Submission No 9

MANAGEMENT OF SHARKS IN NEW SOUTH WALES WATERS

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Southern Cross University (SCU) submission to the Inquiry into Management of Sharks in NSW Waters

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Introduction

When humans enter a wild environment, particularly one that is largely intact, healthy and productive such as most NSW coastal waters, we must deal with (and indeed celebrate) the fact that such environments are capable of supporting large apex predators that may present a risk to us. Fortunately, in any ecosystem, such large predators are rare because each requires an extensive food web to provide sustenance in a large enough form to be energetically worth the effort of catching, and the risk is therefore relatively small. However, in places where food resources become particularly abundant, such as where fish aggregate to spawn or around river mouths after heavy rain, the risk can increase. We can deal with the risk in four ways.

1. *We can kill the dangerous animals:* 'Culling' may be justifiable if a problem animal is an introduced pest or in unnaturally high abundance (e.g. kangaroo culls in Canberra or wild horse culls in national parks) and can be specifically targeted by humane methods without collateral damage to others. But where the animal has already been depleted by human activity, is in its natural wild habitat, is killed by slow, stressful methods and the reason for the culling is to increase safety for recreational purposes, this option becomes, at best, undesirable and, at worst, short-sighted and ineffective.
2. *We can exclude the animals from areas used by humans:* In terrestrial environments it is reasonably easy to erect fences to exclude dangerous animals from areas of human activity. Barrier systems are equally easy to deploy in enclosed sheltered waters (such as Moreton Bay

and other estuaries to protect against bull shark attacks on bathers) but along the open coastline they are difficult and expensive. An alternative to barriers is to find technologies that repel or deter sharks from entering an area. For large areas, such technologies are still developmental (and expensive), although some smaller devices are proven to reduce the risk to individuals (point 4). Given that the number of deaths and injuries from shark incidents is low, the considerable expense of large-area exclusion devices may be better used to prevent deaths from other causes. Moreover, many people hold the mistaken belief that the shark nets used on NSW and Queensland ocean beaches are exclusion devices – they are not. They are fishing/culling devices designed to entangle sharks.

3. *We can avoid the animals*: This option requires that we know where the animals are so we can make an informed decision about the localised risk. This is, by far, the most desirable and practical method of risk reduction from shark attack. Technology already exists for aerial (manned and remote methods) and underwater sonar. Further development is needed from a computer software perspective to use image recognition algorithms to distinguish sharks from other large animals and reduce the incidence of false alarms. Greater observation effort will result in more frequent sightings and greater load on authorities tasked with a response to the detection. Surf-lifesaving is largely a volunteer operation with limited funding, but boasts an even better record of bather protection than beach meshing. We propose a considerable increase in direct funding of this organisation for a 'shark spotters' program as the best use of resources to reduce the risk of attack and, at the same time, also reduce the risk of a far more likely event – drowning.

4. *We can make individuals less attractive as potential attack targets*: The group of beach users most at risk from shark incidents are surfers, bodyboarders and ocean swimmers (West, 2011). They often seek out remote locations that may not be visually monitored or protected by exclusion devices. While there are many devices and strategies marketed to protect surfers, only one (the SharkShield) has been independently demonstrated to be effective in deterring shark attacks. The benefit of this approach is that the protection follows the user and the financial cost is borne by the individual who chooses to take the risk. The cost (up to $1000 for a full kit) is the biggest impediment to greater uptake.

Terms of reference

a) The impact of shark attacks on tourism and related industries

We propose that the impacts on tourism are often overstated by the industry. In a recent survey of 40 Ballina businesses, only 15% (or six businesses) considered that the recent spike in shark incidents, including two fatalities in 12 months, had affected their business. Those six were all in the tourism industry, but a recent survey by the Sea Shepherd Organisation has shown that 6-12 months after a shark incident there is no discernable effect on tourism (http://www.abc.net.au/news/2015-10-12/conservation-group-says-shark-attacks-are-not-affecting-tourism/6846176). In considering the impacts on tourism, these incidents should, therefore, be regarded as relatively minor and short-term.

In terms of public attitudes to response measures, a recent study by Dr Christopher Neff of Sydney University (http://sydney.edu.au/news/arts/2228.html?newsstoryid=15432) found that, despite the vocal minority calling for a cull or nets in the area, 80% of residents in Ballina Shire were opposed to any form of lethal deterrent. Given the turn-out on local beaches in protest against the Western Australian culling program, we suggest that such measures would polarise the community and result in a greater negative impact on tourism by focusing more attention on the issue. Likewise, the unnecessary death of dolphins, protected non-dangerous sharks, turtles and whales as bycatch in nets and on drum lines would also likely have a negative impact on tourism and related industries in the area.

b) Changes in shark numbers, behaviour or habitat

NSW has a high diversity of shark species, however, only three have been responsible for the vast majority of unprovoked attacks in coastal waters; the bull shark (*Carcharhinus leucas*), tiger shark (*Galeocerdo cuvier*) and white shark (*Carcharodon carcharias*) (West, 2011).

Shark numbers

Due to a lack of data on shark species generally (Bensley et al., 2009; Taylor et al., 2011) there are no reliable east coast population estimates for bull or tiger sharks. However, long-term data from bather protection programs (Krogh, 1994; Reid et al., 2011) shows a substantial decline in catches (and size of animals caught) for these species.

An estimate of the east coast population of adult white sharks has recently been published (~800–1000, Bruce 2015) but 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. There is, however, historical evidence of a greater decline in white shark numbers than other shark species and no current evidence supporting a recovery in numbers (DEWHA, 2008; DSEWPC, 2013). The white shark's current status as 'vulnerable' under the EPBC Act is supported by the review of the *White Shark Recovery Plan 2002* (DEWHA, 2008) and reiterated in the recently published *Australian National Recovery Plan for the White Shark* (DSEWPC, 2013).

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 (Last and Stevens, 2009; Worm et al., 2013). This also makes them particularly vulnerable to fishing pressure (nets and drumlines included) (Bensley et al., 2009; Worm et al., 2013).

Behaviour

While there is a lack of data on shark behaviour, 'normal' behaviour for sharks is generally considered to be following and hunting prey. This is 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 (Hammerschlag et al., 2012)

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 (Bruce and Bradford, 2012; Holmes et al., 2014). Juvenile white sharks are known to move into northern NSW waters in winter when sea surface temperatures are cooler (Bruce and Bradford, 2012), following schools of large snapper and Australian salmon (and the whale migration), and stopping wherever food is prevalent (CSIRO, 2015). 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 (Holmes et al., 2014). Bull sharks occur year-round in NSW waters north of Sydney (Rowling et al., 2010). 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 (Knip et al., 2010; Tillett, 2011).

The abundance of schools of fish on the north coast over the past few months is likely to be one of the most important factors in juvenile white shark concentration. Sharks follow food – if there are more sharks in one area at one point in time, there will be less sharks in other areas (CSIRO, 2015). Importantly, despite the abundance of juvenile white sharks at Port Stephens (a known residency location on the NSW coast), and numerous encounters there between humans and sharks, it is not implicated as a high-risk area. This suggests that the presence of juvenile white sharks alone is a poor indicator of risk (Bruce and Bradford, 2012).

Given the knowledge available, there appears to be no evidence for a change in the behaviour

of any of the three shark species. Fundamental knowledge of the sensory cues that drive predatory behaviour in sharks, however, is lacking (Hart and Collin, 2015), and much more research is required.

Habitat

All three shark species use coastal waters (inshore and continental shelf) in NSW (Last and Stevens, 2009), with tiger and white sharks also occurring in oceanic waters (Holmes et al., 2014; Bruce, 2015), and bull sharks additionally entering rivers and estuaries (Last and Stevens, 2009). Selection of habitat by sharks is believed to be influenced by a number of different factors including resource abundance, environmental characteristics (such as salinity, water temperature, tide, depth and substrate type) and competition from other species, all of which can vary over different locations and times (Knip et al., 2010; Taylor et al., 2011; Yates et al., 2015).

No evidence for changed habitat use is apparent in the three shark species. Notably, however, sediment movements in the Ballina-Byron area have resulted in high rates of accretion (build-up) of sand on beaches and in tidal areas. Accretion is linked to a strengthening El Nino weather pattern and smaller southerly/south-easterly swells, and has produced a very pronounced longshore parallel bar with deep water close to the beach (OEH, 2015). At present, the depth and proximity to shore of the channel produced by the longshore bar allows prey seeking refuge from larger predatory fish, and the sharks following them, to move closer to shore. The occurrence of deeper water closer to shore has also previously resulted in significantly higher incidence of white and tiger sharks in beach meshing programs in NSW and Queensland (Krogh, 1994; Taylor et al., 2011).

Finally, 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. The further decline of shark populations, combined with other anthropogenic pressures in coastal waters (climate change, habitat loss and degradation, pollution), would have dire consequences (economic and environmental) for these highly productive marine systems (Myers et al., 2007; Espinoza et al., 2014).

c) Adequacy of management strategies

The 20-year average rate for fatal shark attacks in Australian waters is 1.1 per year (West, 2011). In contrast, there were 100 deaths by drowning in NSW during the 2014-15 season, 10 of those on ocean surf beaches (RLSS 2015), and in 2014 there were 312 deaths on NSW roads (BITRE, 2015). For the same cost as installing and maintaining shark nets more of these preventable deaths and injuries could be addressed. Despite the tragedy of shark fatalities and the horrendous injuries of some survivors, other causes of death or injury may be just as horrendous. It seems a poor use of limited funds to direct such a large portion to the prevention of relatively few incidents.

While the record of only a single fatality on a meshed beach in the Newcastle–Sydney–Wollongong region may be testament to the fact that nets could lower the risk for one person, the question remains whether the continued killing of a threatened species (and many other animals as bycatch) can be justified on this basis, particularly when it is borne out of a desire to enter a wild environment (in complete safety) for purely recreational purposes.

There is one other method that has resulted in zero fatalities over an extended period of time, one that is often overlooked: surf-lifesaving-patrolled beaches. In addition to recording no fatalities from shark incidents, patrolled beaches (with and without nets) can also boast no fatalities from drowning. Given the much higher number of drownings in NSW coastal waters it would seem far better use of funds to increase the capability and resources of the (largely volunteer) surf lifesaving clubs. This would clearly save more lives than any other measure.

d) Measures to prevent attacks by sharks, including strategies adopted in other jurisdictions

Alternative technologies for providing whole-beach protection are not yet adequately developed to replace nets at a similar cost and level of confidence. Even if they were, the protection provided would remain site-specific and expensive compared with the option of new surveillance technologies that are currently being developed.

For large-scale risk mitigation we support the extension of surveillance measures such as manned flights, drones or similar unmanned aerial methods, and underwater sonar warning systems as the most justifiable way to allow the public to assess the risk of entering the water. We also consider that the currently-available and independently proven technology of electro-magnetic fields generated by personal repellant devices (such as SharkShield) are the most effective means of protecting individual surfers, ocean swimmers and divers, in any marine location. The cost of such devices is also borne by the individual choosing to take the risk, not by the broader community.

The main impediment to uptake of devices such as SharkShield is cost (unit, charger, tester, carry bag etc. is approximately $1000) and the drag associated with the long, field-generating cable (less of an issue for scuba divers). A new model is being released in early 2016 that will address the weight and drag issues for surfers by integrating the antenna into the fins of the board. However, the cost issue remains. Perhaps a subsidy system could be considered to encourage greater uptake of this technology and provide wider protection, especially among one of the most at-risk groups, surfers. This would, no doubt, be less expensive than beach protection methods.

e) Any other related matters

Beach meshing (and in Queensland drum lining) is presently carried out only during the peak swimming season (as with surf-lifesaving patrols). This is for several reasons.

1. The lower number of bathers in winter means the risk of shark incidents is inherently lower, and does not justify the cost of maintenance and regular checks for entanglements. On the north coast, the warmer conditions and improved wetsuit technologies mean that surfers, in particular, are in the water year-round.
2. Humpback and southern right whales migrate along the east coast in winter. Not setting nets in winter avoids the time of peak risk for these threatened populations (or critically endangered in the case of right whales). On the north coast of NSW the humpback whale migration path tracks closer to the shore than at any other location, which increases the risk of whale entanglements in winter-set nets.
3. Winter is also the time when threatened grey nurse sharks aggregate at locations along the NSW coast. These sharks are harmless to bathers yet are also a common bycatch of beach meshing programs. Removing the nets in winter reduces (though does not eliminate) the incidence of grey nurse capture. Julian Rocks (near Byron Bay) on the NSW north coast, is a major grey nurse aggregation site. Winter-set nets would present a clear threat to this species.

While some attacks have occurred in summer, the greatest threat to surfers in northern NSW from white sharks is in winter when they tend to be found further north. Yet the issues outlined above mean that winter-set nets would not be a viable option. In addition, access to deploy/retrieve, check and maintain any beach protection device would be hampered by dangerous river bar crossings by support vessels.

Given the lack of market-ready alternative deterrent systems for whole beaches we recommend increased funding for surf-lifesaving, development of automated aerial surveillance methods, encouragement of greater uptake of individual shark deterrent technologies such as

SharkShield, and use of the North coast region for field testing of alternative deterrence technologies as they become available.

Other bycatch issues

In the warmer waters of northern NSW it should be noted that there are some additional bycatch issues with entanglements in shark nets. The region has a high incidence of sea turtles with some loggerhead and even leatherback turtles nesting on local beaches. All populations of sea turtle are threatened with the leatherback critically endangered. Turtles are regularly captured in shark nets on Queensland's Gold Coast.

The Richmond River estuary is close to the locations of the three most recent shark fatalities in the region. It is also home to a significant population of river dolphins. Other dolphin groups frequent local beaches.

In 2015 up to three endangered Brydes whales have been observed feeding on baitfish close to shore near Byron Bay. These animals would also be at high risk from entanglement in shark nets.

Summary

- Shark nets are an undesirable, destructive and expensive way to respond to what is still a low risk of shark attack. The extension of their use to northern NSW raises particular issues with the nature of the beaches and the increased risk of bycatch.
- Alternative technologies for excluding sharks from areas of human use are still in development, are equally expensive, and would not protect surfers on point breaks and remote beaches.
- If such technologies are to be trialed, the North coast of NSW with all three dangerous shark species in all seasons and specific bycatch issues is the ideal testing ground.
- Greater funding is needed for research on behaviour, movements and habitat use of sharks in eastern Australia.
- Greater funding is needed for aerial monitoring, especially the development of automated systems.
- Greater funding is needed to support and expand the services of surf lifesaving, which would save many more lives from drowning as well as reducing the risk of shark incidents.
- Consideration should be given as to how best to encourage greater uptake of the personal protective devices that have been independently tested.

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