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Case report

Shark bite survivors advocate for non-lethal shark mitigation measures in Australia

Michael J. Rosciszewski-Dodgson[1,2] and Giuseppe T. Cirella[2,*]

[1] Marine Planning and Management, Faculty of Science and Engineering, L69 3BX Liverpool, United Kingdom
[2] Faculty of Economics, University of Gdansk, 81-824 Sopot, Poland

* **Correspondence:** gt.cirella@ug.edu.pl; Tel: +48585231258.

Abstract: As the annual number of shark-related human casualties in Australia increases, there is a need for policymakers to grasp how policy is created in the discourse of shark bite incidences. This is discussed in relation to individuals who have been most affected, i.e., shark bite survivors. The defined argument, being that, victims should feel the most animosity towards sharks, therefore if they show signs of discontent towards culling programs, the government should be compelled to change their strategy. The paper reinforces and challenges assumptions that contribute to the flow of commonly accepted knowledge of shark-human relations by illustrating how shark bite survivors are unlikely marine conservation advocates who support non-lethal shark mitigation methods. Shark bite victims were contacted via two Australian-based organizations and a total of six qualitative semi-structured interviews were conducted. Government shark mitigation practices are perceived as heavy handed and further perception- and conservation-based research is needed.

Keywords: shark-human relations; shark nets; drumlines; conservation; qualitative semi-structured interviews

1. Introduction

Numerous academic articles have underscored how the media's portrayal of shark attacks has skewed policy responses in favor of lethal practices for decades. For example, Boissonneault et al. [1] demonstrated how news articles published between 1969 and 2003 in Australia generated public discourse on the ecology of grey nurse sharks. They highlighted how the use of alarming imagery in

describing shark attacks facilitated fearful attitudes towards most species. It emphasized the psychology of irrational fear, i.e., when people where made aware that grey nurse sharks are of no threat to humans, emotions overrode rational thought and people generalized all species of sharks as dangerous. McCagh et al. [2] similarly argued that public fear towards sharks has been exacerbated by the use of emotive descriptions that led to the criminalization of shark bites. For instance, their research utilized a media discourse analysis to monitor media portrayals of shark attacks. They found that most common phrases used to describe sharks included: man-eater, monster, killer, rouge-shark, and *Jaws*. Ultimately, the research was able to pinpoint a correlation between the status quo policy decisions and pressure exerted by the media. This was achieved by highlighting how lethal shark mitigation methods in Western Australia were implemented following heightened beach safety concerns reported on by the press. McCagh et al. [2] illustrated how Western Australia's decision to initiate a shark cull was formed on amplified media reports that relied on peoples' anticipated fear towards sharks rather than the public's newly sophisticated attitudes, which could explain why there was so much opposition towards the policy. The Governments' reliance on fictional narratives was also studied by Neff [3] who called it the *Jaws* effect. Neff's [3] research suggests that Hollywood's popularization of killer shark films such as *Jaws*, filmed in 1975, help portray sharks in a villainous manner. Consequently, the media and government are given a familiar platform through horror films to attribute blame on individual sharks which need to be killed in order to eliminate a threat. Ultimately, Neff [3] theorized that fictional media is used to overwhelm scientific evidence in the shark policymaking process and overestimates the threat sharks pose. As a result, this enabled the governments of Queensland and New South Wales to conduct pre-emptive killing of sharks through their lethal shark control programs as such policies reflected public desires for such an extended period of time with many still holding on to those beliefs.

Despite this, part of the reason proactive policy decision making has gained momentum is in the last half a decade is due to the fact that lethal shark control measures have been losing support from large sections of the community. This is still a relatively new concept government officials are only beginning to comprehend. Neff and Yang [4] pioneered this research in South Africa by gaining an understanding of community attitudes following shark bite incidences in Cape Town. Prior to this research it was widely assumed that public attitude towards sharks was expected to grow negatively following shark-human attacks. However, they demonstrated how levels of pride towards sharks and beach safety remained unchanged following a shark attack. Using a similar model, Neff and Wynter [5] later conducted studies in Ballina and Perth, where 1,100 local residents where surveyed in 2015 following a series of fatal shark attacks that occurred in those areas earlier that year. The respondents were asked questions based on their fear or pride of sharks, media coverage, perceptions of intentionality, and policy preferences. Based on the evidence, the majority of respondents attributed the blame for shark-human conflicts either to the person being attacked or no one at all (i.e., Ballina: 86% and Perth: 87.3%). Moreover, two-thirds of the respondents (i.e., Ballina: 66.2% and Perth: 66.7%) agreed that shark attacks are sensationalized by the media, inferring that their threat is overestimated. Subsequently, the vast majority preferred non-lethal mitigation measures resulting in the rise of reactive campaigning that translates social thought into policy [5]. In addition, there is growing public awareness on the ecological value of sharks. This knowledge is presented to the public through nature documentaries and wildlife programs such as *Shark Week* and *Blue Planet* which highlight their importance. Neff [6] emphasized how sharks are the most televised animals on the planet. Friedrich et al. [7] who conducted studies on public perception of sharks found that individuals

which have gained a high level of knowledge on the ecological value of them are more likely to support their conservation [8–18]. This was further reiterated by the works of Acuña-Marrero et al. [19] who through interviews illustrated how public support for environmental issues can lead to important shifts in conservation policies for sharks. Additionally, their research analyzed public attitudes towards sharks demographically, showing how younger individuals have a greater appreciation for sharks [13,19].

The economic value of the scuba diving industry in Australia is also widely acknowledged with Huveneers et al. [20] highlighting how sharks play a pivotal role in attracting tourists. They provided an estimate revenue generated by tourists partaking in shark diving (i.e., USD 25.5 million annually), and underscored through interviews and surveys how cage diving with great white sharks was among the most sought after tourist activities [20]. For that reason, despite the heavy focus placed by local governments and some media on the dangers great white sharks pose, the Australian community at large understands the importance of protecting these predators [13,20–23]. With people directly affected by shark bite incidences [24,25], Taylor et al. [26] conducted the first study of its kind on the psychological impacts of shark bite survivors. They surveyed 124 members of an Australian shark-bite peer-support group assessing the event, media, and psychological factors following their incident. With a 48% response rate, the results demonstrated that 27.1%, of bite survivors self-reported post-traumatic stress disorders (PTSD) within three months of their shark encounter, resulting in PTSD almost three times the national average. Taylor et al. [26] hypothesized that this high prevalence to PTSD is largely the cause of people perceiving the event as violence against them, that further exacerbated by the thought of becoming prey. However, respondents also showed high PTSD recovery resilience over time, with only 3.6% admitting to still having PTSD three months after their shark bite incident. Despite this, little is known about their feelings towards sharks and shark control programs. To date, academic research conducted on the discourse of shark-human conflicts focused either on general public perceptions of shark bite incidences, i.e., psychologically [6,10,17,23,27,28], or on the defects of lethal shark control methods with the ecological agenda in mind [29–35]. Only research undertaken by Neff [3], McCagh et al. [2], and Acuña-Marrero et al. [19] investigated how public attitudes towards sharks influence policy decisions. Their work gave a snapshot of how shark bite incidences do not always produce negative emotional responses towards sharks, concluding how additional studies are needed to confirm this. No academic research has been conducted on shark bite survivors in relation to their attitudes with how shark-human conflicts should be dealt with. This paper explores these gaps in the literature and aids with research on how shark bite survivors are unlikely marine conservation advocates who support non-lethal shark mitigation measures.

2. Materials and methods

After conducting an extensive literature review on the topic and getting in contact with a number of shark-oriented organizations throughout Australia, the gap in the literature was confirmed—providing the opportunity to further explore the unanswered questions. Gathered data was qualitatively formulated from individuals who have been most affected by this multifaceted issue.

2.1. Semi-structured interviews

Semi-structed interviews were conducted with shark bite survivors, the defined argument being that, having gone through the attack survivors are able to approach the issue of shark management

personally (i.e., in a way no other stakeholder group can). Moreover, because of their firsthand experience with sharks, survivors have a platform of influence over others. Marowa and Matanzima [36] investigated opinions of wildlife attack victims to formulate better policies and strategies in human-wildlife conflict management. Other studies have also utilized this approach, as gathering data in support or animosity of shark attack survivors towards shark control programs is highly significant, when exploring how a society seeks to deal with the issue of shark bite incidents [37–39]. Primary data from the stakeholders was collected using the qualitative semi-structured interviewing method which allowed flexibility to probe and expand interviewee responses [40–44]. These interviews were conducted using Skype with the camera turned on to mimic a real-time conversation [45].

2.2. Sampling

Due to the rare occurrence of shark bite incidences the sample size of shark bite survivors in Australia is small. For this reason, in-depth interviews were conducted with six individuals who have survived a shark attack off Australia's coast in the last ten years. The interviewees were contacted using the snowball sampling approach, in collaboration with coordinators of (1) Shark Attack Survivors for Shark Conservation and (2) Bite Club. Shark Attack Survivors for Shark Conservation, founded in 2009, is made up of two dozen shark survivors who aim to use their platform to raise awareness on shark conservation, by definition before the interviews took place it was expected that these members would advocate for the removal of lethal shark control methods [46]. Once the coordinator learned about the type of research that was being conducted, they eagerly participated in the research and helped arrange interviews with two members who were bitten in Australia. In contrast, Bite Club is a helpline organization for those affected by a shark attack, with significant database worldwide. They have no specific issues to raise but are instead a support group founded by one shark bite survivor in 2011 to help others cope with their traumas of being attacked. Due to their dispersed nature, most Bite Club members interact occasionally through a Facebook group [47]. As a result, the range of how members responded to their attacks varied substantially with each member voicing their personal opinions rather than organizational goals.

The coordinator of Bite Club underscored how not everyone in the community is open to answer questions. Consequently, having an intermediary person ask shark bite survivors for a possible interview helped avoid unwarranted contact with individuals who wanted to be left alone. In doing so, four shark bite survivors affiliated with this organization consented to an interview and no ethical approval form was filled out, instead these individuals where informed about the scope of the research verbally. Furthermore, due to the traumatic event these people experienced, the coordinator of Bite Club moderated the types of questions asked to prevent possible discomfort on the interviewee's behalf. Respondents volunteered to participate anonymously without their identity being recorded. Informed verbal consent was obtained from all the participants in the study. The study was approved and complied with the ethics of scientific research described in the University of Gdansk Charter of Ethics and Ethical Principles in-line with the Declaration of Helsinki and other applicable ethical principles and legislation in Australia and the European Union. Ethical approval was granted by the University of Liverpool's Research Administration and Advancement, Research Ethics Sector, Ethics Committee.

2.3. Thematic analysis

Thematic analysis was utilized to interpret data from the gathered semi-structured interviews [48–50]. This was achieved by asking similarly themed questions and later transcribing each conversation to generate correlating patterns [51–53]. This approach was the most appropriate as thematic analysis provided the flexibility to describe data in detail and interpret various aspects of the research topic [49,53,54]. The similarly themes questioned focused on personal experiences, their attitudes towards sharks, and their thoughts on current shark mitigation practices utilized by Australian state governments. Following the data collection process, the subsequent four themes emerged:

- how the individuals' opinion towards sharks changed following the incident;
- survivors' opinions on currently utilized lethal shark mitigation practices;
- survivors' opinions on the best course of action to mitigate shark bite incidences in the future; and
- how the varied experience of each shark encounter impacted the individual's perception.

Table 1 classifies each conducted semi-structured interview and identifies the different circumstances of each shark encounter.

Table 1. Classification chart for each conducted semi-structured interview identifying the different circumstances of each shark encounter.

Participant no.	Organization	Location of shark incident	Responsible shark species	Age of survivor	Outcome
1	Bite Club	New South Wales	Bull shark	40–50	Pro-culling
2	Bite Club	Western Australia	White shark	40–50	Pro-culling
3	Bite Club	Western Australia	Bull shark	30–40	Pro-non-lethal
4	Bite Club	Queensland	Bull shark	18–20	Pro non-lethal
5	Shark Attack Survivors for Shark Conservation	Queensland	Blacktip or spinner shark	40–50	Pro non-lethal
6	Shark Attack Survivors for Shark Conservation	New South Wales	Bull shark	30–40	Pro-non-lethal

3. Results and discussion

3.1. Have individuals changed their opinion towards sharks following the incident?

Out of the six participants, 66.7% admitted to have developed a greater affinity towards sharks following their incident. Participant no. 6 explained why shark bite survivors often become unlikely supporters of sharks, stating "I think most shark attack survivors come out saying how they do not believe it's the shark's fault and they do not want sharks to be harmed, most of the time we have quite a connection to the ocean and we know the risks. I know there are a few people who are the opposite of that but generally speaking I know we all love the ocean and we all love the sharks." The notion of not blaming sharks for the incident was further reciprocated by the youngest participant (i.e., no. 4), who said "my experience is not worth it, you know, we should not be killing sharks because they can hurt us, a whole ecosystem depends on them." Participant no. 3 acknowledged how his appreciation and understanding of sharks grew, saying "I would not say I studied sharks but I understand what they are now, I understand it was in my case a freaky incident, it happened, I get that. It's just part of the world I'm in and I have to respect those animals." Those who gained respect for sharks did so because

the experience of being attacked ignited their interest in the animals. Before sharks where just something they knew about, but now this animal had a personal connection to them in an event they will think about for the rest of their lives [55]. As such, in an effort to find answers as to why they were attacked by a shark these respondents learned about the extensive culling that is taking place in Australia and all the other threats sharks face [56,57].

Participant no. 3 went on to say that "I don't blame the animal but my shark attack suddenly became main news. But that's what shark attacks do in the media they are so negatively sensationalized." This survivor particularly disapproved of the way his incident was portrayed by media outlets, displaying not only solidarity for sharks but what McCagh et al. [2] highlighted with regards to media blowing up shark bite incidences into horror stories. However, as McKinley and Fletcher [58] underscored shark bite survivors can endure shark bite incidences. This can be seen in this research, as all the respondents overtime no longer viewed themselves as victims, but as survivors who wanted to share their story with others, not just about their attack but also their physical therapy and emotional recovery. A process that required both an emotional and cognitive process, with respondents from Bite Club recollecting how their initial form of copying was to compare emotional and physical scars with other survivors, responded participant no. 1 who said that they celebrate "shark-a-versaries" on the anniversary of their attack [47]. A study conducted by Schildkraut et al. [59] on the survivors of the 1999 Columbine school shooting found that the most effective support came from those who had experienced the same traumas. These individuals communicate more comfortably with each other, enhancing their healing by offering more pragmatic recovery advice [60,61]. Through this process survivors had an outlet to process their attack cognitively and emotionally [62]. Consequently, the range of how members responded to their attacks varied, participant no. 1 and 2 spoke about their resentment of sharks, whilst participant no. 5 and 6 became ardent shark conservationists.

Five out of the six participants returned to the water following their incident as soon as they could. With participant no. 5 saying how the incident "did not diminish my love for the ocean because I understand that sharks are top predators and they are just doing what comes naturally." Participant no. 2 is the only individual who has not returned to the water following his incident despite it being over five years. Although stating that his incident did not alter his perception of sharks, this interviewee admitted he is scared to go back into the ocean. This illustrates, in-line with Taylor et al.'s [26] PTSD research, that individuals may still experience prolonged negative psychological impacts following such an incident.

3.2. Survivors' opinions on currently utilized lethal shark mitigation practices

Four shark bite survivors disapproved of lethal shark control methods deeming them ineffective at reducing shark bite incidences and ecologically devastating for the marine loss of life they generate. Whilst participants no. 1 and 2 found the current lethal methods acceptable, that they would prefer a less environmentally-destructive alternative.

3.2.1. Shark nets

On the topic of shark nets participant no. 4 said they are "probably the most dangerous thing for a shark, dugong, or turtle as it kills so much more marine life and does not make sense at all." Whilst participant no. 3 stated "I think shark nets are very ineffective, it just seems ridiculous to kill so many

sharks, then there are the turtles and dolphins as well and loads of other things that get stuck in them. No, I am completely against shark nets." Participant no. 6 similarly condemned shark nets after experiencing a firsthand account of the damage they cause, proclaiming "it's just ridiculous, the amount of life that's killed to catch animals that are not hurting anybody." In all cases, shark bite survivors not only criticize shark nets for the high bycatch they generate but they also illustrated full awareness in knowing how they operate. Disruptive bycatch from shark nets [34,63–65] and non-selective fish gear [30,33,66] poses a serious conservation concern "in a variety of ecosystems and for a variety of taxa" [30]. Participant no. 1 despite his awareness regarding the environmental damage shark nets cause, he was the only participant who supported their implantation, stating how "the guy that decides to take the net away and the next kid that gets killed, they're going to have some explaining to do."

3.2.2. Drumlines

Drumlines where similarly scrutinized by the shark bite survivors with participant no. 3 saying "in terms of drumlines I am not a big fan of them, they tend to, as far as I understand, bait the shark and they seem to actively attract sharks to an area and then they kill it in a horrible way. The idea of actively attracting sharks to a swimming beach does not strike me as a very good idea." The respondent also opposed the implementation of smart drumlines which he felt also attracted sharks, although he preferred them over the traditional method due to their reduced mortality. Participant no. 5 was of a similar opinion, hearkening back to the Western Australian drumline cull that killed 127 tiger sharks following a fatal great white shark incident. He said "it is like going out into the bush and setting snares on fire to catch wild boars, and you catch three wild boars a year but kill 150 koalas, that's the mentality and I do not see how they can justify that." Concurrently, participant no. 3 noted "on the off chance that a person can identify a particular individual shark that killed somebody then sure go and shoot it—whatever—but not randomly, no. Plus because they look similar to each other you cannot pick a shark and say that was a killer, we do not actually live in a Stephen Spielberg movie." In these extracts, both shark bite survivors aligned their beliefs with Clua and Linnell [29], whose research revealed that shark culling fails to remove single individuals responsible for the incident, whilst simultaneously reinforcing how Neff's [3,6] *Jaws* effect theory has subsided among many of those most affect by shark-human conflicts.

Participant no. 2 underscored how drumlines are not effective enough at catching large sharks and explained that following his incident drumlines where set to catch a white shark in the area "but it was so big it snapped the gear." As a consequence, the respondent criticized the drumline method for its insufficient catching mechanics. Responses are supported by a number of studies that note how drumlines can also effect bycatch species (e.g., turtles and marine mammals)—baiting sharks to a specific area [32,67–69].

3.3. Survivors' opinions on the best course of action to mitigate shark bite incidences in the future

Although all shark bite survivors unanimously agreed that shark nets and drumlines are ineffective mitigation measures. When asked how they think the government should deal with this problem, there were significant differences. With this in mind, 66.7% of shark bite survivors favored a less hands on approach. When asked how shark bite incidences should be avoided participant no. 6 stated "it comes down to humans, being a little bit smarter, not swimming after it rains, not swimming

in murky water, not swimming near the mouth of rivers—where a lot of the times this is happening—and we need to understand when they're coming into these areas." Whilst participant no. 5 claimed "we need to re-look at it all, more awareness needs to be given with surveillance in the water to keep people out, and you have to let people know and understand that you are in an environment where there are sharks, and we have to put more money into it." The respondent went on to say how the government solution of placing more shark nets and drumlines is careless, as human activity keeps dominating sea space, making it less likely for marine life to flourish. A similar sentiment was held by another shark bite survivor, participant no. 3 proclaiming "there is this strong sense of entitlement amongst people where I have the right to go in the water for free, but it's not true, people should be aware of the risks and make a calculated decision and hopefully not interact with sharks." Amongst the shark bite survivors, a reoccurring pattern emerged whereby they hoped to reduce the likelihood of shark bite incidences through raising awareness and changing public behavior, instead of creating of underwater fortifications that kill many sharks in the process [34,64].

In contrast, two respondents favored culling approaches to reduce populations of dangerous shark species. Participant no. 2 underscored how due to the fact that sharks have been protected for three decades the risk of being bitten by a shark has increased; "I don't think you can put any animal on a protected list for 25 years and not expect there to be a population growth. There is no denying that sharks need to be there, there is not talk about wiping them out, but there is a big nock on effect of leaving them alone." As such, the respondent felt that white sharks should be taken off the protected list. Participant no. 1 deemed the culling method appropriate, admitting that if there was an option of protecting people without killing sharks, he would prefer it. The survivor went on highlight how smart drumlines could be a non-lethal mitigation solution in order to catch, tag, and relocate large sharks from populated beaches [68]. The findings show a similar pattern to Pepin-Neff and Wynter [5,70] community studies, whereby the majority of shark bite survivors prefer non-lethal mitigation measures.

3.4. How the varied experience of each shark encounter impacted the individual's perception

The results illustrate that shark bite survivors, for the most part, have become unlikely supporters of sharks who condemn traditional culling methods. However, there where noticeable disparities among the interviewees. Participant no. 5 and 6 were the most positive towards sharks and passionately spoke about their encounter, with participant no. 6 underscoring how it changed his life for the better. This was to be expected as these individuals chose to become members of Shark Attack Survivors for Shark Conservation, i.e., an organization that actively campaigns for the wellbeing of sharks. In comparison, members of Bite Club where more reserved when discussing their encounter but had a lot to say about what they think the government should do to prevent such events from occurring. In-line with Acuña-Marrero et al.'s [19] findings, the results showed how younger survivors have a greater appreciation for sharks and marine life. With the only negative outcomes coming from participant no. 1 and 2 who are aged between 40–50. Participant 2 showed the least enthusiasm towards sharks and was the participant who favored the lethal culling method. This participant was also the only person from the survey who got bitten by a great white shark, a species infamously regarded as the most dangerous shark [27,71,72]. As a result, it can be perceived that this individual experienced a greater trauma during the attack when compared to the other participants—influencing his negative emotions towards sharks. This phenomenon illustrates how the size and species of the shark have a big impact on an individual's perception towards the species [9,25].

4. Conclusion

Would a shark encounter with severe consequences affect how you feel about the species? Fortunately, most people will never need to answer that question. This paper voiced the opinions of those who had too and illustrates how contrary to popular belief, most interviewed survivors have no animosity towards their attacker. In contrast, most survivors have grown founder towards sharks and understand their role in the ocean [2,3,6,19]. The research also demonstrates how these positive attitudes of survivors towards their shark encounter reflected their opinions in relation to shark control polices. With all survivors disapproving of the current mitigation methods utilized by Australian authorities. Two-thirds of the participants thought that the government should focus on raising awareness and changing people's behavior. Whilst the other third deemed lethal-shark mitigation practices to be an unfortunate necessity and advocated towards culling methods that reduce populations of potentially dangerous sharks. As such with lives at stake, shark-human relations will always be a highly divisive issue that needs further revaluation. With this in mind, the studies main constraint was that the findings were drawn from a small sample of participants in Australia. Therefore, conducting additional interviews with shark bite survivors from other parts of the world would add supplementary information and illustrate how individuals most affected by these encounters seek to resolve the issue of shark-human conflicts.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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