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RESEARCH NOTE

Beach-User Attitudes to Shark Bite Mitigation Strategies on Coastal Beaches; Sydney, Australia

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ABSTRACT

Common strategies to protect swimmers from unprovoked shark bite incidents on coastal beaches are controversial. We surveyed beach users on two Sydney beaches to gauge their knowledge and attitudes to current and topical shark bite mitigation strategies. Most interviewees (>55%) were aware that shark nets were deployed on each beach, and gave relatively strong (>60%) support for their use. In contrast, beach users were overwhelming against (>80%) the general culling of sharks, and also opposed (>70%) the strategy of catching and killing sharks following a shark bite incident. There was little difference between genders in their attitudes to each strategy, but the oldest age category (51+) surveyed was generally most supportive of the lethal strategies. The results demonstrated the dichotomies in public attitudes to the different mitigation strategies, particularly passive versus active culling, and highlighted the need for greater public education for the development of socially acceptable solutions to shark hazards.

KEYWORDS

Beach safety; human protection; management strategy; shark attack; wildlife interaction

Introduction

On a global scale, the frequency of unprovoked shark bite incidents on humans has increased over the past two decades, the reasons for which are unclear (Chapman & McPhee, 2016; Curtis et al., 2012; McPhee, 2014; West, 2011). In Australia, surges in shark bite incidents have been observed on the west and east coasts, with 10 fatalities occurring on the west coast since 2010, and three fatalities and more than 20 bite incidents occurring on the east coast since 2014 (Chapman & McPhee, 2016; Gibbs & Warren, 2015; www.sharkattackfile.net). A direct result of spikes in shark bite incidents is increased pressure on governments to provide greater, and often immediate, protection to ocean users, particularly on popular surf beaches (Hazin, Burgess, & Carvalho, 2008; Neff, 2012, 2015).

Common strategies to reduce shark bite incidents and protect swimmers on surf beaches are controversial and have society and governments divided on appropriate actions (Gibbs & Warren, 2015; Gross, 2014; McCagh, Sneddon, & Blache, 2015; Neff, 2012). For example, the policy decision by the Western Australia Government in 2013 to catch and kill large sharks as part of a preemptive strike against threatening species sparked outcry and debate both nationally and internationally (Gibbs & Warren, 2015; Neff, 2015). However, like many human–wildlife interaction issues (Treves & Karanth, 2003), there is as yet no global panacea concerning the prevention of unprovoked shark bites on humans (Neff, 2012, 2015).

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Common responses have ranged from doing nothing, the setting of passive fishing gears (e.g., nets and baited hooks—drum lines) that target sharks adjacent to swimming beaches, to the directed hunting and killing of potentially dangerous species (Dudley, 1997; Gibbs & Warren, 2015; Neff, 2012; Reid, Robbins, & Peddemors, 2011; Wetherbee, Lowe, & Crow, 1994). More recently, catch and relocate approaches (Hazin & Afonso, 2014) and greater education and warning programs have been implemented (Kock et al., 2012).

Most shark bite mitigation measures deployed on ocean beaches are problematic as they have associated environmental risks and ethical dilemmas, such as the incidental entanglement and killing of sea turtles and dolphins in nets and the drowning of harmless sharks on baited drum lines (Cliff & Dudley, 2011; Gribble, McPherson, & Lane, 1998; Krogh & Reid, 1996; Paterson, 1990; Reid et al., 2011). Moreover, such prevention strategies can directly oppose conservation efforts to protect sharks (Curtis et al., 2012; Simpfendorfer, Heupel, White, & Dulvy, 2011), for which the populations of many species have been seriously depleted due to overfishing and habitat destruction (Worm et al., 2013). For example, the great white shark which is responsible for most shark fatalities to humans is itself a threatened and protected species in many countries (Curtis et al., 2012). This poses a societal conundrum on how to protect humans while also protecting such sharks. The polarized social and political debates surrounding these issues endure, and societal attitudes need to be included in government decision-making processes (Gibbs & Warren, 2015; Neff, 2012).

There have been few published studies of communities' attitudes toward shark bite mitigation strategies. In Australia, a survey of beach users in southern and eastern Australia reported that respondents were aware of local shark mitigation strategies but overestimated their benefits and showed only basic understanding on how they actually worked (Crossley, Collins, Sutton, & Huveneers, 2014). These researches also reported that beach users overestimated the risk of shark attack and did not choose to use a beach based on the type and level of protection strategy provided. Neff and Yang (2013) found that beach users did not change their attitudes toward sharks from before to after a shark bite incident in South Africa. Most recently, following the introduction of a shark culling program in Western Australia, several surveys reported the vast majority (>80%) of residents and actual ocean users were against the policy, instead supporting nonlethal alternative measures (Gibbs & Warren, 2015).

We examined beach-user knowledge and attitudes to shark bite mitigation strategies currently used, and commonly debated in the media, in Australia. Our specific focus was on Sydney, which has a beach going population of more than two million people and a worldwide reputation for its ocean beaches. It has also been the region of several shark bite incidences over the past decade (Smoothey et al., 2016; West, 2011) and has had an ocean beach shark netting program in place since 1937 (Reid et al., 2011). This article directly built on research aimed at better understanding public, and most importantly, beach and ocean user attitudes to shark bite mitigation strategies for incorporation into the development of socially acceptable government policies concerning human–wildlife interactions.

Methods

One hundred beach users on each of two popular Sydney metropolitan surf beaches (Bondi, Cronulla) were surveyed. Bondi Beach is located 6 km east of the Sydney city central business district, whereas Cronulla Beach is located 22 km away on the southern

outskirts of the city. Individuals were surveyed on the sand strip and adjoining promenade. The surveys were done in December 2014–January 2015; the middle of the Australian summer when beach visitation and ocean use is greatest, and shark encounters and media attention generally most prolific.

Each interviewee was asked a series of closed survey questions concerning their knowledge and attitudes toward shark bite prevention strategies currently used in Australia and widely debated in the media. The specific questions were designed to have a “yes, no or undecided” answer, to obtain basic information quickly and to not disrupt each interviewee’s beach experience. The main questions were: (a) are you aware that a shark net is used on this beach; (b) do you agree with the use of shark nets; (c) do you agree that sharks should be culled; (d) do you agree that sharks should be hunted and killed following an attack? Each respondent could provide further comments at the end of the survey if they desired. Only adults aged 18+ and only one person from any group was interviewed so that each interview was regarded “independent” and separate from the others on the same beach. Basic demographic information concerning each interviewee was also obtained, including their gender, age category, resident postcode (or country for international visitors) and beach use avidity.

Chi-square tests were used to assess differences in (a) the demographics of interviewees between beaches, and (b) the statistical significance of differences in overall responses among demographic categories across beaches. Multiple Z-tests with adjusted significance values of $p = .01$ were used to test for differences in question responses across genders and age categories separately for each beach.

Results

Demographics

The composition of interviewees across age categories was similar at both beaches ($\chi^2 = 2.56$, $df = 2$, $p = .28$); most people interviewed were in the 18–30 and 31–50 age categories (Table 1). However, interviewees differed between beaches according to gender ($\chi^2 = 5.78$, $df = 1$, $p < .05$), with a greater number of females interviewed at Cronulla and males at Bondi (Table 1). Compared to Bondi, significantly ($p < .01$) more people at Cronulla were regular beach users and had or were planning to enter the ocean on the day they were interviewed. The residential composition of interviewees also differed between beaches ($\chi^2 = 19.14$, $df = 3$, $p < .001$); most interviewees at Cronulla were local and broader Sydney residents, whereas at Bondi there were greater proportions of regional/interstate and international visitors (Table 1).

Knowledge of shark nets

Overall, 74% of interviewees at Bondi, but only 56% at Cronulla were aware of the use of a shark net on each respective beach (Figure 1). Levels of awareness did not differ according to gender at either beach, but differed according to age category at Cronulla, with a significantly ($p < .01$) greater proportion of interviewees in the 51+ age category aware of the shark net compared to the other age categories, but there was no such pattern at Bondi (Figure 1). At Bondi, a greater proportion of local and Sydney residents had knowledge of

Table 1. Summary of the demographics of the people interviewed on Bondi and Cronulla beaches, Sydney, Australia.

	Bondi	Cronulla
Number interviewed	100	100
<i>Gender</i>		
Male	58	41
Female	42	59
<i>Age category</i>		
18–30 years	47	40
31–50 years	35	46
51+ years	18	14
<i>Area of origin</i>		
Local area postcode	55	72
Broader Sydney postcode	21	25
Regional and interstate	11	2
International	13	1
<i>Beach use</i>		
Regular beach user	65	98
Active swimmer	57	94

the shark nets (83%) compared to the regional/interstate (55%) and international (38%) visitors.

Support for mitigation strategies

Across both beaches there was greater than 60% support across both genders and all age categories for the use of shark nets, with fewer than 20% in any category opposing their use (Figure 1). Interviewees in the 51+ age category displayed significantly ($p < .01$) the greatest support (>80%) for use of shark nets at both beaches. There were no differences in levels of support between genders, or between the 18–30 and 31–50 age categories. At Bondi, local and Sydney residents gave less support (66%) to the use of shark nets than the regional/intestate (82%) and international visitors (85%). A greater proportion of interviewees were undecided about the use of shark nets at Cronulla than at Bondi, with people in this category often stating they needed more information on the types and levels of nonshark organisms caught to determine a strong position on the issue.

Except for the 51+ age category at both beaches and male interviewees at Cronulla, fewer than 10% of those interviewed agreed that sharks should be culled as part of a shark bite mitigation strategy (Figure 1). This low level of support was equal for Sydney and out of area visitors at Bondi (8–9%). Agreement responses across all demographic categories were slightly higher (15–38%) for whether sharks should be hunted and killed following any shark bite incident. Across both beaches, agreement with both the strategies of culling, and the hunting and killing of sharks, was greatest in the 51+ age category, but this was only significant ($p < .01$) for the culling strategy at Cronulla. Also at Cronulla, a greater and significant ($p < .01$) proportion of male than female respondents agreed with the strategy of culling sharks. A similar trend between genders (albeit nonsignificant; $p > .05$) was evident at both beaches for the strategy of hunting and killing sharks following a shark-bite incident.

At Bondi, interviewees were also asked whether they agreed that there was adequate public awareness of local shark mitigation strategies, of which the Australian residents

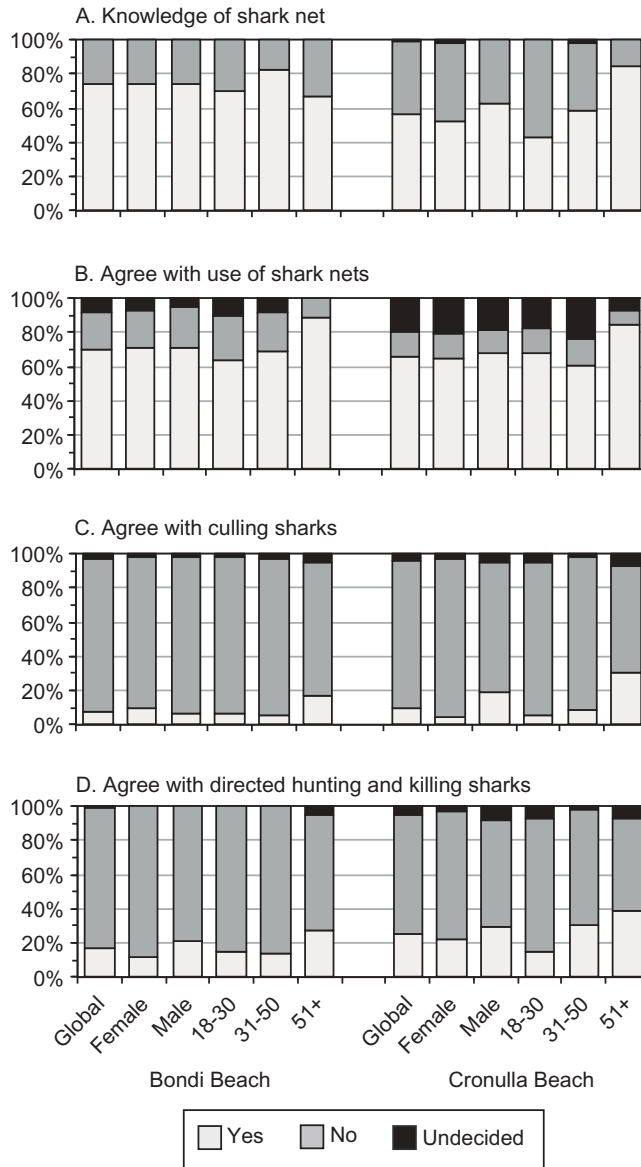


Figure 1. The responses of interviewees in each demographic category to survey questions concerning awareness and attitudes to shark bite mitigation strategies on Bondi and Cronulla beaches, Sydney, Australia.

responded 34–36% in agreement and the international visitors 62%. There was also high agreement (64–78%) among local and out of area interviewees at Bondi that the media over sensationalized shark bite incidents.

Discussion

Although this article surveyed beach users at only two Sydney metropolitan beaches, it nonetheless identified some demographic trends and general dichotomies in public perceptions regarding common shark bite mitigation strategies. Further surveys of users across other metropolitan (with shark nets) and regional (without shark nets) beaches will test the broader generality of the current study outcomes and provide more comprehensive coast-wide community perspectives for inclusion into future decision-making processes concerning shark bite management initiatives.

Knowledge of shark nets

Most beach users interviewed were aware that shark nets were used on the study beaches; however, the overall awareness levels were lower than in a corresponding survey of beach users in the Sydney region of which 92% had knowledge of the broader shark netting strategy (Crossley et al., 2014). In the current article, the levels of awareness of shark nets differed between the two beaches and among some demographic categories, being greatest in the oldest, and least in the youngest age category at Cronulla, and not surprisingly, lower among overseas visitors compared to Sydney residents and regional/interstate visitors at Bondi. Potentially, the older age category at Cronulla may have a greater history and memory of shark net usage. However, there was no such pattern at Bondi, but this may have been confounded by the higher rates of visitors compared to Cronulla. Regardless, awareness of the shark nets was generally lower at Cronulla, even though most interviewees were local residents and active ocean users. There was no official publicity or signage advising of the use of shark nets at either beach, although awareness campaigns have been undertaken (Green, Ganassin, & Reid, 2009) and media reporting is common throughout summer.

Support for mitigation strategies

In contrast to other recent studies in Western Australia where support for shark nets was low (~30%) (Gibbs & Warren, 2015), there was relatively strong overall support (>60%) among those interviewed for the use of the Sydney shark netting program. Such geographic differences in acceptance of shark nets could be associated with the long-term use (70+ years) of nets in the Sydney region compared to elsewhere. We found no differences in support for the nets between genders, but it was greatest (> 85%) in the oldest (51+) age category at both beaches, and this trend was also evident for the strategies of culling as well as the hunting and killing of sharks following a shark bite incident. While the reasons for such trends are unknown, we suggest that levels of awareness of the broader environmental impacts and ethical sensitivities surrounding the use of shark nets and the conservation of sharks in general was not even among age categories, and there may be greater consciousness among younger generations as a result of more recent education programs. Differences in awareness of such issues may further extend to a person's residential origins and their levels of education and exposure to information and debates surrounding shark bite mitigation strategies and shark conservation (Crossley et al., 2014; O'Bryhim & Parsons, 2015).

For example, the international visitors were more supportive than local Sydney residents of the use of shark nets.

Several people that opposed the use of shark nets expressed concerns about the incidental killing of other organisms, while others thought they were just a placebo to make swimmers feel confident. In contrast, some of the people that agreed with their use thought they did a good job at deterring sharks and reducing attacks. When quizzed further, however, few people had a good understanding of how the nets actually worked and their operational management. This concurs with that reported by Crossley et al. (2014). For example, many people were unaware that the nets were not permanent fixtures, but rotated among beaches every couple of days with each net covering a small length (150 m) of a beach. Moreover, each net is 6 m deep and is set in 10–15 m depth of water, so sharks can potentially swim over, under, and around each net. Interviewees generally acknowledged there was a lack of available information and publicity of local shark mitigation strategies, and knowledge of operational information may alter some people's perspectives on the use of such nets.

Although it was evident that beach users were mostly in favor of the use of shark nets, overall they were strongly opposed to the general culling, and the targeted hunting and killing of sharks as mitigation strategies. Although this latter result is in accordance with other recent studies and various media surveys in Australia (Gibbs & Warren, 2015; McCagh et al., 2015), it identifies societies mixed understandings of the different mitigation strategies. This is probably a reflection of the way the different strategies are sold by governments and media (McCagh et al., 2015; Neff, 2012), with shark nets generally promoted as being passive deterrents to sharks, whereas culling invokes active killing. Shark nets are nonetheless a direct form of culling as they are designed and deployed to target sharks in close proximity to beaches to reduce their numbers and potential threats to swimmers (Dudley, 1997; Reid et al., 2011). Since 2000, between 100–300 sharks and other organisms have been captured, and an unquantified number killed, each year (September to April) in the shark nets deployed adjacent to ocean beaches in the greater Sydney region (Reid et al., 2011). Although most commonly used “catch-orientated” shark hazard strategies generally result in the indiscriminate deaths of many sharks and other incidentally caught organisms (Dudley & Cliff, 2010; Krogh & Reid, 1996; Paterson, 1990; Sumpton et al., 2011), there have been recent advances in releasing and relocating captured live animals from such gear (Cliff & Dudley, 2011; Hazin & Afonso, 2014).

Despite the above misconceptions, support for the strategy of hunting and killing a shark following a shark bite incident was greater across all demographics than that for a general culling program. Several respondents qualified their support for this action by stating that “only if the culprit shark could be positively identified,” with others noting “so it didn't re-offend.” Such responses may be partly influenced by emotions and media portrayals of shark behaviors (Muter, Gore, Gledhill, Lamont, & Huveneers, 2013; Neff, 2015). Notably, some people may ethically justify active differentiation between the senseless killing of innocent sharks in a general cull versus the directed killing of an identified perpetrator. Community attitudes and government policies to shark hazard strategies are often polarized and driven by emotion and media portrayals rather than facts (McCagh et al., 2015; Neff, 2012).

Conclusions

This article identified demographically associated divergent views and some misunderstanding among beach users about current shark bite mitigation strategies. In particular, it demonstrated differences in attitudes among beach users toward passive versus active culling strategies. Further studies are required to assess broader-scale societal attitudes to shark mitigation strategies between coastal metropolitan and regional inhabitants. Such research should incorporate targeted surveys of avid (i.e., higher risk) ocean user groups (e.g. surf lifesavers and lifeguards, surfboard riders) (e.g., Gibbs & Warren, 2015), and include opinions on alternative nonlethal mitigation strategies (e.g., catch and relocate—Hazin & Afonso, 2014), as well as the option of doing nothing. Moreover, community attitudes and the cost-benefits of recent initiatives of using aerial drone surveillance, coastal electronic shark sensor and community reporting systems combined with smart-apps to identify and warn the public of shark presence on beaches (e.g., sharksmart—www.sharksmart.com.au; SharkSmart—www.dpi.nsw.gov.au/info/sharksmart), need to be evaluated. Governments along with the media need to take greater responsibility in providing society with balanced facts and arguments about sharks, the risks of shark bite incidents, and the positive and negative attributes of all shark hazard mitigation schemes. This will help facilitate more informed and broader community input into the future development of viable and socially acceptable shark hazard management policies.

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