exemption. Importantly, subsection 43B(3) provides that an enlargement, expansion or intensification of use of the land, sea or seabed is not covered by the exemption. In addition, any change in the location of where the use of the land, sea or seabed is occurring, or any change in the nature of the activities comprising the use, that results in a substantial increase in the impact of the use on the land, sea or seabed is not covered by the exemption.

5.18 The limitations of subsection 43B were considered as part of the first New South Wales north coast trial. Although the New South Wales and Australian Governments consider that the long-running shark control program is exempt from the EPBC Act assessment process, correspondence between government departments indicate that the north coast trial of nets and SMART drum lines is covered by the

10 DoEE, *Submission 55*, p. 6.

11 See DoEE, *Submission 55*, p. 7; Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 4.

12 EDOs of Australia, *Submission 42*, p. 3 (emphasis omitted).

continuing use exemption. That is, if either measure has the potential to have a significant impact on a matter of national environmental significance, the EPBC Act referral and assessment process applies. This trial and the decisions made about the application of the EPBC Act are discussed later in this chapter.

'Significant' impact on a matter of national environmental significance

5.19 For actions that are not exempted from the EPBC Act, whether an action is considered to be a controlled action that requires assessment and approval under the EPBC Act depends on whether the minister considers the action will have, or are likely to have, a significant impact on a matter of national environmental significance.

5.20 Officers from the DoEE explained that matters are assessed against significant impact guidelines.[13] The guidelines that address matters of national environmental significance define a significant impact as one that:

> …is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts…[Proponents] should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance.[14]

5.21 A significant impact is considered 'likely' in the following circumstances:

> To be 'likely', it is not necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility. If there is scientific uncertainty about the impacts of your action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.[15]

5.22 The guidelines set out significant impact criteria for each matter of national environmental significance. For example, the guidelines provide that an action will require approval if the action has, will have, or is likely to have a significant impact on a species that is categorised as extinct in the wild, critically endangered, endangered

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13 See Mr Matthew Cahill, First Assistant Secretary; and Mr Dane Roberts, Director, Northern NSW Assessments, Assessments (NSW/ACT) and Fuels, DoEE, *Committee Hansard*, 16 March 2017, p. 23.

14 DoEE, *Matters of National Environmental Significance: Significant impact guidelines 1.1*, 2013, www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf (accessed 28 April 2017), p. 2.

15 DoEE, *Matters of National Environmental Significance: Significant impact guidelines 1.1*, p. 3.

or vulnerable.[16] Significant impact criteria are provided for each of these categories; for example, the criteria for species listed as vulnerable is as follows:

> An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
>
> - lead to a long-term decrease in the size of an important population of a species
> - reduce the area of occupancy of an important population
> - fragment an existing important population into two or more populations
> - adversely affect habitat critical to the survival of a species
> - disrupt the breeding cycle of an important population
> - modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
> - result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
> - introduce disease that may cause the species to decline, or
> - interfere substantially with the recovery of the species.[17]

5.23 Evidence from the DoEE confirms that some features of state government shark control programs can be assessed as not requiring referral because it is considered that the measure will not have a significant impact on a matter of national environmental significance.

5.24 This was recently demonstrated by correspondence between New South Wales and Commonwealth departmental officers in relation to SMART drum lines. As noted in Chapter 3, SMART drum lines differ from traditional drum lines in that they are not designed to kill sharks. In October 2016, it was announced that the number of SMART drum lines in use in New South Wales would increase to up to 100. The proposal prompted New South Wales departmental officers to write to the Commonwealth Department of the Environment and Energy to seek confirmation that a referral was not required.[18]

16 DoEE, *Matters of National Environmental Significance: Significant impact guidelines 1.1*, p. 8.

17 DoEE, *Matters of National Environmental Significance: Significant impact guidelines 1.1*, p. 10.

18 Correspondence between the DoEE and the New South Wales Government regarding the trial use of shark mesh nets, tabled 21 October 2016, Senate Environment and Communications Legislation Committee, Supplementary Budget Estimates 2016–17, p. [6].

5.25 As part of the self-assessment undertaken by the New South Wales department, it was acknowledged that:

> While the SMART drumlines have the potential to interact with many threatened, protected and migratory species listed under both State and Commonwealth legislation, the results to date clearly indicate that these drumlines are not likely to have a significant impact on either target shark or non-target species.[19]

5.26 After considering the self-assessment undertaken by the New South Wales department, the Commonwealth department advised that the expanded SMART drum line program did not require referral 'at this stage'. The following caveat was made, however:

> If the environmental assessment or results of the operation of the program indicate outcomes for protected species that are inconsistent with the trial, you should carefully consider the need to refer the action for assessment and decision.[20]

5.27 Mr Matthew Cahill, the first assistant secretary at the DoEE who advised the New South Wales department of this decision, noted that this example highlights the need to consider 'the specifics around the matter'. In his evidence to the committee, Mr Cahill stated:

> …you have seen the correspondence where we wrote back [to the New South Wales department] and said, 'In this instance, as long as the outcomes or results of that expansion were consistent with what had happened to date, there is no need to refer.' So it goes very specifically to what is the action being taken.[21]

Recovery plans

5.28 The EPBC Act provides for the development of recovery plans for purposes of the protection, conservation, and management of a listed threatened species.[22] Essentially, a recovery plan is intended to 'guide actions to help a particular listed threatened species recover'.[23]

5.29 Recovery plans made under the EPBC Act are 'are statutory considerations for the minister in deciding whether or not to approve a controlled action that has undergone assessment and proceeded to the approval stage'. The Act provides that the

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19 Correspondence between the DoEE and the New South Wales Government regarding the trial use of shark mesh nets, tabled 21 October 2016, Senate Environment and Communications Legislation Committee, Supplementary Budget Estimates 2016–17, p. [6].

20 Correspondence between the DoEE and the New South Wales Government regarding the trial use of shark mesh nets, p. [3].

21 Mr Matthew Cahill and Mr Dane Roberts, DoEE, *Committee Hansard*, 16 March 2017, p. 23.

22 DoEE, *Submission 55*, p. 5.

23 NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 4.

minister 'must not act inconsistently with a recovery plan in deciding whether or not to approve the taking of an action under the EPBC Act, for which that species is a controlling provision of a proposal's assessment'.[24]

5.30 The DoEE noted that the *Recovery Plan for the White Shark* (2013) and the *Recovery Plan for the Grey Nurse Shark* (2014) both 'identify mortality related to shark control activities (such as beach meshing and drumlining) as one of the two principal and current threats to the species'.[25]

5.31 The existence of recovery plans for shark species was also noted in other submissions.[26] The development and introduction of these plans highlight the importance of the need to minimise actions that could affect the shark population. Several submitters shared the view that lethal shark control programs appear to be inconsistent with these efforts.[27]

5.32 As noted above, however, the continuing use exemption provided for by the EPBC Act means that the long-running New South Wales and Queensland shark control programs have not been assessed under the EPBC Act. Other actions involving shark mitigation and deterrent measures that commenced more recently and are not covered by the section 43B exemption either have not, or did not, reach the approval stage.[28] In its assessment of the then Western Australian Government's proposal to use up to 72 baited drum lines off metropolitan and south west coastal regions of Western Australia for a period of three years, the Western Australian Environmental Protection Authority (EPA) took into account the recovery plan for the white shark. The EPA noted that the recovery plan identified 'the principal threats to the lack of white shark recovery in Australia as mortality resulting from accidental capture by commercial and recreational fishers, and shark control activities'.[29]

5.33 The EPA considered that a high degree of scientific uncertainty existed as to the 'information and evidence about the south-western white shark population, population trends, and the catch of white sharks from commercial fisheries'. On this basis, the EPA expressed concern that the proposal 'may compromise the viability of

24 DoEE, *Submission 55*, p. 5.

25 DoEE, *Submission 55*, p. 5.

26 See Sydney Coastal Councils Group, *Submission 3*, p. 2; NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 4; Mr Duncan Leadbitter, *Submission 7*, pp. 6–7.

27 For example, see Humane Society International (HSI), *Submission 43*, pp. 14–15; and Project AWARE, *Submission 46*, Attachment 1, p. 2.

28 DoEE, *Submission 55*, p. 5.

29 Western Australian Environmental Protection Authority, *Report and recommendations of the Environmental Protection Authority: Western Australian Shark Hazard Mitigation Drum Line Program 2014–2017 – Director General, Department of the Premier and Cabinet on behalf of the State of Western Australia*, Report No. 1527, September 2014, p. 10.

white sharks at the population level (for the south-western white shark population)' and determined that the proposal should not be implemented.[30]

Key threatening process

5.34 Under the EPBC Act, certain processes can be identified and listed as a 'key threatening process'. A process can be listed as a key threatening process under the EPBC Act if it could:

- 'cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category)';
- 'cause an already listed threatened species or threatened ecological community to become more endangered'; or
- 'adversely affect two or more listed threatened species or threatened ecological communities'.[31]

5.35 Assessments of nominations of key threatening processes are undertaken by the Threatened Species Scientific Committee (TSSC). Further information about this process was provided by the DoEE in response to a question on notice as follows:

> A key threatening process can be nominated by any person under s194E of the EPBC Act. The priority of nomination is considered along with other nominations received and may be added to the Finalised Priority Assessment List (s194K). If a process is added to the assessment list, it is then assessed by the Threatened Species Scientific Committee with respect to its likely negative effects on multiple species (s188(4)). The Committee makes a recommendation about its eligibility for inclusion on the list. That recommendation is provided to the Minister who makes the final decision about including the process on the EPBC Act list.[32]

5.36 After a key threatening process is listed, they minister may establish a threat abatement plan.[33] These plans 'establish a national framework to guide and coordinate Australia's response to key threatening processes'.[34]

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30 Western Australian Environmental Protection Authority, Report No. 1527, pp. ii–iii.

31 DoEE, 'Key threatening processes under the EPBC Act', www.environment.gov.au/biodiversity/threatened/key-threatening-processes (accessed 27 April 2017).

32 DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), pp. 2–3.

33 If the Minister thinks that a threat abatement plan is a feasible, effective and efficient way of abating the process, he must ensure a threat abatement plan is in force. See DoEE, 'Frequently asked questions – key threatening processes', www.environment.gov.au/system/files/pages/10a10e3d-e677-4c5a-ba9a-00bfd70d8db2/files/faq-ktp-tap.pdf (accessed 27 April 2017), p. 2.

34 DoEE, 'Frequently asked questions – key threatening processes', p. 2.

5.37 As key threatening processes are not matters of national environmental significance under the EPBC Act, listing does not trigger obligations under the EPBC Act. Rather, listing a process as a key threatening process 'provides official recognition that a process is a key threat to biodiversity at the national level'. The purpose of this recognition is that it 'raises awareness of how threats to biodiversity are operating across Australia and assists with understanding and prioritising management of these threats'.[35] As noted at paragraph 5.11, however, when considering whether to approve a controlled action where species are, have been, or are likely to be impacted by the action, the minister must not act inconsistently with a relevant threat abatement plan.

Assessment of shark control measures

5.38 The DoEE explained that shark nets have undergone assessment as a threatening process on two occasions, as follows:

- Under the former *Endangered Species Protection Act 1992*—on 1 June 1998 the minster accepted advice that shark nets were ineligible to be listed; and
- Under the EPBC Act—on 21 March 2005, the minister agreed with a recommendation that shark nets were ineligible.[36]

5.39 If addition to these assessments, two further nominations have been received. The DoEE provided the following evidence on how these nominations progressed:

- A nomination received in 2015 was not recommended by the TSSC for inclusion on the assessment list. DoEE added that the nomination 'was carried over into 2016 and again not prioritised'.
- More recently, a nomination for the listing of shark nets has been received for consideration in 2017.[37]

5.40 Representatives of Humane Society International (HSI), which has sought to have shark nets listed as a key threatening process, advised the following summary of their efforts to date:

> We have tried to get it listed. We are actually putting in another submission for this round to get it listed under the EPBC Act. Basically what they are saying, though, is that, because it is concentrated in New South Wales and Queensland, it is not a matter of national interest; it is not occurring on a level of national interest to have it listed under the EPBC Act. But it should be.[38]

35 DoEE, 'Frequently asked questions – key threatening processes', p. 2.

36 DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), p. 2.

37 DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), p. 2.

38 Ms Jessica Morris, Marine Scientist, HSI, *Committee Hansard*, 17 March 2017, p. 36.

5.41 Furthermore, it was argued that amendments to the EPBC Act have made it more difficult for a process to be listed as a key threatening process compared to similar mechanisms in state legislation:

> There were amendments to the EPBC Act to make it harder for nominations to be assessed for listing. Under the New South Wales law, you submit a nomination; the scientific committee has to assess that nomination and make a recommendation to the minister. Under the EPBC Act, there is a filter, so you submit a nomination and then the minister and the committee decide if it is a priority or not. If it is not put on the priority assessment list, it does not get listed. The criteria for what is and is not a priority can allow political decisions to come in. That is a problem with the EPBC Act listing process at the moment.[39]

5.42 Despite shark nets not being listed as a key threatening process under the EPBC Act, state governments have recognised that these measures will affect matters of national environmental significance (specifically, threatened and protected species, and migratory species). To address this risk, in a letter to the DoEE on the north coast trial, the New South Wales Director-General of the Department of Primary Industries emphasised that 'monitoring of the trial will provide data and information to more accurately gauge the level of that potential impact and would underpin any future assessments or proposals'.[40]

Referral by state government and assessment under bilateral agreements

5.43 The EPBC Act process requires proponents to undertake a self-assessment of whether a proposed action requires referral to the minister. As a result of this, the state governments that develop programs such as shark control measures are required to consider whether these measures have, will have, or are likely to have, a significant impact on any matter of national environmental significance. The DoEE describes the respective roles of the state and territory governments, and the Australian Government, as follows:

> State and territory governments need to consider whether shark mitigation measures will have a significant impact on protected matters under the EPBC Act, including shark species, turtles and whales. The Department continues to engage with state agencies to help them understand their obligations under the EPBC Act, including helping them identify any activities which may need to be referred under the EPBC Act.[41]

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39 Ms Nicola Beynon, Head of Campaigns, HSI, *Committee Hansard*, 17 March 2017, p. 36.

40 Correspondence between the DoEE and the New South Wales Government regarding the trial use of shark mesh nets, tabled 21 October 2016, Senate Environment and Communications Legislation Committee, Supplementary Budget Estimates 2016–17, p. [2].

41 DoEE, *Submission 55*, pp. 4, 9.

5.44 Assessment of a referral can take place within the state jurisdiction if a bilateral agreement under the EPBC Act is in place. The DoEE explained:

> Where a bilateral agreement under the EPBC Act is in place with a state or territory, the state or territory may undertake various aspects of the assessment and approval processes where those processes have been found to meet the requirements of the EPBC Act by the Australian Government Environment Minister.[42]

5.45 This assessment arrangement has been used for proposed shark control programs. In 2014, the then minister determined that the then Western Australian Government's proposed Shark Hazard Mitigation Drum Line Program 2014–2017, which would have involved the deployment of temporary and static drum lines between certain times of the year over three years, was a controlled action under the EPBC Act.

5.46 The EPA assessed the proposal by a Public Environmental Review (PER). In relation to the potential impact of the proposal on matters on national environmental significance, the program was 'assessed by way of an accredited process with the EPA under the bilateral agreement with the Commonwealth Government made under section 45 of the EPBC Act'. The bilateral agreement allowed the minister to 'to rely on the PER process of the State of Western Australia in assessing the action under the EPBC Act'.[43]

5.47 Another aspect of the relationship between tiers of government is that it appears necessary for the DoEE, in undertaking a risk-based approach to regulation with limited resources, to accept certain information presented by state governments without seeking further details. This is apparent from the committee's questioning of DoEE officers regarding the effects of shark encounters on tourism, which was cited as a reason given by the New South Wales Government to seek an exemption from the EPBC Act's assessment and approval process (this particular matter is discussed later in this chapter). In relation to this, DoEE officers confirmed that the letter from the New South Wales Government outlining these effects on tourism activity were the only details provided by the government in support of this argument. When confirming that a study or further information in support of these statements was not provided, Mr Cahill, a first assistant secretary at DoEE explained:

> As a regulator you make judgement calls on which assertions you need to test. Given it came from a tier of government and it was a matter that they were considering in their own statutory process, we relied on that advice.[44]

42 DoEE, *Submission 55*, p. 4.

43 Western Australian Environmental Protection Authority, Report No. 1527, p. 19.

44 Mr Matthew Cahill, DoEE, *Committee Hansard*, 16 March 2017, p. 22.

Exemptions in the national interest

5.48 As noted above, established lethal shark control programs that pre-date the commencement of the EPBC Act are not required to be assessed under the EPBC Act. In addition to this statutory exemption, individual exemptions granted under section 158 of the EPBC Act have been relevant for enabling trials of shark control programs by state governments.

Overview of section 158 exemptions

5.49 Under section 158 of the EPBC Act, a person proposing to take a controlled action, or the designated proponent of an action, may apply in writing to the minister for an exemption from a specified provision of part 3 or chapter 4 of the EPBC Act. That is, the minister may, by written notice, exempt a specified person from any or all steps in the assessment and approvals process in relation to a specified action. However, the minister may grant exemptions under section 158 only when satisfied that it is in the national interest.[45]

5.50 The DoEE explained that the provisions of section 158 'do not prescribe or limit the matters the minister may consider in determining the national interest in taking a particular action'. In addition, beyond a requirement that an application for an exemption must be in writing, the DoEE advised that there are no regulations that prescribe what must be included in an application.[46] Furthermore, the DoEE confirmed that the minister is not required to specify an end date for a particular action. Mr James Tregurtha, an acting first assistant secretary at the DoEE, commented:

> Usually you would expect that an action would have a start and an end date, but it's possible to conceive of an action that may not have an end date which could be granted a national interest exemption. I won't get into hypotheticals, but it is possible to conceive of that.[47]

5.51 The EPBC Act, however, does establish timeframes for decision-making as well as for publication of both the notice exempting an action and the minister's reasons for granting the exemption.[48]

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45 The EPBC Act provides the following guidance on the scope of national interest: 'In determining the national interest, the Minister may consider Australia's defence or security or a national emergency. This does not limit the matters the Minister may consider'. EPBC Act, s. 158(5).

46 DoEE, *Submission 55*, pp. 7–8.

47 Mr James Tregurtha, Acting First Assistant Secretary, Environment Standards Division, DoEE, *Proof Committee Hansard*, 14 November 2017, p. 10.

48 Specifically, the minister must decide within 20 business days of receiving an application whether or not to grant the exemption and that, within ten business days of making a written notice exempting an action under section 158, a copy of the notice and the minister's reasons for granting the exemption must be published. EPBC Act, ss. 158(2) and (7).

5.52 The use of section 158 exemptions in relation to shark control measures can trigger Australia's obligations under the Bonn Convention. In addition to offences and assessment requirements relating to migratory species that reflect Australia's obligations under the Bonn Convention, various provisions of the EPBC Act stipulate that the minister must not act inconsistently with Australia's obligations under the Bonn Convention.[49]

5.53 Under Article 3 of the Bonn Convention, four exceptions to the taking of listed migratory species are permitted. Of relevance, one of the allowed exceptions is if 'extraordinary circumstances so require'. Exceptions must be 'precise as to content and limited in space and time' and the taking allowed by the exception 'should not operate to the disadvantage of the species'.[50]

Use of section 158 in relation to shark control programs

5.54 Exemptions under section 158 have been granted in 18 instances since the EPBC Act commenced. Of these 18 exemptions, four relate to lethal shark control measures. The four shark control-related exemptions were for the following matters:

- the Western Australian Government's setting of up to 72 baited drum lines (notice dated 10 January 2014, in effect until 30 April 2014);
- the Western Australian Government's imminent threat policy, which involved the deployment of fishing gear in Western Australian state waters, for up to three days, to catch a shark determined to pose an imminent threat to public safety as defined in the Western Australian Department of Fisheries Guidelines (notice dated 2 October 2014);
- the New South Wales Government's first North Coast Shark Meshing Trial (notice dated 16 November 2016); and
- the New South Wales Government's second North Coast Shark Meshing Trial (notice dated 26 October 2017);

5.55 The exemption for the first New South Wales north coast trial was granted by the minister based on arguments put forward by the New South Wales Government in its application for an exemption and a briefing from the DoEE. Conclusions reached by the minister included the following:

- Risk to human life—the minister concluded that 'there was a material risk to humans from interactions with sharks in the North Coast of NSW'. This conclusion followed advice from the New South Wales minister that there was an 'urgent and imminent threat from shark interactions to human life in the trial area', with 41 interactions with sharks in New South Wales waters since 1 January 2015, including three that resulted in fatalities.

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49 EPBC Act, ss. 34E, 37H, 54, 140 and 146L.

50 *Convention on the Conservation of Migratory Species of Wild Animals*, opened for signature 23 June 1979, 1651 UNTS 356 (entered into force 1 November 1983).

- National economic impacts—the minister noted that the North Coast of New South Wales 'is a major national and international recreation and tourism destination' and a gateway to the Gold Coast. The minister concluded that 'the loss of confidence in water-based activities has, and is likely to continue to, impact on tourism and other associated industries, with flow-on effects to the broader Australian economy'. Therefore, the minister formed the view 'that the public safety of water activities in the North Coast of NSW is a matter of national interest'.
- Research objectives—the minister determined that research outcomes of the proposed trial 'are an important benefit, which will be in the national interest in helping to design future shark mitigation' strategies at various locations across Australia'.[51]

5.56 The minister also took into account evidence regarding the effectiveness of shark nets in protecting people, potential impacts on matters of national environmental significance, the measures contained in the management plans to minimise the impact of the program on marine fauna, and reporting and monitoring arrangements for the trial. Finally, after noting that the peak time of year for water-based activities was approaching, the minister also accepted that requiring the New South Wales Government to follow the EPBC Act assessment process would 'likely prevent the deployment of the mesh nets until after the peak period of use of the marine environment'.[52]

5.57 In granting the second exemption for a two-year period, the minister took into account similar factors and reached similar conclusions. The need for data, however, was emphasised. The minister's written reasons for granting the exemption included the following statement:

> …subjecting the proposed action to EPBC Act assessment and approval requirements would delay the provision of new data regarding the relative efficacy of the different shark deterrent measures and prevent other jurisdictions from using this data when required to make decisions about shark control measures.[53]

51 DoEE, *Submission 55*, Attachment 4, p. 6.

52 DoEE, *Submission 55*, Attachment 4, pp. 6, 9.

53 Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, 26 October 2017, http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=a99fcc21-38c0-e711-b175-005056ba00a8 (accessed 9 November 2017), p. 6 [paragraph 30].

Support for the use of section 158 exemptions for shark control measures

5.58 The clearest expressions of support for the use of section 158 to exempt shark control measures in instances where to do so is considered to be in the national interest can be drawn from the applicants and decision-makers who have been involved in recent decisions. That is, although they did not directly participate in this inquiry, it is clear that the current and former ministers and the New South Wales Government have determined that in some instances it is appropriate to use section 158 to enable trials of lethal shark control measures.

5.59 The use of section 158 did not generally attract comment from individuals and organisations which support the use of lethal shark control measures. Nevertheless, some individuals expressed support for the argument that it can be in the national interest to exempt shark control measures from assessment and approval under the EPBC Act. For example, Mr John Heaton wrote in his submission:

> I fully support the NSW Government writing to the Federal Minister for the Environment, Josh Frydenberg requesting him under Section 158 of the above Act, to approve the six month trial of shark nets along beaches of the North Coast.
>
> Furthermore, if any other area experiences a similar level of shark/human interaction similar to what I have outlined in my introduction of this submission (2 years – 2 fatalities, 9 attacks with injuries, 7 attacks without injuries), then that area should be afforded the same deterrent measures available.
>
> I make no apology for supporting measures that puts human life above marine life.[54]

Opposition to the use of section 158 for shark control measures

5.60 Most stakeholders who commented on decisions to exempt shark control measures from assessment and approval on the grounds that doing so is in the national interest were opposed to the decisions that have been made. These submitters consider that the use of the national interest exemption for such measures is unjustified and contrary to the overarching principles of the EPBC Act. Key arguments presented include that:

- killing threatened and migratory species is contrary to the protections given to those species under Australian law and international agreements;
- shark nets in particular result in a high level of bycatch of non-target marine species, including protected species; and
- these negative effects are realised for measures that have questionable effectiveness in reducing the likelihood of fatalities or injuries caused by

54 Mr John Heaton, *Submission 11*, p. 3.

shark species known to present a danger to humans (this argument was examined in Chapter 3).

5.61 For example, the NSW Young Lawyers Animal Law Committee (ALC) argued that the section 158 notices given to the New South Wales and Western Australian governments were 'granted without adequate public consultation, were inconsistent with scientific research and represent a significant undermining of intended objects and governmental responsibilities under both domestic and international law'.[55] After noting that shark control programs remove or reduce shark species from the marine ecosystem, and have 'far-reaching environmental impacts…on other marine fauna', the NSW Young Lawyers ALC submitted that:

> …to grant any person an exemption from the requirement to undertake an environmental impact assessment and/or obtain approval in relation to programs for the killing of the White Shark (and their associated problems of bycatch) is in direct opposition with the objects of the EPBC Act to provide for the protection of the environment, promote the conservation of biodiversity and to assist in the co-operative implementation of Australia's international environmental responsibilities.
>
> Furthermore, the grant of exemptions in relation to existing lethal programs would not appear to be guided by the principles of ecologically sustainable development or supported by the application of the precautionary principle.[56]

5.62 In forming its view, the NSW Young Lawyers ALC argued that decisions to allow actions that involve the killing, injuring, taking, trading, keeping or moving of listed threatened species on the grounds that doing so is in the national interest should occur only when such action is 'reasonably necessary to prevent a risk to human health or to deal with an emergency involving a serious threat'.[57] The ALC stated that 'research illustrates that sharks do not pose the serious public safety that is often suggested and as such the public interest argument relied upon in the grant of the exemptions is not justified'.[58]

5.63 Similarly, Australia for Dolphins argued that the use of section 158 exemptions:

> …is not fulfilling the stated objects of the EPBC Act…namely to provide for the protection of the environment and promote the conservation of biodiversity. Exemptions issued under section 158 should only be granted in very rare instances and not in the case of lethal shark nets, where the data demonstrates the threat to marine life is high.[59]

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55 NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 7.

56 NSW Young Lawyers Animal Law Committee, *Submission 61*, pp. 8–9.

57 NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 7.

58 NSW Young Lawyers Animal Law Committee, *Submission 61*, p. 7.

59 Australia for Dolphins, *Submission 4*, p. 3.

5.64 The Australian Marine Conservation Society (AMCS) acknowledged that although rare, 'unwanted interactions with sharks…can have tragic consequences'. Nevertheless, the AMCS argued that such interactions 'cannot be entirely prevented and do not constitute a national emergency of any kind'.[60] SEA LIFE Trust expressed a similar position:

> SEA LIFE Trust is of the view that the relatively small number of shark incidents, although tragic when they do occur—in northern New South Wales particularly—does not qualify as a national emergency, nor is it in the national interest to have, and it does not warrant, an exemption to the EPBC Act to enable the expanded deployment of shark nets and drum lines.[61]

5.65 Ms Nicola Beynon from HSI described the decisions as being an 'abuse of the national interest exemption'.[62]

5.66 Some submitters argued that, rather than it being in the public interest to exempt the measures, the actions permitted by the exemptions were contrary to the national interest. The Australian Conservation Foundation argued that the deaths and injuries to threatened species such as dugongs and turtles that shark nets and drum lines cause is 'against Australia's national interest'.[63] Likewise, Australia for Dolphins submitted:

> …given a high proportion of tourists come to Australia to view our beautiful marine life, it is not in the national interest to deploy nets which cause significant harm to already threatened and endangered marine animals. Indeed, the nets are arguably doing the most harm to the animals that tourists come to Australia to see.[64]

5.67 The EDOs of Australia argued that the use of section 158 to exempt shark control measures from environmental assessment is 'inappropriate' as:

- the measures have 'questionable efficacy' for reducing the risk of human–shark interactions, but are known to impact on threatened and protected species; and
- there is a lack of knowledge 'about the extent to which many of these species can withstand the loss arising from shark culls'. [65]

60 Australian Marine Conservation Society, *Submission 38*, p. 4.

61 Ms Claudette Rechtorik, Manager, SEA LIFE Trust Australia/New Zealand, *Committee Hansard*, 16 March 2017, p. 7.

62 Ms Nicola Beynon, HSI, *Committee Hansard*, 17 March 2017, p. 34.

63 Australian Conservation Foundation, *Submission 51*, pp. 1–2.

64 Australia for Dolphins, *Submission 4*, p. 3.

65 EDOs of Australia, *Submission 42*, p. 6.

5.68 Accordingly, the EDOs of Australia argued that 'all existing shark cull measures and any new proposals should be subject to full and rigorous environmental assessment'.[66]

5.69 Professor Daniel Bucher argued that in assessing section 158 proposals for shark control measures, the minister should require three issues to be addressed satisfactorily:

- First, the proponent of an activity should demonstrate that the proposed activity is likely to achieve its desired objective. For example, Professor Bucher argued that 'if you are proposing a beach netting exercise to reduce the risk of shark attack, you should be able to demonstrate that that net will actually intercept the majority of sharks coming into the beach—not 10 per cent'. Professor Bucher questioned whether a 10 per cent difference would be notice—he remarked: 'Is it going to change the risk and behaviour of people using that beach?'[67]
- Secondly, it should be considered whether the measure has a minimal impact on the rest of the environment. Professor Bucher argued that 'if you have a process that is supposed to catch sharks and is trying not to catch other things but kills—not catches, but kills—five times as many protected species as it catches sharks then it is not really succeeding in that line either'.
- Thirdly, in a point related to the preceding two, the minister should consider whether there are alternatives that are more efficient at catching sharks and less damaging to the rest of the environment. In developing this final point, the professor referred to SMART drum lines that have minimal bycatch mortality as evidence of a more efficient method than nets that is currently available. The professor concluded: 'if someone was to come to the Commonwealth and say they want an exemption to expand the netting program, I think it would fail on all three of those questions'.[68]

Concern about the recent usage and scope of section 158

5.70 Submitters expressed concern that the interpretation of what constitutes the national interest is changing over time. The EDOs of Australia observed that 'up until 2014, use of these exemptions were extremely rare and were most often used to protect threatened species at immediate risk of harm or for emergency responses in disaster situations'. However, the EDOs of Australia noted that the use of section 158 for shark control programs has only occurred from 2014 onwards.[69] A list of instances where section 158 has been used is at Table 5.2.

66 EDOs of Australia, *Submission 42*, p. 6.

67 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 45.

68 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 45.

69 EDOs of Australia, *Submission 42*, p. 4.

Table 5.2: List of exemptions granted under section 158 of the EPBC Act

Title/summary of exemption activity	Date of notice
North Coast Shark Meshing Trial, New South Wales	26 October 2017
North Coast Shark Meshing Trial, New South Wales	16 November 2016
Dispersal of the Grey-headed Flying-Fox camps at Batemans Bay, New South Wales	17 May 2016
The deployment of fishing gear in Western Australian state waters to catch a shark posing an imminent threat to public safety	2 October 2014
The exemption to capture, remove and establish a captive colony of Bramble Cay melomys (*Melomys rubicola*) from Bramble Cay, Queensland	3 September 2014
The establishment and operation of a captive management program for the Christmas Island Flying-fox (*Pteropus melanotus natalis*)	26 June 2014
Exemption for maritime environmental emergencies in accordance with the National Plan for Maritime Environmental Emergencies	6 March 2014
The setting of up to seventy two (72) baited drum lines each with a single approximately size 25/0 hook, in Western Australian state waters, and management of those lines	10 January 2014
Remediation of Flood Damage to the Warrego Highway near Marburg Range in Queensland	17 April 2011
The drilling of a relief well (and all associated activities) in production licence AC/L7 or AC/L8 to stop the current uncontrolled flow of oil, gas and condensate from the Montara H1 well	6 September 2009
Captive breeding program for the Christmas Island pipistrelle (*Pipistrellus murrayi*)	7 July 2009
Captive breeding program for the Christmas Island Blue-Tailed Skink (*Cryptoblepharus egeriae*) and the Christmas Island Forest Skink (*Emoia nativitatis*)	7 July 2009
All actions taken in response to the current severe bushfires in Victoria, including but not limited to clearance of vegetation, building of fire breaks and back burning	11 February 2009
Release of water from Lake Crescent Tasmania for essential human needs and stock	7 November 2007
The consolidation, during 2004, of science and technology activities	10 August 2004
Christmas Island Immigration Reception and Processing Centre and associated infrastructure	3 April 2002
South Australian Minister for Primary Industries and Resources, Spring-Summer 2000-2001 Australian plague locust control program	21 October 2000

Australian Maritime Safety Authority, National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances	28 August 2000

Source: DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), p. 9; 'EPBC Exemption Notices', http://epbcnotices.environment.gov.au/exemptionnotices (accessed 9 November 2017).

5.71 The EDOs of Australia, which expressed concern that the shark control measures have not been subject to assessment 'under present environmental standards', emphasised that it 'is important that these exceptional circumstances do not continue without the usual legal checks and balances enshrined in our environmental laws'. Accordingly, the EDOs of Australia argued that lethal measures should 'not be permitted to continue under an exemption to federal laws'.[70]

5.72 In light of the use of section 158 to enable the use of lethal shark control measures, some submitters expressed concern about the broad scope of 'national interest'. These submitters advocated for the section to be reviewed or amended.

5.73 As section 158 currently stands, DoEE officers confirmed that the term 'national interest' can be broadly interpreted. This was noted at paragraph 5.50, although the following evidence given by Ms Kim Farrant of the DoEE also provides a useful summary of the broad nature of the term:

> There are a range of reasons that the minister can use. The legislation sets out a range of reasons, like defence and other emergencies, but does not place any particular limits around the minister's discretion under that section of the act…There are no limiting matters.[71]

5.74 HSI noted that stated reasons for using section 158 to exempt trials of shark control measures include improving public safety and averting negative economic effects linked to potential reductions in coastal tourism. HSI expressed concern that the 'absence of information specifying what the minister must consider when making decisions as to whether an action is in the national interest enables the exercise of unrestrained ministerial discretion'. HSI argued that the current pattern of use of section 158 facilitates 'the making of decisions which go against the objects of the EPBC Act'.[72]

5.75 During evidence given at a public hearing, Ms Beynon, Head of Campaigns, HSI, elaborated on her organisation's concerns about the trend in the use of section 158:

> We are extremely concerned about the misuse of that clause, not just for shark nets and drum lines. It is also being used in the destruction of a flying

70 EDOs of Australia, *Submission 42*, p. 4 (emphasis omitted).

71 Ms Kim Farrant, Assistant Secretary, Assessments (NSW & ACT) and Fuel, DoEE, *Committee Hansard*, 16 March 2017, p. 20.

72 HSI, *Submission 43*, p. 13.

> fox camp at Batemans Bay. We think that, for the use of this clause, the bar for using 'national interest' is now set so low by the precedents that we are very concerned about what it could be used for in the future.[73]

5.76 Ms Beynon added:

> I think the clause needs constraint. Humane Society International was involved in the passage of the EPBC Act and advising the senators at the time who were supportive of the act. We were supportive of the act, and we looked at that clause. We thought, 'Well, that's broad,' but, at the time, everyone's understanding of the intention of that clause was for it to be used in very serious national emergencies—natural disasters, terrorism attacks; things of that ilk—not for declines in Nippers enrolments and sales at surf shops.[74]

5.77 To address this issue, HSI argued that section 158 should be reviewed and that guidance 'should be provided to outline the factors that must be considered when determining whether an action is in the national interest'. HSI argued that these factors should include 'conservation of biodiversity, promotion of ecologically sustainable development and protection of the environment'.[75]

5.78 The NSW Young Lawyers ALC also called for factors that must be taken into account when considering an application under section 158 to be prescribed. The ALC argued that 'the assessment of the exemption application should involve mandatory consideration of the principles of ecologically sustainable development and animal welfare issues and the appropriate balancing of those matters against competing interests'. To facilitate this, the ALC argued that the following test should be used when considering whether a proposed action that has, is likely to have or will have a significant impact on a listed threatened species, is in the national interest:

- the 'impacts of the proposed action on any listed threatened species must be identified, having regard to the objects of the EPBC Act, the principles of ecologically sustainable development and any animal welfare concerns';
- 'any identified conflicts with the objects of the EPBC Act and the principles of ecologically sustainable development and impacts on animal welfare must be considered in light of the harm to the national interest sought to be avoided or benefit to the national interest to be gained by granting the exemption'; in relation to this:
    - the 'objects of the EPBC Act and the principles of ecologically sustainable development are considered and adhered to the fullest extent possible';

73 Ms Nicola Beynon, HSI, *Committee Hansard*, 17 March 2017, p. 35.

74 Ms Nicola Beynon, HSI, *Committee Hansard*, 17 March 2017, p. 35.

75 HSI, *Submission 43*, p. 14.

- that any compromise to the objects of the EPBC Act, the principles of ecologically sustainable development or animal welfare is:
    - necessary to avoid the harm or achieve the benefit (that is, 'encroachments on animal welfare should be the minimum necessary to achieve the proposed outcome'),
    - reasonable and proportionate to the ends sought to be achieved; and
- the proposed action can be, and will be, executed and controlled in a way that meets high animal welfare standards and avoids unacceptable animal welfare outcomes.[76]

5.79 Whether the operation of section 158 has been considered in detail recently was of interest to the committee. The DoEE confirmed that section 158 was last reviewed in 2009 as part of the independent review of the EPBC Act undertaken by Dr Allan Hawke (the Hawke Review). The DoEE noted that the operation of the section was noted in the interim report of the Hawke Review, however, the 2009 final report 'made no recommendations in relation to section 158'.[77]

76 NSW Young Lawyers Animal Law Committee, *Submission 61*, pp. 13–14.

77 DoEE, Answers to questions on notice, 16 March 2017 (received 19 April 2017), pp. 4–5.

Chapter 6

New and emerging mitigation and deterrent measures

6.1 This chapter begins the report's examination into alternatives to established mitigation and deterrent measures. In doing so, this chapter focuses on new and emerging technologies, while the next chapter considers other approaches such as education.

6.2 Although the committee's focus is on particular categories of new and emerging technologies, such as personal deterrents and eco barriers, examining these categories necessarily involves discussing specific products within each category. This chapter outlines the evidence received to indicate how it informed the committee's consideration of the overall direction of research into new products and what categories of new and emerging technologies appear to have the greatest potential for increasing public safety.

6.3 The committee received evidence from companies involved in the research, development and/or sale of these products; understandably, these companies presented the strongest possible cases for their particular product or idea. Claims about the efficacy of particular products are presented in this report at face value, as it is not the role of the committee to select and promote a particular company or product over another. Consumers interested in this category of products should research and review the specifications carefully to ensure any product they select is suitable for their requirements.

Overview of new and emerging technologies

6.4 A 2015 report prepared for the New South Wales Department of Primary Industries (DPI) by Cardno identified several four categories of emerging shark deterrent and detection technologies. These categories are as follows:

- large-scale deterrents, which include a range of barriers that separate water users and sharks;
- personal deterrent devices;
- detection technologies, a category which includes land-based observer programs, acoustic and satellite tagging and tracking of sharks and sonar-based shark detection technologies; and
- SMART (Shark Management Alert in Real Time) drum lines.[1]

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1 Cardno, *Shark deterrents and detectors: review of bather protection technologies: Report prepared for the NSW Department of Primary Industries*, October 2015, www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/621407/cardno-review-of-bather-protection-technologies.pdf, pp. 3–4, 17. Pages 4–17 of the report provide an overview of each technology and discusses available evidence about their effectiveness.

6.5 Essentially, the emerging technologies seek to provide an effective safety product for water users while addressing some of the negative consequences of existing lethal measures, such as the impact lethal measures have on the marine environment. This point was well made by the Australian Institute of Marine Science (AIMS), which advised that a key advantage of new and emerging technologies is that they can address 'the conflict between species protection and human safety' that is inherent with lethal measures. AIMS noted that this conflict 'is likely to increase' as sharks are 'increasingly recognised as species of conservation concern'. Over time, it is expected that further species of sharks will be added to international treaties such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Bonn Convention and, therefore, provided with national and international protections.[2]

6.6 Although there is a range of alternative shark deterrent and mitigation measures at various stages of development, this chapter discusses the alternative measures that received significant attention during this inquiry. The first measure discussed are the SMART drum lines, followed by aerial surveillance, other surveillance programs (including land-based shark spotting programs, tagging programs and sonar technology), beach enclosures and eco-barriers, and personal deterrent products.

SMART drum lines

6.7 SMART drum lines are a new measure used in New South Wales. According to the DPI, SMART drum lines 'differ greatly from traditional drum lines as they are not designed to kill sharks'.[3] The committee was advised that drum lines use circle hooks which allow sharks 'to move around in a circle; therefore, [the hook] allows water to get into the gills and oxygenate the shark'.[4] When a shark is captured, a response team is alerted and responds to 'tag and potentially relocate the shark'. The SMART drum lines used in New South Wales are 'only deployed when a team is on hand for immediate response'.[5] In addition, mullet is used as bait with the aim to 'reduce the attraction of, and interaction with, other marine mammals (whales, dugongs and dolphins), seabirds and marine reptiles (turtles)'.[6]

2 Australian Institute of Marine Science, *Submission 49*, p. 6.

3 New South Wales Department of Primary Industries (DPI), 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016).

4 Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 16.

5 DPI, 'Shark management'.

6 Correspondence from Dr Geoff Allan, Deputy Director General, DPI, to Ms Kim Farrant, Department of the Environment and Energy (DoEE), dated 6 October 2016, pp. 1–2, tabled by the DoEE, Supplementary Budget Estimates 2016–17, 21 October 2016.

A DPI Fisheries research program involving 15 SMART drum lines conducted between August 2015 and 30 September 2016 resulted in the capture of 34 white sharks and 15 bull sharks, all of which were tagged and released alive. During this period, only two non-target species were caught, and both were also released alive. As a result of these findings, on 2 October 2016 the New South Wales Government announced that it would use an additional 85 SMART drum lines.[7] As at July 2017, 35 SMART drum lines were allocated to the north coast, with a further 50 to be trialled off beaches in off beaches in the Shellharbour-Kiama, Shoalhaven, Mid North Coast, Forster and Byron Bay regions.[8]

6.8 SMART drum lines have been successful in catching sharks when compared to traditional lethal measures—Dr Daniel Bucher and Professor Peter Harrison observed that 'in one day during January the SMART drum lines caught as many sharks as the nets caught in the entire month'. Dr Bucher and Professor Harrison also noted that bycatch on SMART drum lines is low and although the 'method of hooking a large shark by its mouth and dragging it further offshore does raise some cruelty issues, but short-term post-release survival rates are good'.[9] Overall, Dr Bucher and Professor Harrison concluded:

> Although we prefer to support observational and warning strategies rather than shark removal options, it is clear that smart drumlining is a more effective and far less destructive method to remove dangerous sharks from beaches than nets…[10]

6.9 Humane Society International (HSI) has a 'cautious open mind' towards SMART drum lines.[11] Provided that strong monitoring continues and the technology does not adversely affect any marine species, HSI considers that the drum lines 'could be a possible non-lethal replacement for nets'. Ms Jessica Morris from HSI explained the factors that informed this conclusion as follows:

> We did have concerns when we first heard that they were going to be used, because the only trials that had been done were at Reunion Island. At the time, we were very much concerned for hammerheads because, even though they are a non-target species, they are captured on drum lines. And then the post-release mortality was a big concern for us, because they are very susceptible. The Reunion Island's trial showed that hammerheads were dying within the two-hour period that they have to come out and

7 Correspondence from Dr Geoff Allan, DPI, to Ms Kim Farrant, DoEE, dated 6 October 2016, p. 2, tabled by the DoEE, Supplementary Budget Estimates 2016–17, 21 October 2016.

8 The Hon Niall Blair MLC, 'NSW gets SMART on sharks', *Media release*, 3 July 2017.

9 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, pp. 5–6.

10 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, pp. 5–6. A similar conclusion was reached by Ms Kathrina Southwell, General Manager, Australian Seabird Rescue. See *Committee* Hansard, 2 May 2017, p. 67.

11 Ms Nicola Beynon, Head of Campaigns, Humane Society International (HSI), *Committee Hansard*, 17 March 2017, p. 40.

> unhook them, and some animals were being eaten on the drum lines before the contractor could come out and take them off. We did have concerns initially, but so far in New South Wales, with DPI running it, there have been no mortalities from the SMART drum lines. But we were worried, because there were a few great hammerheads caught. If they are not tagging these non-target species we do not know if they are going off and dying as a result.[12]

6.10 Representatives of Sea Shepherd made similar comments. Ms Natalie Banks stated:

> The smart drum lines have caught various shark species in New South Wales. They have tagged and relocated those sharks, which allows us to get evidence that those sharks are surviving, because the tags are being picked up and their data analysed. If Western Australia was to look at SMART drum lines, it would be something that I would not be as vocal about as I was about a static drum line that does not allow a shark to move around.[13]

6.11 However, other stakeholders on either side of the argument about the current need for lethal measures expressed scepticism about the merits of SMART drum lines. The Sunshine Coast Environment Council submitted that the measures are questionable on animal ethics grounds and their contribution to public safety:

> Although 'Smart' drum lines provide a degree of research benefit, they still harm marine life and provide the same false sense of security as standard drumlines and nets. Given the small number of sharks tagged, this cannot be considered a major solution or enhancement to ocean-user safety. Likewise, animals susceptible to stress related death like that of the Hammerhead species have a significantly reduced chance of survival once released.[14]

6.12 Individuals who consider lethal drum lines are successful were critical of the tag and release approach used by SMART drum lines. Mr Donald Munro commented:

> The only problem is that that shark is still released. No matter how far off the shore they tow them, they can end up coming back if they are of a mind to—and they are. Tagged or not, they are still a risk to ocean-goers. It is a double-edged sword, that one.[15]

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12 Ms Nicola Beynon, Head of Campaigns; Ms Jessica Morris, Marine Scientist, HSI, *Committee Hansard*, 17 March 2017, p. 40.

13 Ms Natalie Banks, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 16.

14 Sunshine Coast Environment Council, *Submission 35*, p. 7.

15 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 2.

6.13 Mr Alan Baldock stated:

> They are releasing them from the SMART drum lines. I watch them from the beach with binoculars. I have seen huge sharks getting released only about 200 or 300 yards off the beach. What is the sense in that?…You say, 'What are you letting it go for? Come on! You have a chance.' There are families swimming there.[16]

Advances in aerial surveillance

6.14 As discussed in Chapter 3, fixed wing and helicopter aerial patrols are a long-established tool for shark spotting with four aerial patrols currently in use in Australia that are dedicated to bather protection.[17] Although the method is fundamentally not new, evidence was received about how technological advancements could improve shark spotting, particularly by improving spotting rates across a wide range of conditions.

Multispectral and hyperspectral imagery

6.15 Mr Duncan Leadbitter, Director, Australian Aerial Patrol, discussed how hyperspectral scanners could enhance detection efforts where the clarity of the water is an issue or to address reflections from the water—essentially, the technology could help 'the human eyes to look deeper into the water'. Mr Leadbitter advised that, although funding for research into this technology has been made available, his organisation has been unsuccessful in obtaining funding to deploy the technology on aerial patrols.[18]

6.16 The committee was also referred to multi-spectral camera technology that 'can eliminate the limitations inherent in detecting animals solely in the visible wavelengths of light'.[19] Specifically, the committee received evidence about a product called Shark Alert, which uses a 'multispectral camera to look at sharks in deeper water than the current technology'.[20] The managing director of the company behind Shark Alert, Mr Chris Gurtler, described the technology as being 'an innovative method to detect sharks over a wide area, deep below the water surface, using military grade multispectral technology'. Mr Gurtler added:

> The technology was originally designed for the US navy to detect Russian submarines. We have now customised it to detect sharks at depth in the ocean…Our system of protection includes a suite of technologies from

16 Mr Alan Baldock, *Committee* Hansard, 2 May 2017, p. 12.

17 Australian Aerial Patrol, *Submission 6*, p. 9.

18 Mr Duncan Leadbitter, Director, Australian Aerial Patrol, *Committee Hansard*, *Committee Hansard*, 17 March 2017, p. 21.

19 Associate Professor Daryl McPhee, *Submission 58*, pp. 5–6.

20 Dr Craig Blount, Senior Environmental Scientist, Cardno (New South Wales/Australian Capital Territory) Pty Ltd, *Committee Hansard*, 17 March 2017, p. 14.

> radiometric and algorithmic analysis detection, transition of shark details and type to public notification via our partner app Dorsal. We have designed a waterproof smart watch for surfers that will run our notification platform, enabling them to simply leave the water when a dangerous shark is nearby.[21]

6.17 Dr Craig Blount, a senior environmental scientist with Cardno, who has reviewed the Shark Alert technology, noted that it addresses the problem of only being able to detect sharks that are on or near the surface. He added, however, that like any aerial survey, multispectral camera technology is limited to temporal coverage; that is, 'they fly over once and that is it'.[22]

Unmanned aerial vehicles

6.18 Although new and emerging technologies may assist traditional aerial patrols, most of the evidence received in this area related to the potential for unmanned aerial vehicles (UAVs), which are more commonly referred to as drones.

6.19 Some submitters highlighted, and were optimistic about, the potential for drones to assist with efforts to reduce the risk of humans encountering dangerous sharks. For example, Australia for Dolphins included the following observations about drones in its submission:

> Drone technology is growing at a rapid pace, and a recent trial in 2016 of the Westpac-funded "Mini Ripper" drone was found to be very effective. The drone is fitted with a video camera, loudspeaker and an emergency pod containing lifesaving equipment capable of being dropped into the ocean remotely.
>
> Further research is currently being conducted at Sydney's University of Technology to fit the drone's video camera with specific software that would give it the ability to recognise a shark in the water.[23]

6.20 Surf Life Saving NSW and Australian Lifeguard Service NSW explained that Surf Life Saving NSW has been involved in trials of drones in various locations in New South Wales and that individuals involved in both organisations have undertaken UAV pilot training to further develop 'capacity for enhanced beach surveillance and response'.[24]

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21 Mr Chris Gurtler, Managing Director, Shark Alert, *Committee Hansard*, 20 April 2017, p. 51.

22 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 14.

23 Australia for Dolphins, *Submission 4*, p. 3.

24 Surf Life Saving NSW and Australian Lifeguard Service NSW, *Submission 15*, p. 7.

6.21 Associate Professor Daryl McPhee argued that drones 'will more than likely' replace the 'traditional approach of using people in planes and helicopters to spot sharks', which he considered is 'outdated'. The associate professor added:

> Which drones are optimal and protocols around their use are part of ongoing investigation, but there use is likely to become more widespread and their efficacy improve.[25]

6.22 The cost associated with drone technology also appears to be decreasing. The Mayor of Ballina Shire Council, Cr David Wright, referred to a drone that initially cost $100,000 but now costs less than $10,000. This includes a camera that was $30,000 but is now $800 'and completely waterproof and thermal and everything'. Cr Wright remarked that the drone technology 'is changing so quickly'.[26]

6.23 The potential for drones to support other lifesaving measures was noted. For example, Greenpeace, which called for funding to be provided for trialling drones as well as for other research programs, stated:

> There is potential for drones to be used to supplement shark spotting efforts by identifying sharks from above the water. If drones are found to work effectively, they could be a great additional resource for shark spotters and surf lifesavers. If the drones have a high success rate, they could eventually replace the Shark Spotters Program.[27]

6.24 However, it was noted that some of the challenges and limitations associated with traditional aerial surveillance similarly apply to drone surveillance. Dr Christopher Neff submitted that:

> …the use of drones, helicopters, shark spotters, and fixed wing aircraft all rely on the proper weather conditions and the public should be informed that cloud cover, white caps, sun glare, the type of shark, position of the shark, and size of shark can all affect visibility.[28]

6.25 In addition, the use of drones may encounter unique challenges. The Australian Aerial Patrol submitted:

> Drones as currently developed have some significant operational limitations such as time of flight (an hour for high end drones), range (experimental drones can travel about 40km but off the shelf solutions have far smaller ranges) and vulnerability to wind (a major issue on the coast in summer), amongst other issues.[29]

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25 Associate Professor Daryl McPhee, *Submission 58*, pp. 5–6.

26 Cr David Wright OAM, Mayor, Ballina Shire Council, *Committee Hansard*, 2 May 2017, p. 21.

27 Greenpeace Australia Pacific, *Submission 50*, p. 17.

28 Dr Christopher Neff, *Submission 48*, p. 5.

29 Australian Aerial Patrol, *Submission 6*, p. 10.

6.26 Dr Jan-Olaf Meynecke, who spoke positively about drone technology and the ability for it to replace the more expensive traditional aerial surveys, noted that in perhaps ten years' time automated drone systems could be capable of sending alerts to surf lifesavers. However, Dr Meynecke noted that there are potential safety issues associated with the technology, such as 'if they just fall from the sky and hit someone'.[30]

6.27 Sea Shepherd referred the committee to an article co-authored by a senior research scientist at the DPI and researchers at Southern Cross University. The article identified five major issues that drones need to overcome. These issues are as follows:

- civil aviation regulations;
- public safety concerns;
- public privacy concerns;
- the reliability of hardware; and
- the development of purpose-designed software that automatically detects sharks with a high level of accuracy.[31]

6.28 It was also noted that in order for drones to be effective, people are needed to operate the drones and monitor the video footage. Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW, explained that resources for surf lifesaving are already limited, regardless of whether the resources are provided by council or on a volunteer basis.[32] This is significant because, as Mr Leadbitter observed, 'the drone does not spot the sharks: it is the person who is watching the screen'.[33]

Information collected from tagging programs and sightings

6.29 Shark tagging programs aid research into shark movements and behaviour and are also intended to support public safety efforts by enabling the identification of individual sharks that approach the coast and areas of higher risk for water users generally.[34] The tags used include fin-mounted satellite tags and surgically inserted

30 Dr Jan-Olaf Meynecke, *Committee Hansard*, 31 July 2017, p. 12.

31 See Sea Shepherd Australia, *Submission 57*, p. 44. The article cited is B Kelaher, A Colefax, B Creese, P Butcher and V Peddemors, 'How drones can help fight the war on shark attacks', *The Conversation*, 3 February 2017.

32 Mr Kent observed 'If it is the council paying for the lifeguard services, that is at less cost to council; if it is us providing volunteers, it is less volunteer time'. Mr Andy Kent, Lifesaving Manager, Surf Life Saving NSW, *Committee Hansard*, 16 March 2017, pp. 15–16.

33 Mr Duncan Leadbitter, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 21.

34 Associate Professor Daryl McPhee, *Submission 58*, p. 3; DPI, 'Shark tagging', www.dpi.nsw.gov.au/fishing/sharks/management/shark-tagging-project (accessed 1 June 2017).

acoustic tags.[35] The committee received evidence that highlighted how tagging programs can help improve the understanding of shark movements and behaviour. CSIRO submitted that it:

> …works with a variety of State government and university-based research teams to achieve a broad coverage of tagging and genetic sampling of white sharks. This supports research into a national-scale understanding of their movements, behaviour and population status. Such information also helps with the interpretation of human-shark interactions and can inform assessments of the efficacy of both shark control programs as well as shark detection and deterrent devices.[36]

6.30 The tagging programs are linked to other shark management measures including SMART drum lines (sharks hooked on SMART drum lines are tagged where possible) and public safety websites and social media accounts that publicise when tagged sharks are detected near the coast. These online services include government-operated social media accounts, social media accounts operated by surf lifesaving organisations and dedicated apps such as Dorsal. At one beach in Western Australia, when a tagged shark is detected this information is used as part of a system of alarms and flashing lights that is active when the beach is not patrolled.[37]

6.31 A significant number of people refer to the information distributed as a result of tagging programs and public shark sightings. Mr Alan Bennetto from Dorsal advised that approximately 100,000 people use the Dorsal app. The users of Dorsal's social media sites total around 250,000 people.[38]

6.32 Dr Christopher Neff commented that shark tagging programs which provide the public with real-time information on sharks can 'reduce the underlying levels of risk and make beach-going safer'. Dr Neff continued:

> A good example of this is the education provided to the public by scientific shark tags, which highlight shark movements year round, and from which information can be displayed accessibly on smart phones. I recommend

35 DPI, 'Shark tagging', www.dpi.nsw.gov.au/fishing/sharks/management/shark-tagging-project (accessed 1 June 2017). For a description of how the tagging system works and the information collected, see Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 42.

36 CSIRO, *Submission 33*, p. 5. The committee was also advised that the tagging programs allow for genetic samples to be taken for analysis, which provides information useful for estimating population trends and the trend over time. Professor Nic Bax, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 7.

37 Mr Troy Pickard, Mayor, City of Joondalup, *Committee Hansard*, 20 April 2017, pp. 31–32.

38 During the committee's Brisbane hearing, Dorsal provided detailed evidence about the sources of the information relied on for the Dorsal app, including how public reports are filtered to ensure the reports are relevant, timely and sufficiently detailed. See Mr Allan Bennetto, Dorsal, *Committee Hansard*, 31 July 2017, pp. 42–43.

> continued scientific tagging of sharks and sharing of data with the public so they can have informed decisions before going in the water.[39]

6.33 Associate Professor McPhee, who described tagging programs as 'an important part of mitigation', noted that such programs are a 'long-term approach' as the efficacy of these efforts 'is enhanced when the number of animals tagged is large, and the number and location of receivers to detect tagged sharks are optimised'.[40]

6.34 Others, however, questioned the overall benefits of tagging programs for public safety. Australian Aerial Patrol submitted that:

> Tagging programs may provide some useful data on shark movements but their utility for protecting bathers is unproven and not evaluated by independent scientists. Tagging rates are low and the number of listening stations is unlikely to be of any relevance to bathers. The cost of a bather protection program would be astronomical and beachgoers deserve the full facts on what tagging programs can actually deliver.[41]

6.35 Dr Blount from Cardno noted that a practical limitation to shark tagging programs is that, for them to be effective, every dangerous shark or a large proportion of them would need to be tagged.[42] Dr Blount also noted there are a limited number of listening stations to detect acoustic tags. He considered this might not be clear to members of the public who rely on websites that use this information about detected sharks. He explained:

> I have looked at the SharkSmart app and where I live at Long Reef and where I surf there is no listening station. The nearest one, I think, is Bondi. So it kind of gives a false sense of security. If you do not really understand how the system works you look at your app and think, 'Well, there's no shark been spotted in my area for a long time,' but that is because there is no system in place to actually tell you if there is a shark there or not.[43]

6.36 Mr Duncan Leadbitter, Director, Australian Aerial Patrol, made a similar observation:

> If you look at the tagging work, the general public would think that all sharks have tags and there is a little beeper that goes off when a shark comes close to the beach. In reality, very few sharks are tagged. There are very few listening stations, and for the ones which are satellite tags, they

39 Dr Christopher Neff, *Submission 48,* p. 5.

40 Associate Professor Daryl McPhee, *Submission 58,* p. 3.

41 Australian Aerial Patrol, *Submission 6,* p. 3. See also page 22 of the submission.

42 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 13.

43 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 12.

> only work when the shark is on the surface. So these sorts of programs are quite misleading from a beach safety viewpoint.[44]

6.37 Mr John Heaton noted that a further limitation of the tracking apps is that surfers will not be using them when surfing. He stated:

> There is not much point in having that SharkSmart app on your phone, when it is in your trouser pocket locked in your car and you are out surfing, and the listening station goes off. It is useless.[45]

6.38 Mr Bennetto from Dorsal advised that, in response to this issue, it unsuccessfully sought funding from the DPI to develop a wearable device that provides users with real-time alerts. Mr Bennetto added that 'technology still needs to play a little bit of catch-up for that to be seamless'.[46]

6.39 Individuals may also not want to access information about shark sightings before they enter the water. For example, when asked whether he used the New South Wales Government's Sharksmart program, Mr Daniel Webber responded:

> No, I do not, and I do not want to know about it. I avoid people on the way to the surf so I do not have sharks on my mind. It is not fun thinking about sharks, and you try to keep busy. The worst thing that happens is when the surf backs off, you are dangling for 20 minutes and you start to think about it. Usually for me that is a downward spiral and within half an hour I get out.[47]

6.40 Whether the existence of multiple shark alert platforms, including those operated by state governments, surf lifesaving organisations and Dorsal, is an ideal arrangement was discussed. Mr Bennetto from Dorsal explained that Dorsal was established after a spike in shark encounters and when he realised a national register for surfers and other water users to check before entering the water did not exist. In developing the Dorsal app, Mr Bennetto advised that Dorsal contacted state fisheries departments and the state and national surf lifesaving bodies in an attempt to collaborate with those organisations, yet most of those efforts 'fell on deaf ears and we just went about doing it ourselves'. Mr Bennetto remains of the view, however, that a national platform to collate and disseminate shark information would be preferable to the current arrangement. Mr Bennetto stated:

> We have fallen into that platform by default, because there is nothing available. But I think there is room for improvement with a much more coordinated national approach and services. We need more stakeholders

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44 Mr Duncan Leadbitter, Australian Aerial Patrol, *Committee Hansard*, 17 March 2017, p. 20.

45 Mr John Heaton, *Committee Hansard*, 2 May 2017, p. 9.

46 Mr Allan Bennetto, Dorsal, *Committee Hansard*, 31 July 2017, pp. 44, 57.

47 Mr Daniel Webber, *Committee Hansard*, 17 March 2017, p. 29. Mr Dale Carr also described individuals using apps for a period that, after time, tired of reviewing the information and decided to use them no longer. See *Committee Hansard*, 2 May 2017, p. 16.

> from government, researchers, local communities and ultimately the water user.[48]

6.41 Animal welfare concerns were also expressed regarding the tags. Mr Fred Pawle submitted that 'there are reasons to believe that tags are not benign to sharks'. He explained:

> Most tags these days are surgically inserted. They emit regular beeps and are powered by batteries. Many satellite tags, which can be picked up anywhere on earth the shark breaches the ocean's surface, have suspiciously disappeared soon after they have been attached. Researchers are strangely incurious about the possibly malign effects they inflict. They are supposed to be recording "natural" behaviour, yet there are reasons to imagine they are significantly altering the behaviour of both the sharks and their prey.[49]

6.42 Dr Peter Kerkenezov, who discussed this issue extensively in his submission, argued that:

> It is…highly probable the demeanour of most captured sharks, inserted with a 69 kHz abdominal V16 acoustic tag transmitting at 150–162 dB power output, is altered for the rest of its pitifully shortened life span.[50]

6.43 Associate Professor McPhee, however, submitted that animal welfare issues associated with tagging 'can be dealt with through existing Animal Ethics protocols'.[51]

6.44 Finally, Professor Meeuwig expressed concern that, by tagging sharks, researchers could potentially be endangering them by providing a means by which the sharks could be tracked down and killed.[52] When questioned about this risk, Professor Nic Bax, CSIRO, acknowledged that as many tagging devices belong to state governments potentially the information could be used for this purpose. However, Professor Bax stressed that as only a small proportion of the shark population is tagged 'the likelihood that a tagged shark would be involved in one of those attacks is, correspondingly, relatively small'.[53]

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48 Mr Allan Bennetto, Dorsal, *Committee Hansard*, 31 July 2017, p. 42.

49 Mr Fred Pawle, *Submission 56*, p. 2.

50 Dr Peter Kerkenezov, *Submission 8*, pp. 4–5. See also Mr Kim Allen, *Submission 47*.

51 Associate Professor Daryl McPhee, *Submission 58*, p. 3.

52 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 43.

53 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 8.

Sonar technology

6.45 In the section on aerial surveillance earlier in this chapter, multispectral and hyperspectral imagery was discussed as a form of detection technology that may assist to overcome the difficulties associated with identifying sharks in the water visually. A further category of detection technology being developed for this purpose relies on sonar.

6.46 A product under development that uses sonar technology is Clever Buoy, which is a device being commercialised by Shark Mitigation Systems with funding from Google and investment from Optus.[54] Clever Buoy uses 'sonar technology coupled with tailored software to detect shark sized objects'.[55] Both the New South Wales DPI and the Western Australian Department of Fisheries have recently conducted in-water trials of the technology.[56]

6.47 Mr Richard Talmage, who is the general manager of the business developing Clever Buoy, explained that the technology does not utilise any deterrent measures; rather, it is an early warning detection system that facilitates information about sharks being disseminated to beach patrols and the public. Mr Talmage stated:

> Conceptually it works as a virtual shark net. We installed a number of sonar transducers and on the seafloor to create a virtual shark net, which is non-invasive to marine life. It lets them come and go as they please and provides an early warning system to beach authorities. It differentiates based on the size and shape and swim pattern of the object between different species. If it is determined to be highly likely to be a shark, that information is passed on to the beach authorities.[57]

6.48 On how the information about sharks can be disseminated to assist beach safety efforts, Mr Talmage explained that, for metropolitan beaches with volunteer or professional lifesaving services, the information can be communicated directly to them. As with information about tagged sharks, the sharks detected by Clever Buoy can also be made public via existing public warning systems, such as the Western Australian Government's Sharksmart program, which publishes information about

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54 Mr Richard Talmage, General Manager, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, p. 44.

55 DPI, 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016).

56 DPI, 'Shark management'; The Hon Joe Francis MLA, Western Australian Minister for Fisheries, and the Hon Bill Marmion MLA, Minister for Innovation, 'Trial of new shark detection technology', *Media release*, 26 November 2016, www.mediastatements.wa.gov.au/Pages/Barnett/2016/11/Trial-of-new-shark-detection-technology.aspx (accessed 5 December 2016).

57 Mr Richard Talmage, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, p. 41.

sharks detected to the general public via social media. For beaches in remote areas, Mr Talmage noted that the information could be provided to the police or a ranger.[58]

6.49 Mr Talmage used the recent trial at City Beach, Perth to provide an overview of how the technology detects and reports sharks in practice:

> Once an object enters the sonar's field of view, the software looks at that object's size, shape and swim pattern and determines whether there is a high probability that it is a shark. That happens within a few seconds. It continues to track and monitor that object while it is in the field of view of the sonar. As soon as we have detected an object that has a high probability of being a shark our system does two things…An alert goes straight through to the fisheries interface and that automatically goes out through their smart shark network. An alert also goes directly into a closed mobile application, so a lifeguard sitting on a beach or Surf Life Saving Western Australia's head office in Balcatta both get a notification through a mobile app…The mobile application will give them the size of the object and the date and time that it was detected; so, within a few seconds, they have got that information. We will also then geolocate the location of that object on a map. Similar to a Google map view, they will get a pin on a map saying this is where the object is. It will also show them the direction that object is heading in—for example, if it is heading parallel to the beach, into the beach or out to sea.[59]

6.50 Dr Neff expressed concern that the limitations of products such as sonar technology are not understood by the public. He argued that this technology 'can be heavily influenced by ocean conditions, swell, and may only be effective at low-energy beaches similar to Sydney Harbour'.[60]

6.51 It was emphasised, however, that the technology is at a trial stage. Mr Talmage explained that the City Beach trial had the following three key objectives: to undertake an environmental factor assessment; to enable the government to assess the stability and robustness of the technology; and to assess the practical application of the technology, including by working with the Department of Fisheries and Surf Life Saving Western Australia.[61]

6.52 Some submitters that follow the development of emerging technologies provided favourable comments about Clever Buoy. For example, the Australian Marine Conservation Society submitted:

> Clever Buoy is a rapid prototype, proof of concept R&D project that aims to develop shark detection technology. They are smart ocean buoys that

58 Mr Richard Talmage, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, p. 41.

59 Mr Richard Talmage, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, p. 43.

60 Dr Christopher Neff, *Submission 48*, p. 5.

61 Mr Richard Talmage, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, pp. 41–42.

> detect large swimming objects, like sharks, and send real-time valuable information to lifeguards on the beach. This technology has potential to improve detection and communication in real time, particularly at peak periods when large numbers of visitors visit the coast.[62]

6.53 As a category of emerging technology generally, AIMS submitted that systems intended to detect sharks could potentially be effective for metropolitan beach environments. AIMS commented that if systems designed to detect the presence of potentially dangerous sharks are coupled with a cost-effective early warning system, this could 'shape up as the most effective approach for minimizing human–shark interactions in these areas'.[63]

6.54 The current expense associated with systems such as Clever Buoy was noted, however. Dr Blount explained:

> Clever Buoy has a lot of potential, but it is very focused on a small area. Once you try and cover a whole beach or larger scale it is an incremental unit cost of the unit to have them. Say, for Bondi they may need 10 units…it will be a lot of money. It will be in the hundreds of thousands or the millions. That is just one beach. In terms of cost-effectiveness that is something that has to be considered.[64]

6.55 Mr Talmage countered that, as the system is a 'very new technology at the moment' that is 'evolving rapidly with more research and development', the costs are high at present but are expected to decrease over time. In particular, Mr Talmage emphasised that the system is being procured in small numbers (one to three units) at a high unit cost; if (or when) higher volumes are procured, there would be 'a significant reduction in unit cost'. Mr Talmage further argued that the cost of installing one Clever Buoy unit, which would provide coverage for approximately 400 metres, is comparable to the cost associated with installing and maintaining a shark net particularly once the lower operational costs of the Clever Buoy are taken into account.[65]

Beach enclosures and eco-barriers

6.56 As discussed in Chapters 3 and 4, shark nets cover a specific space but do not provide a barrier between swimmers and surfers and potentially dangerous sharks—they essentially are a passive fishing activity that removes sharks. However, the committee received evidence regarding beach enclosures that provide a physical barrier, including 'eco-friendly' barriers.

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62 Australian Marine Conservation Society (AMCS), *Submission 38*, p. 6.

63 Australian Institute of Marine Science, *Submission 49*, p. 5.

64 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 14.

65 Mr Richard Talmage, Shark Mitigation Systems, *Committee Hansard*, 17 March 2017, pp. 42–43.

6.57 Generally, eco barriers are 'made from nylon, with a clip-together interlocking mechanism hung between a nylon float line on the water surface and an anchored line along the seabed'.[66] Global Marine Enclosures, which is a developer of beach enclosures, explained that these products are intended to restrict large predators from entering the enclosed area while 'allowing smaller species such as fish to pass freely inside'. The nylon material prevents marine life from becoming entangled with the barrier; Global Marine Enclosures advised that there 'has never been any bycatch or entanglement in our beach enclosures'.[67]

6.58 Another business involved in eco barriers, Sharksafe Barrier, explained that its product:

> …successfully bio-mimics the visual effects of a kelp forest and combines this with a series of permanent magnetic (i.e. barium-ferrite magnets) stimuli to form a visual and magnetic barrier that dissuades sharks from passing through. It does not negatively affect any other marine life such as seals or bony fishes that naturally utilize the kelp forest as effective refuge areas.[68]

6.59 The key advantage of effective enclosures and barriers is that, for areas of the coastline where they are suitable, they can provide bathers with 100 per cent protection from sharks.[69] Global Marine Enclosures emphasised that, not only are its products effective in suitable conditions at keeping sharks away from beach users, they 'give ocean users confidence and peace-of-mind as they provide a physical barrier that can be seen'. Global Marine Enclosures continued:

> The point here is that a measure that increases actual safety without increasing perceived safety will lead to a suboptimal outcome as people will not enjoy the benefits of the ocean environment. The two must be achieved together, which is a key advantage that physical structures (beach enclosures) have over electrical, sonar, light pulse, and other experimental measures.[70]

6.60 Global Marine Enclosures argued that this benefit is proven by evidence that beach enclosures 'attract more people to the beach, including locals, visitors and tourists, who previously were not using the beach', with consequential benefits for

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66 Australia for Dolphins, *Submission 4*, p. 4. See also Global Marine Enclosures, *Submission 31*, p. 3.

67 Global Marine Enclosures, *Submission 31*, pp. 3, 4. For further details about the design and deployment of eco barriers, see Mr Troy Pickard, Mayor, City of Joondalup, *Committee Hansard*, 20 April 2017, p. 31.

68 Sharksafe Barrier explained that mimicking the kelp forest exploits the 'natural instinct of sharks of avoiding to enter thick kelp forests'. It also argued that the 'addition of the magnetic fields adds an extra safety measure, since large magnets proved to be a strong deterrent for shark species…' Sharksafe Barrier, *Submission 29*, pp. 3–4.

69 Professor Shaun Collin, *Committee Hansard*, 20 April 2017, p. 39.

70 Global Marine Enclosures, *Submission 31*, p. 3.

businesses associated with coastal tourism. Global Marine Enclosures acknowledged that the extent of these economic benefits is unknown and suggested that further research on this matters would be valuable.[71]

6.61 Eco barriers attracted support from environmental groups provided that the design of the barriers does not negatively affect marine life.[72]

6.62 Shark barriers are used successfully at Coogee Beach and Sorrento Beach in Western Australia.[73] The Mayor of the City of Joondalup, which includes Sorrento Beach, described the barrier there as being 'a significant success'. He explained:

> We have seen a dramatic increase in the number of people using Sorrento Beach as a safe swimming destination. They are not only from our community; there are a significant number of people coming from outside the city of Joondalup. Sorrento Beach is a very popular beach anyway, but we now have an asset in our city that is attracting visitations from other local governments across the metropolitan area. The northern corridor of Perth has a high proportion of immigrants—40 per cent of our community were born overseas—and many of them are not competent and comfortable in the ocean, so it provides them with peace of mind. Not only is there a surf club with an appropriate lifeguard on duty, but indeed there is now a beach enclosure.[74]

6.63 The New South Wales Government attempted trials of eco-friendly shark barriers at two beaches on the north coast. The Ballina Lighthouse & Lismore Surf Life Saving Club explained that the community supported the barrier as it was intended to provide whole of beach protection.[75] However, as the manufacturers 'were unable to safely and effectively install the barriers', the trials were discontinued in 2016.[76]

6.64 Dr Blount from Cardno commented on why conditions at the beaches chosen for the New South Wales trial were unsuitable for eco barriers, and indeed why many New South Wales beaches may be unsuitable. He explained:

> One of the special things about New South Wales is that it is a high-energy environment. There is quite a lot of swell. A greater than three-metre sized swell is pretty common, and you really need to have something that is capable of staying out there for a long time. You just have to look at the

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71 Global Marine Enclosures, *Submission 31*, p. 5.

72 AMCS, *Submission 38*, p. 6; HSI, *Submission 43*, p. 22; Greenpeace Australia Pacific, *Submission 50*, p. 16.

73 Australia for Dolphins, *Submission 4*, p. 4.

74 Mr Troy Pickard, Mayor, City of Joondalup, *Committee Hansard*, 20 April 2017, p. 31.

75 Ballina Lighthouse & Lismore SLSC, *Submission 52*, p. 2.

76 DPI, 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016).

> *Pasha Bulker*—ships actually wash up on the shore in New South Wales, so it is important that these things have durability.[77]

6.65 On the failed New South Wales north coast trial, Australian Seabird Rescue commented:

> Eco Shark Barriers were placed in areas that were not suitable as a trial at Lighthouse Beach in Ballina and Seven Mile Beach in Lennox Head. The barrier that was attempted to be installed at Seven Mile Beach at Lennox Head was far from an eco barrier. [Australian Seabird Rescue] received many pieces of nylon rope and plastic ties and buoys that had come loose from the barrier that were delivered to us from members of the public, that had been found on the beach. This created a hazard for marine wildlife and was an eyesore.[78]

6.66 Australian Seabird Rescue explained that it would welcome a new trial in areas 'not so affected by currents, waves and sand movements'.[79]

6.67 Some submitters were optimistic that the challenges associated with placing eco-barriers at high-energy beaches, including surf beaches, could be overcome. HSI submitted:

> A beach enclosure design funded by the French Government has been trialled at surf beaches on Reunion Island, with mixed results. Our first surf beach trial at Lennox Head in August 2016 proved unsuccessful due to installation challenges and dynamic sand movements affecting the barrier near the seabed. These issues were addressed in the design and installation methodology of the successful Quinns Beach project. The upgrades have been significant and we believe a second surf beach trial is warranted.[80]

6.68 In addition to the current challenges associated with successfully using eco barriers at high-energy beaches, a view among several submitters is that while eco barriers may be a suitable solution for bathers, there may have continued limitations for surfers due to the nature of the surfing activity. For example, Dr Blount told the committee:

> It is very difficult, in terms of the systems I have looked at, to come up with something that will protect surfers. A lot of them surf around headlands, not along the beaches themselves. There are all sorts of challenges with getting a system to operate around headlands as well as the beaches.[81]

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77 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 11.

78 Australian Seabird Rescue, *Submission 37*, p. 3. Mr Fred Pawle also commented on the hazards created by the failed trial: see *Submission 56*, p. 4.

79 Australian Seabird Rescue, *Submission 37*, p. 3.

80 Global Marine Enclosures, *Submission 31*, pp. 3–4.

81 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 16. Dr Christopher Neff also recommended that eco barriers be used in low-energy areas, such as the beaches in Sydney Harbour. See *Submission 48*, p. 5.

6.69 Associate Professor McPhee added that surfers 'do not necessarily want them—and for very good reason; they interrupt surfers'.[82]

6.70 The Queensland Department of Agriculture and Fisheries noted that other uncertainties of eco barriers at present 'include the ability to withstand multiple years of deployment and the potential escalating costs of cleaning of bio-fouling from marine growth'.[83] Dr Blount added that the barrier systems can be expensive, costing up to $1 million to install 'for one small beach or a part of a beach'.[84]

6.71 Nevertheless, there was significant support for eco barriers to be maintained or trialled at suitable locations, and for continued research to improve the technology. For example, HSI submitted:

> We suggest that further research be conducted to explore the effectiveness of eco-barriers in locations across Australia. Eco-barriers have proven to be effective for WA beaches. Northern QLD could be a suitable location for these barriers, due to the nature of wave action and a lack of surfing beaches. In particular, Eco-barriers would be an ideal replacement for nets and drumlines within the GBRMP, and use of these should be explored in locations that would be suitable in NSW and Southern QLD instead of lethal methods.[85]

6.72 Dr Sharon Burden also expressed support for measures such as eco barriers that isolate children from sharks and do not create other risks, such as entanglement.[86]

Personal and 'whole of beach' deterrent and protection products

6.73 There is a wide range of personal deterrents utilising emerging shark deterrent and detection technologies. These deterrents and other protection devices that are currently available or under development include chemicals intended to repel sharks, camouflage wetsuits and surfboards intended to disrupt shark vision, a protective Kevlar wetsuit, and electric deterrents and magnets.[87] Although other deterrent products were drawn to the committee's attention and their efficacy discussed,[88]

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82 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, pp. 38–39.

83 Queensland Department of Agriculture and Fisheries, *Submission 32*, p. 6.

84 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 11.

85 HSI, *Submission 43*, p. 23.

86 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, p. 23.

87 See Cardno, *Shark deterrents and detectors: review of bather protection technologies: Report prepared for the NSW Department of Primary Industries*, October 2015, www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/621407/cardno-review-of-bather-protection-technologies.pdf (accessed 5 December 2017), pp. 3–4, 17; Cr David Wright OAM, Mayor, Ballina Shire Council, *Committee Hansard*, 2 May 2017, p. 20.

88 For example, see Associate Professor Daryl McPhee, *Submission 58*, pp. 3–4.

electric deterrent products such as Shark Shield and RPELA were the subject of detailed examination during this inquiry.

Overview of products

6.74 Shark Shield is a range of personal electrical deterrents developed by a Western Australian company of the same name. Shark Shield takes advantage of small, short-range electrical receptors in shark snouts which are used for finding food. The electromagnetic field generated by Shark Shield is intended to cause 'unbearable spasms in these sensitive sensors which turn sharks away'.[89] At the committee's first Perth public hearing, Mr Lindsay Lyon, Managing Director, Shark Shield, provided further details about the technology utilised by Shark Shield. Mr Lyon stated:

> The way this works is that sharks have little gel-filled sacs they use to find food at close range, in the same way you and I use touch; they have to be that close. That is as well as sight, sound and all those things that they have. What this does is to create a very powerful electric field, so these little gel-filled sacs that they have, which are expecting to feel electrical field from a heartbeat or that kind of thing, get near this powerful electric field—if you could see it, it is about six metres by three metres and looks like a football—and it causes them to spasm and turns them away.[90]

6.75 After Mr Lyon advised that the technology uses a direct current of 100 volts, he explained:

> Even though that sounds like a lot, it is actually not a lot because you are in the water and you have a big body of water to spread that over. If you touch it, it gives you a shock. Think of it as more than a static electricity shock but significantly less than an electric fence shock. Interestingly, a lot of people reach around and grab it to know it is working. It gives them confidence. In fact—I now use this on my board all the time—every now and again, if I cannot feel it, I reach around to touch it and go: 'Yeah, it's working. It's okay.' It is sort of like a 'Listerine burns my mouth, so it must be good for me' kind of thing.[91]

6.76 Evidence was also received about another shark deterrent product for surfboards known as RPELA. Mr David Smith, who manages the company that develops RPELA, advised that the product is cost-effective and has the additional benefits of not affecting 'the way the board performs, and the surfers do not get affected by its electromagnetic field'.[92] The committee was advised that RPELA

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89 Shark Shield, 'Shark Shield Ocean Guardian', tabled 20 April 2017, p. 6.

90 Mr Lindsay Lyon, Managing Director, Shark Shield, *Committee Hansard*, 20 April 2017, p. 19. See also *Committee Hansard*, 28 July 2017, p. 57.

91 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, p. 19.

92 Mr David Smith, Chief Executive Officer, Surfsafe, *Committee Hansard*, 20 April 2017, p. 25.

would be subject to independent testing, with trials to be conducted in August or September 2017.[93]

6.77 Shark Shield attracted support from Associate Professor McPhee, who described it as a product that has been 'independently and scientifically tested' and which has been 'shown to significantly reduce the risk of a bite, but not eliminate it entirely'.[94] The associate professor explained that:

> In controlled experiments, when the Shark Shield was switched off—so when the sealed decoy was switched off; and this was in a high white shark area adjacent to a seal colony in South Africa, from memory—there was a 90 per cent chance of a bite. When it was switched on there was a 16 per cent chance of a bite. So scientifically there is a statistically significant reduction in risk from a Shark Shield. Is it zero? No. But the manufacturers, from my understanding, have never said it is zero, but there is a statistically significant reduction in risk—down from 90 per cent to 16 per cent. It is going to be a long time before anything improves on that.[95]

6.78 Associate Professor McPhee commented that:

> There may be other electric individual deterrents that can also be shown to be effective, but they have not been subjected to independent and rigorously designed testing to demonstrate that this is the case.[96]

6.79 As noted above, research has concluded that, in a test where sharks were allowed access to bait for a 10-minute period, the use of Shark Shield reduced the probability of a shark bite from 90 per cent to 16 per cent. That personal deterrents such as Shark Shield are not 100 per cent effective, however, was commented on by several witnesses. Dr Blount from Cardno observed that the product 'changes the behaviour of sharks so it reduces the potential for a shark to come closer to a person more than if you did not have one on'. He added that the user might still be attacked if they are wearing a Shark Shield 'but there is less chance of that happening'.[97] Dr Christopher Neff similarly noted that electronic shark deterrents do not provide

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93 Mr David Smith, Surf Safe, *Committee Hansard*, 28 July 2017, p. 66.

94 Associate Professor Daryl McPhee, *Submission 58*, pp. 3–4.

95 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 36. For more details about the experiments, see Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, p. 18; and Professor Shaun Collin, *Committee Hansard*, 20 April 2017, pp. 37–38. Professor Collin noted that his testing relates to the product used by divers (with a two metre antenna), not the product used with surfboards. The research which concluded that the probability of a shark bite was 90 per cent when the device was in power-off mode and 16 per cent when in power-on mode involved a test where sharks were allowed access to bait for a 10-minute period and the first version of the Shark Shield devices (knowns as SharkPOD). See Shark Shield, *Submission 1*, p. 7.

96 Associate Professor Daryl McPhee, *Submission 58*, pp. 3–4.

97 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 12.

guaranteed protection against shark bites, and stated that 'research suggests that much depends on the motives of the shark'.[98]

6.80 It was also acknowledged that, at present, certain personal electrical deterrents are not appropriate for children. With respect to the Shark Shield product, Mr Lyon advised:

> You cannot apply it to very small boards, so it actually does not work for young children and teenagers. The smaller the board the more the electrical field is likely to come around the board and interfere with the user's experience.[99]

6.81 However, evidence was received indicating that other products, such as RPELA, might be more suitable for children. [100]

6.82 Dr Blount also noted that personal deterrents do not provide 'whole-of-beach' scale protection.[101] Following the committee's April hearings, however, Shark Shield announced a pre-production release of a long-range version of its technology that could repel sharks up to a range of 100 metres away. It is intended that the technology, known as Ocean Guardian, will be subject to independent scientific testing.[102]

6.83 The committee is also aware of a shark repellent cable developed in South Africa by the KwaZulu Natal Sharks Board. At present, a 100 metre cable that emits a low frequency pulsed electronic signal is being tested in Cape Town.[103] Media reports in August 2017, however, suggest that the Western Australian Government has been in discussions with the KwaZulu Natal Sharks Board regarding a trial of the cable at Cottesloe Beach.[104]

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98 Dr Christopher Neff, *Submission 48*, p. 5.

99 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, p. 21.

100 See Mr David Smith, Surfsafe, *Committee Hansard*, 20 April 2017, pp. 25, 27.

101 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 12.

102 Shark Shield, 'Shark Shield announces breakthrough long range shark deterrent & capital raising', *Media release*, 1 May 2017. See also Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, pp. 21–22; *Committee Hansard*, 28 July 2017, p. 57.

103 KwaZulu Natal Sharks Board, 'Shark repellent cable', www.shark.co.za/Pages/SharkRepellentTechnology (accessed 9 November 2017).

104 R Ardon, 'Cottesloe set to get world-first electromagnetic shark cable', *The West Australian*, 18 August 2017, https://thewest.com.au/news/sharks/cottesloe-set-to-get-world-first-electromagnetic-shark-cable-ng-b88571488z (accessed 9 November 2017).

Role of government in relation to emerging commercial products

6.84 Electrical shark deterrents have attracted the attention of state governments. For example:

- the New South Wales DPI is monitoring emerging technology such as 'the development of electronic shark deterrents…to determine their effectiveness and suitability';[105] and
- as noted in Chapter 3, the Western Australian Government is trialling a program where rebates of $200 are available for independently verified devices purchased by surfers and divers. By September 2017, approximately 630 individuals had accessed the rebate.[106]

6.85 Several submitters and witnesses reflected upon what should be the role of government in relation to personal deterrents developed by the private sector. Some submitters argued that governments should invest in these personal products rather than spending money on lethal measures. For example, Australia for Dolphins is of the view that:

> …the government should be investing in emerging shark mitigation and deterrent measures…rather than continuing with out-dated techniques such as shark meshing and drumlines.[107]

6.86 Ms Claudette Rechtorik, Manager, SEA LIFE Trust Australia/New Zealand, noted that surfers, divers and snorkelers are at a higher risk of encountering a shark. Accordingly, Ms Rechtorik argued that the $16 million associated with the New South Wales shark management strategy instead could be used to subsidise electrical deterrents for these individuals.[108] Ms Belinda Atkins, Manager, Projects and Programs, Sydney Coastal Councils Group, suggested that government subsidies could be directed to a hire program for personal deterrent devices, which would be available to individuals undertaking activities that may expose them to a greater risk of encountering a shark than other ocean users, such as surfers.[109]

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105 DPI, 'Shark management', www.dpi.nsw.gov.au/fishing/sharks/management (accessed 5 December 2016).

106 The Hon Dave Kelly MLA, Western Australian Minister for Fisheries, 'Shark deterrents prove popular with community', *Media release*, 21 September 2017.

107 Australia for Dolphins, *Submission 4*, p. 4.

108 Ms Claudette Rechtorik, Manager, SEA LIFE Trust Australia/New Zealand, *Committee Hansard*, 17 March 2017, p. 10.

109 Ms Belinda Atkins, Manager, Projects and Programs, Sydney Coastal Councils Group, *Committee Hansard*, 16 March 2017, p. 4.

6.87 It was argued that there is a need to consider how to encourage greater uptake of independently tested personal deterrents,[110] such as promoting such devices in public safety campaigns.[111] Related to this, submitters and witnesses suggested that there is a role for government in assisting consumers to understand which products may be effective and to encourage individuals to use them. Dr Blount from Cardno, who advocated for this approach, argued it is particularly important for individuals 'in remote areas away from unpatrolled beaches where there is very little protection for bathers and surfers…to make good use of the personal protection devices in areas that the government cannot really cover through its existing programs'.[112]

6.88 Associate Professor McPhee (and others), emphasised that it is not the role of a government to endorse or promote particular products. Notwithstanding this, Associate Professor McPhee argued that governments do have a role in ensuring that 'consumers are fully informed on products designed to enhance human safety'. He added:

> Fully informing consumers should include identifying that a product has been independently tested by scientists, the type of shark species that it has been tested on, the spatial area over which a product is likely to be effective, and any other factors that may substantially influence effectiveness in a given circumstance (e.g. murky water).[113]

6.89 Noting that there is currently 'intense commercial activity in individual deterrents', Associate Professor McPhee emphasised that credible independent scientific testing is necessary for consumers to identify which products are reliable. The associate professor noted that in the market there are:

> …a lot of false claims and a lack of full disclosure of limitations in a form that is easily accessible for consumers. Further, there appears to be a reluctance by some manufacturers to subject their products to independent scientific testing. If money can be spent on substantial marketing of products, money can be spent on scientific testing. There is much "Science by YouTube". At least one manufacturer actively filters and removes any criticism or hard questions from their social media profile.[114]

6.90 Both Shark Shield and the manufacturer of RPELA emphasised the need for products to be subject to scientific testing. Shark Shield suggested that shark deterrent products are entering the market without being supported by independent research, which undermines 'the consumers' confidence in the product category'. Mr Lyon stated that in the shark deterrent product category 'a consumer today has no idea whether

110 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 6.

111 HSI, *Submission 43*, p. 23.

112 Dr Craig Blount, Cardno, *Committee Hansard*, 17 March 2017, p. 13.

113 Associate Professor Daryl McPhee, *Submission 58*, p. 4.

114 Associate Professor Daryl McPhee, *Submission 58*, p. 4.

they are buying something that has or has not been peer reviewed or is complete and utter snake oil—and, honestly, some of them are'.[115]

6.91 Shark Shield suggested that an Australian Standard for shark deterrent products is required to assist consumers to make informed purchases.[116] Shark Shield observed that other safety products designed to reduce risk, such as seat belts and bicycle helmets, are subject to regulated minimum standards.[117] Mr Lyon remarked:

> If you have an Australian standard for bike helmets you can go into a store and buy a bike helmet and have a degree of confidence that it will do what it is claimed to do.[118]

6.92 At a subsequent hearing, Mr Lyon hinted at difficulties in identifying where products such as Shark Shield 'would fit within Australian standards at this point in time'. As an alternative, Mr Lyon suggested a process could be developed by which manufactures would self-declare, by statutory declaration, whether their product meets certain government-endorsed criteria.[119]

6.93 AIMS noted, however, that it is difficult to test deterrent technology as 'humans cannot be used in tests, and simulating human interaction scenarios is complex'.[120] Associate Professor McPhee, who emphasised that the government has a role in ensuring that deterrent products are suitable for that purpose, commented that an Australian Standard 'would be tricky because of the diversity of approaches'.[121]

6.94 Professor Nic Bax, CSIRO, recognised that there appears to be uncertainty in the community about 'how some of the shark deterrent devices work, how well they work and in what situations they would work'. Professor Bax argued that 'Australian citizens would profit from having some clear advice which came from an authoritative body'. When considering what role CSIRO could have in supporting such a process, Professor Bax commented:

> I think CSIRO is open to how that body would be constructed, and we would certainly, I believe, support it. It's not necessarily our role to run that body, but I imagine that CSIRO would be happy to discuss with the appropriate groups to see what our role would be. We would be quite open, I think, to what our role would be.[122]

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115 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, p. 22.

116 The makers of RPELA and Mr Rick Gerring, whose brother Ben was killed in a shark attack, supported this position. See *Committee Hansard*, 20 April 2017, pp. 29, 46.

117 Shark Shield, *Submission 1*, p. 4.

118 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 20 April 2017, p. 22.

119 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 28 July 2017, p. 58.

120 Australian Institute of Marine Science, *Submission 49*, p. 5.

121 Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 39.

122 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 2.

6.95 Professor Bax continued by providing the following evidence on the issues that need to be addressed to improve consumer confidence in the product category:

> I think there are two issues…One is testing the devices to understand how they work. The other is reviewing what testing has occurred and whether the claims made by manufacturers actually are supported by the evidence they provide. I think our position has been: actually, it is very difficult to test these devices because, of course, fortunately shark attacks are quite rare. As I understand it…a lot of testing is done in South Africa, where they have a more clear aggregation of white sharks they can test against.
>
> So I would say that the role of an Australian group in this would not be to test these different devices; it would be to review whether the testing has been appropriate and whether the manufacturers' claims are backed up by evidence. [123]

6.96 Professor Bax suggested that a process for reviewing the scientific testing of deterrent devices could be a technical advisory group, reporting to a department or a minister, modelled on the stock assessment groups used by the Australian Fisheries Management Authority in fisheries management.[124]

Consumer support for the product category

6.97 Finally, it is necessary to consider the degree to which consumers, and in particular frequent water uses such as surfers, will use products such as electric personal deterrents.

6.98 Overall views on the potential of these products differ. For example, Dr Sharon Burden highlighted how these products support personal responsibility. Dr Burden commented that surfers who purchase a surfboard and wetsuit should also 'be able to budget for personal protective devices'. Dr Burden continued this line of argument by equating equated personal deterrents with protective equipment required for other activities that involve an aspect of danger:

> If a surfer says, 'I can't afford it,' to me that is like when my son wanted to get his motorbike licence. I would never have allowed him to get on a motorbike without a helmet or the best boots I could put on my credit card for him. I even went so far as to get him one of those Kevlar jackets, even though I couldn't afford it. I said, 'I'm going to kit you out in everything. My expectation is that you will wear them. If I see you on that motorbike on your learner plates without them, there will be trouble.'[125]

6.99 The cost associated with personal devices, however, may limit take-up by tourists, other occasional beachgoers and families with multiple surfers.[126]

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123 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 2.

124 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 2.

125 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, p. 19.

126 Mr Tony Isaacson, DiveCareDare, *Committee Hansard*, 31 July 2017, p. 49.

6.100 Occasional minor electric shock is another issue that users of particular products currently on the market encounter; some will tolerate the shocks, although others may decide to discontinue using the product because of them. Mr Daniel Webber told the committee:

> My experience…is I was really not confident in the initial experience of Shark Shield. I thought there was no way I am going to be able to surf and enjoy my surfing with these electric shocks. It seems bizarre, but after 10 or 12 surfs now I am actually used to it. It is because the benefit is that I am getting to surf plenty of waves and having fun. The disadvantage is getting zapped a couple of times—some of the shocks are quite nasty—but the benefits outweigh the disadvantages.[127]

6.101 However, other evidence received by the committee also reveals a broader issue in that some surfers may not be interested in personal deterrents, regardless of their effectiveness. Mr Webber provided the following observation:

> Oddly enough, among the hardcore surfers—and they are the ones that are surfing most regularly—almost none of them have it [Shark Shield]. There are definitely a lot of them in the area, but I think that they are mainly the surfers who are not surfing as frequently. I apply the 80-20 rule, which I think really does make a lot of sense: that 20 per cent of the surfers surf 80 per cent of the time. I am pretty sure that this group that I am familiar with—and we are mainly surfing at Lighthouse Beach—I do not think any of them have it. It is not like I have asked everyone. I see them after surfs and they do not have it attached to their board. I think the attitude among this crew is to simply take the risk and just get on with your life.[128]

6.102 Furthermore, some submitters and witnesses were sceptical about the current state of the product category. For example, Dr Meynecke, who stated that he prefers education and community outreach strategies over personal shark deterrent products, commented that he is 'concerned about some of the companies that are clearly making money out of this but not necessarily in the interest of the individual or of the public'.[129]

127 Mr Daniel Webber, *Committee Hansard*, 17 March 2017, p. 31.

128 Mr Daniel Webber, *Committee Hansard*, 17 March 2017, p. 32.

129 Dr Jan-Olaf Meynecke, *Committee Hansard*, 31 July 2017, p. 9.

Chapter 7

Other approaches

7.1 This chapter continues the examination of alternatives to currently employed mitigation and deterrent measures, such as shark spotting programs, making medical kits available at beaches to aid immediate responses to shark incidents and education. The chapter then discusses the evidence received regarding whether the various measures discussed in Chapter 6 and this chapter are ready to provide an effective response to the risk of shark encounters.

Shark spotting programs

7.2 In Byron Bay, a shark spotters program modelled on a program used in South Africa has been trialled. The program works by:

> …positioning "spotters" at strategic points along the beach and coastline. When a shark is spotted, a loud warning is issued and emergency assistance is called in the case of an incident. The spotters also work closely with local Surf Life Saving Clubs.[1]

7.3 In October 2017, it was reported that the Mayor of Busselton would support a shark spotting program if the proposal was also supported by the community.[2]

7.4 SEA LIFE Trust, which contributed funding to the Byron Bay trial, advised that in 2015–16 the Byron Bay shark spotters observed five sharks 'compared to only one recorded by authorities'. SEA LIFE Trust described the trial as 'highly effective and implemented at minimal cost'.[3] Sea Shepherd Australia, which has also been involved in efforts to encourage the development of shark spotting programs in Australia, noted that the South African program has operated successfully for over a decade.[4]

7.5 A wide range of environmental groups support the implementation of some form shark spotting program throughout Australia.[5] Sea Shepherd argued that a shark spotting program 'could be implemented easily and immediately into specific beaches

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1 SEA LIFE Trust, *Submission 25*, p. 6.

2 R Tetlow, 'Sharks put on the sport', *Sunday Times*, 22 October 2017, p. 22.

3 SEA LIFE Trust, *Submission 25*, p. 6.

4 Sea Shepherd Australia, *Submission 57*, p. 41.

5 See Australia for Dolphins, *Submission 4*, p. 3; Sunshine Coast Environment Council, *Submission 35*, p. 8; Greenpeace Australia Pacific, *Submission 50*, p. 16; Australian Seabird Rescue, *Submission 37*, p. 3; Australian Marine Conservation Society (AMCS), *Submission 38*, pp. 5, 6; International Fund for Animal Welfare, *Submission 40*, p. 3; Humane Society International (HSI), *Submission 43*, p. 22; Sea Shepherd Australia, *Submission 57*, p. 11;

in New South Wales, Queensland and Western Australia'. Sea Shepherd explained that two representatives of the South African program who visited Australia identified 'five beaches in South-West Western Australia, three in the Gold Coast, seven in northern New South Wales and two in Sydney which showed promise for a shark spotting program'.[6]

7.6 A key challenge with the program is staffing. The Shark Watch program used in Byron Bay is a volunteer program, which a key challenge for the program being 'retention and recruitment of enough volunteers to ensure the program's ongoing effectiveness'.[7] The South African program is a paid model,[8] which may be difficult to replicate in Australia due to higher labour costs.[9]

7.7 Mr John Heaton, who stated that he is any favour of any program 'that assists to reduce the number of encounters between humans and sharks', noted that even with the assistance of technology such as drones, shark spotting is 'very labour intensive'. Mr Heaton submitted:

> It is reported that NSW Surf Life Saving membership at Ballina and Lennox Head Clubs has decreased since the increased shark activity. I am involved in a volunteer organisation and it is even hard to get 4 people to volunteer 2 hours per day, four days per week.
>
> A Shark Watch NSW spokesperson is quoted as saying "We need 32 volunteers at one beach over two days from 9.00am to 5.00pm". Have a think about the number of beaches and headlands between Byron Bay and Yamba and try and come up with a figure to adequately cover that coastline! By all means, incorporate Shark Spotting as another mitigating measure wherever possible, but it is NOT the complete answer everywhere.[10]

7.8 Dr Christopher Neff noted that another limitation of shark spotting program is that, like other forms of surveillance, it requires certain weather conditions. Dr Neff argued that 'the public should be informed that cloud cover, white caps, sun glare, the type of shark, position of the shark, and size of shark can all affect visibility'.[11]

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6 Sea Shepherd Australia, *Submission 57*, p. 41.

7 Sunshine Coast Environment Council, *Submission 35*, p. 9.

8 Sunshine Coast Environment Council, *Submission 35*, p. 9.

9 Dr Craig Blount, Senior Environmental Scientist, Cardno (New South Wales/Australian Capital Territory) Pty Ltd, *Committee Hansard*, 17 March 2017, p. 12.

10 Mr John Heaton, *Submission 11*, p. 4.

11 Dr Christopher Neff, *Submission 48*, p. 5.

7.9 Other general observations about the limitations of surveillance are also relevant. Mr Andrew Stark, Chief Executive Officer, Surfing Australia indicated that surveillance measures can have value, but there are also clear limitations in their effectiveness. Mr Stark used the incident in 2015 when surfer Mick Fanning escaped from a shark during a surfing competition to illustrate his concerns:

> All of these different surveillance measures combined are good, but I would add that when Mick Fanning got attacked by a great white shark on live TV in South Africa, there was more surveillance than you could imagine. There were 10 cameras, thousands of people on the beach, spotters, and people looking straight at him in the water and the surrounding area, and no-one saw that great white shark. It was on live television.[12]

Medical kits

7.10 Another suggestion is that medical kits containing supplies for controlling bleeding and injuries should be made available at secure locations near a beach. Although only a small number of stakeholders commented this idea, those that did were supportive. The deployment of trauma kits can also be related to other programs, such as surf lifesaving and shark spotting programs. Kits developed by Sea Shepherd Australia include 'medical shears to cut through neoprene if necessary, trauma bandages, emergency blankets to keep a patient warm, tourniquets to stop the flow of blood loss, and a pictorial instructional sheet'.[13] The committee also received evidence that manufacturers of surfboard leg-ropes are producing leg-ropes that can also be used as a tourniquet.[14]

7.11 Cr Simon Richardson, Mayor, Byron Shire Council, explained that the kits ensure an immediate trauma response can be provided:

> The bottom line is that if there is an attack on the beach…sometimes those first few minutes can be quite crucial as far as stemming the blood flow et cetera is concerned.[15]

7.12 Evidence of the medical kits enabling a successful response to a shark bite can be found from the South African shark spotting program. Ms Banks from Sea Shepherd Australia explained that the trauma kits available as part of that program have saved a life.[16]

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12 Mr Andrew Stark, Chief Executive Officer, Surfing Australia, *Committee Hansard*, 2 May 2017, p. 31.

13 Sea Shepherd Australia, *Submission 57*, p. 12.

14 Mr Jeff Hansen, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 16.

15 Cr Simon Richardson, Mayor, Byron Shire Council, *Committee Hansard*, 2 May 2017, p. 23.

16 Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 14.

7.13 Representatives of Sea Shepherd Australia, which was the main advocate of trauma kits during this inquiry, commented that if these kits 'were in a locked box where a number of people knew the codes there would be great advantages for saving lives'. It was noted that, at Byron Bay, the kits are kept a café near the beach to protect the kits from being stolen.[17] At remote beaches where the kits cannot be stored in a secure location, it was suggested that a locked box with a code known by locals could be used. On the risk of vandalism to these unprotected boxes, Mr Hansen from Sea Shepherd stated:

> We have spoken to a number of surfers down south [in WA]…and they said, 'Well, if anyone messes with that, they'd have to deal with us first.' So whether it would be a locked box or whatever that a number of the locals know so that at least someone on the beach would know it, we need something if there are tourists there on the day. There are tourniquets on leg-ropes that are coming out now, that companies are pushing as well. There are a range of options.[18]

7.14 Cr Simon Richardson, Mayor, Byron Shire Council, explained kits are available in Byron Bay and the council is investigating making further kits available 'probably…with the surf lifesavers et cetera'. Cr Richardson noted that the kits are 'not overly expensive' and suggested that a further rollout of kits is likely to be supported by the community.[19]

7.15 Mr Dale Carr, who survived an encounter with a shark, stated that the shark attack first aid kit promoted by Sea Shepherd 'is a good idea'. He added:

> When I spoke to Dave Pearson and his friends on the south side of Crowdy Bay—it is a good 12 kilometres away from Harrington—they had one in their car. They did not need to have it because of a shark attack. They always had one, and that was just good common sense. Any suggestions from someone over in Western Australia in regard to remote locations and medical facilities, I would wholeheartedly support.[20]

7.16 It was acknowledged, however, that some training is needed to use the kits effectively.[21]

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17 Mr Jeff Hansen, Managing Director; Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 13.

18 Mr Jeff Hansen, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 13.

19 Cr Simon Richardson, Mayor, Byron Shire Council, *Committee Hansard*, 2 May 2017, p. 23.

20 Mr Dale Carr, Member, Bite Club; Beyond the Bite, *Committee Hansard*, 2 May 2017, p. 16.

21 Mr Jeff Hansen, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 13.

Education

7.17 Regardless of their views on the effectiveness and desirability of lethal shark control programs and other non-lethal measures, the submitters and witnesses that participated in this inquiry generally supported proposals for education programs to help enhance public safety and knowledge about sharks. This section discusses the evidence received regarding education strategies.

Education about sharks generally

7.18 CSIRO noted that although information about sharks can be easily found 'the veracity of some of this information is questionable'. Consequently, CSIRO submitted that there 'is an important role in continuing to provide accurate information to the public regarding sharks in the marine environment'.[22] This issue was picked up by other witnesses, who commented on some of the myths about sharks that can be accepted. Dr Neff stated:

> I would say it is the combination of an absence of educational information and the presence of movie monster myths. It is the worst-case scenario, where the only stories people hear are the ones about rogue sharks—and this happened in Ballina; they said, 'If we just kill the seven sharks that are responsible for all the shark bites, we'll have solved the problem.' I heard that same story in Reunion Island. I heard that same story in Cape Town. I hear that same story Western Australia. There is this sort of myth that travels, and it really gets a hold of folks, and I completely understand it, but part of it is the way in which government reinforces myth-making and folklore instead of public education.[23]

7.19 Similarly, the Australian Marine Conservation Society (AMCS) suggested that government-supported education programs could assist to 'mitigate negative public attitudes and misplaced fear about sharks'. Noting that the risk of shark encounters is statistically low, the AMCS argued that education that assists the public to understand 'the very low risks associated with shark interactions in relation to the other risks people are exposed to in our daily lives' is important, including for addressing the concerns of the tourism sector.[24]

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22 CSIRO, *Submission 33*, p .5.

23 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 3.

24 AMCS, *Submission 38*, p. 10. Education in this area could potentially be achieved by other means; for example, it has been suggested that eco-tourism would 'alter the way sharks are perceived'. See Sea Shepherd Australia, 'Alternatives to drum lines and shark nets', www.seashepherd.org.au/apex-harmony/overview/alternatives.html (accessed 7 December 2016).

Suggestions for education strategies and programs intended to promote public safety

7.20 Several stakeholders argued that raising public awareness about swimmer safety (such as avoiding swimming where sharks are known to congregate and when it may be difficult to see an approaching shark)[25] is an area where education programs could add particular value. There was broad support for an education program to improve understanding among the general public and tourists visiting beaches about shark behaviour and conditions or activities associated with a higher degree of risk.[26] For example, Mr Chris Peck, General Manager, Lifesaving and Training, Surf Life Saving Western Australia, stated:

> …we certainly think that more education and awareness could be provided…In terms of developing a culture and an understanding, there is a long process for that and you have to start somewhere. We do not think we have enough support to deliver that education and awareness, particularly to school groups where you are often commencing the development of a culture.[27]

7.21 Existing education efforts were noted which, it was suggested, could be enhanced and expanded. For example, Professor Shaun Collin noted that, as part of its Sharksmart website, the Western Australian Government has published an online list of the 'dos and don'ts of interacting in the ocean in relation to sharks'. Professor Collin noted this should be updated as needed. Professor Collin added that the delivery of educational strategies could be supported by the establishment of an educational officer for the state. He suggested that this officer would 'help educate the public and open a very good communication channel which is always there'.[28]

7.22 Examples of where shark-related deaths have occurred in situations considered to be dangerous were provided to demonstrate how further education may assist. The Sunshine Coast Environment Council (SCEC) submitted:

> The last shark fatality classified as unprovoked in Queensland at a protected site was in 2006 where the victim was swimming in the evening, in murky water, in an ocean channel during tidal change, in an area near baited drum lines, and while local fishermen were cleaning caught fish and dumping the

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25 A list of safety measures is at Taronga Conservation Society Australia, 'Prevention of shark attacks', https://taronga.org.au/animals-conservation/conservation-science/australian-shark-attack-file/prevention-shark-attacks (accessed 20 December 2016).

26 Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 24; Australian Seabird Rescue, *Submission 37*, p. 4; HSI, *Submission 43*, pp. 25–26; Sunshine Coast Environment Council, *Submission 35*, p. 12. The Sunshine Coast Environment Council added that this education should also emphasise the role sharks perform in the marine environment.

27 Mr Chris Peck, General Manager, Lifesaving and Training, Surf Life Saving Western Australia, *Committee Hansard*, 20 April 2017, p. 4.

28 Professor Shaun Collin, *Committee Hansard*, 20 April 2017, pp. 42–43.

> entrails into the water. All of these listed environmental conditions are known general indicators for shark attacks and as such, regardless of the presence of drumlines, education about these risks could have helped prevent this tragedy.[29]

7.23 Other stakeholders noted the importance of education about potentially dangerous conditions. Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, noted that:

> Surfrider has had a policy for many years that, if there are reported shark sightings, surfing at dawn and twilight is not the best. Surfing near effluent outlets is no good. River mouths, where congregations of baitfish occur and where there is loads of fishing taking place are all things to be avoided. I think surfer education, beachgoer education and more money for research and medical facilities at beaches are the way to go.[30]

7.24 Mr Don Munro agreed that it is important to teach children to look for signs that sharks may be present. Mr Munro stated:

> You teach kids to swim and then you teach kids to understand what is happening in the ocean, particularly when it comes to marine life. We know simple little signs like bird thrashing, bait balls—they are very easy to distinguish. There is not much more you can do other than what I have just explained, but we drill that into the kids, and even our five-year-olds will tell you, 'Look, Donny, there's baitfish there; I shouldn't go out.' That is right. You do not.[31]

7.25 Mr Munro added that he has suggested that a program to pass on this knowledge to children should be introduced in schools. He added:

> I know I would volunteer my time to do that, and there would be others who would do so as well. It just has not got off the ground as such.[32]

7.26 Dr Leah Gibbs and Dr Jan-Olaf Meynecke also expressed support for the expansion of education strategies, particularly through schools and nippers programs. Dr Meynecke advised that he has given talks on marine biology and marine science to schools, although he added that these talks occurred following invitations from individual schools, rather than as part of a comprehensive program.[33]

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29 Sunshine Coast Environment Council, *Submission 35*, pp. 3–4 (emphasis omitted).

30 Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, *Committee Hansard*, 17 March 2017, p. 24.

31 Mr Donald Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve, *Committee Hansard*, 2 May 2017, p. 5.

32 Mr Donald Munro, *Committee Hansard*, 2 May 2017, p. 5.

33 Dr Leah Gibbs, *Committee Hansard*, 31 July 2017, p. 6; Dr Jan-Olaf Meynecke, *Committee Hansard*, 31 July 2017, p. 14.

7.27 Education programs on how to respond to shark bites was also suggested. Surfing Australia explained that it operates a program in New South Wales, which it would like to expand to nationally, that seeks to educate and train surfers to provide first aid. Mr Stark added that the program aims to get surfers out of the water and providing first aid, and that how to respond to a shark bite could be added to the program.[34]

7.28 Increased signage at beaches so that beachgoers are exposed to reliable information about the shark-related risks was also supported. Dr Sharon Burden argued that appropriate signage is a straightforward and essential public safety strategy. Dr Burden stated:

> As a simple example, if you go into any workplace, you will see warning signs where there are risks: 'watch your head', 'watch your step', danger signs about electrical risks, and you will see signs on beaches. And yet I have been down on Bunker Bay for the two days preceding today and there is still no sign at any point there that would let any visitor know that there has ever been an attack, that there is a risk and that there are high-risk times of the year.[35]

7.29 Dr Burden recounted a conversation with a local surfer at Bunker Bay who told her that '[a]s a local I know that this spot is not a beach you would surf at around August and September…because the whales come in too close to the headland'. Dr Burden remarked:

> Why isn't there a nice sign down the bottom done in nice colours that talks about shark migration patterns and says that the whales will be around at this time of year, when the salmon come into the bay, these are things to look out for and, more importantly, if something does happen what you do? What first aid could you apply to try to save that person's life if it did occur? What are you going to do to make access? There could be a QR code that takes them straight to all the apps. You could check your sign. There are so many things that could be on that sign that would give me as an individual some options.[36]

7.30 Dr Burden further contrasted the lack of signs about sharks with the approach taken to other risks elsewhere, such as the signs used in northern Australia warning about crocodiles and stingers.[37]

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34 Mr Andrew Stark, Chief Executive Officer, Surfing Australia, *Committee Hansard*, 2 May 2017, p. 31.

35 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, pp. 18–19.

36 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, pp. 21–22.

37 Dr Sharon Burden, *Committee Hansard*, 28 July 2017, p. 22.

7.31 The SCEC also referred to the signs and education campaigns used to warn about crocodiles. The SCEC, which referred to the 'Be Croc Wise' campaign, argued that signage and a campaign based on the crocodile awareness efforts would be 'relatively low-cost' and 'provide significant benefit'. The SCEC cautioned that the program 'should be changed to reflect that, similarly to crocodile prone areas, it isn't always appropriate to swim in "shark habitats" under certain conditions'.[38]

7.32 Mr Ian Wiese, who supports additional signage, cautioned that any signs used need to provide information designed to help beachgoers understand the different risks presented by sharks at particular locations at different times of the year. Mr Wiese explained by referring to a sign put up a local council that indicates past shark activity, with space for displaying the date of the activities. Mr Wiese commented that the sign does not provide interpretative information that beachgoers need to assess the risk of sharks. Mr Wiese continued:

> I just noticed that the sign is still there, this morning, and there haven't been any sharks sighted there for several months. So it loses credibility. What I was recommending was that there be more substantial signage installed that explained that at this time of year there are salmon migrating, and sharks follow them on a routine basis; they're being attracted in to the shore by fishermen, and it's probably not wise to go swimming if you don't want to be swimming with sharks.[39]

7.33 However, other witnesses noted that the evidence suggests education about risky conditions can go only so far in assisting public safety. Mr Heaton observed that:

> Apart from the attack on Graig Ison at Evans Head at approx 6.10am on 1/8/15, all the attacks from September 2014 to October 2016 have occurred in the middle of the morning or afternoon on a bright sunny day with clear visibility in the ocean.[40]

Are new technologies and other approaches ready to replace lethal measures?

7.34 Having examined the evidence received about emerging technologies and the evidence received about lethal measures, the key issues for consideration are whether new and emerging technologies, either individually or when used as a suite of measures, are sufficiently advanced, proven to be effective and can be utilised at a reasonable cost.

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38 Sunshine Coast Environment Council, *Submission 35*, p. 11.

39 Mr Ian Wiese, *Committee Hansard*, 28 July 2017, p. 42.

40 Mr John Heaton, *Submission 11*, p. 2. Mr Andrew Stark, Chief Executive Officer, Surfing Australia, made a similar point: he noted that according to Surfing WA, the average time of shark attacks in WA in the last few years was 11 am. See *Committee Hansard*, 2 May 2017, pp. 34–35.

7.35 There is already movement in this direction, such as the Western Australian Government's shark management strategy that includes a trial rebate of $200 for independently verified devices purchased by surfers and divers. The strategy also provides funding for drones, receivers for tagged sharks and for an additional beach enclosure.[41]

7.36 Dr Bucher and Professor Harrison expressed support for 'observational and warning strategies rather than shark removal options'; however, they acknowledge that SMART drum lines are 'a more effective and far less destructive method to remove dangerous sharks from beaches than nets'. Accordingly, Dr Bucher and Professor Harrison argued that new nets and traditional drum lines should not be permitted and existing equipment phased out.[42]

7.37 Environmental groups urged the removal of shark nets and drum lines. An example of this position was expressed by the AMCS. In addition to the overall removal of shark nets and drum lines, the AMCS argued that the following actions should be prioritised:

- removing nets and drum lines 'during known wildlife migration times and from known migration pathways';
- removing nets and drum lines from 'high conservation value areas such as the Great Barrier Reef Marine Park and from areas where high catches have been recorded of dugong, turtles, dolphins, grey nurse sharks and other threatened, endangers or protected species'; and
- removing nets and drum lines in areas that 'have stinger nets in place and that have never had a shark incident'.[43]

7.38 The evidence given by Mr John Heaton, who supports lethal shark control measures to support public safety, provides an example of the contrary approach. Mr Heaton argued that the number of shark attacks warrant the use of all available measures, including lethal measures. He stated:

> As a surfer of over 50 years, I have never experienced the number of shark attacks like we have had for the two years September 2014 to October 2016. The "experts" cannot give a reason for the spike in attacks and provide a figure for the number of Great Whites we currently have migrating the east coast of Australia.
>
> Therefore, until such time as the "experts" can provide some answers, I am prepared for the NSW Government to use all shark mitigating &

41 The Hon Dave Kelly MLA, Western Australian Minister for Fisheries, 'A smarter approach to shark mitigation in WA waters', *Media release*, 13 May 2017.

42 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, pp. 5–6.

43 AMCS, *Submission 38*, p. 11.

> deterrent measures available to prevent/reduce the number of interactions between humans and sharks.[44]

7.39 Mr Don Munro argued that nets and drum lines should be replaced following further research and development of alternative technologies and 'when proven long-term technologies have been successfully identified'. At present, Mr Munro argued that the alternative shark mitigation and deterrent technologies that are available 'should be in conjunction with but not in place' of the existing lethal measures.[45]

7.40 There are some clear limitations associated with new technologies. For example, as noted in Chapter 6, at present personal electrical deterrents are not suitable for children due to the electric shocks involved. Other products appear to require further testing; Australian Aerial Patrol argued that the criteria used to evaluate the performance of sonar devices and beach enclosures 'are unknown'. Regardless, it argued that '[w]aiting for shark bites to occur in areas that have trials versus no trials could take decades and have a questionable ethical basis'.[46]

7.41 Uncertainties about emerging technologies are sufficient for key organisations to be wary of endorsing them. In relation to personal deterrents, Mr Andrew Stark, Chief Executive Officer, Surfing Australia, commented that his organisation would not want to endorse a product without being certain that the product would provide compete protection. This position was summed up as follows: 'If we were to recommend a product like that and say that we advise that surfers should choose it…and then someone was killed by a shark with one of those on, what position would that put Surfing Australia in?'.[47]

7.42 The Australian Institute of Marine Science (AIMS) added that providing large-scale protection against sharks is inherently challenging. It observed:

> The scale of Australia's marine estate, the extent of the migrations of many species known to interact with humans, the fact that most shark attacks occur on surfers, spear-fishers and divers, commonly away from patrolled swimming beaches (and often in remote locations) make 'large scale' mitigation a daunting challenge.[48]

7.43 Although AIMS considers that personal deterrent devices offer 'hope of risk reduction', it is of the view that, at present, 'there is nothing on the horizon that is considered an effective universal deterrent'.[49]

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44 Mr John Heaton, *Submission 11*, p. 6 (emphasis omitted).

45 Mr Donald Munro, *Committee Hansard*, 2 May 2017, p. 1. See also *Submission 39*, p. 1.

46 Australian Aerial Patrol, *Submission 6*, p. 25.

47 Mr Andrew Stark, Surfing Australia, *Committee Hansard*, 2 May 2017, p. 32.

48 Australian Institute of Marine Science, *Submission 49*, p. 5.

49 Australian Institute of Marine Science, *Submission 49*, p. 5.

7.44 Finally, concerns were expressed that, despite the government and public interest in shark-related matters, the development of new technologies does not receive adequate support. In correspondence to the committee, Mr Talmage was sharply critical of the lack of support received to date from government regarding the development of the technology. Mr Talmage commented that although the 'expansion curve is steep', the Clever Buoy system is:

> …progressing towards being the world's first fully sustainable ocean wildlife monitoring system and is a great example of innovative technology developed in Australia by Australians with no direct government support.[50]

7.45 Despite this progress, Mr Talmage wrote that the ongoing innovation of Clever Buoy in Australia is, in his view, being constrained by 'inertia' within government. Mr Talmage described his experience engaging with local, state and Commonwealth governments as 'extremely slow and frustrating'. Mr Talmage elaborated on his concerns as follows:

> There appears to be no clear guidelines for engagement or ownership from federal and state government to support and fund local government initiatives for shark mitigation measures. We have engaged with many local councils and local mayors around Australia, and consistently they want to proceed but are constrained by lack of direction and funding support. The early adopters market in Australia would seem to be too small to support the required growth of a unique and viable technology like Clever Buoy. Momentum for Clever Buoy in Australia has waned as a result of the bureaucratic process, and [Shark Mitigation Systems] is now shifting focus on the global market, specifically the US market, with substantial interest in the technology and the incidence of shark interactions increasing around the globe.[51]

7.46 A further aspect of the role of government in relation to emerging technologies is the support they can provide for the development and commercialisation of emerging technologies. Like the developer of Clever Buoy, the managing director of Shark Shield expressed concern that governments are not sufficiently interested in the development of new technologies. As noted in Chapter 6, during his evidence to the committee in April 2017, Mr Lyon announced a new product that, unlike personal deterrents, is designed to provide long-range protection. During a subsequent appearance before the committee, Mr Lyon advised an order had been placed by a police force; however, 'no queries from local councils or state or federal governments' had been received. Mr Lyon stated:

> We are relatively amazed, given the lives lost and the community economic damage from shark attacks, as to why there has been no interest to date in commissioning a pilot or a test program for Ocean Guardian, given that it is

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50 Mr Richard Talmage, Correspondence dated 4 August 2017 (published as *Additional Information 11*), p. 1.

51 Mr Richard Talmage, *Additional Information 11*, p. 2. See also Mr Tony Isaacson, DiveCareDare, *Committee Hansard*, 31 July 2017, p. 46.

based on science and proven shark-deterrent technology that has been in the market for 20 years. We have over 60 years of knowledge of shark sensory systems and 20 years of building deterrent products. We are wondering what more evidence is required.[52]

7.47 Mr Lyon continued:

At this time we are building the Ocean Guardian product to target the luxury yacht and commercial market, but at this point in time we are not progressing with solutions for beach barrier community protection to replace shark nets as, clearly, there appears to be no commercial interest in a solution to protect beaches and the environment. The federal government talks about innovation, and yet the world's leading technology company in shark mitigation—the Tesla of our space—has received no interest in a commercial implementation from any Australian government body.[53]

52 Mr Lindsay Lyon, Managing Director, Shark Shield, *Committee Hansard*, 28 July 2017, p. 56.

53 Mr Lindsay Lyon, Shark Shield, *Committee Hansard*, 28 July 2017, p. 57.

Chapter 8

Committee view and recommendations

8.1 Over the past century, the beach and beach culture has been an important part of the Australian identity. Most of the country's population is located in coastal regions, giving millions of Australians access to remarkable beaches. In addition, popular beaches in these areas are a major drawcard for domestic and international tourists. Going to the beach and the beach lifestyle is generally enjoyable for all, however, there are dangers associated with swimming and other ocean activities. One of these dangers, although a very low probability, is the risk of a person being bitten by a shark.

8.2 Shark bite incidents are not unique to Australia, but it is apparent that the risk of a human–shark interaction is generally greater in certain parts of Australian waters than elsewhere. Several unprovoked shark encounters occur each year. These events can cause serious and life-changing injuries and, in a small number of cases, tragically, the people involved died.

8.3 The committee wishes to make clear that, in examining this subject, it understands that it is dealing with terrible, traumatic events. The emotion attached to this subject is evident from the evidence given by family members of victims of fatal shark bites and the evidence taken by the committee during its first public hearing in Perth, which coincidentally took place days after a young Western Australian tragically died as the result of a shark bite incident. The committee acknowledges that responders to shark bite incidents and others in the local community can also be deeply affected.

8.4 In conducting this inquiry, the committee is seeking to make a valuable contribution to the public debate on this important and controversial matter. Although it is clear that there is widespread sympathy and a heightened sense of community when fatal shark bites occur, this unity dissipates when whether, and how, governments should respond to the risk of shark bites is debated. For example, as this report has demonstrated, fiercely divergent views are held in coastal communities on whether lethal shark control programs are an effective response to the risk presented by dangerous species of sharks. Although shark bites can understandably trigger emotional responses, there is a need for policymakers across the country to consider how to respond to shark bites objectively and critically, using an evidence-based approach. Diverging from this practice is not in the public interest.

8.5 The risk of encountering a shark is rare and needs to be placed in perspective. As has been observed in evidence received during this inquiry, the number of shark bites should be considered in context. Millions of beach visitations occur each year without incident, and drowning is far more likely to be the source of a coastal fatality. Injuries and deaths from interactions between humans and many other animals, such as farmyard animals, dogs and kangaroos occur much more frequently than

shark-related incidents. The number of deaths and injuries associated with shark bites is also greatly outnumbered by the number of road deaths that occur across Australia (1300 in 2016). While all accidental deaths are tragic, and the committee is not arguing one cause of death deserves greater attention than another does, it is relevant that shark-related fatalities, injuries and near misses capture far greater public and media attention than deaths linked to other aspects of life. This likely influences community demands for action and decisions about how government resources should be utilised.

8.6 With the limited resources available to governments, a tension exists between the extent to which governments can intervene to enhance public safety and the need for individuals to take personal responsibility for decisions made of their own free will to participate in activities involving a known degree of risk. In addition, governments need to consider the safety of particular segments of the population that might have a different approach to or understanding of risk, such as children and young people and visitors to Australia's beaches who may not have grown up understanding the risks associated with entering the ocean.

8.7 After conducting this inquiry, the committee is concerned that a heightened fear of sharks has led to responses that may calm the public and appear to provide an effective response, but which are not verified by scientific evidence. That is, communities and governments may be attracted to lethal measures as a simple solution to a complex problem, when a more sophisticated, multifaceted approach is actually required. In particular, the committee is of the view that the available evidence about the effectiveness of lethal shark control measures (mesh nets and traditional drum lines) used in New South Wales and Queensland does not warrant their continuation. The committee is concerned that the existence of lethal measures and the government resources devoted to their management provides the beach-going public with a false sense of security.

8.8 Logically, it follows that for every shark of a species known to be dangerous to humans which is killed by a lethal measure, there is one less shark that can harm a person swimming, surfing or diving in the ocean. It also follows, therefore, that to guarantee public safety using lethal measures, all dangerous sharks in coastal areas around Australia would need to be killed.

8.9 This is simply not practicable. The lethal shark control programs are limited to certain parts of the coastline and, in places where lethal measures are deployed, they do not separate humans and sharks. The most striking example of this relates to the size of the shark nets, which range from only 150 to 180 metres in width. The nets may catch some dangerous and non-dangerous sharks, along with vast quantities of other marine life, however, sharks can swim around and under the nets. This is demonstrated by the 2009 review of the New South Wales program, which noted that

23 shark encounters had occurred at meshed beaches since the program began.[1] The committee understands and notes that when finalising this report such an encounter occurred. On 13 November 2017, a surfer was bitten near the lagoon at Avoca Beach on the Central Coast. Avoca is one of the beaches netted between 1 September and 30 April each year under the New South Wales shark meshing program.

8.10 The New South Wales and Queensland shark control programs have been operating for decades, during which time medical responses have improved and surf lifesaving and other beach surveillance has increased. Most netted areas are near high population centres, where these various forms of beach surveillance are in place. Compelling evidence was also given to the committee that 83 per cent of drum lines in Queensland have been deployed at locations where fatal shark bite incidents had not been recorded before the program commenced.

8.11 It also cannot be known whether a particular white, tiger or bull shark that has been removed would have bitten a person and, therefore, whether the removal has enhanced public safety. There are significant gaps in knowledge about the triggers for shark encounters and, with the clear difficulties and ethical issues involved in such research, questions about the causes of shark bite incidents may not be answered. The very low number of shark fatalities before and after lethal measures were introduced makes rigorous analysis difficult. Simply put, however, any correlation between the deployment of lethal shark measures and zero or low numbers of human–shark encounters does not prove causation.

8.12 Although the effectiveness of lethal shark control measures for public safety is difficult to evaluate, the significant damage to the marine environment these measures cause by killing many non-dangerous species of sharks and other marine species is clear. Passive fishing activities such as nets do not target dangerous sharks specifically and entangle vast amounts of marine life.

8.13 In making this observation, the committee emphasises that it wants to enhance the safety of the oceangoing public; the committee's consideration of these impacts might differ if the lethal measures were clearly effective at protecting beachgoers. However, measures that cannot be proven to have a significant positive effect on public safety but which significantly damage the environment and affect the structure of the marine ecosystem should not be permitted to remain in place. Despite Australia's international obligations to conserve migratory sharks and advances in scientific knowledge of the marine environment, including about the importance of sharks for healthy oceans, the decades-long New South Wales and Queensland shark control programs continue to escape assessment under the Commonwealth's

1 New South Wales Department of Primary Industries, *Report into the NSW Shark Meshing (Bather Protection) Program: Incorporating a review of the existing program and environmental assessment*, March 2009, p. 27.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). This is simply because the programs predate the commencement of the Act.

8.14 Despite the many arguments and counterarguments that can be made about the effectiveness of lethal measures, fundamentally, it is impossible to determine whether there would have been a higher number of deaths if they were not in place. Nevertheless, for the reasons outlined above, it can be concluded that it is impossible for lethal shark control measures to guarantee public safety. Relying on outdated approaches from the 1930s that are not backed by science would not be tolerated in other areas of public safety. The committee, therefore, is of the view that it is necessary to carefully consider the effectiveness of alternative approaches.

8.15 The committee received detailed evidence about a wide range of alternative approaches to shark management. These included eco barriers that, unlike traditional shark nets, actually separate swimmers from sharks and may be a suitable solution, which can be deployed now, for beaches where the predominant activity is swimming. The committee also received evidence about personal shark deterrent devices for surfers and divers, sonar technology and various shark-spotting techniques. Further new technologies are currently in development. Noting that different measures will be necessary for different conditions and types of activities, the committee is not endorsing a particular category of product over others: the committee expects that a successful shark mitigation and deterrent strategy would feature a wide range of non-lethal measures.

Future of lethal shark control measures

8.16 In the committee's view, the use of lethal shark control measures in Australia should end. The committee acknowledges that non-lethal measures are not 100 per cent effective in preventing a shark bite incident from occurring. However, the same observation applies to lethal devices. Evidence presented to the committee regarding non-lethal measures clearly indicates that new and emerging technologies can provide effective protection in many circumstances without causing the damage to the marine environment associated with nets.

8.17 The committee recommends that the end of lethal measures should occur as follows:

- Traditional drum lines—these should immediately be replaced by SMART drum lines, which differ from traditional drum lines in that they are not designed or operated to kill sharks. Given the development and success of SMART drum lines, the continued use of lethal drum lines cannot be justified.
- Mesh nets—Rather than recommending the immediate end of mesh nets, the committee is of the view that they should be phased out. Although the committee does not support mesh nets, it acknowledges that there is a need to build the public's understanding about the limitations of the lethal measures and the effectiveness of non-lethal measures before the removal of nets gains widespread public acceptance.

8.18 As lethal shark control programs involve matters of national environmental significance protected under Commonwealth legislation, the committee considers there is a role for the Australian Government in pursuing the committee's recommendation to end the use of lethal shark control measures at a future Meeting of Environment Ministers.

Recommendation 1

8.19 The committee recommends that the New South Wales and Queensland Governments:

- **immediately replace lethal drum lines with SMART drum lines; and**
- **phase out shark meshing programs and increase funding and support for the development and implementation of a wide range of non-lethal shark mitigation and deterrent measures.**

8.20 The committee further recommends that the Australian Government pursue this recommendation at a future Meeting of Environment Ministers.

Building knowledge about sharks and shark management strategies

8.21 As noted above, to facilitate the phasing out of nets, there is a need to build the public's understanding about sharks generally and the specific lethal and non-lethal measures that can be used as shark mitigation and deterrent measures. For example, the committee notes that there are many widespread myths about shark behaviour. In addition, there is evidence that lethal measures provide an important psychological benefit that has flow on effects for local businesses and tourism activity—it is important that non-lethal measures have the same effect. Accordingly, there is a clear role for governments to support research, develop or refine public education efforts and to increase support for the development and utilisation of effective non-lethal measures. The remaining recommendations of this report focus on how to enhance existing knowledge about sharks and how to respond most effectively to the risk of human–shark encounters.

8.22 While lethal measures remain in place, the committee considers there is a need to increase the scientific rigour and transparency associated with these programs. Accordingly, the committee agrees with CSIRO's position, as put to the committee during this inquiry, that there is a need for management arrangements for lethal programs to require more effective catch monitoring and for the programs to be underpinned by clear objectives and trigger points.

8.23 The committee notes that the New South Wales Government updated its management plan for the shark meshing program in July 2017, which included objectives, performance indicators and trigger points. However, the collection of further data on the operation of the lethal devices would assist the public debate on the effectiveness of the program; for example, whether sharks entangled by mesh nets were caught on the beach-side or ocean-side of the net is information that should be collected and made publicly available.

8.24 Regarding the Queensland shark control program, the committee considers the Queensland Government should similarly publish a management plan that commits to minimising the harm to marine life, particularly species protected under the EPBC Act, as well as further relevant data about the operation of the program.

8.25 There is also a need for a single source of reliable data on the bycatch associated with lethal shark control programs. Although some data are published, further historical data should be readily available to enable trend analysis and greater effort should be made to ensure the data collected are reliable. To address these issues, the committee recommends that the Australian Government establish a national database of interactions involving shark control programs that records interactions involving target and non-target species.

8.26 In addition to ensuring this information is promptly made publicly available at regular intervals throughout the year, the committee considers that the Australian Government should direct the Department of the Environment and Energy to prepare and publish an annual assessment of the impacts of lethal shark control measures on marine life. Given the Australian Government's responsibilities regarding the protection of matters of national environmental significance, the deaths and injuries of protected species linked to shark control programs should be a particular focus of the database and annual assessment.

8.27 To facilitate the national database, the Australian Government will need to require state governments to provide relevant data. In doing so, the Australian Government should oblige state governments to improve the reliability of the data collected, including through audits of information provided by contractors involved in clearing nets and drum lines.

Recommendation 2

8.28 The committee recommends that, while state government lethal shark control programs remain in place, management arrangements for these programs should include more effective and transparent catch monitoring with the objective of improving understanding of the efficacy of lethal measures for public safety and the effects of the measures on the populations of marine species.

Recommendation 3

8.29 The committee recommends that the Australian Government:

- **establish a publicly accessible national database of target and non-target species interactions with shark control measures; and**
- **require the Department of the Environment and Energy to use this information to prepare and publish an annual assessment of the impacts of lethal shark control measures on target and non-target marine species.**

Recommendation 4

8.30 The committee recommends that state governments review and regularly audit the quality of the data collected on target and non-target species interactions with shark control measures.

8.31 One area where there was some agreement between supporters and opponents of lethal shark control measures is that further research is necessary to gain a better understanding about sharks, particularly regarding their population, behaviour, movement and breeding patterns. The committee notes that CSIRO, in a partnership under the National Environmental Science Program, has been seeking to address the lack of reliable white shark population estimates. Estimates on white shark abundance are due for release soon and will assist the upcoming review of the white shark recovery plan. Although it will be some time before an estimate of trend in population can be established, the committee is hopeful that the initial data on abundance will lead to a more informed debate about shark conservation.

8.32 Further knowledge about shark behaviour would clearly help inform the development of effective shark management strategies and deterrent measures. It is known that there are key differences between the species of sharks in Australian waters that are dangerous to humans (white, bull and tiger sharks): for example, the committee was advised that white sharks are visual specialists, bull sharks rely on electro reception and tiger sharks utilise the sense of smell. The committee considers these differences need to be taken into account in shark management to a greater extent than is occurring at present, and further research could assist in building understanding of what measures may be successful at deterring particular species.

8.33 Given the states bear the direct costs of shark control measures and that research outcomes would be of benefit to multiple jurisdictions, the committee considers there is a role for the Australian Government to increase the support it provides for shark-related research. At a minimum, the committee considers that the Australian Government should ensure CSIRO has the resources necessary to undertake the potential areas for further investigation that CSIRO identified during this inquiry. These areas, which were discussed in Chapters 1 and 2, include:

- ongoing data collection and monitoring to support the determination of population trends;
- development of a predictive model of shark abundance and location; and
- a social survey to determine how the behaviour of water users has changed in response to recent human–shark interactions.

8.34 In addition, during this inquiry it became evident there are various theories or concerns about activities that might attract sharks or otherwise increase the risk of human–shark interactions. Among others, these concerns relate to the use of teaser baits in cage diving, crayfish pots and trophy hunting.

8.35 It is clear that speculation about these theories shape views on whether particular mitigation and deterrent measures are effective; however, there is a lack of scientific evidence to determine whether these views have merit. Although there would be clear value in obtaining research that can verify or disprove these theories and inform policymaking as a result, the committee acknowledges that there are ethical and practical difficulties in conducting research that relates to human–shark interactions.

8.36 Accordingly, as an initial step, the committee recommends that the Australian Government seek advice from CSIRO on whether research can be undertaken to address anecdotal evidence presented to the committee on the potential risks for human–shark interactions that may be associated certain ocean-based activities. The Australian Government should then review the funding provided for marine science research to enable CSIRO (or another research institution) to conduct the research CSIRO advises could be undertaken.

Recommendation 5

8.37 The committee recommends that the Australian Government establish a review into the effectiveness of shark research and, following the review, commit to providing funding on a long-term basis for research areas that are considered likely to significantly contribute to improved knowledge about effective shark mitigation and deterrent measures.

Recommendation 6

8.38 The committee recommends that the Australian Government review the funding provided to CSIRO to enable CSIRO to:

- **undertake ongoing data collection and monitoring to support the determination of white shark population trends;**
- **develop a predictive model of shark abundance and location; and**
- **undertake a social survey to determine how the behaviour of water users has changed in response to the recent human–shark interactions.**

8.39 The committee further recommends that the Australian Government seek advice from CSIRO as to whether research can be undertaken to address anecdotal evidence presented to the committee on the potential risk that certain ocean-based activities, such as the use of teaser baits in cage diving, crayfish pots and trophy hunting, might increase the risk of human–shark interactions. The Australian Government should review the funding provided for marine science research to enable CSIRO (or another research institution) to conduct the research CSIRO advises could be undertaken.

8.40 To improve scientific understanding of shark behaviour and to assist evaluations of the effectiveness of non-lethal devices, the committee also considers there is a need to consider how information on shark bite incidents is used. It is possible that shark bite incidents yield valuable information on the intent of the shark involved; that is, whether the shark involved in the bite incident was, to use the terms commonly used during this inquiry, 'curious' or in 'full attack mode'. The committee notes the concerns among stakeholders and in the community that, at present, personal deterrent devices will not prevent incidents involving a shark that is determined to attack.

8.41 The collection of information at a clinical level for subsequent expert interpretation would likely be useful for better understanding shark behaviour. It could also assist in assessing the effectiveness of personal deterrent devices. Although the collection of this information is in the public interest, the committee acknowledges that this information is linked to traumatic events and the rights of the individual and their families need to be considered. Accordingly, the committee recommends that the Australian, state and Northern Territory governments consider how information on shark bite incidents can be collected and centrally reported with a view to enhancing knowledge about shark behaviour, provided that the information can be collected respectfully and, in the case of fatalities, that family and cultural concerns are considered.

Recommendation 7

8.42 The committee recommends that the Australian Government initiate discussions with state and Northern Territory governments regarding the clinical information collected about shark bite incidents to enable subsequent expert analysis of shark behaviour.

Supporting the transition to non-lethal mitigation and deterrent measures

8.43 The committee supports the development of effective, scientifically tested, non-lethal shark mitigation and deterrent measures. Such measures provide swimmers, surfers and divers with protection without causing damage to the marine environment. Non-lethal measures are cost-effective and enable individuals to take personal responsibility for their safety. In addition, the committee considers that an economic opportunity exists in that Australia could be a world leader in the development and commercialisation of new technologies. Governments need to provide a supportive environment so this opportunity can be realised.

8.44 The committee notes that state governments have backed certain trials of new technologies, however, the degree of interest and willingness to back such trials varies. Although there is evidence of Australian ingenuity and innovation at work, the committee is concerned by the possibility that new technology may need to be taken overseas to be commercialised. The Australian Government could perform a greater role in this area. In particular, the Australian Government could assist by matching funding committed by state governments to the trialling and development of

non-lethal measures, which in turn would enable state governments to support a wider range of trials or facilitate trials that are more extensive.

8.45 To ensure the amount of funding provided is appropriate, the committee suggests that the Australian Government seek advice about funding requirements, if necessary from a consultant with expertise in shark management. Specifically, the advice should consider the amounts spent by state governments on various shark management activities and provide an estimate of the quantum of funding from the Australian Government necessary for supporting the objective of ending lethal measures.

Recommendation 8

8.46 The committee recommends that the Australian Government match funding provided by state governments in support of the development of new and emerging shark mitigation and deterrent measures.

8.47 As the above recommendations indicate, the committee supports a transition from lethal shark control measures to effective non-lethal measures. There is a range of non-lethal measures that can, and should, be considered as part of a comprehensive strategy for promoting public safety. However, the committee considers that an impediment to a successful transition from lethal to non-lethal measures is ensuring consumer confidence in the personal deterrent product category. The committee is concerned that the marketplace for personal deterrent devices includes products that have not been subject to independently verified scientific testing.

8.48 When buying a safety product, consumers expect that the product will be effective. An attractive feature of personal deterrent devices from a policymaking perspective is that they enable individuals to take personal responsibility for the risks they take. Governments have a duty to ensure there is appropriate information available so that individuals can make informed decisions. The committee urges the Australian Government to support consumers by establishing an appropriate framework to encourage the commercialisation and take up of reliable products that consumers can trust.

8.49 Furthermore, in light of the evidence received during this inquiry about the effectiveness of personal deterrent devices, the committee questions why some key organisations are reluctant to endorse this category of products. Scientific testing has concluded that the use of a particular product in an environment with a high number of white sharks resulted in the probability of a shark bite falling from 90 per cent to 16 per cent. Other studies similarly support the conclusion that the use of a certain personal deterrent device reduces the risk of shark bite. The committee is aware that other products are also undergoing independent scientific testing.

8.50 It follows that a significant reduction in the risk of shark bite does not mean the risk is eliminated. In the committee's view, however, it is unreasonable to withhold support for personal deterrent devices on the basis that they do not eliminate the risk

of shark bite for divers and surfers when, at present, no measure will eliminate this risk.

8.51 As with many other adventurous activities, diving and surfing are associated with some degree of risk. By choosing to undertake these activities, the individual accepts this. Nevertheless, there are steps that can be taken to reduce the risk, including by using an effective personal shark deterrent product. The available evidence indicates that, overall, users of independently verified personal deterrent devices will be at a significantly lower risk of shark bite than they would be if they were not using the device. Provided that users understand the remaining risk, this evidence should be sufficient for relevant stakeholders to promote this product category among their members. The committee hopes that such action may avoid a tragic shark bite incident which could have been avoided had the individual involved been using an effective personal deterrent product.

Recommendation 9

8.52 The committee recommends that the Australian Government develop a process to ensure products marketed as personal shark deterrent devices are independently verified as being fit-for-purpose.

Recommendation 10

8.53 The committee recommends that the Minister for the Environment and Energy and relevant state governments work with key stakeholder groups, such as national surfing organisations, to encourage water users to take all reasonable steps to reduce the probability of being involved in a shark bite incident, including by endorsing the use of independently verified personal deterrent devices.

8.54 On the evidence available, the committee supports the Western Australian Government's trial rebate program for independently verified personal deterrent devices. The committee recommends that all state governments with shark management programs consider initiatives to support the take up of new, effective approaches to public safety, including rebate programs for independently verified personal shark deterrent devices.

Recommendation 11

8.55 The committee recommends that the Western Australian Government's trial rebate program for independently verified personal deterrent devices be made ongoing in Western Australia and adopted by other relevant state governments.

8.56 The committee further recommends that relevant state governments consider developing programs for subsidising independently verified personal deterrent devices for occasional surfers at beaches associated with the risk of dangerous shark encounters.

National cooperation and coordination

8.57 Although state governments are most directly involved in shark management, the committee considers all levels of government have a role. Importantly, the committee considers that the Australian Government has a national leadership role in providing funding support for research and trials of new measures, as well as ensuring that consumers are informed when purchasing safety products. The Australian Government can also facilitate the sharing of knowledge from its research agencies and between jurisdictions, and can encourage the use of best practice management strategies. There is a need to ensure that knowledge about successful shark management strategies is shared effectively and that all jurisdictions have access to the latest expert advice. Accordingly, the committee considers there is a need for a National Shark Summit of shark experts from around the world, with the summit to be chaired by the Minister for the Environment and Energy.

8.58 In recommending a national shark summit, the committee is cognisant that the New South Wales Government hosted a shark summit in 2015. However, the committee considers there will be key differences between the summits. In particular, as the issue of human–shark bites is relevant to several states, and state governments have taken different approaches to the issue, a national summit would provide an opportunity for these varying approaches and lessons learnt in particular jurisdictions to be shared and assessed. A national summit would also facilitate the involvement of the Australian Government. This is appropriate for two reasons:

- first, the Australian Government has an established role in protecting matters of national environmental significance; and
- secondly, given the various statements made by the Minister for the Environment and Energy throughout 2017 about sharks, there appears to be acceptance of the Australian Government's emerging role in shark management matters.

8.59 To ensure the results of the summit influence and are reflected in management strategies and government policies, and that there is an ongoing commitment to pursuing best practice shark management strategies following the summit, the committee further recommends that a National Shark Stakeholder Working Group be established. The Working Group should comprise senior Australian, state and Northern Territory government officials from relevant areas (environment, fisheries, and parks and wildlife services agencies), representatives of local government, scientific experts, surf lifesaving organisations and other relevant groups.

8.60 The committee envisages that, using the evidence gathered during this inquiry and the findings of the National Shark Summit, the Working Group would seek to develop a national risk management plan for sharks and an integrated approach to the development, promotion and use of a wide range of effective non-lethal measures. Practical advice to promote the use of non-lethal shark management strategies should be developed; for example, the committee considers that one impediment to the establishment of shark spotting programs is the lack of guidance available about

suitable locations for these programs and how communities can establish successful programs.

8.61 The committee considers that the Working Group would also assist the Australian Government in developing strategies to address other recommendations of this report, such as the recommendation relating to the effectiveness of ensure products marketed as personal shark deterrent devices are independently verified as being fit-for-purpose.

Recommendation 12

8.62 The committee recommends that the Australian Government hold a National Shark Summit of shark experts.

Recommendation 13

8.63 The committee recommends that the Australian Government establish a National Shark Stakeholder Working Group comprising key stakeholders in shark management policies. The principal function of the Working Group would be to further the objective of ending lethal shark control programs by developing strategies and facilitating information sharing about the effective use of non-lethal measures.

Other practical actions

8.64 During this inquiry, Dr Sharon Burden advised the committee that no signs are in place at the beach where her son died to warn beachgoers of past shark bite incidents and the continued risk. The committee shares Dr Burden's concerns about the lack of adequate signage and similarly questions why lethal measures are proposed when basic approaches such as public information strategies have not been pursued. In addition, although knowledge about previous shark incidents may help local residents to stay safe, this information should be readily available for the benefit of visitors to the area.

8.65 The committee considers the following approaches should be pursued as a matter of priority:

- adequate warning and information signage to be installed at beaches known to have a heightened risk of shark bite incidents;
- specialised trauma kits for responding to shark bite incidents to be made available at venues near beaches; and
- state governments to review (or introduce as necessary) education programs at schools in coastal areas on reducing the risk of shark interactions and improving knowledge about sharks, including by addressing myths about shark behaviour and educating about the important role of sharks in healthy marine ecosystems.

8.66 The committee also notes that there are various social media accounts and apps intended to distribute information about sharks and shark sightings, including those operated by state governments, surf lifesaving organisations and the Dorsal community shark reporting app. The committee supports the provision of real-time information about shark sightings. However, the committee questions whether the current arrangements of multiple platforms is the most effective means for disseminating information about sharks. One reliable, national source of information, provided it could be tailored to local conditions, would: be easier to promote (thus maximising the number of users); assist beachgoers who travel interstate; and allow for greater economies of scale. The committee considers there would be merit in the National Working Group considering whether an integrated national shark database and app would be a more effective use of available resources.

8.67 The committee further considers there is a need for the information provided through apps about shark sightings and shark risk updates to be readily available at beaches. The committee notes the evidence that online apps are not always accessible to beachgoers and that checking these apps may not be at the forefront of beachgoers' minds. In addition, this information is necessary to support the safety of visitors to the area who may be unaware of social media accounts and apps that distribute shark safety alerts.

Recommendation 14

8.68 The committee recommends that the National Shark Stakeholder Working Group review the adequacy of information available to beachgoers regarding the risk presented by sharks, such as signage at beaches and how real-time information provided through shark alert apps can be made available at beaches.

Recommendation 15

8.69 The committee recommends that the Australian Government, working with relevant state governments, develop a program to provide grants for specialised trauma kits at venues near beaches associated with the risk of human–shark encounters.

Recommendation 16

8.70 The committee recommends that relevant state governments review the water safety education programs and education about sharks generally that is provided in schools (particularly schools in coastal areas), with a view to enhancing the education provided on reducing the risk of shark interactions and improving knowledge about shark behaviour and the ecological value of sharks.

8.71 As part of these reviews, the committee recommends that state governments consider the role that relevant community and scientific organisations with expertise in human–shark encounters could have in supporting the delivery of such programs.

Recommendation 17

8.72 The committee recommends that the National Shark Stakeholder Working Group review the various social media accounts and apps that distribute real-time information about shark sightings and warnings about the risk of shark activity to consider whether an integrated national database and app should be established.

8.73 As this report has established, lethal measures present a significant threat to non-target marine life, including endangered species. During the committee's public hearing at Byron Bay, the committee received evidence indicating that animal welfare could be improved if communication between the New South Wales Department of Primary Industries (DPI) and animal rescue groups was strengthened. While lethal measures remain in place, the committee urges the DPI to review its engagement with animal rescue groups to improve rescue and rehabilitation outcomes for non-target animals.

Recommendation 18

8.74 The committee recommends that the New South Wales Department of Primary Industries improve its consultation and communication with animal rescue groups regarding marine wildlife caught in or injured by lethal shark control measures.

Application of the EPBC Act

8.75 Another issue of concern to the committee is that state governments have been permitted to conduct trials of lethal shark control measures targeting protected species without the trials requiring assessment and approval under the EPBC Act. Under section 158 of the EPBC Act, an exemption to undergo assessment and approval under the EPBC Act may be granted by the Minister for the Environment and Energy if the Minister is satisfied that to do so is in the national interest.

8.76 Section 158 of the EPBC Act is rarely used, but exemptions have been granted more frequently in recent years, including in relation to shark control programs. The relevant Minister has granted an exemption on both occasions when the introduction of a new lethal shark control program has been proposed (for the Western Australian program in 2014 and for the New South Wales north coast trial in 2016). These decisions have attracted controversy. The use of section 158 on 'national interest' grounds in relation to sharks is contrary to good environmental management: it is particularly telling that despite the exemption granted for the Western Australian program in 2014, the Western Australian Environmental Protection Authority ultimately determined that the proposal should not be implemented.

8.77 Moreover, as a general principle the committee is concerned about the increased use of a discretionary power based on the Minister's interpretation of the 'national interest' where the matters the Minister may consider in determining the national interest are not prescribed or limited in any way. The committee does not consider that the desire to trial lethal shark control measures can be justified on national interest grounds. These measures should be subject to the regular EPBC Act assessment and approval process.

8.78 The October 2017 decision by the Minister to exempt the New South Wales north coast trial for an additional two years is also of concern to the committee. The effect of this second exemption is that the north coast trial of nets will operate for three years without assessment and approval under the EPBC Act being required. This is despite data collected by the DPI demonstrating clearly that the SMART drum lines used in the trial area target the species of sharks known to present a risk to humans far more effectively, and do so with minimal impacts on threatened species and the marine environment generally.[2] The committee is of the strong view that use of the section 158 exemption power to exempt the same, or similar, activity repeatedly is a significant flaw in the EPBC Act that needs to be addressed.

8.79 Given the use of section 158 to exempt new shark control measures from assessment, the committee considers there are clear grounds for this provision to be reviewed and for the provision to not be used for shark control measures until such a review has taken place. As the committee has considered section 158 in the context of shark-related matters only, the committee is not recommending amendments to section 158; for sound policymaking there is a need for section 158 to be reviewed as part of a process that enables broad consultation and considers how the provision applies across a wider range of activities. The committee is of the view that the next independent review of the EPBC Act would provide such an opportunity.

2 As noted in Chapter 4, during the first trial the nets caught nine target sharks, representing just three per cent of the total catch. On the other hand, SMART drum lines caught more target sharks and had significantly lower levels of bycatch (36 target sharks were caught, which represented 92 per cent of the total catch of SMART drum lines). In addition, only 47 per cent of the animals caught by the nets survived, whereas the survival rate associated with SMART drum lines is 97 per cent. See Minister for the Environment and Energy, *North Coast Shark Meshing Trial, New South Wales: Statement of reasons for granting an exemption under section 158 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, 26 October 2017, http://epbcnotices.environment.gov.au/exemptionnotices/exemptionnotice/?id=a99fcc21-38c0-e711-b175-005056ba00a8 (accessed 9 November 2017).

Recommendation 19

8.80 In light of the repeated use of section 158 exemptions for lethal shark control programs, the committee recommends that the next independent review of the *Environment Protection and Biodiversity Conservation Act 1999* carefully consider whether section 158 is operating as intended. In particular, the committee recommends that the independent review consider:

- **whether the matters the Minister may consider in determining the national interest should be limited; and**
- **whether section 158 should be amended to prohibit the repeated granting of exemptions for the same controlled action or any other controlled action of a similar nature.**

Recommendation 20

8.81 The committee recommends that the Minister for the Environment and Energy refrain from granting exemptions under section 158 of the *Environment Protection and Biodiversity Conservation Act 1999* for matters relating to shark control programs until after the operation of section 158 has been reviewed in accordance with Recommendation 19.

Role of the media

8.82 Finally, some of the media coverage given to shark bite incidents over recent years is of great concern to the committee. The attention shark bite incidents receive from the Australian media greatly exceeds the coverage given to most other events causing death or injury. To some extent this is understandable: shark bites occur in an environment where humans are vulnerable and have a limited ability to respond. As predators known to cause human fatalities, sharks also trigger a primal fear.

8.83 Reporting of shark bite incidents is important for keeping the public informed about incidents in their community and sharks generally. In the committee's view, however, shark incidents in Australia have in recent years received disproportionate and sensationalised levels of press coverage. Shark bites are not unique to Australia, yet how they are reported here appears to differ dramatically from how shark bites are reported in other countries, such as the United States. Fatalities and serious injuries require coverage; however, at present even close encounters are front-page news. Although the committee understands the fear such encounters cause to the individuals involved, sensationalised media reporting is problematic for supporting responsible and respectful public debate on shark issues and for the public perception of beach safety generally.

8.84 Media reporting has consequences—emotive reporting without scientific evidence encourages 'solutions' that are not backed by science and have questionable efficacy. Intense media interest also has consequences for the victims; for example, during this inquiry the committee received evidence about methods used in preparing these reports, such as one instance where a photographer climbed a tree outside of a hospital to photograph a shark bite victim. Criticism of headline-grabbing,

sensationalised media reporting on shark bite incidents was widespread, including from shark bite victims and their families, shark scientists, social science researchers, local governments, environmental groups and the tourism industry. Importantly, when asked about the role of the media in educating the public, a journalist who writes about sharks acknowledged that whether the media would take up this role depends on whether it is commercially viable to do so. This reinforces the need for governments to ensure the public can obtain reliable information and the preceding recommendations in this report are directed toward this aim.

8.85 It is not the role of this committee to dictate to the media what they can report and how they should report it—the committee strongly supports and defends a free press. However, as the media can have a powerful influence on how people's attitudes to matters of public interest are shaped, the committee urges media organisations to consider how they report shark-related events to ensure these matters are, all things considered, covered responsibly.

Senator Peter Whish-Wilson
Chair

Australian Greens' additional comments

Shark mitigation and deterrent measures: Fear and facts

1.1 The Australian Greens do not support the use of lethal shark mitigation methods, such as shark nets. This inquiry has established that shark nets currently in place in New South Wales and Queensland are significant and indiscriminate killers of protected marine life; provide no guarantees of safety to ocean users; and are an outdated, last century approach to shark mitigation.

1.2 Accordingly, many environmentalists will be disappointed that the committee's primary finding—Recommendation 1—does not call for the immediate removal of all shark nets; and instead recommends phasing these nets out over time.

1.3 In saying this, we acknowledge the political difficulty in immediately removing shark nets. Even so, we would hope to see a commitment from both federal and state governments that they are no longer necessary and should be phased-out and replaced with other measures. This will require a staged process, and federal leadership given the differences in opinion amongst the states. The establishment of both the National Shark Summit and the National Shark Working Group recommended in the committee report would be critical in achieving this.

1.4 It is unfortunate that the federal Labor Party could not even agree with this somewhat 'soft' Recommendation 1. We expected opposition from the Liberal Party to any removal of lethal mitigation measures—they seem determined to go a step further and remove the Great White Shark from EPBC listing and introduce shark culls. However, we had hoped that federal Labor might have sided with the Western Australian Labor Government's position that lethal mitigation options are not necessary, rather than Queensland Labor's position of continued use of unnecessary destructive nets and drum lines. The firm weight of evidence received through this inquiry supports this view, but it was still ignored.

1.5 The Greens have grave fears about the future survival of the Great White Shark and other shark species like the Grey Nurse Shark in Australian waters. Much depends on the interpretation of a scientific study soon to be released which estimates Great White Shark population numbers. The Greens were hopeful this study may have been released prior to this committee report and are disappointed this was not possible. Given the current acute politicisation of the risks of shark encounters and concerns over moves to delist the Great White Shark from EPBC protection, conservationists and the many users and lovers of the ocean who don't support killing sharks will need to be vigilant in the future to make sure sharks are better protected.

1.6 As acknowledged in this committee report, the subject matter at hand is very emotive, highly political, can be very divisive and media coverage is sometimes brutal and unrelenting. We acknowledge this can take its toll on those educating, advocating and working in this field.

1.7 The Greens would also like to place on record our appreciation for the work of the many scientists and community members who research sharks and their impact on healthy oceans, especially Dr Barry Bruce from CSIRO who has spent nearly 20 years building scientific capacity in our understanding of one of the world's most misunderstood creatures: the Great White Shark.

Senator Peter Whish-Wilson
Chair

Coalition Senators' additional comments

1.1 Coalition Senators wish to make clear that public safety in the water is paramount and must be the central consideration in discussions around shark mitigation and deterrent measures. Water users, namely surfers, swimmers and divers, must be made aware of known risks relating to shark sightings or encounters and all effective shark mitigation and deterrent measures must be considered in pursuit of improving public safety.

1.2 Coalition Senators share the concerns expressed through the inquiry regarding bycatch and shark mortality from current mitigation and deterrent measures and agree that, where possible and without exposing the public to increased risk, this is to be minimised. On that basis, Coalition Senators largely support the use of non-lethal and deterrent measures where such measures are proven to be as effective as existing measures.

1.3 Throughout this inquiry, Coalition Senators having consistently observed that environmental ideology must not prevent nor detract from the preservation of human life.

1.4 Many recommendations relate to state and territory laws and Coalition Senators note that it is largely the responsibility of these governments to ensure public safety in the water and manage the risks to humans from sharks.

1.5 The Australian Government has responsibility to ensure that state and territory shark mitigation and public safety activities are consistent with national laws. It therefore follows that the Australian Government should not be involved in shark management and monitoring other than that which is required under Commonwealth legislation.

1.6 Coalition Senators note that the Australian Government is responsible for managing fishing activity in Commonwealth fisheries, which includes commercial fishing on shark certain shark species.

1.7 Target species in Commonwealth fisheries include gummy sharks and other small species. Some larger species, known to have been harmful to humans, may be taken as bycatch, but this is generally limited. There is generally an ecological divide between the sharks that are targeted for food or captured as bycatch and those that are considered dangerous to humans.

1.8 Commonwealth fisheries management does not include other anthropogenic interactions with sharks, such as clinical information around shark bite incidents or bather protections in coastal waters.

1.9 Coalition Senators note that no questions were raised during the inquiry regarding issues relevant to Commonwealth fisheries management, such as commercial fishing activities and their impact on shark populations.

1.10 Coalition Senators note that the development of grant programs requires the appropriate constitutional and legislative coverage. Consideration should also be given to the appropriate agency with portfolio responsibility for the matters covered by any proposed grant program. Any additional funding would need to be considered in the context of other budget priorities and should be outcomes focused.

1.11 With regard to exemptions granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Coalition Senators are not satisfied that sufficient evidence has been presented to the inquiry to suggest that the Minister for the Environment and Energy has exercised powers inconsistent with the law or the intention of the law. On that basis, Coalition Senators do not see the basis for recommendations relating to section 158 of the EPBC Act.

The Western Australia Case

1.12 Evidence provided to the committee was largely related to the mitigation measures adopted in Queensland and New South Wales, such as shark nets and drum lines, which the Western Australian government is yet to implement, based on ideological, rather than safety grounds.

1.13 In New South Wales and Queensland, at the approximately 85 protected beaches, only one death has resulted in the last 50 years. Despite these statistics, the Australian Greens-led inquiry insisted that "nets and drum lines don't make beaches safe" which the Coalition Senators strongly reject.[1]

1.14 Coalition Senators acknowledge and note that the circumstances, environment and conditions in the West are significantly different and many of the assertions gathered from this politically charged inquiry were largely based on metrics and evidence that are inappropriate to apply to all states and territories. Coalition Senators are of the view that any policy formed in relation to human safety in the water must not be outweighed by environmental ideology.

1.15 Consistent evidence from witnesses in Western Australia noted that there has been an increase in shark numbers and changes in shark behaviours. Coalition Senators note the overwhelming evidence to the effect:

> Since [2007] we have observed a huge increase in the number and size of great white and bronze whaler sharks as well as a change in their behaviour…shark behaviour changes have been remarkable in the last decade.[2]

1 Senator Whish-Wilson, *Committee Hansard*, 28 July 2017, p. 12.

2 Mr Russell Morey, *Committee Hansard*, 28 July 2017, p. 50.

1.16 Coalition Senators note further evidence from Western Australian individuals who have spent their livelihoods in and around the Western Australian coastline and waters:

> I'd never seen a great white in the ocean until 2010; now I see them several times a year…Adult great whites eat mammals almost exclusively, and we're mammals. Colours, stripes, helicopters, signs will have no effect on shark behaviour.[3]

1.17 Coalition Senators note that without further studies and research, it is difficult to definitively rule out any measures to mitigate shark attacks and reduce the risk to human life in the water, including shark population control.

1.18 Given the need to further understand the shark population, their breeding patterns and behaviours, Coalition Senators agree in principle with Mr Ranford's statement that:

> As our population rapidly expands along the coastline, growing conflict between humans and sharks is inevitable. It is thus time to commit to the funding of these technologies as well as research to learn more about shark behaviours and populations.[4]

1.19 In contrast to the experiences of Queensland and New South Wales, 15 lives have been lost in Western Australia as a result of shark attacks since 2000, with many more wounded. Coalition Senators believe that the Western Australian Government should take more pro-active public safety measures to protect beachgoers at popular beaches.

1.20 Lastly, Coalition Senators acknowledge and pay their respects to the victims of shark attacks in WA and the east coast. In particular, during the conduct of this Inquiry, 17-year-old Laeticia Brouwer from Western Australia tragically lost her life due to a shark attack and others have since been attacked in the same water.

Senator Jonathon Duniam
Deputy Chair
Senator for Tasmania

Senator Linda Reynolds CSC
Senator for Western Australia

3 Mr Russell Morey, *Committee Hansard*, 28 July 2017, p. 50.

4 Mr Blair Ranford, *Committee Hansard*, 28 July 2017, p. 62.

Labor Senators' dissenting report

1.1 Labor's National Platform states:

> In Australian waters and throughout the world's oceans, Labor will encourage protection for iconic marine species like whales, dugongs, turtles and sharks, and will promote the conservation and research of key bioregional health indicator species.

1.2 Labor has a proud record of conservation and ocean protection—it was a Labor Government that initiated the protection of the Great Barrier Reef and in 2012 put the world's largest network of marine parks in place.

1.3 Labor's network added 40 marine reserves around Australia and increased marine protection to over 3.1 million square kilometres. This world leading conservation step is now under attack from the conservative Turnbull Government.

1.4 Labor Senators thank the individuals and organisations who provided evidence to the committee and appreciate their knowledge and insights.

1.5 Labor Senators support almost all recommendations in the committee's report. We took part in the committee process in good faith to seek policy improvement options. Labor supports evidence-based policy—this means solid research and ensuring data and information are available to researchers and policy makers.

1.6 Shark management is a controversial issue and steps are being taken around Australia to deliver improved shark protection and safety for beachgoers.

1.7 Advancements such as SMART drum lines and non-lethal shark mitigation and deterrent measures are steps in the right direction and States should be encouraged to use new technology and approaches wherever possible.

1.8 Labor Senators support actions such as those of the Western Australian Government to undertake aerial and beach patrols, beach enclosures, ongoing research into shark behaviour and innovative programs such as the Beachsafe app. More recent measures such as the below are also supported by Labor and these actions should be looked at by all jurisdictions:

- a trial rebate of $200 for independently verified devices purchased by surfers and divers;
- grants for local councils to install Beach Emergency Numbering signs to improve emergency response times; and
- funding for Surf Life Saving WA to use drones to monitor beaches, two additional receivers to detect tagged sharks and funding for an additional beach enclosure.

1.9 Labor Senators note the concerns raised around some personal deterrent devices not being independently verified and support recommendations that 'products marketed as personal shark deterrent devices are independently verified as being fit-for-purpose'.

1.10 The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth law that protects sharks and relates to lethal shark control programs.

1.11 The EPBC Act has been in place since the Howard Government and has been applied by both Labor and the conservatives. The Act is the reason that world heritage properties such as the Great Barrier Reef are protected and is the basis of marine reserve management planning. The EPBC Act also means that threatened species such as Blue Whales, Flatback Turtles, Koalas and some sharks are protected.

1.12 Labor Senators note that the EPBC Act is being reviewed in 2019 as per section 522A of the Act and the advice that preliminary work by the Department of Environment and Energy on the review has begun. Labor Senators note that section 158 relating to lethal shark control programs will be included as part of the statutory review.

1.13 Labor Senators consider it unfeasible to place a blanket restriction on the Minister for what could be over 24 months. However, Labor Senators note that the concept of conducting a 'shark cull' program to rid our ocean of a particular species as been floated by the previous Western Australian Government was absurd.

Senator Anne Urquhart
Senator for Tasmania

Senator Anthony Chisholm
Senator for Queensland

Additional comments from Senator Williams

1.1 I was astounded at the evidence given by two witnesses at the hearing in Byron Bay. In his evidence, Mr. Dean Jefferys, Founder, *Migaloo 2* said:

> Mr Jefferys:…On the issue of a human life being more valuable than a marine life, something inside me really grates when I hear that. I see images of a baby whale tangled up and drowned in the net, and I would question whether the mother of that whale, or the baby itself, would think that a human life was more valuable than a marine life.
>
> Senator WILLIAMS: Mr Jefferys, are you suggesting that animal life is parallel to human life?
>
> Mr Jefferys: Definitely.
>
> Senator WILLIAMS: Crikey!
>
> CHAIR: Mr Jefferys is entitled to an opinion.
>
> Senator WILLIAMS: I am entitled to mine as well, and I disagree.[1]

1.2 He was followed later in the day by Miss Leah Hays, Coordinator, Sunshine Coast Environment Council.

> Senator WILLIAMS: When you made your statement, it appeared that way. It looks like: who is most important—the sharks or the humans? Would you disagree with the Queensland Premier's statement that she is putting human safety above everything else? You disagree with that sort of statement?
>
> Miss Hays: I do indeed.
>
> Senator WILLIAMS: Do you think animals and humans should be treated equally?
>
> Miss Hays: Absolutely.[2]

1.3 I find this evidence disturbing, that anyone would put the same value on an animal's life as that of the life of a human. These are examples of ill-informed statements simply to oppose proven shark mitigation measures. I urge the government and the opposition to disregard the evidence of these two witnesses as they are extreme in their views.

Senator John Williams
Senator for New South Wales

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1 Mr Dean Jeffreys, Founder, Migaloo 2, *Committee Hansard*, 2 May 2017, p. 42

2 Miss Leah Hays, Coordinator, Sunshine Coast Environment Council, *Committee Hansard*, 2 May 2017, p.74

Appendix 1

Submissions, tabled documents, answers to questions on notice and additional information

Submissions

1	Shark Shield Pty Ltd
2	Surf Life Saving Queensland
3	Sydney Coastal Councils Group
4	Australia for Dolphins
5	Mr Dan Webber
6	Australian Aerial Patrol
7	Mr Duncan Leadbitter
8	Dr Peter Kerkenezov
9	Confidential
10	Surf Life Saving South Australia
11	Mr John Heaton
12	Ms Holly North
13	Surf Life Saving Western Australia (Inc)
14	Mrs Rochelle Ferris
15	Surf Life Saving NSW and Australian Lifeguard Service NSW
16	Surf Life Saving Australia
17	Surfrider Foundation Australia
18	The Hon Lynn MacLaren MLC
19	Confidential
20	Surfing Australia
21	Dr Leah Gibbs, Mr Lachlan Fetterplace, Associate Professor Quentin Hanich and Mr Matthew Rees
22	Mr Greg Webber
23	Dr Daniel Bucher and Professor Peter Harrison
24	Ms Caitlin Weatherstone
25	SEA LIFE Trust
26	Mr Dale Carr
27	NSW Greens
28	Migaloo 2 Foundation
29	Sharksafe Barrier
30	Mr Keith Williams
31	Global Marine Enclosures

32	Queensland Government, Department of Agriculture and Fisheries
33	Commonwealth Scientific and Industrial Research Organisation
34	Fisheries Research and Development Corporation
35	Sunshine Coast Environment Council
36	Illawarra Greens
37	Australian Seabird Rescue Inc.
38	Australian Marine Conservation Society
39	Mr Don Munro
40	IFAW – International Fund for Animal Welfare
41	Eurobodalla Greens
42	EDOs of Australia
43	Humane Society International
44	Nature Conservation Council of NSW
45	Ballina Chamber of Commerce
46	Project AWARE
47	Mr Kim Allen
47.1	Supplementary 1 to Submission 47
47.2	Supplementary 2 to Submission 47
47.3	Supplementary 3 to Submission 47
48	Dr Christopher Neff
49	Australian Institute of Marine Science
50	Greenpeace Australia Pacific
51	Australian Conservation Foundation
52	Ballina Lighthouse & Lismore SLSC
53	Ms Keri James
54	Ballina Environment Society Inc.
55	Department of the Environment and Energy
56	Mr Fred Pawle
57	Sea Shepherd Australia
58	Associate Professor Daryl McPhee
59	Mr Tony Isaacson, DiveCareDare
59.1	Supplementary to Submission 59
60	Dorsal
61	New South Wales Young Lawyers Animal Law Committee
62	Associate Professor Richard Gates
63	Ms Jann Gilbert
64	Mr Peter Stephenson
65	Government of South Australia
66	Mrs Rebecca Clough

67	Mr Geoff McPherson
68	Confidential
69	Ballina Shire Council
70	Abalone Industry Association of South Australia
71	Mr Eric Kotz
72	Mr Ian Wiese
73	Dr Sharon Burden
74	Mr Blair Ranford
75	Mr Paul Collier
76	Esperance Ocean Safety and Support Group
77	Dr Jan-Olaf Meynecke
78	Finding Salisbury Inc

Form letter

Form letter received from 223 individuals

Tabled documents

Mr Lindsay Lyon – Finding of Inquest concerning the death of Paul William Buckland, 11 April 2003 (public hearing, Perth, 20 April 2017)

Mr Lindsay Lyon – Finding of Inquest concerning the death of Peter Stephen Clarkson, 9 August 2013 (public hearing, Perth, 20 April 2017)

Mr Lindsay Lyon – Article, CF Smit and V Peddemors, 'Applications estimating the probability of a shark attached when using an electric repellent' (public hearing, Perth, 20 April 2017)

Mr Lindsay Lyon – Shark Shield Ocean Guardian (public hearing, Perth, 20 April 2017)

Professor Shaun Collin – Article, C Huveneers et al, 'Effects of an Electric Field on White Sharks: In Situ Testing of an Electrical Deterrent' (public hearing, Perth, 20 April 2017)

Professor Shaun Collin – Article, R Kempster et al, 'How Close is too Close? The Effect of a Non-Lethal Electric Shark Deterrent on White Shark Behaviour', Plos One, 2016, 11(7) (public hearing, Perth, 20 April 2017)

Professor Jessica Meeuwig – Article, J Meeuwig et al, 'When Science Places Threatened Species at Risk' (public hearing, Perth, 20 April 2017)

Mr Chris Gurtler – Photographs, Shark Alert (public hearing, Perth, 20 April 2017)

Mr John Heaton – Record of shark incidents September 2014 – October 2016 (public hearing, Byron Bay, 2 May 2017)

Mr John Heaton – Documents outlining personal effects after the last 2 years of shark attacks (public hearing, Byron Bay, 2 May 2017)

Ms Jann Gilbert – Various newspaper articles (public hearing, Byron Bay, 2 May 2017)

Sunshine Coast Environment Council – Queensland shark control program maps (public hearing, Byron Bay, 2 May 2017)

Senator Sue Lines – Report on international visitors to Australia, Tourism Research Australia (Austrade) (public hearing, Perth, 28 July 2017)

Mr Lindsay Lyon – Shark Shield opening statement (public hearing, Perth, 28 July 2017)

Mr Bradley Woods, Australian Hotels Association (WA) – Internet searches on shark attacks (public hearing, Perth, 28 July 2017)

Ms Kellie Lindsay, Coolum and North Shore Coast Care – Summary of the ecological impacts of the Queensland shark safety program, and options and recommendations for solutions (public hearing, Brisbane, 31 July 2017)

Coolum and North Shore Coast Care – Opening statement (public hearing, Brisbane, 31 July 2017)

CSIRO – Opening statement (public hearing, Canberra, 20 October 2017)

Answers to questions on notice

Sydney Coastal Councils Group – Answer to question taken on notice, public hearing, Sydney, 16 March 2017 (received 12 April 2017)

Department of the Environment and Energy – Answers to questions taken on notice, public hearing, Sydney, 16 March 2017 (received 19 April 2017)

Dr Christopher Neff – Answer to question taken on notice, public hearing, Sydney, 17 March 2017 (received 28 April 2017)

SEA LIFE Trust – Answer to question taken on notice, public hearing, Sydney, 17 March 2017 (received 2 May 2017)

Mayor Troy Pickard – Answers to questions taken on notice, public hearing, Perth, 20 April 2017 (received 16 May 2017)

Ms Tooni Mahto – Answer to question taken on notice, public hearing, Byron Bay, 2 May 2017 (received 16 May 2017)

Mr Bradley Woods – Answers to questions taken on notice, public hearing, Perth, 28 July 2017 (received 24 August 2017)

CSIRO – Answers to questions taken on notice, public hearing, Canberra, 20 October 2017 (received 23 November 2017)

CSIRO – Answers to questions taken on notice, public hearing, Canberra, 20 October 2017 (received 24 November 2017)

Department of the Environment and Energy – Answers to questions taken on notice, public hearing, Canberra, 14 November 2017 (received 29 November 2017)

Additional information

The Hon Colin Barnett MLA, Premier of Western Australia – Correspondence dated 14 December 2016

Associate Professor Nathan Hart – 'Sharks senses and shark repellent' in Integrative Zoology (2015)

Dr Christopher Neff – Tables and charts regarding shark control programs and shark bite incidents

Humane Society International – Additional statement provided after 17 March 2017 public hearing

Mr Dan Webber – Additional information provided after 17 March 2017 public hearing

Mr Chris Gurtler – Cardno report for Shark Alert, 'An Innovative Method for Obtaining High Detection Rates of Sharks on Ocean Beaches'

Mr Chris Gurtler – Briefing note on Shark Alert by Dr Daryl McPhee

Cr Simon Richardson – Clarification of evidence provided after 2 May 2017 public hearing

Ms Jann Gilbert – Journal article: 'Human-shark interactions: The case study of Reunion Island in the south-west Indian Ocean'

Ms Jann Gilbert – Article: 'Why is this Indian Ocean island a hot spot for shark attacks?'

Mr Richard Talmage – Correspondence from Shark Mitigation Systems dated 4 August 2017

The Hon Niall Blair MLC, New South Wales Minister for Primary Industries – Correspondence dated 14 August 2017

Appendix 2

Public hearings

Thursday, 16 March 2017, Sydney

Sydney Coastal Councils Group

Ms Belinda Atkins, Manager, Projects and Programs

Surf Life Saving Australia

Mr Shane Daw, Coastal Safety and Risk Manager

Surf Life Saving NSW

Mr Brent Manieri, Australia Lifeguard Service Manager
Mr Andy Kent, Lifesaving Manager

Department of the Environment and Energy

Mr Matthew Cahill, First Assistant Secretary
Ms Kim Farrant, Assistant Secretary, Assessment (NSW/ACT) and Fuel
Mr Dane Roberts, Director, Northern NSW Assessments, Assessments (NSW/ACT) and Fuel

Friday, 17 March 2017, Sydney

Dr Christopher Neff – via teleconference

SEA LIFE Trust Australia/New Zealand

Ms Claudette Rechtorik, Manager

CARDNO (New South Wales/Australian Capital Territory) Pty Ltd

Dr Craig Blount, Senior Environmental Scientist

Australian Aerial Patrol

Mr Duncan Leadbitter, Director

Surfrider Foundation Australia

Mr Brendan Donohue, Northern Beaches Branch President

Mr Daniel Webber – Private capacity

Humane Society International

Ms Nicola Beynon, Head of Campaigns
Ms Jessica Morris, Marine Scientist

Shark Mitigation Systems Ltd – via teleconference

Mr Richard Talmage, General Manager

Thursday, 20 April 2017, Perth

Surf Life Saving Western Australia

Mr Chris Peck, General Manager – Lifesaving and Training

Sea Shepherd Australia

Mr Jeff Hansen, Managing Director
Ms Natalie Banks, Chief Advisor

Shark Shield Pty Ltd

Mr Lindsay Lyon, Managing Director

Surfsafe Pty Ltd

Mr David Smith, Chief Executive Officer

City of Joondalup

Councillor Troy Pickard, Mayor

Professor Shaun Collin – Private capacity

Professor Jessica Jane Meeuwig – Private capacity

Mr Rick Gerring – Private capacity

Shark Alert

Mr Chris Gurtler, Managing Director

Western Australian Department of Fisheries

The Hon David Kelly MLA, Minister for Water; Minister for Fisheries and Minister for Forestry
Mr Tony Cappelluti, Regional Manager, Metropolitan
Dr Warrick Fletcher, Executive Director, Science and Research Assessment

Tuesday, 2 May 2017, Byron Bay

Mr John Heaton – Private capacity

Le-Ba Boardriders and Lennox Head National Surfing Reserve

Mr Don Munro, President, Le-Ba Boardriders; and Spokesperson, Lennox Head National Surfing Reserve

Mr Alan Charles Baldock – Private capacity

Beyond the Bite – via teleconference

Mr Dale Carr, Member, Bite Club

Ballina Shire Council

Councillor David Wright OAM, Mayor
Mr John Truman, Group Manager, Civil Services

Byron Shire Council

Councillor Simon Richardson, Mayor

Surfing Australia

Mr Andrew Stark, Chief Executive Officer

Associate Professor Darryl McPhee – Private capacity

The Hon Ian Cohen – Private capacity

Migaloo 2 Foundation

Mr Dean Jefferys, Founder

Professor Daniel Bucher – Private capacity

Australian Maritime Conservation Society

Miss Tooni Mahto, Senior Marine Campaigner

Ms Jann Gilbert – Private capacity

Ms Caitlin Weatherstone – Private capacity

Australian Seabird Rescue Inc

Ms Kathrina Southwell, General Manager
Mrs Rochelle Catherine Ferris, Projects and Research Manager

Sunshine Coast Environment Council

Miss Leah Hays, Coordinator
Mr Chad Latham Buxton, Marine Scientist and Volunteer

Friday, 28 July 2017, Perth

Miss Amanda Elizabeth Morgan – Private capacity

Australian Hotels Association (WA)

Mr Bradley Woods, Chief Executive Officer/Executive Director
Ms Clare McPherson, Research and Policy Analyst

Dr Sharon Burden – Private capacity

Mr Leon Deschamps – Private capacity

Mrs Rebecca Clough – Private capacity

Mr Ian Wiese – Private capacity via teleconference

Mr Paul Collier – Private capacity

Mr Russell Morey – Private capacity

Shark Shield Pty Ltd
Mr Lindsay Lyon, Managing Director

Mr Blair Ranford – Private capacity via teleconference

Surfsafe Pty Ltd
Mr David Smith, Chief Executive Officer

Monday, 31 July 2017, Brisbane

Dr Leah Gibbs – Private capacity

Dr Jan-Olaf Meynecke – Private capacity

Coolum and North Shore Coast Care
Mr Chad Buxton, Admin Officer/Volunteer
Ms Kellie Lindsay, Support Person

Mr Fred Pawle – Private capacity

Tag For Life – via teleconference
Mr Kent Stannard, Founder and Trustee

Dorsal – via teleconference
Mr Alan Bennetto

DiveCareDare
Mr Tony Isaacson

Tuesday, 29 August 2017, Cairns

Mr Paul O'Dowd – Private capacity

Wednesday, 30 August 2017, Townsville

Professor Colin Simpfendorfer – Private capacity

Friday, 20 October 2017, Canberra

Commonwealth Scientific and Industrial Research Organisation

Dr Peter Thompson, Acting Research Director
Professor Nic Bax, Senior Principal Research Scientist
Russell Bradford, Senior Experimental Scientist

Tuesday, 14 November 2017, Canberra

Department of the Environment and Energy

Mr James Tregurtha, Acting First Assistant Secretary, Environment Standards Division
Mr Geoff Richardson, Assistant Secretary, Protected Species and Communities Branch, Biodiversity Conservation Division
Ms Lesley Gidding-Reeve, Director, Marine and Freshwater Species Conservation Section, Biodiversity Conservation Division
Mr Dane Roberts, Director, Northern New South Wales Assessments Section, Environment Standards Division

Appendix 3

Popular shark myths, misconceptions and factoids

A3.1 During this inquiry, various beliefs about how shark behaviour and the causes of shark bite incidents were discussed. Some of these have gained a degree of acceptance in the community; however, they are not supported by expert evidence. One of the major challenges in ensuring accurate information about sharks is the acceptance of correlation implying causation. That is, increases or decreases in human–shark encounters in particular areas are attributed to changes in some other variable, such as whale migration or the presence of shark nets, without scientific evidence demonstrating a link between the two changes.

A3.2 It can be difficult to disprove and dispel some of the myths and misconceptions that exist. There are significant challenges in conducting shark research about human–shark interactions. It is also generally accepted that there is a need for further research to improve understanding about shark populations, behaviour, movement and breeding patterns. The difficulties associated with obtaining and disseminating reliable scientific evidence are in stark contrast to the ease in which incorrect information can spread, gain credence and become accepted as fact. For example, it has been argued that incorrect information about shark behaviour shown in the blockbuster film *Jaws*, in which a terrifying monster targets humans at a particular location, has shaped people's attitudes towards sharks.

A3.3 This appendix provides a selection of myths and misconceptions about sharks and shark bites, followed by evidence received during this inquiry that responds to them.[1] Questioning and challenging widely held beliefs about sharks is important for evidence-based policy, particularly as it is evident that many of these myths and misconceptions influence how interested individuals (and governments) approach the debate on shark mitigation and deterrent measures.

All sharks are dangerous

A3.4 Although around 180 species of sharks can be found in Australian waters,[2] the available data indicate that the overwhelming majority of shark bites in Australia, including 99 per cent of fatalities, can be attributed to the following three species:

- white sharks (*Carcharodon carcharias*);
- tiger sharks (*Galeocerdo cuvier*); and
- bull sharks (*Carcharhinus leucas*).[3]

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1 In compiling a selection of myths in one place, this appendix repeats some of the evidence referred to elsewhere in the report.

2 Department of the Environment and Energy (DoEE), 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 2 December 2016).

The shark population has 'exploded'

A3.5 That the number of sharks in Australian waters has increased significantly was put forward by many individuals who contributed to this inquiry.

A3.6 Unfortunately, reliable data on shark populations is not available, although there is work underway by CSIRO to develop an estimate of white shark abundance. Nevertheless, due to what is known about sharks, shark experts consider it highly unlikely that the population could have dramatically increased. For example, Professor Jessica Meeuwig explained that white sharks only start reproducing between 17–20 years of age and 'have one or two offspring every couple years'. The professor emphasised that white sharks 'are just not capable of rapid rebound like a herring or a pilchard'.[4]

A3.7 Professor Nic Bax, a senior principal research scientist at CSIRO told the committee that, with respect to the white shark population, 'it would be hard to imagine that their growth rate could be more than about four per cent a year'.[5]

A3.8 Experts suggested that the perception of an increasing shark population could be explained by a greater number of people being in the water resulting in a higher number of observations.[6] Potentially, a larger number of sharks could be approaching the coast due to changes in the distribution of their prey.[7]

Sharks target humans as prey

A3.9 As the Department of the Environment and Energy explains on its website, the current understanding of shark species known to be dangerous to humans is that these sharks do not target humans as prey. The majority of human–shark encounters that occur are instead because the shark confuses the person with its normal prey.[8]

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3 Taronga Conservation Society Australia (TCSA), 'Australian shark attack file: FAQs', https://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file/faqs (accessed 5 December 2016). See also New South Wales Department of Primary Industries (DPI), 'Identifying sharks', www.dpi.nsw.gov.au/fishing/sharks/identifying-sharks (accessed 5 December 2016).

4 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

5 Professor Nic Bax, Senior Principal Research Scientist, CSIRO, *Committee Hansard*, 20 October 2017, p. 4.

6 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

7 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

8 DoEE, 'Sharks in Australian waters', www.environment.gov.au/marine/marine-species/sharks (accessed 2 December 2016).

A3.10 It was noted that 'sharks are inquisitive (and opportunistic) animals, and will investigate almost anything in the water column or on the surface'. Furthermore, it is considered that most sharks take a 'cautious investigative approach' to large objects in the water.[9] Professor Daniel Bucher added:

> Basically, sharks being a top predator, the only enemies they have are bigger sharks. Anything that is sitting on the surface is worth investigating as a potential food item. I do not think they are mistaking us for other prey; I think they have got this electrical sense. They have got a really good sense of sound and movement. They k006Eow this is not their normal food, but it is big enough and it is sitting there, and it is not doing much, and it does not seem to be able to swim as fast as all the other food it might be eating. That is why a lot of attacks are from behind; they are a cautious approach.[10]

Killing 'rogue' sharks will solve the problem

A3.11 Related to the suggestion that sharks hunt humans is the theory of 'rogue sharks'. The existence of rogue sharks was theorised by Victor Coppleson in the 1950s. Essentially, the theory centres on a 'rogue' shark or sharks that have developed a taste for human flesh, and that a series of shark encounters in the same area can be attributed to 'the work of a single shark—a rogue shark—which maintains even for years a beat along a limited stretch of shore'.[11]

A3.12 As Dr Christopher Neff has observed, the film *Jaws* captured the public imagination about the risk of sharks and provided a vehicle through which rogue shark theory became accepted as a true explanation for human–shark encounters. The committee was also referred to other examples where individuals have called for rogue sharks to be killed to solve the problem of human-shark encounters.[12] Governments have also hunted 'rogue' sharks following shark bite incidents.

A3.13 Shark experts who the committee questioned during this inquiry do not accept the rogue shark theory. In particular, it is emphasised that sharks are migratory. CSIRO explained that bull, tiger and white sharks have similar movement patterns in that they 'roam over considerable distances (1000s of km)…and utilise both nearshore and offshore waters as part of their normal habitat'. Regarding white sharks, CSIRO noted that they 'are not permanent residents at any one site' with movements that 'indicate temporary residency at various sites, mixed with periods of long-distance travel that may include common corridors'.[13]

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9 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 3 (citation omitted).

10 Professor Daniel Bucher, *Committee Hansard*, 2 May 2017, p. 48.

11 V Coppleson, *Shark attack*, Angus & Robertson, Sydney, 1958, p. 45; cited in C Neff, 'The Jaws Effect: How movie narratives are used to influence policy responses to shark bites in Western Australia', *Australian Journal of Political Science*, vol. 50, no. 1, 2015, p. 118.

12 Dr Christopher Neff, *Committee Hansard*, 17 March 2017, p. 3.

13 CSIRO, *Submission 33*, p. 7.

A3.14 Essentially, experts were clear that they 'have no evidence for anything called a rogue shark'.[14]

Sharks are dumb

A3.15 Professor Jessica Meeuwig argued that sharks 'are actually quite smart'. To illustrate, the professor referred to learned behaviour where sharks start to follow boats that are chumming.[15] Professor Bax from CSIRO stated that sharks are 'highly evolved creatures in a very specialist area'.[16]

The presence of sharks in an area means an attack is likely

A3.16 Essentially, there is a belief in some quarters that if a shark is in the area, then an attack is likely. In response to this suggestion, Professor Bax from CSIRO told the committee:

> Clearly we've seen areas where there are large numbers of white sharks with no attacks. Similarly, large numbers of tiger sharks were caught in the WA drum line program when there weren't attacks by white sharks. So just because there are sharks there doesn't mean there's going to be an attack.[17]

A3.17 Similarly, it was noted that the waters off Port Stephens in New South Wales are a known residency location for juvenile white sharks and, although encounters often occur between humans and sharks 'it is not implicated as a particularly high-risk area'.[18] It was also noted that bull sharks regularly travel through the waters off Sydney and in Sydney harbour, and that this activity occurs without incident when people are in the water.[19]

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14 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 36.

15 Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 44.

16 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 12.

17 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 10.

18 Dr Daniel Bucher and Professor Peter Harrison, *Submission 23*, p. 3 (citation omitted).

19 Mr Brendan Donohoe, Northern Beaches Branch President, Surfrider Foundation Australia, stated: 'In Sydney there has not been a serious ocean beach attack for a number of years, so people feel safe—and they should. We know that bull sharks track straight in through Bondi pretty much daily, and there are thousands of people there all the time and no-one is attacked'. *Committee Hansard*, 17 March 2017, p. 27. The committee was also referred to a study of bull shark movements in Sydney Harbour on Australia Day 2016 where over 20 bull sharks were tracked and travelled through areas where people were swimming at popular beaches. See Mr Chad Buxton, Marine Scientist and Volunteer, Sunshine Coast Environment Council, *Committee Hansard*, 2 May 2017, p. 74.

Lethal measures stop human–shark encounters

A3.18 Although lethal measures reduce the risk of a human–shark encounter by reducing the number of sharks in the water, the degree to which this risk is reduced is impossible to quantify. Nevertheless, the available evidence suggests that culling programs do not reduce the number of shark bite fatalities. For example, in Hawaii over 4,500 sharks were culled over nearly two decades. After an evaluation demonstrated that the cull did not affect the number of fatalities, the program was abandoned in favour of non-lethal measures.[20]

A3.19 Culling programs can also fail to target the species of sharks associated with shark bites in a particular region. For example, the trial of drum lines conducted in Western Australia in 2014 is estimated to have killed 173 tiger sharks but did not kill any white sharks. White sharks were the species involved in the shark bite incidents that led to the trial, whereas tiger sharks have not been implicated in any lethal attacks in the region since 1923.[21]

A3.20 The New South Wales and Queensland shark control programs also do not prevent human–shark encounters. For example, the committee was advised that:

- Since the Queensland measures were introduced, 17 human–shark encounters have occurred at beaches with drum lines and/or nets, including one fatality. The fatality occurred at a location where eight drum lines were in place. It was also noted that shark encounters have increased at the Central Coast beaches since shark nets have been installed.[22]
- In New South Wales, 40 non-fishing related human–shark encounters have occurred at netted beaches, including 24 incidents between September 1992 and the end of 2016 (almost one per year). It was also noted that no shark bite fatalities occurred between 1929 and 1937 (when the nets were introduced), or during World War II when the nets were removed.[23]

A3.21 Given that serious injuries have resulted in recent shark bite incidents, when considering the low rate of fatalities, several stakeholders argued that improvements in medical responses (such as blood loss prevention) need to be taken into account.

A3.22 The location of lethal shark measures also mean that people involved in activities associated with a higher risk of shark encounters are unlikely to be protected. For example, divers are unlikely to be protected by drum lines or nets located near beaches.

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20 Ms Natalie Banks, Chief Advisor, Sea Shepherd Australia, *Committee Hansard*, 20 April 2017, p. 11; Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 41.

21 See Professor Jessica Meeuwig, *Committee Hansard*, 20 April 2017, p. 36.

22 Sea Shepherd Australia, *Submission 57*, pp. 6, 8; Associate Professor Daryl McPhee, *Committee Hansard*, 2 May 2017, p. 38.

23 Dr Christopher Neff, *Submission 48*, p. 3; Sea Shepherd Australia, *Submission 57*, pp. 3, 6.

A3.23 Further evidence regarding the effectiveness of lethal measures is in Chapter 4.

Shark nets provide a barrier separating sharks and humans

A3.24 Shark nets have limited coverage and do not provide a barrier that separate people in the water from sharks. This is because the nets are only 150 metres to 186 metres wide, and are six metres deep with limited vertical coverage (bottom set nets result in a gap between the surface and the top of the net, whereas surface-set nets result in a gap underneath the net to the seafloor). The nets are generally deployed up to 500 metres offshore.

A3.25 It is not intended that the nets create an enclosed area: rather, they are a passive fishing device designed to cull sharks in the area.[24] Sharks can, and do, swim around them.

A3.26 There are new types of non-lethal devices that seek to provide a barrier between sharks and beachgoers, such as the eco barriers. These products are discussed in Chapter 6.

The Queensland shark control program is a model that other states should follow

A3.27 During this inquiry it was argued that due to the low number of shark-related fatalities and injuries in Queensland since the Queensland shark control program was introduced, other states should follow the Queensland Government's example and introduce nets and drum lines. Putting aside evidence received about the limitations of lethal measures in general, there are key differences between the marine environments in Queensland and other areas, such as Western Australia, that make comparisons problematic.

A3.28 The most significant difference is the species typically involved in shark bites (white sharks in Western Australia and bull sharks in Queensland). Although the lethal measures capture the shark species involved in shark bite incidents in Queensland, when drum lines were trialled in Western Australia they failed to catch any white sharks. The committee received expert evidence emphasising the need to account for how different species behave, such as white sharks being visual specialists whereas bull sharks rely on electro reception.[25] It was also noted that white sharks are migratory and travel great distances, whereas bull sharks are more territorial; therefore the risk in Queensland arises from bull sharks that spend significant time near the coastline. Furthermore, other differences between the marine environments were noted, such as Queensland being a semitropical to tropical environment where white sharks do not spend large amounts of time, and the difference in seal and sea lion

24 Queensland Department of Agriculture and Fisheries, 'Shark control equipment and locations' www.daf.qld.gov.au/fisheries/services/shark-control-program/shark-control-equipment-and-locations (accessed 6 December 2016).

25 Professor Shaun Collin, *Committee Hansard*, 20 April 2017, p. 38.

populations (these animals are present in Western Australian waters but not in Queensland).[26]

A3.29 Overall, the evidence available indicates that copying measures used in one region to target a different species of shark in another region will not necessarily be effective.

The closure of a shark fishery in Western Australia has led to shark attacks

A3.30 The Western Australian Minister for Fisheries told the committee that there is a local myth about a shark fishery in Western Australia which was closed and that that this has contributed to recent spikes in human–shark encounters. The Minister informed the committee that:

> There has never been a great white shark fishery. We have just never fished specifically for great white sharks for human consumption. There is a shark fishery still here in Western Australia in the southwest. It actually targets other species. My understanding is that most of the attacks have actually occurred where that shark fishery operates. There is a bit of confusion around: 'There's been a closure of a shark fishery.' People assume that that must have been a shark fishery where they were targeting great whites. There has never been a great white shark fishery as such, here in Western Australia.[27]

The presence of whales has resulted in higher numbers of sharks off the coast

A3.31 A factoid discussed during the committee's public hearings is the suggestion that an increase in the number of whales off the Western Australian coast has attracted greater numbers of sharks and resulted in a higher number of human–shark encounters. When asked about this suggestion, Professor Bax warned that correlation does not prove causation. More specifically, CSIRO referred to a recently peer reviewed paper that examined coastal movements of white sharks off Western Australia. CSIRO explained that the paper found that, 'although the distribution of white sharks along the west Australian coastline overlapped that of humpback whales, there was no evidence to support the statement that white sharks were following the humpback whale migration'.[28] Instead, CSIRO suggested that many other factors are

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26 Mr Blair Ranford, *Committee Hansard*, 28 July 2017, p. 64.

27 The Hon David Kelly MLA, Western Australian Minister for Water; Minister for Fisheries and Minister for Forestry, *Committee Hansard*, 20 April 2017, p. 57

28 CSIRO, Answers to questions on notice, 20 October 2017 (received 23 November 2017), pp .6–7. The research referred to by CSIRO is RB McAuley, BD Bruce, IS Keay, S Mountford, T Pinnell and FG Whoriskey, 'Broad-scale coastal movements of white sharks off Western Australia described by passive acoustic telemetry data', *Marine and Freshwater Research*, vol. 68, 2017, 1518-1531.

responsible for increased human–shark interactions, such as changes in near-shore fish species preyed on by sharks.[29]

Electrical shark deterrents attract sharks

A3.32 The committee was also advised that some people believe that the technology used in electrical shark deterrent products, such as Shark Shield, attracts sharks. In response, Mr Lindsay Lyon, the Managing Director of the company that produces Shark Shield, explained that the electrical fields produced by the product are limited.

A3.33 Mr Lyon stated:

> From a physics electronics perspective, it is extremely difficult to transmit electrical fields under water. The reason we have submarines in defence is when you have a nuclear explosion and it causes an electromagnetic pulse it does not affect the submarines because the water acts as a complete shield. The electrical field from these devices at about six or 10 metres is, in the technical marketing term, 'jack to none'. So it is very hard to transmit under water.[30]

Perceptions on the risk of shark bites

A3.34 Finally, although this is not a myth as such, it is important to note that, statistically, the risk of a fatal shark bite incident is very low. According to data collected by the Taronga Conservation Society Australia (TCSA), in the last 50 years there have been 47 fatalities in Australia arising from unprovoked shark bites (an average of 0.9 per year).[31] Although the overall number of shark bite incidents in Australian waters has gradually increased over the last few decades, the risk is very low when compared to other causes of death and when the millions of beach visitations that occur each year are taken into account. For example, Sea Shepherd Australia cited TCSA data indicating that, over a person's lifetime the risk of being killed by a shark is one in 292,525, compared to a one in 3362 chance of drowning at the beach.[32]

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29 Professor Nic Bax, CSIRO, *Committee Hansard*, 20 October 2017, p. 5.

30 Mr Lindsay Lyon, Managing Director, Shark Shield, *Committee Hansard*, 20 April 2017, p. 18.

31 TCSA, 'Australian shark attack file', http://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file (accessed 2 December 2016).

32 Sea Shepherd Australia, *Submission 57*, pp. 30–31.