



3 March 2017

Committee Secretary, Christine McDonald
Senate Standing Committees on Environment and Communications
PO Box 6100

RE: Submission to the Committee's inquiry into the efficacy and regulation of shark mitigation and deterrent measures. This submission was written by Dr. Christopher Neff in his personal capacity as an academic in the School of Social and Political Sciences at the University of Sydney. The opinions expressed in this article are the author's own and do not necessarily reflect the views of the University of Sydney.

Dear Committee:

This submission addresses (a) the current range of mitigation options in use and suggests that they lack scientific foundations, rely on anecdotal evidence, and rest on correlation rather than scientific causation. (b) It also briefly notes emerging technologies and highlights that there is no cure-all or silver-bullet in shark bite prevention in Australia. I suggest beach enclosures are the most viable future avenue for appropriate beaches. (c) This submission looks at public education as an under-utilized tool in shark bite prevention. Importantly this would represent a shift in government perspective toward swimmer awareness and their participation in risk mitigation rather than government action as an attempt at risk reduction. This, I believe, is the most important change the committee can consider. (d) Lastly, I note academic survey data results (collected by the author) from communities affected by shark bites. In short, it is time to stop pretending that many of the current shark bite mitigation methods from the 1930's and 1960's are effective today. Shark bites are tragic, ungovernable events and there is no scientific rigor or causality in the record between the use of drum lines, shark hunts, or shark (gill) nets and the occurrence of shark bites on humans over the long term.

a. the range of mitigation and deterrent measures currently in use;

I would begin with a quote from the imminent shark researcher Dr. Perry W. Gilbert and his edited book *Sharks and Survival* (1963: 475) in which he notes:

In spite of the acceptance of meshing in South Africa and Australia, it is difficult to evaluate the method for use in other areas, because it is not certain what factors produce the favourable record. The records do not show that meshing operations drove sharks away from beaches or diverted them to other areas. The meshing removed large sharks from the shark populations presumably resident in the beach areas during the shark season. This removal of sharks may have been sufficient to be immediately effective in materially reducing the probability of shark attack; however, since attacks are relatively uncommon and may, in some years, not occur at all on certain much-used but unprotected



Australian and South African beaches in the danger area, it is not certain that meshing initially affected the probability for causality in any significant way.”

The premise in favour of lethal shark control methods as a means of shark bite prevention asserts that, “the shark control measures achieve their protective function through reducing the populations of large sharks and hence the probability of an encounter between a shark and a bather” (Dudley, 1997). Underlying this assumption is a number of arguments:

First, it assumes the sharks that were killed would have bitten someone in the water, which cannot be scientifically established. For instance, Table 1 compares NSW DPI records of white sharks caught in shark nets per month between 1990-2008 with the occurrence of shark bites between 1900-2009 during those same months. It is clear that the time when the most sharks are caught coincided with the fewest fatalities and periods (like Dec and Jan) and with the highest fatality rates during relatively small shark catch periods. Importantly, this is an example of the correlation without causation that cannot establish scientific fact. All it can do is note that the number of sharks does not automatically relate to shark bite occurrences – and killing sharks to low numbers would then not necessarily reduce the rate of shark bites.

Table 1.

Elasmobranchs	January	February	March	April	September	October	November	December	Total
Great whites caught in NSW nets from 1990-2008 (Table 3, pg. 17).	9	6	3	6	36	21	9	10	100
Number of attacks in NSW from 1900 to 2009 (Table 10, pg. 36).	55	29	23	24	5	12	11	29	188
Number of fatalities from shark bites in NSW from, 1900 to 2009 (Table 10, pg. 36).	18	9	8	4	0	0	1	12	52

Second, there is an assumption that the presence of a dead shark is good for beach safety. However, the gill nets are not taken out at night so sharks that are killed at night could potentially attract other sharks making a beach more dangerous. Thirdly, it ignores former Australian Museum John Paxton’s statement that “Forty per cent of sharks caught in nets are found on the inside” (Paxton, 2006). Fourthly, it also ignores the other variables that bring humans and sharks into contact such as water temperature, offal, waste or construction discharge, distance from shore, and the presence of other marine life. Fifthly, this assumption ignores that sharks and humans are in proximity to one another nearly all the time without the occurrence of shark bites. Sixthly, it neglects that the distribution of shark nets changes week to week; when they are moved or take out completely.



In addition, there are a number of real-world examples from Australia that highlight the problems with lethal shark control problems and any inference of causality with shark bite prevention. First, the utilization of temporal data of shark nets is scientifically insufficient. The argument that the absence of a shark bite fatality in the presence of a drum line or shark net is correlation without proven causation. The leading argument in support of the use of lethal shark nets in NSW has been that there has only been one fatality since the nets were put in in 1937. However, this analysis also fails to acknowledge that shark bite fatalities ended in 1929, eight years before nets went in and that there have been 29 shark bite incidents at netted beaches in New South Wales over this period (CSIRO, 2014). Moreover, the absence of shark bites at beaches without shark nets or drum lines must be considered. Also, the absence of shark bites between 1943-1946 at any beaches when shark nets were been taken out during World War II should be included in any analysis (SMH, 1946).

This analysis extends to analyses of drum lines in Queensland, where additional data is also missing. Professor Jessica Meeuwig, Director, Centre for Marine Futures at University of Western Australia has looked at scientific evidence of “success” in Queensland’s shark control and noted that “Shark-related fatalities in Queensland have declined in both areas with and without drum lines, with the steepest rates of decline before their installation. The effectiveness of drum lines is difficult to evaluate, as the rates of attacks before and after their deployment are both very low. Moreover, 83% of drum lines are deployed at locations where a fatal attack has never occurred” (Meeuwig, 2014).

Scientific analyses of shark control fail to include models of mathematical probability that make the presence and absence of clusters of sharks bites a statistical certainty. Professor David Kelton, Academic Director of MS - Business Analytics Program at the University of Cincinnati has addressed shark bite clusters and noted that, “It really does seem that there is indeed something odd going on with the ocean currents, temperatures, food supply, or water chemistry. However, even if such attacks were purely ‘random’ and independent of each other, it is not surprising that they seem to occur in ‘clumps’... and then not at all for a long time” (Science Daily, 2001).

The incomparability of data between one shark control program and another has been stated by the programs themselves. The different target species, beach topology, and ecosystem conditions between WA, NSW, and QLD make comparing locations inappropriate and invalid. The 2006 Queensland Department of Primary Industries and Fisheries report states (QLD, 2006: 7): Comparisons between these programs and the Queensland situation are complicated by a number of factors which preclude the making of valid comparisons with the Queensland experience. Principal among these are significant differences in oceanographic features of sites, specific climatic conditions including water temperature, differing shark species composition and different patterns of beach usage, particularly in Queensland where large number of visitations occur through the entire year. The QLD report concludes, “it would not be appropriate to assume that



strategies successful in other regions would be suitable for the Queensland environment” (QLD, 2006: 7).

Moreover, research exists that challenges the success of shark control programs. Wetherbee, Lowe and Crowe (1994) analyse a series of shark control programs using long-lines in Hawaii between 1959-1976. Compiled together they state:

“Shark control programs in Hawaii have operated on the premise that by fishing for sharks, the population could be reduced to a level where the risk of a shark attack was decreased. Each of the major shark control programs referred to continual decreases in catch rates for consecutive fishing circuits as evidence that shark populations had been reduced and that shark control efforts had been successful.” They add, “However, factors such as seasonality, weather and fishing effort also appear to have contributed to declines in catch rates observed during shark control programs.” They explain, “Rate of shark attacks appears to be better correlated with human population than with shark population” (p. 109). And conclude, “Therefore, based on the available data, shark control programs and the associated reduction in coastal shark populations do not appear to have dramatic effect on the rate of shark attacks in Hawaii” (p. 109).

A key variable for Wetherbee et al (1994) was the movement patterns of tiger sharks and the failure of shark control measures to reduce populations that are not locally resident. This analysis is consistent with Jeremy Cliff’s analysis of white shark movements in Cape Town and Simpfordorfer’s (2014) analysis of white shark movements in Western Australia. Simpfordorfer notes, “Based on this, the available evidence suggests the Western Australian program is unlikely to achieve its aim of reducing white shark numbers close to popular beaches and hence reducing risk for ocean users.”

Lastly, In the case of Western Australia, a shark hunt policy was opposed by more than 100 international scientists, local conservation science groups. Shark control programs such as “catch and kill” policies, “imminent threat” policies can portray sharks as movie monsters rather than fish and undermine public education. For example, in Australia's 2004 CITES listing proposal for white sharks, it states:

"The negative image of the white shark and the fear it inspires in humans often precipitates unwarranted killing of the species. The impact of these actions is made worse by the proximity of white shark feeding and breeding areas to coastal human populations.

Examples include campaigns to kill white shark after shark attacks or in anticipation of such attacks, and disregard of conservation and management measures."

b. emerging mitigation and deterrent measures;

I would briefly note that I attended the Shark Mitigation Workshop on 31 July 2014 and a number of the emerging mitigation deterrents were discussed. This conversation was



continued at the NSW Shark Summit, which I attended and participated in. In short, what is missing from the discussions about these potential measures are the limitations on what they can do, which is an unattractive narrative on the commercial market. Specifically, electronic shark deterrents are not guarantees against shark bites, and research suggests that much depends on the motives of the shark. Additionally, 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. It is likewise a concern that the public has not been informed about the potential limits of shark enclosures or buoy sonar technology. Both can be heavily influenced by ocean conditions, swell, and may only be effective at low-energy beaches similar to Sydney Harbour. Beach enclosures at these locations are recommended.

c. alternatives to currently employed mitigation and deterrent measures, including education;

I believe linking science and public education is the one deterrent measure that can reduce the underlying levels of risk and make beach-going safer. 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 continued scientific tagging of sharks and sharing of data with the public so they can have informed decisions before going in the water.

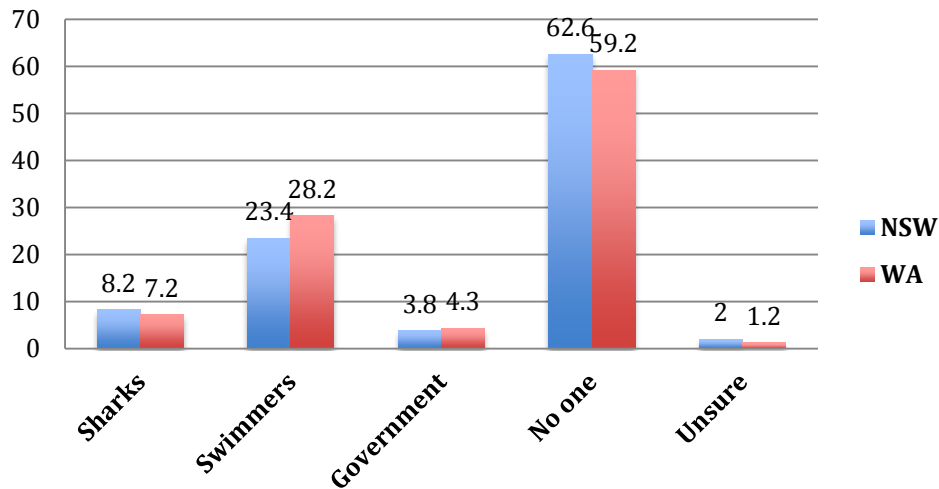
Public education and public opinion about sharks, human-shark interactions, and policy responses to shark bites and fatal shark bites is a major focus of my research. My research concludes that Government attempts to prevent shark bites are not really about preventing shark bites, generally, and this is important for the public to understand. It is more about preventing certain frequencies of shark bites in certain locations that produce political penalties. For instance, in NSW, the political capital upon which shark nets rests is the narrative that there has only been one fatality at a netted beach since 1937. Yet, it has been reported that there have also been 29 shark bites at netted beaches. So the goal is not to stop all shark bites, but rather fatalities and clusters for which the threshold is low and political penalties are perceived to be high.

I would suggest respectfully to the Committee that the future of public education and shark bite deterrence can be seen in public surveys of those communities most effected. The charts below are results of two survey projects in 2016 following multiple shark bites in Ballina (NSW) and Western Australia (WA). The data was collected using a representative sample of each community and over sampled the beach areas affected.

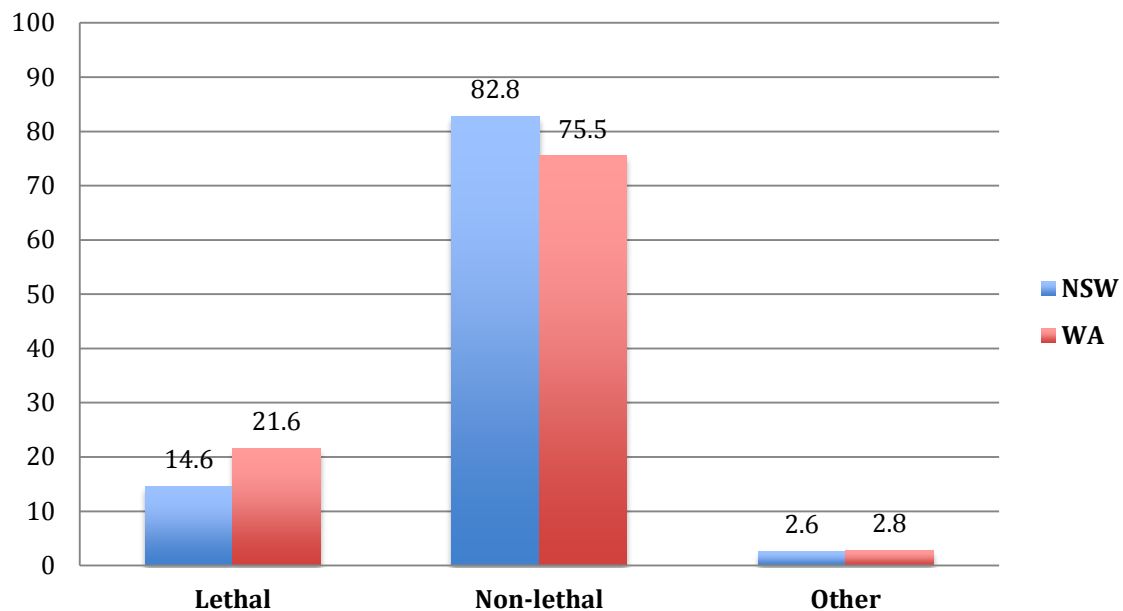


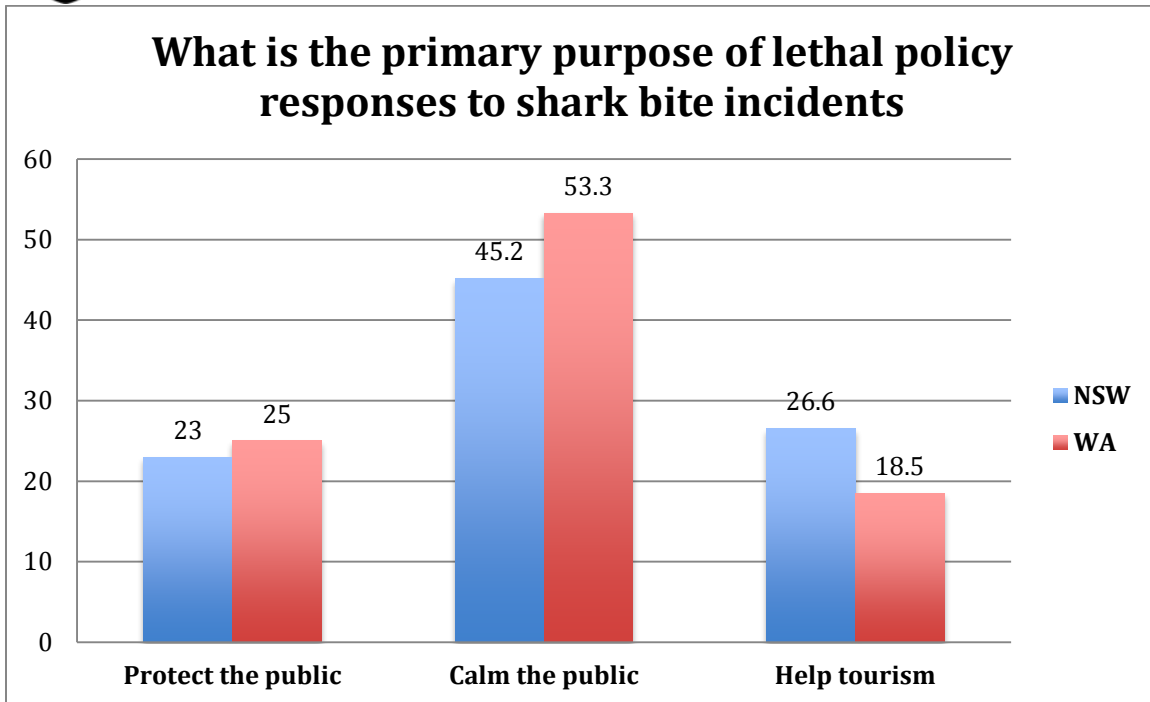
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Who is to blame for shark bites?



When shark bites happen, how should the government respond?





The statistically significant data show that a majority of respondents do not blame sharks, do not support lethal shark control measures (even shortly after an incident at their beach), and do not believe the government is killing sharks to protect the public. This last point should be of grave concern to each government because it demonstrates an erosion of trust by the public regarding public safety narratives.

Lastly, it is important to recognize the role of political pressure on researchers addressing this issue. I suggest that the inability of some scientists to speak up is due to the State's and Commonwealth Government's control of scientific funding and resources. I have encountered political pressure in my 10 years of research in this area (Appendix 1). However, there is a changing role as the policy space around shark bite prevention is contested. In particular, the role of leading scientists, joint academic letters, activists, and associations has emerged to challenge government policymaking and sensationalized media reporting. Recently, a CSIRO peer-review paper by Dr. Barry Bruce helped inform the WA EPA judgment. More than 300 scientists also presented research against the expansion of drumlines in WA. In the United States, the American Elasmobranch Society (AES) endorsed a new categorization of human-shark interactions listed by this author in Neff and Hueter (2013) that include four classifications: no-contact *shark sightings*, non-injurious *shark encounters*, *shark bites* and *fatal shark bites*. The Oceania Chondrichthyan Society (OCS) has also taken positions regarding shark control measures in Australia. In closing, this issue is getting bigger and not smaller. The number of groups involved will continue to grow and the time has come to address shark bites in Australia from a reasoned, scientific point of view that favours public safety and public honesty.



Bibliography

CSIRO1 (July 2014). Western Australian Shark Hazard Mitigation Drum Line Program 2014-17 Peer review report Client: Government of Western Australia – Environmental Protection Authority

Davies, D.H (1964). *About Sharks and Shark Attack*. Pietermaritzburg: Shuter and Shooter.

Dudley, S. F. J. (1997). A comparison of the shark control programs of New South Wales and Queensland (Australia) and KwaZulu-Natal (South Africa). *Ocean & coastal management*, 34(1), 1-27.

FSC, 2005. Final Recommendation: Current Shark Meshing Program in New South Wales Waters. Ref. No. FR24. Fisheries Scientific Committee of NSW. Available at: http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0005/208319/FR24-shark-meshing.pdf

Gilbert, 1963. In Gilbert P. W., American Institute of Biological Sciences., & Conference on the Basic Research Approaches to the Development of Shark Repellents. (1963). *Sharks and survival*. Boston: Heath.

McPhee, D.P. (2012) Likely Effectiveness of Netting or Other Capture Programs as a Shark Hazard Mitigation Strategy under Western Australian Conditions. Published by Western Australia Department of Fisheries.

Meeuwig, J. (21 February 2014). Has Queensland really saved lives by killing thousands of sharks? The Conversation. Available at: <http://theconversation.com/has-queensland-really-saved-lives-by-killing-thousands-of-sharks-23437>

Neff, C., & Hueter, R. (2013). Science, policy, and the public discourse of shark “attack”: a proposal for reclassifying human–shark interactions. *Journal of environmental studies and sciences*, 3(1), 65-73.

NSW, 1929. New South Wales Government. Shark Menace Committee. *Summary of New South Wales Shark Menace Committee’s Report*. Report 86206-a. New South Wales, Australia.

NSW, 1935. New South Wales Government. Shark Menace Advisory Committee. *Report of the Shark Menace Advisory Committee on Suggested Methods of Protecting Bathers from Shark Attack*. Report 58107 244-a. New South Wales, Australia.

NSW, 2006. New South Wales Government. Department of Primary Industries. *Scientific Shark Protection Summit Report*. Retrieved from: http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0008/137294/Report-from-th



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Scientific-Shark-Protection-Summit.pdf

NSW, 2009. New South Wales Government. Department of Primary Industries. *Report into the NSW shark meshing (bather protection) program [public consultation document]*. New South Wales Department of Primary Industries website. Retrieved from: http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0008/276029/Report-into-the-NSW-Shark-Meshing-Program.pdf

Paxton, J. 2006. Shark nets in the Spotlight. The Last Word. Available at: <http://australianmuseum.net.au/Uploads/Documents/25812/sharkmesh.pdf>

QLD, 2006. A Report on the Queensland Shark Safety Program. Department of Primary Industries and Fisheries. March, 2006. Available at: <http://www2.dpi.qld.gov.au/extra/pdf/fishweb/sharksafetyreport.pdf>

Science Daily, 2001. Shark Attacks May be a Poisson Burst. Science Daily. Available at: <http://www.sciencedaily.com/releases/2001/08/010823084028.htm>

Shiffman, D. 2013. World's largest group of shark scientists calls on AP and Reuters to resist using the phrase "shark attacks. Southern Fried Science Blog. Available at: <http://www.southernfriedscience.com/?p=15258>

Simpfendorfer, C. (March 17, 2014). The science of shark control (and what it means for the Western Australia cull). South Fried Science Blog. Available at: <http://www.southernfriedscience.com/?p=16786>

Wetherbee, Bradley M, Lowe, Christopher G, & Crow, Gerald L. (2008). *A Review of Shark Control in Hawaii with Recommendations for Future Research*. University of Hawaii Press.