NSW Shark Meshing (Bather Protection) Program
2018/19 Trigger Point Review Report

Introduction

The Shark Meshing (Bather Protection) Program (SMP) operates in accordance with a Joint Management Agreement (JMA) and an associated Management Plan authorised by the *Fisheries Management Act 1994* (FM Act).

The Management Plan contains a performance assessment and reporting framework to assess the performance of the Plan in achieving its objectives, and to communicate the results transparently. Achievement of those objectives is determined against performance indicators and trigger points, and is communicated by annual performance reports and reviewreports.

The annual performance report for 2018/19 (Dalton and Peddemors, 2019) identified that the trigger point for the objective of '*minimising the impact on non-target species and threatened species*' was tripped for Smooth Hammerhead Sharks, Hawksbill Turtles, Leatherback Turtles and Loggerhead Turtles. The trigger points related to the other objectives of: reducing the risk to humans from shark attacks at meshed beaches; work health and safety (WHS) risks; and transparent monitoring and reporting were not tripped during the 2018/19 reporting period.

Loggerhead Turtle and Leatherback Turtle are listed as endangered species in the *Biodiversity Conservation Act 2016*. Hawksbill Turtles are not a threatened species, however like most other native animals of NSW they are protected by the *Biodiversity Conservation Act 2016*.

The trigger points are considered to be precautionary measures as they relate to the number of entanglements, not the number of animals that die as a result ofentanglement.

Trigger Point Reviews

SHARKS

Smooth Hammerhead Shark (*Sphyrna zygaena*)

Trigger point description

The entanglement of 87 Smooth Hammerhead Sharks (*Sphyrna zygaena*) during the 2018-19 Shark Meshing season tripped the trigger point for non-target species as it was preceded by similarly high catches totalling 261 individuals in the three years preceding this meshing season. One of the caught Smooth Hammerhead Sharks was released alive, however, post-release survivorship in net-caught hammerhead sharks is unknown but thought to be low.

Genetic samples and vertebrae were collected from seventy four of the eighty six deceased sharks. Eight of the twelve non-sampled animals were decomposed. All biological samples are accessioned into the DPI shark sample collection to potentially be used for confirmation of species identification, plus various future biological or ecological studies such as ageing, ecological microchemistry or isotope purposes.

Review findings

Historically, Smooth Hammerhead Shark captures in the SMP are substantial and spread throughout the region, with interactions occurring at all 51 beaches; however, most captures tend to occur at beaches close to estuary mouths (Wray-Barnes, 2017). Estuaries have been identified as representing nursery habitat for Smooth Hammerhead Sharks in northern New Zealand (Francis, 2016) and the small size classes caught in the SMP suggest a similar role for estuaries in NSW.
All Smooth Hammerhead Sharks caught in the SMP are sexually immature with the size at capture indicating their age to span between neonates and 10 year old animals (mode three years) (Wray-Barnes, 2017).

In the case of Smooth Hammerhead Sharks, the SMP is effectively acting as a gauntlet fishery (Prince 2005), which has been shown to be an appropriate harvest management strategy for whaler sharks such as Silvertip Sharks (*Carcharhinus albimarginatus*) and Common Blacktip Sharks (*Carcharhinus limbatus*) (Smart *et al.* 2017). Such an assessment has not been done for hammerhead shark species, however, the Non-Detriment Finding with respect to CITES indicates that harvest levels in NSW (of which the SMP is a small component) are sustainable (Department of Environment 2014).

Conclusion

Although there is an ongoing catch of Smooth Hammerhead Sharks in the NSW Shark Meshing Program, considering the majority of captures are of juveniles less than five years old, the age at sexual maturity likely being around 10 years (DoE, 2014), and the large litter sizes of between 20-49 pups (Stevens, 1984), it is unlikely that the SMP catch negatively affects the overall population status for this species.

Recommendation

Due to the gauntlet fishery nature of the SMP with regards to Smooth Hammerhead Shark interaction, the 10 year average of 43 captures, few mature sharks in the catch and the large litter sizes for this species, it is unlikely that SMP-induced fatality will negatively impact the population. Further research into age and growth, age at maturity, and population estimates in an eastern Australian setting need to be conducted to provide confidence in the proposed non-detrimental effect that the SMP may have on Smooth Hammerhead Shark populations.

SEA TURTLES

Hawksbill Turtle (*Eretmochelys imbricata*)

Trigger point description

The entanglement (and subsequent death) of four Hawksbill Turtles (*Eretmochelys imbricata*) during the 2018-19 Shark Meshing season tripped the trigger point for threatened species entanglements. It should be noted that prior to the 2009-10 reporting period all turtles were combined at non-specific reporting levels, thereby leading to an apparent zero catch for this species during this period and subsequently affecting trigger points for this species. The tripping of the trigger point for Hawksbill Turtles in the current reporting year may therefore not represent an unusually high catch for this species, but may be an artefact of the historical lack of species differentiation in reporting.

Two of the Hawksbill Turtles caught were retained and provided to the Taronga Zoo for necropsy and accessioning of specimens into the Australian Registry of Wildlife Heath; but the other two were decomposed and returned to the sea after measuring.

Review findings

Nets are generally set away from reef structure to minimise their damage, enhance ease of operation for the contractors, and are less likely to capture reef-associated species such as Hawksbill Turtles.

Although Hawksbill Turtles are considered to occupy shallow waters (less than 30m), they are infrequently caught in either the Queensland Shark Control Program or NSW SMP.

Although Hawksbill Turtles occur in NSW waters, none of their key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are in NSW (Department of the Environment, 2017).

A review of their strandings along NSW beaches highlighted a skewed stranding frequency to

northern NSW beaches (Ferris, 2016), suggesting that the region of the NSW SMP is outside of their preferred range. However, it is possible that a range extension southward could be expected with warmer waters associated with climate change.

The size range of between 60 and 38 cm curved carapace length (CCL) corresponds to the size at recruitment onto reef habitat from the pelagic environment (Limpus, 1992; Limpus et al., 2008). This range in size overlaps the size of stranded Hawksbill Turtles in NSW (Ferris, 2016). The months of capture (October and January) in the SMP reflect increased periods of strandings in NSW waters (Ferris, 2016) and may reflect changes in the strength and seasonal variation of the East Australian Current (EAC) during this period.

Leatherback Turtle (*Dermochelys coriacea*)

Trigger point description

The entanglement of four Leatherback Turtles (*Dermochelys coriacea*) during the 2018-19 Shark Meshing season tripped the trigger point for threatened species entanglements. It should be noted that prior to the 2009-10 reporting period all turtles were combined at non-specific reporting levels, thereby leading to an apparent zero catch for this species during this period and subsequently affecting trigger points for this species. The tripping of the trigger point for Leatherback Turtles in the current reporting year may therefore not represent an unusually high catch for this species, but may be an artefact of the historical lack of species differentiation in reporting.

None of the three deceased Leatherback Turtles were retained due to their bulk and inability to safely bring them to shore. The live turtle that was released was not tagged as contractors have not received tagging equipment and training from relevant authorities.

Review findings

Leatherback Turtles are the largest of all sea turtles, but are seldom found close to shore in NSW as they are considered to be a pelagic species primarily found in tropical and sub-tropical waters throughout the world (Marquez 1990). However, their physiological adaptation allowing them to maintain elevated body temperatures in cold water enable them to extend their range into temperate waters. Although a few Leatherback Turtle nests have been reported for the far north coast of NSW, no major nesting has been recorded in Australia (Department of Environment and Energy, 2017).

Leatherback Turtles are considered to primarily occupy pelagic waters, but they are caught in the Queensland Shark Control Program and more infrequently in the NSW Shark Messing Program. The southern waters of Australia are one of five identified foraging grounds (where area restricted behaviour occurs) (Bailey *et al*., 2012) so their movement through NSW waters may represent a ‘corridor’ between nesting sites and primary foraging sites.

Although Leatherback Turtles are known to occur in NSW waters, none of their key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are in NSW (Dept. of Environment and Energy, 2017).

Loggerhead Turtle (*Caretta caretta*)

Trigger point description

The entanglement of six Loggerhead Turtles (*Carettta caretta*) during the 2018-19 Shark Meshing season tripped the trigger point for threatened species entanglements. It should be noted that prior to the 2009-10 reporting period all turtles were combined at non-specific reporting levels, thereby leading to an apparent zero catch for this species during this period and subsequently affecting trigger points for this species.

Three of the entangled Loggerhead Turtles were released alive from the net. None of the three dead Loggerhead Turtles caught were retained for research as two of these were decomposed and returned to the sea *in situ* after measuring, whilst the sixth specimen was not collected due to unavailability of an observer on the day.

Review findings

Loggerhead Turtles are considered to spend most of their lives in the open ocean and can undergo return journeys exceeding 14,500km between nesting on land (Nichols, 2010). The foraging habitats of juvenile and adult Loggerhead Turtles range from near shore to 55m depth (Limpus, 2009) and include tidal and sub-tidal habitats with hard and soft substrates including rocky and coral reefs, muddy bays, sand flats, estuaries and seagrass meadows (Bjorndal, 1997).

Although Loggerhead Turtles are known to occur in NSW waters, none of their key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are in NSW (Dept. of Environment 2017). Loggerhead turtles leave the pelagic habitat and recruit to neritic habitats over a range of sizes between 46 to 64cm curved carapace length (Bjorndal *et al*., 2000). These lengths correspond to the size classes on animals caught in the SMP and imply that NSW nearshore habitats may provide suitable foraging grounds, particularly for adults and large juveniles (Limpus *et al.*, 1994). They are infrequently caught in the Queensland Shark Control Program and NSW Shark Meshing Program.

Conclusions for all sea turtles

Although the trigger point was tripped following the capture of these three species of sea turtle, this is likely due to the historical long period of zero reported catch for this species when turtles were not reported to species level. This highlights the benefits of the JMA and associated Management Plan in ensuring that the program accurately reports on all species caught, thereby allowing determination of long-term trends in catch rates and potential for impact on the populations of species affected by this program.

The SMP has maintained an active policy of ensuring nets are set sub-surface in an attempt to enable air-breathing marine mammals, reptiles, and birds to swim over the top of the net.

Recent studies into reducing turtle bycatch in passive net fisheries have highlighted the potential to use LED lights to illuminate nets and reduce bycatch (Gilman *et al*., 2010; Wang *et al*., 2010, 2013; Ortiz *et al*., 2016). The wavelengths produced by lightsticks often incorporated into longline gear appear to attract Loggerhead Turtles (Swimmer et al., 2017), because Loggerhead, Leatherback, and Green turtles rely extensively on visual cues (Constantino & Salmon 2003; Wang *et al*., 2007; Young *et al*., 2012), particularly when foraging (Swimmer *et al*., 2005; Southwood *et al*., 2008; Wang *et al*., 2010). These LED lights are now actively produced and internationally endorsed as turtle excluder devices, e.g. in the European Union: http://ec.europa.eu/environment/integration/research/newsalert/pdf/352na1_en.pdf, and Australia: http://www.abc.net.au/science/articles/2013/07/24/3809278.htm.

Recommendations for all sea turtles

The NSW SMP nets have caught few sea turtles over the past decade, however, it is anticipated that catches for these species could increase with increasing temperature of nearshore waters and subsequent movement of warm-water species into central NSW waters.

Although it is unlikely that the current rate of SMP-induced fatality of sea turtles will negatively affect the populations, it is imperative that ongoing efforts to reduce any bycatch be continually re-assessed. Incorporation of special LED lights in the SMP nets could potentially reduce bycatch of all turtle species and warrant further investigation into the practicality of their use in NSW waters. An

analysis of historical turtle catches will be conducted to determine whether there are any beaches with peaks in sea turtle (all species combined) catches to potentially identify sites of preferred LED experimentation where a BACI test will allow determination of their efficacy in reducing turtle catch.

It is anticipated that the proximity of nets to reef will have little effect on Leatherback Turtle catches as this species is oceanic and therefore remain planktivorous throughout their life, feeding on jellyfish and large planktonic ascidians (Limpus, 2009); however, proximity to reef may be important for Loggerhead and Hawksbill Turtle catches as both these species are considered to forage on reef-associated prey.

Finally, ensuring nets are not stretched tight when they are laid could assist turtles to reach the surface post-entanglement and thereby potentially reduce turtle mortality.

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