

8 March 2017

Senate Standing Committees on Environment and Communications  
PO Box 6100  
Parliament House  
Canberra ACT 2600

By email: [ec.sen@aph.gov.au](mailto:ec.sen@aph.gov.au)

Dear Sir/Madam

**Submission to the inquiry into the efficacy and regulation of shark mitigation and deterrent measures**

On behalf of the Australian Institute of Marine Science (AIMS) I enclose our submission to the above inquiry.

I would be happy to meet with the Committee if required. Should you require any additional technical information in relation to our submission, please contact and advise that Dr Michelle Heupel, AIMS Research Scientist

Yours sincerely

John Gunn  
CEO AIMS

## TERMS OF REFERENCE

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.

**Response:**

**The efficacy and regulation of shark mitigation and deterrent measures, with particular reference to:**

**(a) research into shark numbers, behaviour and habitat**

Determining the status and trends of shark populations (including their biology, ecology, movement patterns and habitat preference) requires dedicated research over long time periods. Unlike the situation for targets of commercial fisheries or iconic marine mammals (whales, dolphin etc), where economic and societal drivers have provided sustained funding for multi-dimensional research, there are very few shark species for which we have adequate data to guide advice on the impacts of interventions/management actions on shark population size, or in reducing the likelihood of reducing interactions.

To illustrate this shortcoming, global statistics indicate as many as 47% of shark and ray species cannot be assessed for listing in the International Union for the Conservation of Nature due to limited data. This trend continues in Australia with over 43 species classified as Data Deficient based on lack of information about their populations.

To compound the uncertainty around population status, most of the shark species that interact with humans are apex predators (i.e. top of the food chain), and as such are relatively rare components of marine ecosystems/communities. Their low numbers and often sparse distribution make it very difficult to predict where they are/will be at any point in time. Thus, it is extremely difficult to predict where attacks will occur, when they are likely to occur, or even define why they occur. Only in the last decade or so, following the development of smart tagging technologies, improvements in remote (satellite/drone) ocean observations and ocean circulation models, have we had the power to collect and analyse movement patterns and ties these to environmental variability. This technical revolution is certainly providing significant (and exciting) new insights, but both the sample sizes of movement data, and the inherent variability in ocean ecosystems mean it is early days in development of robust models for movement and residence prediction.

In short, our view is that for the shark species most likely to interact with humans, current data on population size/trends, behaviour and habitat use is of limited use in directly mitigating attacks. Assuming that R&D focussed on these key uncertainties is adequately resourced, it is likely that over the next 5-10 years our understanding of population trends (increasing, decreasing or stable), movement patterns and habitat use data will give regulators and the public the data required to predict migration timing and routes, and routinely report (and perhaps predict) on areas where sharks are spending extended periods. These data will provide a basis for predicting the possibility of interactions with humans.

Prediction of the likelihood of shark attacks however, is a much more difficult problem. We know from observations around the world that greater shark abundance does not necessarily result in more attacks. The conditions/circumstances around attacks are not well understood simply because the presence of a shark does not mean an attack will occur. Triggers for attacks are unknown and difficult to determine, although the presence of cues related to feeding opportunities such as fish blood or struggling, dying fish could increase the risk of attack (e.g. fishing or spearfishing activities). Low visibility may also increase incidence of interactions.

**(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**

As a Publically Funded Research Agency, AIMS' role is to advise regulators and policy makers rather than make (or provide commentary on) regulation and decisions.

However, we note recent arguments around the case for, or against, exemptions to the EPBC Act related to shark mitigation have created a platform for pro-shark-conservation and pro-shark-culling sectors to air what are philosophically opposing views. It is clear that the two sectors have different threshold requirements for scientific evidence.

For the conservation sector, the views are informed by a decision to list a species as threatened. These decisions are based on consideration of a species' biology and population status, but as we note above the data to support these status considerations are often limited. This conundrum is not unique to sharks, and for this reason the EPBC Act (and a number of international conventions) invokes the Precautionary Principle/Approach as a means of dealing with uncertainty. AIMS' expertise and substantial record of providing support to regulators and international conservation bodies on conservation status gives us confidence that the approach of combining use of available data and the precautionary principle provides a robust means for advising on the likely impacts of culling/fishing/environmental change on sharks.

Clearly, in situations where human-shark interactions are a risk to human life, the choice on whether to mitigate risk through measures such as culling involves consideration of more than environmental/biodiversity factors. Social acceptance, societal values and economic impact all come into the equation. In this situation, debates around the relative importance of species conservation and human risk centre on value judgements rather than conflicting interpretation of data, or uncertainty on impact or efficacy. Decisions such as Section 158 exemptions – by Governments and politicians – thus involve evaluating trade-offs across a suite of considerations.

Taking into consideration the conservation risks of culling, the paucity of data on shark population status and the reality that cases for exemptions are likely to differ between species, regions and contexts, AIMS recommends that where a 158 exemption is being considered that regulators and proponents work through a formal decision framework/process along the lines of:

1. Evaluation of the available data on: species population status; nature, extent and persistence of interactions/risks; likely impacts on the species status in the event that culling takes place.
2. Evaluation of available measures – starting with non-lethal means of reducing human risk and moving to lethal only when these have been shown to be ineffective;
3. Ensuring that mitigation measures are tightly constrained, thoroughly monitored, regularly reviewed and reported.
4. Regular independent estimation of the impact of culling on target and by-catch species status, with these estimates fed back into the regular reviews of program efficiency and impact.

**(c) the range of mitigation and deterrent measures currently in use**

State mitigation measures currently in use include gillnet and drum line installations (Qld, NSW) and shark tracking/detection systems (NSW, WA).

Lethal removal of sharks via gillnet or drum line are designed to cause localised depletion of shark populations thus reducing the level of interaction with the public (Dudley and Simpfendorfer 2006). It is uncertain how well this approach works with wide-ranging potentially migratory species such as white and bull sharks.

There are several unintended consequences of using nets and lines to control sharks : 1) catch (and potential death) of threatened marine mammals, sea turtles or other species included as Matters of National Environmental Significance, including shark and ray species listed on international conservation treaties (e.g. hammerhead, manta); 2) catch (and potential death) of non-target, non-threatening shark species; 3) catch (and potential death) of non-target fish species.

There are a number of personal deterrents available such as Shark Shield, SAMS, SharkBanz, etc. The efficacy of many of these is poorly understood and/or poorly tested. Some technologies may be effective under some circumstances, but scientific studies are limited (Huveneers et al. 2014, Kempster et al. 2016). Without adequate testing there is the possibility that the public will use products that have no ability to reduce the chances of being bitten by a shark. It has also been speculated that use of personal deterrents may lead to more risky activity by people who believe they are protected.

#### **(d) emerging mitigation and deterrent measures**

**Deterrents** : Many methods have been trialled to deter sharks from entering or residing in a locality, including bubble curtains, rare earth magnetics, etc; but none have proven to exclude sharks over the long-term. The underlying explanation appears to be that sharks are highly capable of adapting to novel phenomena in their environment and learning, which makes passive mitigation difficult.

It is also difficult to assess the effectiveness of passive (or active) deterrent technology since humans cannot be used in tests, and simulating human interaction scenarios is complex.

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. The proliferation of R&D on new personal deterrent devices (see section c above), certainly offers the hope of risk reduction, but at this stage, there is nothing on the horizon that is considered an effective universal deterrent.

For surf and swimming beaches close to urban centres, the situation is somewhat more promising. Systems to detect the presence of potentially dangerous sharks, coupled with a cost-effective early warning system shape up as the most effective approach for minimizing human-shark interactions in these areas.

#### **(e) bycatch from mitigation and deterrent measures**

In the years 2001-2016 the Qld Shark Control Program has caught over 2500 individuals of non-target species including fish, marine mammals, marine reptiles and elasmobranchs. The table below indicates the amount of bycatch (number of individuals) excluding non-dangerous sharks. All species/groups in the table below are included on international conservation agreements such as the Convention on International Trade in Endangered Species (CITES) or the Convention on Migratory Species (CMS) and listed as requiring protected status.

Species of concern:

Species/group	National Conservation status	Number
Whales	Threatened species and/or MNES	51
Dolphins	Threatened species and/or MNES	276
Turtles	Threatened species and/or MNES	690
Dugong	MNES	16
Sawfish	Threatened species and/or MNES	46
Manta/Devilray	MNES	246

\*MNES = Matters of National Environmental Significance

The 2016-2017 Northern NSW net trial (the subject of the current exemption) has resulted in the capture of 2 white sharks, 2 tiger sharks and 1 bull shark [of these 1 white and 2 tiger sharks were released alive] based on reports to date. However, a total of 115 animals have been reported in the nets with 28 and 44% of individuals in each month listed as dead.

List of significant catches in NSW trial netting (Dec and Jan reports)

Species/group	National Conservation status	Number alive	Number dead
White shark	Threatened species and/or MNES	1	1
Tiger shark	None	2	0
Bull shark	None	0	1
Great hammerhead shark	MNES, under EPBC assessment	0	14
Dolphins	Threatened species and/or MNES	0	2
Turtles	Threatened species and/or MNES	5	3
Manta/Devilray	MNES	3	6
Other rays	None	57	16

Based on records from QLD and NSW it is apparent that non-target species and species of conservation concern are regularly captured, and that a significant portion of these incidental catches die as a result of capture.

**(f) any other relevant matters**

Sharks are increasingly recognised as species of conservation concern with multiple species listed on international treaties such as CITES and CMS. This concern includes potentially dangerous species (white, hammerhead) and concern is growing over the global status of tiger sharks. Thus the conflict between species protection and human safety is likely to increase as sharks are added to these treaties and granted national and international protections.