NSW Shark Meshing (Bather Protection) Program
2019-20 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 under 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 review reports.

The annual performance report for 2019-20 identified that the trigger point for the objective of '*minimising the impact on non-target species and threatened species*' was tripped for Greynurse Sharks, Scalloped Hammerheads, Common Dolphins and Thresher Sharks. The trigger points are considered a precautionary measure as they relate to the number of entanglements, not the number of animals that died as a result of entanglement.

The trigger point related to the objective of '*minimise OHS risks associated with implementing the SMP*' was also tripped with two minor incidents being reported by DPI staff during the meshing season. Trigger points relating to the other objectives of '*reducing the risk to humans from shark attacks at meshed beaches*'; and 'transparent monitoring and reporting' were not tripped during the 2019-20 reporting period.

Trigger Point Reviews

SHARKS

Greynurse Sharks (*Carcharias taurus*)

Trigger point description

The entanglement of thirty-one (31) Greynurse Sharks (*Carcharias taurus*) during the 2019-20 shark meshing season tripped the trigger point for the objective '*minimising the impact on non-target species and threatened species'*. Of these 31 captures, 17 sharks (55%) were released alive. Ten of the deceased animals were retained whole for research purposes, whilst three carcasses were sampled at sea for requested biological specimens. Seven of the released sharks were tagged with pop-up archival tags to determine post-release survivorship.

Review findings

The SMP nets are generally set away from reef structure to minimise their damage and enhance ease of operation for the contractors. The shark nets are therefore considered less likely to capture predominantly reef-associated species such as Greynurse Sharks. The nets are generally set in similar positions throughout and between years, and the materials and other specifications have not changed, indicating that operational matters are unlikely to account for the high catches and tripping of the trigger point.

Greynurse Sharks were caught in five of the seven SMP regions, but a substantial proportion (58%) were caught in the central coast region (Central Coast South). The beach with highest Greynurse Shark catch was North Avoca (8 sharks). Central Coast South region also recorded the highest catch of Greynurse Sharks in 2018-19 (4 sharks). Stockton Beach has historically had the highest catch of Greynurse Sharks (2015-16, 2016-17 and 2017-18) and this season

recorded a catch of six sharks. Reid *et al*. (2011) found no peak in Greynurse Shark catch for any beach over the 60 year dataset analysed; however, the Hunter Region did consistently report high Greynurse Shark catch during the three decades pre-1980 but these then dropped to similar levels as other regions of the SMP (Reid *et al*., 2011). Operationally there has been no change in any of the SMP regions, suggesting an unknown environmental or habitat driver is affecting catches of Greynurse Sharks in the northern region of the SMP.

Greynurse Sharks were caught throughout the meshing season, with no single month representing a notably higher mortality rate. This currently precludes consideration of temporal changes in shark meshing to reduce bycatch of Greynurse Sharks

Conclusion

The catches of 19, 17 and 20 Greynurse Sharks in recent years, were more than three times the previous ten-year annual average catch in the SMP. Successive annual catches of that magnitude have not been reported in the SMP since the 1970s (Reid *et al.*, 2011), a time when the SMP season was a full calendar year, not eight months as it is now.

Even following the high catches in the last five years, the trigger point was tripped following the capture of 31 Greynurse Sharks. This is likely due to the long period of substantially lower reported catch for this species during the preceding decade.

Fifty-five per cent of Greynurse Sharks caught were released alive with no statistically significant difference in size between animals found alive or dead in the nets. At least 71% of Greynurse Sharks caught were female. The ongoing and high catch, particularly of females, is of significant concern to DPI and the Parties to the JMA, noting that the Greynurse Shark is listed as 'critically endangered' under the *Fisheries Management Act 1994*. Unfortunately, there are currently no known effective methods to completely mitigate bycatch of Greynurse Sharks from shark nets like those used in the SMP; however, an analysis of long-term catch data is currently underway which may provide some potential Greynurse Shark bycatch mitigation measures.

Table 1: Detail of Greynurse Sharks (*Carcharias taurus*) tagged and released from the NSW shark nets during the 2019-20 season.

Installation Name	*Date*	*Sex*	*TL (cm)*	*Time at boat (mins)*	*Condition of shark*	*Serial #*	*PTT ID*	*Date Popped*	*Location Popped*	*Days at Liberty*	*Date Recovered*	*Location Recovered*
Bondi	2019/02/11	M	250	16	Very healthy	84911	18P1248	2019/05/28	Unknown Offshore	107	Not recovered	Not recovered
Stockton	2019/09/06	F	~290	7	Very good	84921	18P1260	2019/12/06	Unknown Offshore	90	2020/12/06	Fish Rock
Copacabana	2019/09/27	F	250	4	Sluggish	84910	18P1247	2019/09/30	Copacabana	3	2019/10/15	Ulladulla
North Avoca	2019/12/20	M	210	15	Good	84915	18P1253	2019/12/22	Avoca	3	2020/01/02	North Avoca
Garie	2020/01/13	M	280	30	Good	84919	18P1257	unknown	unknown	unknown	Not recovered	Not recovered
Bondi	2020/01/28	F	320	5	Sluggish	84912	18P1249	2020/02/09	Malua Bay	12	Not recovered	Not recovered
Stockton	2020/03/02	F	270	12	Poor	84929	18P1272	Unknown	Hunter River Mouth	8	Not recovered	Not recovered

Recommendation

The SMP nets have continuously caught small numbers of Greynurse Sharks over the past decade, however, the release of over 50% of all Greynurse Sharks since the implementation of the first JMA in 2009 highlights the efficacy of more regular checking of nets by the contractors through reducing the number of hours between checks of nets to a maximum of 72 hours. It is anticipated that most of these released individuals will survive and this will be determined using pop-up archival tags to measure post-release. Unfortunately, hardware malfunctions due to manufacturing faults resulted in several of the tag deployments providing minimal data during the past season (see Table 1). The manufacturer has rectified the issue and a new batch of pop-up archival tags to be deployed during the next SMP season. At this stage there are no readily identifiable deficiencies or issues to be addressed from an operational perspective of the JMA and Management Plan.

Alternative bather protection devices, such as SMART drumlines, could achieve reduced impact on threatened species such as Greynurse Sharks. A trial of SMART drumlines adjacent to the nets in the SMP region for six months in 2019 did not catch a single Greynurse Shark. In the longer running north coast trial (four years), while Greynurse Sharks were caught, all individuals were released alive due to the communications system enabling rapid release of captured animals (within 30 minutes).

Scalloped Hammerhead Sharks (*Sphyrna lewini*)

Trigger point description

The entanglement of four Scalloped Hammerhead Sharks (*Sphyrna lewini*) during the 2019-20 shark meshing season tripped the trigger point for the objective '*minimising the impact on non-target species and threatened species'*. All four individuals were immature and caught during the summer months in warm waters. Few Scalloped Hammerhead Sharks have historically been caught in the SMP leading to any catch of more than a single animal tripping the trigger point.

Review findings

The Scalloped Hammerhead Shark is listed in NSW as endangered under the *Fisheries Management Act 1994*. The species has a circumglobal distribution in tropical and subtropical oceans (Last and Stevens, 2009). Although early studies suggested that this species of shark displays relatively small home ranges with an affinity to aggregate around bathymetric features such as sea mounts (Klimley, 1993; Hearn *et al*., 2010), more recent tagging studies suggest they may undergo substantial movements exceeding 1000km (Bessudo *et al*., 2011; Spaet *et al*., 2017). Movements of large (mature) Scalloped Hammerhead Sharks off Australia are still unknown, but genetic data suggest some connectivity throughout northern and eastern Australia, Papua New Guinea and Indonesia, but not with Western Australia (Heupel *et al*., unpublished data). It has been suggested that there is likely limited connectivity between the east coast stock of Scalloped Hammerhead Sharks and other international jurisdictions (Heupel *et al*., unpublished data).

Scalloped Hammerhead Sharks are also listed as 'Conservation Dependent' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and, as such, are required to undergo assessment for a plan of management that ensures long-term sustainability of this species in Australian waters. Currently, the plan of management for Scalloped Hammerhead Sharks includes a total allowable commercial catch (TACC) of 200 tonne per annum (150 tonnes for Queensland and 50 tonnes for the Northern Territory).

Table 2: Catch details for the four Scalloped Hammerhead Sharks (*Sphyrna lewini*) caught in the shark nets during the 2019-20 season. None of the four caught were released alive.

Date	Region	Beach	Species	Size (m) (fork length)	Sex
24/01/2020	Hunter	Stockton	*Sphyna lewini*	1.6	M
06/02/2020	Sydney North	Warriewood	*Sphyna lewini*	1.45	F
13/03/2020	Central Coast North	Shelly	*Sphyna lewini*	1.1	U
21/02/2020	Sydney North	Warriewood	*Sphyna lewini*	1.42	F

Conclusion

The capture of four immature Scalloped Hammerhead Sharks in the NSW Shark Meshing Program is unlikely to negatively affect the viability of the Australian stock for this species.

Recommendation

The four Scalloped Hammerhead Shark captured occurred across three beaches with varying bathymetry and beach characteristics. The historical low capture of this species precludes assessment of biotic or abiotic factors that may influence their capture. As a result of the SMP representing the southern-most range for this species, the low catches of Scalloped Hammerhead Sharks and the resulting unlikely negative impact on the population viability of this species, no changes to the operations of the SMP are recommended to abate potential capture of this shark species.

Common Thresher Shark (*Alopias vulpinus*)

Trigger point description

The entanglement of four Common Thresher Sharks (*Alopias vulpinus*) within ten days at the end of September during the 2019-20 shark meshing season tripped the trigger point for the objective '*minimising the impact on non-target species and threatened species'*.

Review findings

The Thresher Shark is not listed as a threatened or protected species in NSW and is harvested by fishers. The Common Thresher has a circumglobal distribution throughout tropical and temperate pelagic waters, usually occurring in outer shelf waters surrounding Australia (Last and Stevens 2009). This species is not as migratory as other Thresher species. Several apparently isolated subpopulations exist globally, and genetically discreet populations occur in the Pacific and Atlantic Oceans (Trejo 2005).

Due to its pelagic distribution, fishing pressure on Common Thresher Shark is high throughout much of its range; however, in Australia they are infrequently taken in tuna longline fisheries and usually returned to the sea alive (Simpfendorfer *et al.*, 2019). The Common Thresher Shark is therefore assessed as globally 'Vulnerable' (International Union for Conservation of Nature (IUCN)) and in Australia is suspected to be assessed as 'Least Concern'[1] (IUCN) and 'Sustainable' (Status of Australian Fish Stocks) (Simpfendorfer *et al* 2019).

Table 3: Catch details for the four Common Thresher Sharks (*Alopias vulpinus*) caught in the shark nets during the 2019-20 season. None of the four caught was released alive.

Date	Region	Beach	Species	Size (m) (fork length)	Sex
20/09/2019	Sydney North	Palm Beach	*Alopias vulpinus*	1.23	M
23/09/2019	Illawarra	Garie	*Alopias vulpinus*	1.45	M
23/09/2019	Illawarra	Garie	*Alopias vulpinus*	1.35	F
30/09/2019	Central Coast North	Lakes Beach	*Alopias vulpinus*	2.07	F

Conclusion

The fatality of four individuals, of which only one (caught at Lakes Beach, Table 2) was potentially mature, is unlikely to negatively impact the population status of this species.

Recommendation

The four Common Thresher Shark captures occurred across three beaches with varying bathymetry and beach characteristics. The historical low capture of this species precludes assessment of biotic or abiotic factors that may influence their capture. As a result of the SMP being in shallow waters, the low catches of this pelagic shark species and the resulting unlikely negative impact on the population viability of this species, no changes to the operations of the SMP are recommended to abate potential capture of Common Thresher Sharks.

[1] The IUCN Red List Categories define the extinction risk of species assessed. In descending order of threat, the IUCN Red List threat categories are: Extinct or Extinct in the Wild; Critically Endangered, Endangered and Vulnerable (i.e. species threatened with global extinction); Near Threatened (i.e. species close to the threatened thresholds or that would be threatened without ongoing conservation measures); Least Concern (i.e. species evaluated with a lower risk of extinction); Data Deficient: no assessment because of insufficient data. See https://www.iucn.org/resources/conservation-tools/iucn-red-list-threatened-species

MARINE MAMMALS

Common Dolphin (*Delphinus delphis*)

Trigger point description

The entanglement of seven Common Dolphins (*Delphinus delphis*) during the 2019-20 shark meshing season tripped the trigger point for the objective '*minimising the impact on non-target species and threatened species'*.

Review findings

The Common Dolphin is a protected species in NSW under the *Biodiversity Conservation Act 2016*. Common Dolphins are found in offshore waters. They have been recorded in waters off all Australian states and territories but are rarely seen in northern Australian waters (Jefferson & Van Waerebeek 2002; Ross 2006). Skull morphometric analysis confirmed early genetic evidence for a single continuously variable species in southern Australian waters (Bell *et al.*, 2002). At least six separate management units for Common Dolphins have been identified, five of which are in the south-eastern Indian Ocean and one for the south-west Pacific Ocean (Bilgmann *et al*., 2014). These authors identified relatively high levels of genetic diversity for the population of Common Dolphins off south-eastern Australia, and that Common Dolphins from the Pacific Ocean moved west into the Indian Ocean off southern Australia during times of increased upwelling and enhanced fish in those waters (Bilgmann *et al*., 2014). Therefore, Common Dolphins off NSW may represent a more 'open' population than those within the Great Australian Bight and may comprise a larger population than found off southern Australia.

Neither the extent of occurrence nor the area of occupancy of the Common Dolphin have been estimated. However, in a similar habitat and latitude on the east coast of South Africa, the population was estimated to be 15-20,000 (Cockcroft and Peddemors, 2002), implying that a similar population size could be expected for the SMP region.

There is no information on movements of Common Dolphins in and out of the Australian jurisdiction, or studies on stock structure of this species in Australia and neighbouring areas. The relationship between Australian Common Dolphins and those inhabiting other regions is thus not known (Department of Environment, 2021).

Table 4: Catch details for the seven Common Dolphins (*Delphinus delphis*) caught in the shark nets during the 2019-20 season. None of the seven caught were released alive.

Date	Region	Beach	Species	Size (m) (total length)	Sex
19/09/2019	Sydney North	Warriewood	*Delphinus delphis*	1.8	U
27/09/2019	Sydney South	Maroubra	*Delphinus delphis*	1.9	M
01/11/2019	Hunter	Stockton	*Delphinus delphis*	1.73	F
28/10/2019	Sydney South	Maroubra	*Delphinus delphis*	2.1	M
01/11/2019	Sydney South	Maroubra	*Delphinus delphis*	2.1	F
11/03/2020	Hunter	Nobbys	*Delphinus delphis*	2.1	F
20/04/2020	Sydney North	Avalon	*Delphinus delphis*	2.0	F

Conclusion

There are no estimates of population size or genetic structuring of Common Dolphins from the east coast of Australia. The genetic data indicates high levels of diversity and the concurrent inference of a large population size suggest that the annual average capture of 2.7 Common Dolphins in the SMP over the past decade does not warrant concern for the continued viability of this species.

Recommendation

Several versions of 10 kHz and 70 kHz dolphin deterrent devices (popularly known as ‘dolphin pingers’) have been trialled in the NSW Shark Meshing Program for the past few decades; however, dolphin captures continue.

Although it is unlikely that current levels of capture of Common Dolphins could potentially negatively impact the viability of the population, it is recommended that ongoing efforts be made to investigate alternative dolphin deterrent devices to reduce marine mammal captures.

Alternative bather protection devices, such as SMART drumlines, could achieve reduced impact on non-target and threatened species such as Common Dolphins. A trial of SMART drumlines adjacent to the nets in the SMP region for six months in 2019 and in a longer running north coast trial (four years), no Common Dolphins were caught. The SMART drumlines provide bather protection from shark interactions and warrant further investigation into the practicalities of incorporating into the NSW Shark Meshing Program.

OH&S RISKS ASSOCIATED WITH THE SMP

Trigger point description

Objective 11.1.3 of the SMP Management Plan 2017 is to '*Minimise work health and safety risks to Contractors and agency personnel associated with implementing the SMP*', with the associated trigger point being tripped if '1 major or 2 minor incidents' occur during a meshing season. During the 2019-20 meshing season two DPI employees suffered minor injuries while loading and unloading sharks caught as part of the SMP, tripping the trigger point.

Review of incidents

Incident one involved the lifting of a shark on to the back of a utility vehicle for transport back to a storage freezer. The shark was lifted and carried by three people to a transport vehicle as there was no direct access to park the transport vehicle next to the vessel at this location. Weather conditions at the time (raining) also played a factor in the incident as the shark momentarily slipped from the employee's grip causing a reactive movement to grab the shark resulting in a back spasm and subsequent back strain injury.

The second incident occurred during the loading of a shark into the storage freezer. The shark had been lifted from a utility vehicle by a forklift and carried to the freezer. While doing so the shark slipped to one side squashing the employee's hand against the side of the freezer wall. In a reactive movement the employee quickly pulled their hand back and in doing so lacerated their hand on the shark's teeth. First aid was immediately applied, and the employee was sent to a doctor for further medical treatment. The injury required several stitches.

Both incidents were reported and investigated as per DPI work, health and safety policy and procedures.

Conclusion

Both incidents involved manual handling issues while loading and unloading sharks caught in the Shark Meshing Program. The JMA requires the collection of samples as part of the Management Plan and these are collected as either 'part' or 'whole' animal samples. The collection of 'whole' samples is normally for protected and/or species of scientific interest (as determined by the Senior Shark Scientist). The collection of 'whole' specimens has historically involved some sort of manual handling and the potential risks have been noted. The recent purchase of a trailer and crane for the purpose of collecting 'whole' specimens has removed the need for any manual handling however this equipment can only be in one place at a time and can only be used in association with an appropriate tow vehicle.

Recommendation

Current work procedures for the collection of 'whole' specimens requires that there is to be no manual handling involved; if the crane and trailer, and an appropriate tow vehicle are not available then only 'part' samples will be taken.

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