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Shark Meshing (Bather Protection) Program 2022/23 Annual Performance Report

Prepared in accordance with the 2017 Joint Management Agreement and associated Management Plan

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Executive Summary

Between the 2009/10 and 2016/17 meshing seasons, the Shark Meshing (Bather Protection) Program (SMP) operated in accordance with Joint Management Agreements (JMAs) and an associated Management Plan authorised by the *Fisheries Management Act 1994* (FM Act) and the *Threatened Species Conservation Act 1995* (TSC Act).

A new, single JMA under the FM Act was prepared in 2017 and the 2017/18 meshing season marked the beginning of SMP operations under the 2017 JMA. Some of the key changes to the JMA were refined trigger points and defining 'target shark' species as White Shark, Bull Shark, and Tiger Sharks for the purposes of the JMA and Management Plan.

The objectives of the JMA are to: minimise the impact of the SMP on threatened and protected species; and ensure that the SMP does not jeopardise the survival or conservation status of threatened species or cause species that are not currently threatened to become threatened.

The JMA and the Management Plan require an Annual Performance Report to be prepared and submitted to the parties to the JMA and relevant Scientific Committees convened under the FM Act and *Biodiversity Conservation Act 2016* (BC Act) by 31 July each year.

A total of 228 marine animals were caught in the SMP during the 2022/23 meshing season, comprised of 24 target sharks and 204 non-target animals. Eighty-five animals (37%) were released alive.

The 24 target sharks comprised 18 White Sharks and 6 Tiger Sharks.

The 204 interactions with non-target animals consisted of:

- 120 non-target sharks, including Greynurse Sharks; a Great Hammerhead Shark; an Australian Angel Shark; Smooth Hammerhead Sharks; *Broadnose Sevengill Sharks; *Whaler Sharks (Bronze Whalers, Common Blacktip Sharks, Dusky Whalers, a Spinner Shark, an unidentified whaler species), and *Shortfin Mako Sharks; (* reported as target sharks prior to 2017).
- 58 rays, including Southern Eagle Rays; Australian Cownose Rays; Black Stingrays; White Spotted Eagle Rays; Smooth Stingrays; and unidentified rays.
- 14 marine reptiles comprised of: 6 Leatherback Turtles; 5 Loggerhead Turtles; and 3 Green Turtles.
- 10 marine mammals comprised of: 6 Indo-Pacific Bottlenose Dolphins; 2 Common Dolphins, and 2 seals (Australian Fur Seal and New Zealand Fur Seal).
- 2 interactions with finfish (Longtail Tuna, and Yellowfin Tuna).

51 (22%) of the interactions were with threatened species comprised of: 18 White Sharks; 16 Greynurse Sharks; 6 Leatherback Turtles; 5 Loggerhead Turtles; 3 Green Turtles; 2 seals (1 Australian Fur Seal and 1 New Zealand Fur Seal), and 1 Great Hammerhead Shark.

Eight (3.5%) of the interactions were with protected species comprised of: 6 Indo-Pacific Bottlenose Dolphins and 2 Common Dolphins.

The observer program was implemented with observers present on 22% of all net checks (hauls/runs) undertaken by SMP contractors. Observers continued to focus on ensuring collection of biological samples in accordance with the Strategic Research and Monitoring Program. Biological samples were taken from 101 of the 143 animals found dead in the nets in 2022/23.

The trigger point for the objective of '*minimising the impact on non-target species and threatened species'* was tripped in 2022/23 for seals.

The trigger point related to '*reducing the risk to humans from shark attacks at beaches of the SMP*' for the 2022/23 reporting period was not tripped, as during the 2022/23 meshing season there were no reported shark-human interactions at a meshed beach of the SMP.

During the 2022/23 meshing season, there were two verified shark-human interactions at unmeshed beaches along the NSW coastline. These two interactions were outside of the SMP area of operation and occurred at: South Rosedale Beach, Batemans Bay in the South Coast region (minor injuries to

foot and ankle), and Crescent Head on the Mid North Coast (serious injuries to achilles and lower leg).

One shark-human interaction did occur in the SMP region but outside the meshing season, with a surfer sustaining minor injuries after an encounter with an unidentified Whaler Shark at North Avoca in August 2022. North Avoca beach is part of the NSW Shark Meshing Program and is a meshed beach from September to April inclusive.

The Management Plan trigger points related to the other objectives of '*minimise OHS risks associated with implementing the SMP*' and '*transparent monitoring and reporting*' were not tripped in 2022/23.

In 2022/23, DPI met all requirements of the JMA and associated Management Plan.

In accordance with clause 9 of the JMA, the Management Plan and 2017 JMA were subject to review in 2022. The review by the Parties to Agreement in 2022 did not identified a need for any specific amendments to the JMA but specific amendments to the Management Plan were identified. A working group was established to make changes to the Management Plan with specific attention being placed on trigger point analysis of threatened species entanglements. The investigation of a new trigger point system is ongoing, with the working group consulting internal and external biometricians to assist in determining a more effective and relevant analysis system for the SMP.

Introduction

The Shark Meshing (Bather Protection) Program (SMP) is a public safety measure introduced in 1937 to reduce the risk of shark interactions at the State's most popular public bathing beaches. Surf Life Saving NSW figures indicate that about 4.3 million people visited those beaches in 2022/23. Under the current program, 51 beaches between Wollongong and Newcastle (Table 1, Map 1) are netted by seven contractors using specially designed mesh nets.

The aim of the SMP is to reduce the threat of shark interactions within the area of the SMP whilst minimising impacts on non-target species. The only fatality at a meshed beach occurred over 60 years ago, but the nets are not a guarantee that shark encounters will not occur at meshed beaches. According to the May 2023 update of the Australian Shark Incident Database (ASID, formerly known as the Australian Shark Attack File) thirty-five (35) unprovoked shark encounters have reportedly occurred at netted beaches of the SMP, 12 of which involved target sharks: 11 with White Sharks and one with a Tiger Shark. Other encounters at meshed beaches were with unknown species of sharks (9), Wobbegong Sharks (10), and unidentified Whaler Sharks (4). Although one White Shark bite was fatal and some have caused serious injuries, the shark bite data for the SMP and similar programs in other jurisdictions have reportedly reduced the rate of interactions by an average of 90% (Dudley, 1997 – noting that at the time of that publication there had only been 14 interactions at NSW netted beaches).

Traditional shark bite mitigation programs such as the SMP invariably affect non-target species, and the SMP is listed as a key threatening process in the *Fisheries Management Act 1994* and the *Biodiversity Conservation Act 2016* as it adversely affects threatened species, populations, or ecological communities, or causes species, populations or ecological communities that are not threatened to become threatened.

The operation and environmental impacts of the SMP were reviewed in 2009, and between 2009/10 and 2016/17 it operated in accordance with Joint Management Agreements (JMAs) and an associated Management Plan authorised under the *Fisheries Management Act 1994* (FM Act) and the *Threatened Species Conservation Act 1995* (repealed by the *Biodiversity Conservation Act 2016)*. The purpose of a JMA is to manage, regulate or restrict an action that is jeopardising the survival of a threatened species, population, or ecological community.

The JMAs included provisions for five-yearly reviews, and those reviews gave rise to a single 2017 JMA between the then Minister for Primary Industries and the then Chief Executive of the Office of Environment and Heritage (now the Coordinator General for the Department of Environment, Energy & Science) in accordance with section 221W(3) of the FM Act. This Annual Performance Report was prepared in accordance with the 2017 JMA and the 2017 Management Plan for the SMP (https://www.dpi.nsw.gov.au/fishing/sharks/management/shark-meshing-bather-protection-program).

The objectives of the JMA are to:

1. Minimise the impact of shark meshing on fish and marine vegetation which are a threatened species, population, or ecological community, and on marine mammals, marine birds and marine reptiles which are protected fauna or a threatened species, population, or ecological community.
2. Ensure that shark meshing does not jeopardise the survival or conservation status of threatened species, populations or ecological communities, or cause species that are not threatened to become threatened.

To achieve the objectives of the JMA, the DPI will:

- only carry out shark meshing in accordance with the JMA and the associated Management Plan.
- only carry out shark meshing during the meshing season (1 September - 30 April of the following year).
- ensure that nets are fitted with acoustic warning devices for cetaceans.

- require that contractors comply with by-catch reduction protocols and release protocols contained in the Management Plan and any release plans.
- continue research into methods of minimising by-catch of non-target species through implementation of the Strategic Research and Monitoring Program contained in the Management Plan.
- provide comprehensive release plans to the parties to the JMA as required.

The objectives of the Management Plan are to:

1. Reduce the risk to humans from shark attack at beaches subject to the SMP, and, consistent with that objective.
2. Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species, populations and ecological communities, or cause species that are not threatened to become threatened.
3. Minimise occupational health and safety risks to contractors and agency personnel associated with implementing the SMP.
4. Ensure that monitoring and reporting on the SMP is undertaken in a transparent manner.

Table 1 The seven regions and 51 beaches of the SMP in 2022/23.

Hunter	Central Coast North	Central Coast South	Sydney North	Sydney Central	Sydney South	Illawarra
Stockton	Blacksmiths*	Terrigal	Palm	North Narrabeen	Bondi	Wattamolla
Nobbys	Caves	North Avoca	Whale	Narrabeen	Bronte	Garie
Newcastle	Catherine Hill	Avoca	Avalon	Dee Why	Coogee	Coledale
Bar	Lakes	Copacabana	Bilgola	Curl Curl	Maroubra	Austinmer
Dixon Park	Soldiers	Macmasters	Newport	Harbord	Wanda	Thirroul
Merewether	The Entrance	Killcare	Mona Vale	Queenscliff	Elouera	North Wollongong
Redhead	Shelly	Umina	Warriewood	North Steyne	North Cronulla	South Wollongong
				Manly	Cronulla	

* Blacksmiths was historically called Swansea-Blacksmiths

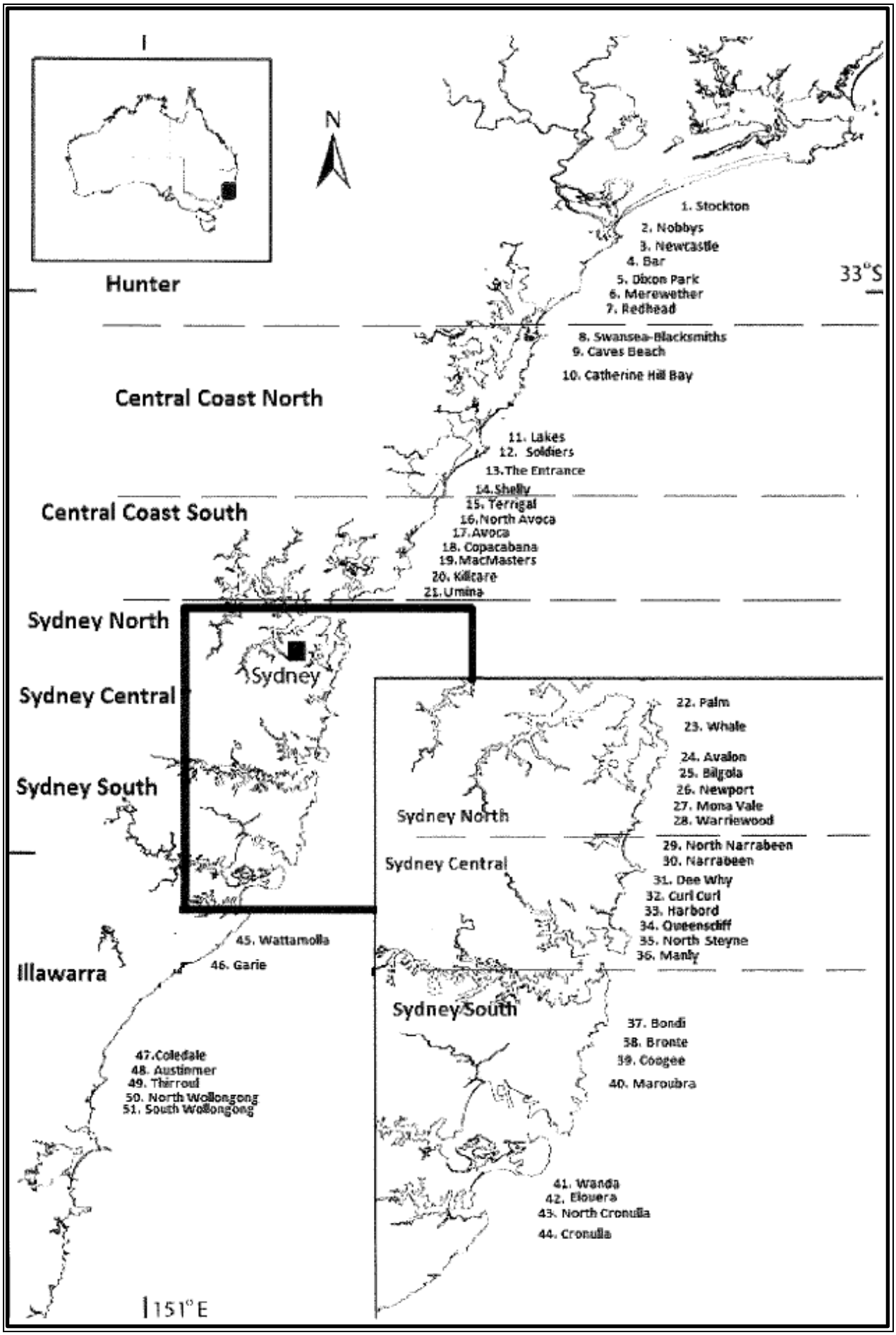

Figure 1 Location of Shark Meshing (Bather Protection) Program beaches.

1 SMP Management Plan Performance Assessment

In accordance with the requirements of the JMA and the Management Plan, this Annual Performance Report has been prepared for the Fisheries Scientific Committee (FSC) and the Scientific Committee (SC) to inform their annual review of the performance of all parties to the JMA. The FSC and SC will advise the Minister for Agriculture and Western NSW and the Coordinator-General - Environment, Energy and Science (EES), respectively, of any deficiencies in implementation of the JMA by either party. This report and the advice of the FSC and SC are publicly available.

1.1 Controls on the activity

The Management Plan sets out the controls on the activity by specifying the operational parameters of the program including contract management, restrictions on waters, timing, gear and methods, and environmental protection provisions.

- Nets and equipment were inspected prior to the commencement of the season to ensure all contractors were complying with current contract conditions.
- All other aspects of the program related to contract management, restrictions on waters, timing, gear and methods, and environment protection provisions remained in line with the contract as per previous years.
- The 51 nets are now distributed across seven meshing regions instead of six, with net numbers and geographic size of regions more even, where possible.
- All contractor vessels are required to be equipped with an Automatic Identification System (AIS) whilst undertaking meshing activities. The AIS units are a contractual requirement under the Shark Meshing Program, and live monitoring of vessels is conducted by the DPI Shark Program staff.
- All vessels are required to carry at least two spare nets before going to sea.
- Contractors are required to own and have inspected a minimum number of nets, depending on the number of nets in their respective region.
- Auditing processes are conducted regularly through cross referencing of vessel movement data, contractor catch reports, observer reports, and compliance reports.

The SMP nets are also subject to numerous factors outside the control of the Management Plan such as weather conditions, whale strikes and human interference. The following damaged, vandalised, or lost nets were reported during the 2022/23 season.

There were five reports of nets being damaged during the 2022/23 season:

- 25 September 2022, Fisheries Officers reported that the head rope of the shark net at Wanda beach had been cut. The Sydney South contractor inspected and replaced the net the following day and confirmed the damage. The damage is suspected to have been caused by a boat propeller.
- 18 October 2022, Sydney North contractor reported a large 3 x4 m hole in the Bilgola net. Mesh appeared to be torn so suspected to be from a large animal. All ropes and mesh recovered.
- 10 March 2023, Sydney South contractor reported that the head rope of the North Cronulla net had been broken, suspected boat strike.
- 26 April 2023, Sydney South contractor confirmed net damage to the Wanda net after SLS NSW cut the net to free an entangled turtle on the 25 April 2023.
- 1 May 2023, Sydney North contractor reported that the Newport Beach net had a hole in it approx. 2m x 2m in size. Suspected interaction with a large animal.

* Contractors report 'suspected whale damage' to nets when it is obvious that the net mesh and/or ropes have been torn, snapped, or broken under strain, as opposed to being cut. These reports also coincide with the whale migration season.

There was one report of vandalism during the 2022/23 season:

- 12 September 2022, Sydney North contractor reported that the end marker float of the net at Bilgola beach had been cut off. Net was hauled and replaced.

The extreme and adverse weather conditions throughout the 2022/23 season meant that on several occasions many of the contractors removed one or more of their nets from the water to reduce the chances of losing nets. Only one net was reported lost during the meshing season. The Illawarra contractor reported that he could not find the net at Coledale and believed the net was caught on reef and submerged due to the sea conditions. The net was found and retrieved in full on 24 January 2023.

1.2 Observer Program

The Management Plan requires an Observer Program to operate as part of the SMP.

Employment of Observers

To satisfy the Observer Program requirements, four people were initially employed as 'observers' for the eight months of the SMP: two observer positions being full-time (one permanent and one full-time temporary); and two employed on a casual basis. The two full-time observers conducted their duties predominantly in the Hunter, Central Coast North, and Central Coast South regions, with the two casual observers covering the Sydney North, Sydney Central, Sydney South and Illawarra regions. The casual observer covering the Illawarra region only worked in the SMP for approximately 3 months due to secondments to other areas of Fisheries.

Overall observer coverage was reduced again this meshing season due to several factors including reduced hours across Illawarra region (mentioned previously); all observers being heavily involved in the continued rollout of equipment for the Smart Drumline (SDL) and shark listening stations as part of the NSW Shark Management Program; reduced access to vessels due to contractors suffering from Covid; and reduced hours of one of the permanent staff due to illness. Observers also assisted the Shark Scientist with collation of data, dissections, cataloguing of collected biological samples, purchasing, and maintaining acoustic alarms, and other duties associated with the SMP.

Training of Observers

The duties of the observers require that they have a good general knowledge of the meshing operations as specified in the Tender Specification and are proficient at shark identification. Most importantly, observers require training and equipment to undertake the work safely, particularly with regards to seagoing skills, assisting in the release of entangled animals and performing animal dissections and tissue sampling.

On 3 August 2022 the observers and contractors attended an information session at the Sydney Institute for Marine Science (SIMS) focussing on the upcoming 2022/23 meshing season. The day broadly covered management changes; contract management; administration; threatened species; new technologies; and research requirements including acoustic tag and pop-up satellite archival tag (PSAT) deployments. Any specialized sample collection techniques for new collaborative research projects are also highlighted and explained by DPI Shark Scientists.

On 15 December 2022 all shark meshing observers attended a training day delivered by the Environment and Heritage Group (EHG) on the use of Passive Integrated Transponder (PIT) tags. PIT tags will be used by observers across the SMP on live turtles released from the nets to assist in determining post-release survival.

Number of Observer Days

Observers were present for 22% of all net inspections by contractors during the 2022/23 season. A breakdown by region of observer coverage is provided in Table 2.

Table 2 Total net inspections by region during 2022/23 meshing season.

Meshing Region	Total No. of net Inspections	No. of net inspections with observer present	% of net inspections observed
Hunter	728	105	14%
Central Coast North	728	126	17%
Central Coast South	728	197	27%
Sydney North	728	168	23%
Sydney Central	832	272	33%
Sydney South	840	232	28%
Illawarra	722	84	12%
Total	**5306**	**1184**	**22%**

Outcomes of Observer Program

Outcomes of the Observer Program for the 2022/23 meshing season include:

1. Catches of target and non-target species taken in nets were certified by the observer where they were present at the time and included in monthly catch data sheets (records held by DPI Fisheries).
2. The observers provided accurate details for all witnessed net inspections using iPhones equipped with a customised data recording application. All the data is uploaded and stored in Jotforms. Figure 2 shows the catch numbers recorded by the contractors when an observer was present or absent.
3. Details for all marine mammals and reptiles captured in nets were reported to DPI and DPIE-EES via a monthly report.
4. Collection of 86 biological samples and 15 whole animals.

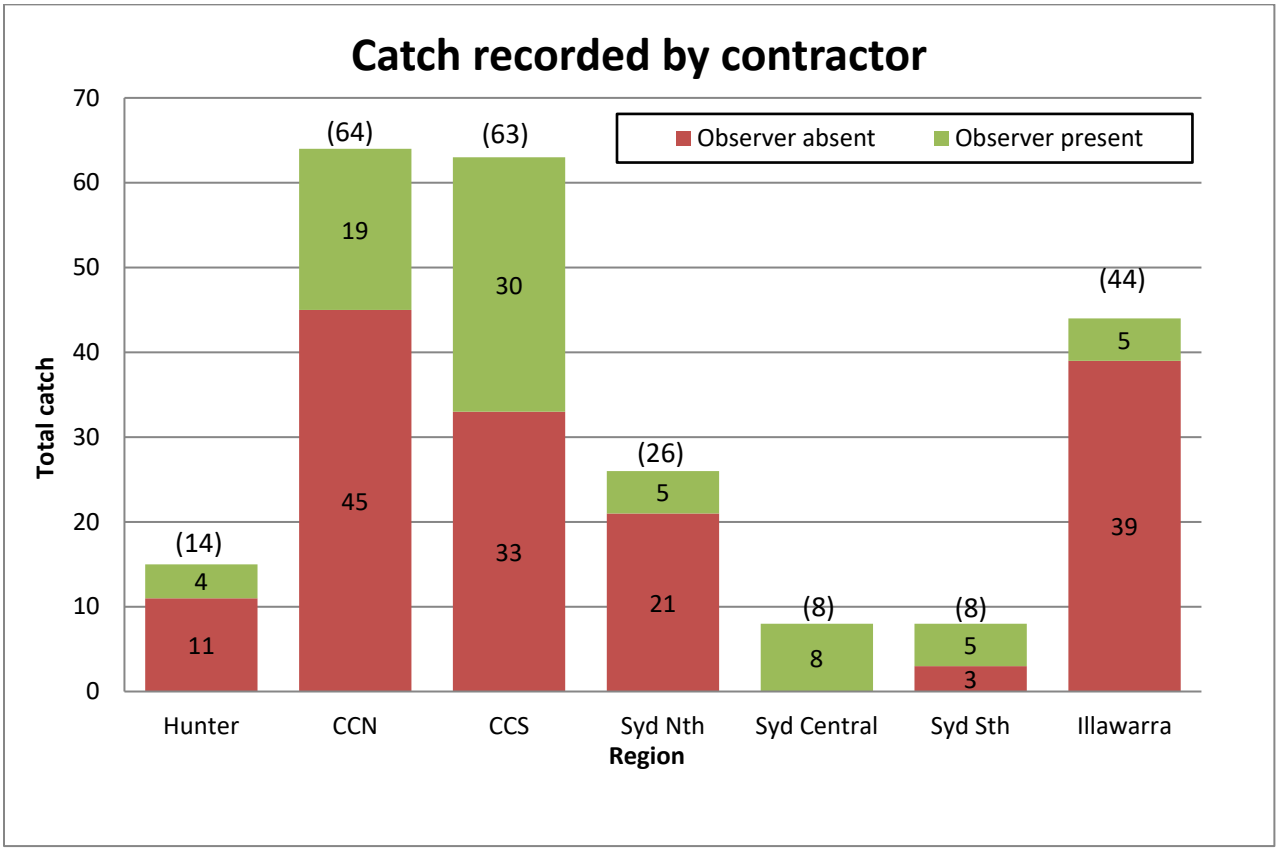

Figure 2 Catch recorded by contractor when observer present or absent during 2022/23.

1.3 Compliance Plan

The Management Plan requires a Compliance Plan to be implemented as part of the SMP.

Audit and Compliance Checks in 2022/23

Compliance inspections were undertaken prior to and during the 2022/23 meshing season.

- Pre-season checks of the contractors' nets were conducted by the DPI Shark Meshing Observers. A small number of minor issues were detected during these inspections with all being rectified on the spot. All nets complied with current contract conditions prior to the commencement of the 2020/21 meshing season.

- Fisheries Officers physically inspected mesh nets off 33 of the 51 SMP beaches from offshore patrol vessels or on board the contractor's vessels.

- Fisheries Officers conducted several overt and covert inspections of the contractors' operations throughout the meshing season. Fisheries Officers were encouraged throughout the season to carry out random, thorough inspections of the mesh nets during their routine offshore patrol work. All inspections were recorded on smart devices using a customised data recording application. All the data are uploaded and stored on the Fisheries Compliance Database.

Table 3 displays the number of inspections by Fisheries Officers and pre-season net checks by Shark Meshing Observers per region and whether the outcome was a 'comply' or 'non-comply' for the contracts.

Table 3 Compliance data by region during 2022/23.

Region	Pre-season		Meshing season		Inspection Count	% Comply
	comply	non-comply	comply	non-comply		
Hunter	16	-	-	-	16	100%
Central Coast North	16	-	5	-	21	100%
Central Coast South	16	-	10	-	26	100%
Sydney North	16	-	14	6	36	83%
Sydney Central	16	-	10	3	29	90%
Sydney South	16	-	5	-	21	100%
Illawarra	16	-	4	-	20	100%
Total	112	0	48	9	169	**95%**

Contractors are required to check their set nets every 72 hours weather permitting. This commitment was met on most occasions with 90% of set net inspections taking place within the 72-hour timeframe. The occasions where this requirement was not met, was due to severe weather conditions; and three occasions being due to a boat breakdown. The intention of the 72-hour inspection timeframes is to potentially increase the chances of survival of any marine life caught in the nets.

Overall compliance

Compliance with contractual arrangements must be greater than 80% under the Compliance Plan.

Compliance by all contractors exceeded 80% for the following tasks:

- The compliance rate for the size, length and marking of nets during the season was 100%. The nine non-compliance issues recorded by Fisheries Officer's during the meshing season (Table 3) related to nets not being marked correctly or markings not visible. Contactors were informed of these issues when Fisheries Officers reported them, and observers checked floats for compliance with marking requirements when they were next onboard.
- The compliance rate for dolphin pinger and whale alarms presence and their placement on nets was 100%.
- The overall compliance rate by contractors was 95% in accordance with the Shark Meshing (Bather Protection) Program Compliance Plan, which specifies that the rate of compliance will be calculated on a per/100 basis (e.g. if there is non-compliance detected in one of every ten inspections the compliance rate will be recorded at 90%).
- The contractors must comply with a range of specifications under the contract outside of routine overt and covert inspections. During the 2022/23 meshing season all contractual requirements were met by all contractors, with no instances of non-compliance detected.

All non-compliance issues in 2022/23 were resolved to the satisfaction of the DPI Shark Meshing Supervisor.

1.4 Strategic Research and Monitoring Program

The Management Plan requires a Strategic Research and Monitoring Program to be implemented as part of the SMP. The purpose of the Strategic Research and Monitoring Program (SRMP) is to provide information that will lead to continuous improvement in the operation of the SMP and in achieving the objectives of the Management Plan.

- Table 4 provides details of the SRMP research topics and their current status.
- Table 5 provides the outcomes of the SMP Monitoring Program for 2022/23.

Table 4 SRMP Research Topics and Current Status.

Level 1: Identify information gaps and research needs	
Level and Topic	**Status and Comment**
1.1 Review and report on research and information needs, funding requirements and possible sources of funding.	Status: **Complete** *Activities in 2021/22*: SMP research and information needs were included in an overall review of shark hazard mitigation research needs.

Level 2: Data collection and review of existing data	
Level and Topic	**Status and Comment**
2.1 Review and refine data collection methods	Status: **Ongoing**. ***2.1.1: Review data collection methods used in the SMP.*** *Activities in 2022/23*: Online real-time reporting continued following the success of implementation of online data forms using the JotForm application for mobile devices during the previous SMP season. There was no change in species identification methods as onboard photography for species confirmation has proved efficient and effective and is included in the JotForm mobile device app. *Previous*: Data collection methods are regularly reviewed and adapted as technology and applicable uses are identified. Following the successful implementation of photographing each animal captured during the 2015/16 SMP season, this technique to confirm species identification continued during the period reported herein. ***2.1.2: Develop refined catch data forms and identification resources.*** *Activities in 2022/23*: Real-time online catch data forms were continued via the mobile application, JotForm. No new relevant species identification resources were identified, so no updates to the contractor and observer materials were implemented. A new catch and tagging data form was implemented for Cownose Ray catches to enable collection of additional information, especially for animals released alive carrying an acoustic tag as part of a new PhD study via Macquarie University *Previous*: Catch data forms and instructions for use were dispensed at the pre-season training days for observers and contractors. New skate and ray, dolphin, sea turtle and Mobulid identification aids was supplied to contractors in 2016/17, 2017/18, 2018/19 and 2019/20, respectively. These identification guides aim to assist in correct identification for the catch records at sea. The Hammerhead Shark identification guide developed by DPI Fisheries was also incorporated in the species identification guide distributed to all contractors.

Level 2: Data collection and review of existing data	
	2.1.3: Identify associated training programs for observers and contractors. *Activities in 2022/23*: The most important training required for the 2022/23 meshing season for observers and contractors was reiterating tagging procedures for nominated shark species, especially regarding deployment of acoustic tags on the three target shark species, plus Cownose rays, and pop-up satellite archival tags (PSATs) on Greynurse Sharks. PSATs. Contractors and observers received training in acoustic tag deployment on Cownose Rays using carcasses during the annual pre-season training day. Acoustic tags were supplied to each contractor to ensure every opportunity of deployment on sharks released alive. The release of 37% of animals alive from the SMP nets highlights the relevance and importance of protocol reviews. Disentanglement procedures for non-target species from DPIE-EHG were reviewed and discussed with observers at a separate training day where deployment of Passive Integrated Transponder tags in turtles was demonstrated by qualified EHG staff and practiced by the SMP observers. These skills were subsequently passed on to contractors via on-board sessions with the senior shark meshing observer.
2.2 Review genetic samples to compare with reported species identification.	Status: **Ongoing**. **2.2.1*: Review shark genetic samples held by DPI and cross-reference with reported species identification.*** *Activities in 2022/23*: No further review of reported catch using genetic identification was conducted during the period being reported on following the 100% correct identification of various Hammerhead Shark catches in the SMP as reported in the 2017/18 Annual Performance Report. *Previous*: General research has continued into molecular forensics for captures in the SMP and led to analyses of species composition and reporting for the 2016/17 SMP season. The 100% correct identification of Hammerhead Shark species was reported on in the 2017/18 Annual Performance Report. Genetic samples are also used for longer term projects and are made available on request to researchers from around the world. The 100% record in correct species identification for Hammerhead Sharks through the use of catch photography to confirm species ID and the ability to obtain good quality photographs and sharing via mobile phone technology for rapid confirmation by scientists has exceeded genetic technique capabilities for rapid confirmation of catch data accuracy. **2.2.2*: Identify associated training programs/resources for observers and contractors.*** *Activities in 2022/23*: Although all the observers and seven SMP contractors were ongoing appointments, a preseason training day was held at the Sydney Institute for Marine Science. Using Cownose Ray carcasses held from the previous season, scientists with experience in tagging pelagic rays provided training and a demonstration of how and where to tag rays with acoustic tags. The PhD candidate also provided an overview of her previous research results into the biology and distribution of Cownose and Southern Eagle Rays. *Previous*: Training of contractors and observers is designed to improve accuracy of catch identification. The use of the DPI publication '*Identifying Sharks and Rays, A Guide for Commercial Fishers*' is revisited during the annual pre-season training day for observers and contractors to ensure all team members are proficient in identification of species caught in the SMP. Each contractor is provided with an updated copy of the identification book and the purpose-made in-house SMP Marine Species Identification Guide. The latter guide is updated annually (see Section 2.1.2) and incorporates any new information added for groups of species identification and/or research project sampling protocols. Each observer is also issued with an updated version of our SMP Marine Species Identification Guide.

Level 2: Data collection and review of existing data	
2.3 Review data on temporal and spatial factors affecting the operation of the SMP.	Status: **Ongoing.** ***2.3.1: Review research being conducted on White Shark movements.*** *Activities in 2022/23*: A total of eight White Sharks were released alive during the past SMP season, one of which was externally tagged with an acoustic tag whilst the others were already acoustically tagged and released from SMP nets after recording those tag details. These SMP-released White Sharks will be detected on acoustic listening stations administered through DPI Fisheries and/or the IMOS Animal Tracking Facility. No new research on White Shark temporal and spatial factors affecting the operation of the SMP were published during the past year; although a study investigating vertical diving behaviour and spatial dynamics of immature sharks tagged with pop-up satellite archival transmitting and acoustic tags off NSW was published (Spaet et al., 2022). This study corroborated the importance of the NSW coast for immature White Sharks with seasonal peak abundance in NSW coastal areas from October to December which supports the periods of highest White Shark catch in the SMP (Reid et al., 2011). A second NSW tagging study targeting large White Sharks (430-388 cm TL) indicated these size cohorts displayed a preference for offshore habitats, confirming why large White Sharks are seldomly caught in the NSW shark nets (Niella et al., 2021b). *Previous*: Historically, the DPI has worked closely with the CSIRO White Shark Project, supplying data from White Sharks caught in the SMP and data of tagged sharks detected on DPI Fisheries arrays of underwater acoustic listening stations. The CSIRO research results showed that the main aggregations of juvenile White Sharks in NSW occur north of Stockton Beach and therefore outside the SMP area of operation. Juvenile White Sharks appear to occur in the Stockton Bight region from mid-August through early January and are in Victoria from January through April (Bruce et al., 2019). Since the start of the NSW Shark Management Strategy in 2015 more than 700 White Sharks have been tagged following capture on SMART drumlines. DPI Fisheries now runs the largest White Shark tagging program in the world. The success of external deployment of acoustic tags by contactors on White Sharks released from the SMART drumlines led to development of similar tags and tagging procedures to implement in the SMP since 2018/19. Data collected via tagged White Sharks indicates that they travel large distances of ~10,000 km per annum and across ocean basins (Spaet et al., 2020b**)**. White Sharks can be found in a large range of water temperatures but appear to optimise in ~20°C (Lee et al., 2021), with abundance and distribution likely linked to ocean-influenced distributions in potential prey (Spaet et al., 2020a). White Sharks are more likely to exhibit area-restricted movement when sea surface temperatures are between 19 and 23°C, with moderate to high surface Chlorophyll-α concentrations and thermal and productivity fronts increasing their likely presence (Lee et al., 2021), with nearshore activity exhibiting predictable patterns of slow (~2.2km.hr^{-1}) movement parallel to the shoreline and typically behind the surfbreak (Colefax et al., 2020). Although there is no evidence that White Sharks are 'resident' off NSW beaches, an increased occurrence of juvenile White Sharks within the SMP region has been postulated in response to changes in the East Australian Current (SMP Annual Performance Report 2021). This may lead to increased catches and highlights that ongoing efforts to tag and release all live sharks will minimise negative impact the net catches could have on the East Australian White Shark population, particularly since post-capture recovery period is relatively rapid at ~10 hours (Grainger et al., 2022). ***2.3.2 : Review existing data on other species (e.g. Tiger Shark, Bull Shark).*** *Activities in 2022/23*: During the past year, there have been no published research that may affect the operation of the SMP. Target sharks released alive from the SMP are externally tagged with acoustic tags, as per procedures used by SMART drumline contractors in NSW, During the 8-month reporting period of the SMP, two of the three Tiger Sharks released alive were tagged. More than 250 Tiger Sharks have now been acoustically tagged by DPI as part of the NSW Shark Management Program (SMP and SMART drumline caught individuals combined). Analysis

Level 2: Data collection and review of existing data	
	of movement data from 16 Tiger Sharks equipped with satellite tags indicated that they moved offshore after release from the SMART drumlines and then headed north off the continental shelf (Lipscombe et al., 2020). It is likely that Tiger Sharks released from the SMP shark nets react in a similar manner to their release; however, deployment of mini-PSATs on SMP-released sharks should be considered to confirm post-release survival and subsequent behaviour. Recent genetic analyses using historical and contemporary samples has elucidated the potential for two distinct populations of Tiger Shark to have occurred off the eastern coast of Australia (Manuzzi et al., 2022). These authors hypothesize that one population, possibly a nearshore south-eastern Australian eco-type, has all but disappeared and highlight the important role of dedicated sampling programs. Continued collection of biological and genetic samples from Tiger Sharks caught in the SMP, and tagging of animals released alive from the nets, is therefore imperative to elucidate the population structure and ecology of Tiger Sharks occurring in nearshore waters within the SMP region. No Bull Sharks were caught during the 2022/23 meshing season, but Bull Shark movement research did continue with individuals being tagged as part of the SMART drumline program. Over 200 Bull Sharks have been acoustically tagged by DPI Fisheries with various iterations of analysis of movement data currently underway to better understand nearshore abundance, distribution and movements to assist in developing data-driven shark bite mitigation messaging. Analysis of SMP catch data has corroborated previous conclusions that bull sharks can be caught throughout the SMP region and, as a result, only large-scale changes to replace shark nets with alternative gear will reduce potential impact of the shark net catches on this population of sharks (Niella et al., 2021b). Although global analysis of genetic structuring of Bull Shark populations using mitochondrial analyses has highlighted reproductive isolation of the Indo-West Pacific, with mitogenome differentiation showing three separate clusters within Australia (western, northern and eastern Australia) (Devloo-Delva et al., 2023), it is unlikely that the low levels of catch in the SMP will impact overall population sustainability. *Previous*: Previously, there were few studies on Tiger and Bull Sharks that provided new knowledge that would affect the operations of the SMP; however, research conducted over the past few years on the population structure, movements and SMP catch characteristics have indicated that ongoing sampling and tagging of sharks caught and released from the nets is imperative to enhance our understanding of potential impacts of these catches, plus the role of climate-induced warming of the East Australian Current on changing the distribution and abundance of these two target species for the SMP. Telemetry tracking of Tiger Sharks off the east Australian coast revealed that water temperature change, particularly at higher latitudes, was the most influential environmental factor regulating shark movements (Niella et al. 2021a). This study predicted that the range for Tiger Sharks along the east coast of Australia will extend ~3.5° south by the year 2030, potentially increasing the risk of interactions with humans in nearshore waters within the SMP region. Bites attributed to Tiger Sharks has historically been low in NSW waters (Riley et al. 2022), a factor likely due to low nearshore presence. In fact, Tiger Shark catches in the SMP nets have historically been low (Reid et al, 2011), with probability of catch higher at beaches with deep water closer to the nets (Lee et al. 2018); however, predicted changes in distribution and nearshore abundance of this species could result in future increases in capture. Implementing alternative shark bite mitigation gear, as suggested by Niella et al. (2021b), will have minimal impact on Tiger Shark catch due to the two high catch beaches (Wattamolla and Garie) being too far from suitable launch sites for contractors to respond to alerts from catches on SMART drumlines. Tiger Sharks released from SMART drumlines initially moved offshore, where-after they traversed temperate, sub-tropical and tropical waters (Lipscombe et al., 2020) in a manner consistent with previously reported movements (Holmes et al., 2017). It is likely that Tiger Sharks released from the SMP shark nets would undergo similar post-release movements; however, post-release survivorship and subsequent movements of net-caught Tiger Sharks should be investigated through deployment of mini-PSAT tags. .

Level 2: Data collection and review of existing data	
	Historical genetic research including SMP samples, implied that there was no genetic structuring within the Indo-Pacific Ocean basin (Holmes *et al*., 2017). It was therefore hypothesised that the small annual Tiger Shark catch in the SMP was unlikely to substantially affect the viability of this large homogeneous east Australian population. These results appeared to corroborate the findings of large-scale movements of tagged Tiger Sharks in eastern Australia with individuals of all size classes moving between the SMP region, southern Queensland and New Caledonia *(*Holmes *et al.,* 2014*).* The apparent preference of Tiger Sharks for deeper waters (Holmes et al., 2017) corroborated analyses indicating Tiger Shark catch increased at localities where shark nets were in close proximity to deep waters (Lee et al., 2018). Tiger shark catch rates decreased over the six decades examined in Reid et al. (2011), with low annual levels in the recent vicennium precluding robust analysis of potential correlates to catch (Lee *et al*., 2018). Similarly, catches of Bull Sharks were historically low and confounded by poor species identification in early years hampering robust analysis of potential correlates to catch (Lee et al., 2018). There has therefore been a reliance on using movements of acoustically tagged Bull Sharks to determine factors that influence their abundance and distribution in NSW coastal waters. Initial research focussed on the Sydney waterways following a serious shark bite in the harbour. Scientific manuscripts detailing patterns of occurrence of sharks in Sydney Harbour have been published (Smoothey *et al*., 2016; 2019) while larger-scale examination of environmental factors affecting Bull Shark movements and abundance along the south-east coast of Australia are published as Lee et al. (2019). Subsequently, these Sydney-tagged Bull Sharks were included in larger-scale research amalgamating all Bull Sharks tagged along the east coast of Australia. This collaboration has revealed that Bull Sharks tagged by DPI Fisheries in the Sydney region are travelling beyond Townsville, while Bull Sharks tagged in Queensland are unlikely to travel into the SMP region. This collaboration has resulted in publication of two manuscripts investigating these latitudinal differences in bull shark movements (Heupel *et al*., 2015; Espinoza *et al*., 2021). Analyses indicate that movements of Bull Sharks varied according to their tagging location, with sharks tagged in Sydney exhibiting seasonal movements and limited residency times, while 35% of the sharks tagged in the tropics exhibited year-round residency on tropical reefs (Espinoza et al., 2021). Network analyses complemented these findings by revealing different seasonal habitat preferences between regions. Movement patterns of Bull Sharks tagged in Sydney Harbour were driven by seasonal temperature change, while tropical individuals appeared more driven by biological needs such as reproduction. These seasonal movements to and/or from distant bays and estuaries highlights the need for regional conservation approaches, and improved understanding of the degree of connectivity between habitats and latitudes. Analysis of tagged Bull Shark and prey fish movements around Sydney waterways highlighted the importance of rainfall in the catchment. Both teleosts and sharks exhibited varying responses to water flows, with males Bull Sharks responding most promptly to high rainfall by moving upstream within a day, followed by teleost movements between 2-7 days, and female Bull Sharks after 4 days (Niella et al., 2021d). Variability in Bull Shark space use suggested spatial segregation by sex and size. Although individuals target similar prey, they appear to do so in different areas or at different times, enabling them to exploit different resources when in the same habitats (Niella et al., 2021d). Analysis of juvenile Bull Shark use of different habitats within a nursery riverine system, the Clarence River in northern NSW, highlighted the reliance of young sharks on prey associated with salt marshes (Niella et al., 2022). This is a threatened habitat type due to anthropogenic pressures and underscores the potential threat of climate-induced habitat changes to both predators and prey. Australia-wide acoustic tracking data for 1,491 individuals of seven teleost and seven shark species, including Bull, Tiger and White Sharks, were used to assess stock structure and connectivity and compared to findings from genetic and conventional tagging. Network analysis revealed previously unknown population connections in some species, and in others bolstered support for existing stock discrimination by identifying nodes and routes important to connectivity, e.g., for Bull and White Sharks the network analysis showed movement patterns consistent with previous understanding of stock structure derived using genetic approaches whilst Tiger Sharks show structure within Australian waters, despite genetic evidence indicating panmixia, with individuals not connecting between east and west coasts of Australia (Lédée et al., 2021). Using SMP and commercial catch data for Bull Sharks, it was determined that increase in occurrence of Bull Sharks over time was associated with seasonal variability of thermal gradients larger than 21°C and westward coastal currents stronger than 0.2 $m.s^{-1}$ (Niella et al., 2020). Predictive models using these results overlayed on CSIRO predicted change in oceanographic conditions along the east coast of Australia subsequently indicated that

Level 2: Data collection and review of existing data	
	there will be an approximately 1° southward shift in the optimal thermal habitats favourable for year-round Bull Shark occurrence over the next 12 years (Niella et al., 2020). This will lead to a three month increase in the availability of favourable sea surface temperatures along the coast of NSW (i.e. from January-February to December-April) which could have implications for bather safety from shark bite. This information has subsequently been used in NSW DPI Fact Sheets and SharkSmart outputs, plus television documentaries, to educate public about sharks and shark hazard risks. **2.3.3: *Review existing data on spatial and temporal movements of non-target species.*** *Activities in 2022/23:* Additional analyses incorporating updated environmental data have been performed on the helicopter sightings of Australian Cownose Rays (*Rhinoptera neglecta*) initially used as part of a Master in Research thesis submitted to Macquarie University (Chan, 2021). These rays were more likely to occur along the NSW coast during the warmer months (i.e. spring and summer) with increased sea temperatures supporting larger groups which inevitably swam further from shore. Although Australian Cownose rays were seen more frequently in the northern half of NSW, group sizes were larger in the southern half and suggest seasonal migration events may be occurring, possibly related to reproduction as female rays caught in the SMP appear to be gravid (Chan, 2021). As the species consistently exhibit high catch, albeit that historically over 60% are released alive, there has been concern about the post-release survivorship of these gravid females and the potential impact of shark net catches. An acoustic tagging program was subsequently initiated during the past year, however, the low catch during the 2022/23 season led to only four Australian Cownose Rays being released alive, of which three were tagged with acoustic transmitters. A further nine released Greynurse Sharks were tagged with mini-PSATs during the 2022/23 season. This contributes to a total of 23 Greynurse Sharks tagged with these satellite telemetry tags and will be sufficient to confirm level of post-release survivorship and associated movements. *Previous*: The scientific literature on spatial and temporal movements of non-target species is reviewed where possible given available resources. Biological samples from Hammerhead Sharks have recently substantially contributed to knowledge gains for all three species caught in the NSW shark nets. Examination of Great Hammerhead Shark diets highlighted their important link between food webs off eastern Australia (Raoult et al., 2019). The geographic range of Great Hammerhead Sharks was subsequently investigated via stable isotope analysis using these same samples which suggested that this species is not resident off the NSW coast, but rather spends most of its time off Queensland (Raoult et al., 2020). As such, the SMP is unlikely to significantly impact the conservation status of this species, although a watching brief on potential increasing catches with warming oceans through climate change is recommended. SMP catch data contributed to a National Stock Assessment for Scalloped Hammerhead Sharks (*Sphyrna lewini*) (Saunders *et al*., 2021). Several analyses and two population structures were modelled to ensure all potential scenarios were accounted for. The results indicate that the biomass of all stocks of Scalloped Hammerhead Shark in Australian waters are considerably higher (less depleted) than previously reported and that the current Total Allowable Catch (TAC - not applicable in NSW where the species is listed as 'endangered' under the *Fisheries Management Act 1994*) for this species is well below the levels required to cause stock declines (Saunders *et al.*, 2021). Notwithstanding these results, Scalloped Hammerhead Sharks has been listed as *Endangered* under the EPBC Act by the Australian Department of Agriculture, Water and the Environment and will therefore affect the SMP. A study using the SMP catch data to investigate ecological and environmental drivers for juvenile Smooth Hammerhead Shark distribution in temperate NSW was completed as a chapter in a Masters Degree through the University of Newcastle (Wray-Barnes, 2017) and is being prepared for scientific journal publication. This new information will not affect the operation of the SMP.

Level 2: Data collection and review of existing data

A PhD on Broadnose Sevengill Sharks (*Notorynchus cepedianus*) was completed through University of Tasmania (Schmidt-Roach, 2018). Acoustic tracking data indicate that both neonate and other life-stages tagged in Port Philip Bay, Victoria, travel to NSW and Tasmania. These results corroborate their genetic findings that there is likely a single population for the south-east coast of Australia. Genetic material collected from the SMP will contribute to publication of these data. These results imply that few catches of this species in the SMP is likely to have minimal impact on the population viability of Broadnose Sevengill Sharks.

Several projects linked to the DPI Fisheries testing of drone technology as an aerial surveillance tool for mitigating shark interactions have led to publications incorporating abundance and distribution of non-target species (Kelaher *et al*., 2019; Tagliafico *et al*., 2019), but these studies were not within the SMP region.

2.4 Review data on shark interactions and beach usage.

Status: **Ongoing.**

2.4.1: *Access / review data collection by various organisations*

DPI Fisheries cross-references data held by the Australian Shark Attack File and the International Shark Attack File to report on any incidents associated with meshed beaches. The Australian Shark Attack File has now been renamed to the Australian Shark Incident Database (ASID) and will continue to receive NSW DPI shark attack reports to enter the standardised database (Riley *et al*., 2022).

Number of sharks sighted by Surf Life Saving (SLS) NSW

Shark sightings										
Region	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Hunter	33	60	28	8	1	4	18	32	18	5
Central Coast	38	29	24	1	3	0	8	12	20	1
Sydney	46	46	58	8	1	9	25	45	53	17
Illawarra	7	4	7	0	1	0	3	11	13	2
Total	124	139	117	17	6	13	54	100	104	25

In 2016/17 SLS NSW change their procedure for recording shark sightings on patrolled beaches with only sightings where a lifesaver or lifeguard was able to confirm the presence of a shark by a second sighting being recorded. This was because the number of reported sightings impacted the incident management process within the State Operations Centre (SOC). Patrollers and the general-public, presumably following heightened awareness from media focus were communicating several unconfirmed sightings daily. These procedural changes along with the increased use of drones by SLS NSW to conduct aerial surveillance over patrolled beaches over the past four years has resulted in greater accuracy in the number of shark sightings at patrolled beaches in NSW.

Level 2: Data collection and review of existing data

2.4.2: *Review data on beach usage rates and future usage predictions.*

From 2006 to 2036 the NSW population is projected to grow by over 2.3 million due to natural increase and net overseas migration, while Sydney's population is projected to grow by 1.7 million people (DECCW, 2009). An increase in beach usage in the area of the SMP is expected into the foreseeable future given these predictions and recent data collected by SLS NSW.

SLS NSW provided the following beach visitation figures for the past 10 years for the regions listed. The recorded beach visitation is the combined total of attendance as assessed in the morning at the start of each patrol, the mid patrol point (1pm) and in the evening at the end of each patrol for the period 25 September to 25 April of the next consecutive year.

The summer beach visitation within the area of the SMP over the last 10 years averaged approximately 5.5 million people per annum. The drop in beach attendance in 2019/20 and 2021/22 may be related to reduced outdoor activities and travel in the latter months of these periods as a result of government initiatives to reduce the spread of Covid-19, whilst the rebound in beach visitations for the 2020/21 period reflects the success in managing Covid-19 outbreaks in NSW and subsequent abilities for NSW residents and domestic visitors to enjoy our beaches and waterways prior to new restrictions coming into effect at the start of 2022.

Visitations										
Region	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Hunter	741,444	690,343	728,803	764,529	729,592	714,965	656,794	619,769	599,050	773,270
Central Coast	1,260,034	1,241,243	1,145,309	1,173,890	736,021	1,182,741	943,798	1,312,599	1,062,130	1,355,769
Sydney	3,488,837	3,897,491	3,681,255	3,743,419	3,526,008	4,679,380	2,970,793	3,255,870	2,455,210	1,801,351
Illawarra	304,703	392,447	363,194	380,299	343,473	297,351	252,013	436,677	268,050	426,869
Total	**5,795,018**	**6,221,524**	**5,918,561**	**6,062,137**	**5,335,094***	**6,874,437**	**4,823,398**	**5,624,915**	**4,384,440**	**4,357,259**

* Patrol period for 2017-2018 was between the 23 September to 29 April

DPI Fisheries supported research into unmanned aerial vehicle applicability for marine and coastal research has demonstrated that drones are an effective assessment tool to quantify beach users across a range of environmental conditions and thereby improve coastal management decisions (Provost *et al.*, 2019). DPI Fisheries have supported SLS NSW with drones and training of lifesavers and it is envisaged that these will be used for beach management purposes, including beach counts, as well as water safety.

Level 2: Data collection and review of existing data	
2.5 Review effectiveness of fishing operations used in shark control programs	Status: **Ongoing.** **2.5.1: *Review NSW shark meshing net configurations.*** *Activities in 2022/23*: No new research into net configurations occurred during the period reported; however, eDNA from broken nets was collected to identify the species the broke free form the nets. These samples will be collated and analysed once sufficient samples have been collected to warrant the costs & effort for genetic analysis. *Previous*: Analysis of catch trends in the far north coast shark net trials has been completed and published as Broadhurst and Cullis (2020). They conclude that nets should be checked every 72-96 hours to optimise efficiency for target species whilst minimising the absolute mortality of rays. This implies that no changes in the current JMA are required regarding regularity of checking the SMP shark nets. Amendments to net configurations would be outside the scope of existing contracts for the SMP, however, further research on SMP net configurations will be undertaken pending contractor cooperation. **2.5.2: *Review the application of other shark control measures for use in NSW (e.g., drumlines).*** *Activities in 2022/23*: The DPI Fisheries senior shark scientist contributed to an investigation into the efficacy of shark nets, SMART drumlines, drones and VR4G shark listening stations in reducing shark-human interactions, which has resulted in a manuscript for publication. *Previous*: refer to the 2021/22 Annual Performance Report **2.5.3: *Use the outcomes of those reviews to trial gear-related modifications of the SMP.*** *Activities in 2022/23:* SMART drumlines were deployed in April 2022 off eight beaches in the Newcastle region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0006/1393548/Map-SMART-drumlines-Newcastle-web.png), six beaches in the Lake Macquarie region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0003/1393563/Map-SMART-drumlines-Lake-Macquarie.png), sixteen beaches in the Central Coast region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0007/1403746/SD-Map-Central-Coast-Nth-Sth.png) , twenty-one beaches in the Sydney Northern Beaches region, eight beaches in the Sydney East region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0008/1393568/Map-SMART-drumlines-Randwick-Waverley.png), six beaches in the Sutherland region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0007/1393279/Sutherland-web-map.png), and thirteen beaches in the Wollongong region (https://www.sharksmart.nsw.gov.au/__data/assets/image/0010/1393570/Map-SMART-drumlines-Wollongong.png). These SMART drumlines continued to fish year-round (weather permitting), including throughout the 2022/23 shark meshing season. Catches on these SMART drumlines will be compared with SMP catch to determine relative efficacy of the two different gears in catching both target sharks and non-target marine fauna. The NSW Shark Management Program for 2022/23 continued to support the pilot training and use of drones at beaches patrolled by SLS NSW. Every coastal LGA along the NSW coastline one had at least one UAV patrol location, with fifty beaches provided aerial shark surveillance via certified SLS NSW drone operators over the 2022/23 summer holidays. *Previous*: refer to the 2021/22 Annual Performance Report

Level 2: Data collection and review of existing data	
2.6 Develop methodologies for standardising fishing effort and analysing comparative CPUE data.	**Status: Completed** **2.6.1: *Investigate the feasibility of standardising soak-times for shark nets.*** Soak times were standardised in 2014/15 as part of the season contracts with contractors required to check their set nets every 72 hours weather permitting. These standardised procedures were continued throughout the 2022/23 season. **2.6.2: *Develop alternative approaches to standardised soak-times.*** No alternative approaches were developed.

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
Level and Topic	**Status and Comment**
3.1 Research needs identified (e.g. environmental impacts of shark meshing).	Status: **Ongoing** **3.1.1*: Distribution, abundance, biology and ecology of target species affected by the SMP.*** *Activities in 2022/23:* A Sydney University of Technology student, in collaboration with colleagues from the CSIRO, has analysed White Shark tooth morphometric data using White Sharks collected throughout their Australian range, including those caught in the SMP, to determine the role of tooth shape and strength in ontogenetic dietary changes (Grainger et al.,2020). Collaboration with a suite of researchers from Australian and international affiliations has continued work on a manuscript describing age and growth of Australian White Sharks. To facilitate understanding of foraging ecology, eDNA swabs were collected from five regions of the digestive tract for comparison with stomach contents of all carcasses retrieved for necropsy. Analysis of Bull Shark nearshore presence was initiated through analysis of VR4G shark listening station detections of tagged sharks. *Previous*: refer to the 2021/22 Annual Performance Report ***Distribution, abundance, biology and ecology of non-target species affected by the SMP.*** *Activities in 2022/23*: Eight whole carcasses of non-target animals caught in the SMP were collected during the 2022/23 period. One deceased Australian Cownose Ray (*Rhinoptera neglecta)* and a Southern Eagle Ray (*Myliobatis australis)* were collected to contribute to a new PhD study through Macquarie University. Necropsies of marine mammals and sea turtles caught in the SMP were conducted in collaboration with Taronga Zoo and the NSW Environment and Heritage Group (EHG) during the 2022/23 SMP season. These included assessing options for telemetry tag placements for future research into post-release survivorship and subsequent movements of sea turtles. Additionally, observers were trained by EHG collaborators in deployment of Passive

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
	Integrated Transponder (PIT) tags in carcasses taken offshore to assist in determining the percentage of SMP bycatch that wash ashore and get reported as strandings. One deceased Greynurse Shark was retrieved whole to contribute to the ongoing DPI Fisheries research program on this species. Samples for a genomics study were collected by DPI Fisheries collaborators from Sydney University. Fourteen non-target species were tagged prior to release during the 2022/23 SMP period (see Table 5) *Previous*: refer to the 2021/22 Annual Performance Report
3.2 Establish DNA library of shark species taken in the SMP to improve accuracy of identification.	Status: **Ongoing** **3.2.1*: Conduct collaborative research with relevant research institutions*.** *Activities in 2022/23:* One new collaboration for genomic analysis of SMP-collected samples was established during the past year as a DPI collaboration with the National Environmental Science Program (NESP) project on Greynurse Sharks. Genetic samples from all deceased animals were collected to contribute to future collaborations, particularly for priority species to determine stock size & structure. *Previous*: refer to previous Annual Performance Reports **3.2.2*: Develop SMP DNA library.*** A shark DNA library incorporating material from the SMP has been developed by DPI Fisheries and currently contains over 1,200 samples. Accessioning of new material from the SMP is ongoing. For further details, refer to previous Annual Performance Reports
3.3 Conduct scientifically-based shark attack risk assessment.	Status: **Ongoing** **3.3.1*: Compile data from research relating to identified high-risk elements.*** *Activities in 2022/23:* The NSW Shark Management Strategy (SMS) has initiated substantial research effort into better understanding factors influencing shark attacks (https://www.sharksmart.nsw.gov.au/). Data streams include aerial survey data on marine wildlife abundance and distribution, beach user data, tagged target shark movements (acoustic tags and satellite tags), target shark behavioural studies especially with respect to their foraging, shark behaviour and movements in relation to beached whales. All these studies and data streams are being collected to identify high-risk elements and will be analysed during the life of the SMS. A suite of publications on these topics have been published during the past year (see publications in the supplied list of References). An independent review of the first seven years of the new NSW DPI shark hazard mitigation programs was completed (Cardno, 2021) and is available online. This review has now been prepared for publication in a peer-reviewed scientific journal. An in-depth analysis of NSW shark attacks has been completed and is also being prepared for publication. The SMS has supported a new industry-linked post-doctoral position to develop a scientifically driven risk analysis for unprovoked shark-human interactions. *Previous*: A review of alternative systems to shark nets was conducted as part of the NSW SMS (Cardno, 2015). This review was subsequently updated for publication in a peer-reviewed scientific journal (McPhee *et al*., 2021).

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
	Data are regularly being reviewed and assessed for potential inclusion in a database proposed to incorporate all activities and environmental conditions in both temporal and spatial fields. It is anticipated that further research in this area will be initiated in due course. **3.3.2*: Apply standard risk assessment model (i.e., AS/NZ: 4360).*** *Activities in 2022/23:* More data has been collected to assist in this application. An agreement has been reached with an independent company, Risk Frontiers, to use DPI Fisheries data for modelling potential risk to shark attack. This project stalled due to the Covid-19 pandemic; however, the post-doctoral position at Macquarie University has now started. *Previous*: refer to previous Annual Performance Reports.
3.4 Conduct morphometrics on sharks and other species caught in the SMP.	Status**: Ongoing** **3.4.1*: Identify need for morphometrics in meeting the needs of the SMP.*** Quality morphometric data is needed to assess the efficacy of the shark nets in reducing interactions with target sharks. The data provides information on the size classes and any possible size-based stock structuring of sharks off NSW. Morphometric data are included in ongoing assessments of shark bite to determine species and size of shark involved in the interaction and contribute to data collected during research activities linked to the management of NSW commercial shark fisheries. All catches are measured, plus a full set of 52 morphometrics recorded for all whole carcasses collected. **3.4.2*: Include in research priorities document (1.1) if considered appropriate.*** All research priorities are detailed in the Strategic Research and Monitoring Plan.

Table 5 SMP Monitoring Program

SMP Monitoring Program – Outcomes for 2022/23	
1. Shark Meshing Contractor Catch Report	All contractors provided daily reports of catch in real-time via Jotform application on their mobile devices and submit a monthly catch data summary sheet with all details of meshing operations and catch during that reporting period. In the event the Jotform application is not working correctly, daily catch information is submitted via email.
2. Shark Meshing DPI Catch Summary Report	Monthly catch summary reports were submitted to the Fisheries Scientific Committee, the NSW Scientific Committee and DPIE-EES (Appendix 1)
3. Tagging program	The tagging program continued in 2022/23, with tagging of 19 of the 34 sharks released alive from the SMP nets. Tagged sharks included: 1 White Shark (acoustic tag); 9 Greynurse Sharks (mini-PSATs); 2 Tiger Sharks (acoustic tags); and 2 Bronze Whalers (spaghetti tags). Prior to 2019 DPI Fisheries protocols did not support the tagging of Greynurse Sharks, however, with the purchase of mini-PSATs the tagging of Greynurse Sharks commenced in February 2019. Twenty-three Greynurse Sharks released from the shark nets have been tagged with mini-PSATs to date. Three Australian Cownose Rays were tagged with acoustic tags as part of a University research project One Leatherback Turtle was tagged in 2022/23 with a Passive Integrated Transponder (PIT) tag. One Common Dolphin was tagged with a PIT prior to being disposed of at sea. Another eleven sharks (10 White Sharks & 1 Bronze Whaler) had pre-existing tags present upon capture. For further details refer to Appendix 1.
4. Routine DNA sampling and verification	Routine DNA sampling of 77 dead and 9 live animals was undertaken in 2022/23, with fifteen whole animals also being collected during 2022/23 (for further details refer to 'monitoring parameter 5' below). All whole animals were necropsied in June 2023. Sampling DNA from live sharks and ray was undertaken in 2022/23 as part of the SMP tagging program and University research projects. Species identification was not genetically verified during 2022/23 following the Australian Museum analysis indicating 100% correct identification of hammerhead sharks (Frankham, 2017). All turtle samples were sent to the Australian Museum on behalf of the Environment and Heritage Group (EHG).

5. Shark vertebral and other tissue samples. Historically no samples have been taken from Skates and Rays

Biological samples were taken from 101 (9 alive, 92 dead) of the 143 animals deceased in the 2022/23 season, and are listed below:

Common Name	Sample Type and Number	Total Number Dead
Australian Angel Shark	Genetics = 1	1
Australian Cownose Ray	Genetics = 7*, Whole = 1	4
Broadnose Sevengill Shark	Genetics = 2	10
Bronze Whaler	Genetics = 8	10
Common Blacktip	Genetics = 4	4
Common Dolphin	Genetics = 1, Whole = 1	2
Dusky Whaler	Genetics = 7	9
Great Hammerhead	Whole = 1	1
Green Turtle	Genetics = 1	2
Greynurse Shark	Genetics = 2*, Whole = 1	2
Indo-Pacific Bottlenose Dolphin	Genetics = 2, Whole = 2	6
Leatherback Turtle	Genetics = 1	2
Loggerhead Turtle	Whole = 1	3
Shortfin Mako	Genetics = 2	2
Smooth Hammerhead	Genetics = 40	56
Southern Eagle Ray	Genetics = 2*, Whole = 1	8
Spinner Shark	Genetics = 1	1
Tiger Shark	Genetics = 1, Whole = 1	3
White Shark	Genetics = 4, Whole = 6	10

*** some genetic samples were taken from animals that were 'released alive' as part of the SMP tagging program or University research projects. Samples taken from live animals included: 7 Australian Cownose Ray samples, 1 Southern Eagle Ray sample, and 1 Greynurse Shark sample.**

6. Monitoring of all shark attacks

When an attack occurs in NSW the DPI Fisheries Shark Scientist or delegate interviews the victims, where they are willing to cooperate, and seeks as much information and evidence of shark identification as can be attained. This includes scale-bar photography of wounds requested from responders/surgeons, examination of wounds and damage to surf craft or clothing/diving materials that show evidence of bite marks and collection of any tooth fragments for analysis to help determine shark species.

The Shark Scientist also provides key media support following shark attacks in NSW providing balanced information to the community on the reasonable level of threat.

There was one serious injury due to shark interactions in 2022/23 in NSW waters, and another two instances where a surfer and a swimmer suffered minor injuries.

A total of 5 shark interactions were reported and investigated in NSW waters during 2022/23. These interactions included: two interactions with White Sharks (Korffs Islet – Coffs Harbour (uninjured), and Crescent Head (serious); one with an unidentified whaler shark leading to minor injuries (North Avoca), one with a wobbegong (South Rosedale Beach – Batemans Bay), and one with an unidentified shark species (South Broulee – South Coast). None of these interactions occurred within the SMP region of NSW coastline during the eight-month netting season.

7. Monitor technological advances in shark control measures	Reviews of alternative, non-lethal, shark management technologies have been published in a peer-reviewed scientific journal (McPhee *et al.*, 2021) and online (Cardno, 2021). Monitoring of technological advances in shark control measures is ongoing in this rapidly developing field.
8. Patterns of movements of non-target marine animals	DPI Fisheries continues working with relevant agencies and reviewed available information during 2022/23 and is not aware of any new information that would necessitate any changes to the SMP.
9. Population trends and patterns of movements of dangerous sharks and attack behaviour	DPI Fisheries has sourced information from relevant agencies during 2022/23 and is continuing collaborative research into trends and patterns of movements of target sharks (refer to Table 4 section 2.3). Information available to date does not necessitate any changes to the SMP. As reported in the 2020/21 Annual Performance Report, the only species for which a population estimate now exists is the White Shark. Close-kin genetic techniques were used by CSIRO to estimate adult White Shark abundance for the eastern Australasian population to be 750 individuals in 2017 (uncertainty range of 470 to 1,030), and the total population size was estimated at 5,460 individuals (uncertainty range 2,909-12,802) with a high survivorship of approximately 93% (Bruce *et al.*, 2018). The trend in abundance was not significantly different from zero (i.e., no trend so an apparently stable population where births = deaths, on average). This apparently stable population has been corroborated by Davenport et al. (2020) who used genetic samples of White Sharks to determine that the effective number of breeders in the population was comparable over the four years between 2010 and 2013.
10. Patterns of recreational water contact activities in marine waters	DPI Fisheries has reviewed the information that is available from relevant agencies for 2022/23 (refer to Table 4 section 2.4). DPI Fisheries collected some data on recreational water contact activities at SMP beaches during UAV aerial surveys conducted by SLSNSW. Information collected to date does not necessitate any changes to the SMP.
11. Threatened species recovery plan reviews	No new recovery plans were prepared in 2022/23 and DPI Fisheries is not aware of any new information that would necessitate any changes to the SMP.
12. Contractor compliance	Nine non-compliance issues were reported by Fisheries Officers during the 2022/23 season, and all related to nets not being marked correctly. All non-compliance issues in 2022/23 were resolved to the satisfaction of the DPI Senior Manager Shark Programs (for further details refer to section 1.3 Compliance Plan).
13. Monitor net locations by GPS	GPS location of nets was completed at the start of the 2022/23 meshing season with net locations being checked by observers throughout the meshing season. Net location GPS marks will vary slightly throughout the season due to the process of setting a net in an active environment. All nets were in similar positions to those reported in previous years.
14. Shark Meshing Program Annual Performance Evaluation.	The 2022/23 Annual Performance Report provides an evaluation of the performance of the SMP under the Management Plan. The JMA and Management Plan have been reviewed in 2022 as per clause 9 of the JMA. Any modifications identified in this review process will be introduced into the SMP during the 2023/24 season.

1.5 Performance Indicators

Performance indicators and trigger points from the Management Plan are assessed below to determine the extent to which the SMP met its four objectives in 2022/23.

1.5.1 Objective 1 - reduce the risk to humans from shark bites at beaches of the SMP

The trigger point for this objective is: *one fatality or serious injury per meshing season on a meshed beach*. Serious injuries are those that result in a threat to life or limb. There were no shark-human interactions at meshed beaches during the 2022/23 meshing season, so the trigger point was not tripped during 2022/23.

Table 6 Shark interactions per meshing season in the SMP Region 2008/09 to 2022/23

Meshing Period	Fatal	Serious	Minor	No injury	Total Fatal / Serious	Total interactions in SMP region
2008-09 (pre-JMA)	0	3	0	0	3	3
2009-10	0	0	2	0	0	2
2010-11	0	0	0	0	0	0
2011-12	0	1	2	1	1	4
2012-13	0	0	0	1	0	1
2013-14	0	0	1	0	0	1
2014-15	0	0	3	0	0	3
2015-16	0	0	2	2	0	4
2016-17	0	0	0	1	0	1
2017-18	0	1	1	0	1	2
2018-19	0	0	2	0	0	2
2019-20	0	0	2	2	0	4
2020-21	0	1	0	3	1	4
2021-22	1	0	1	2	1	4
2022-23	0	0	0	0	0	0

Note: Interaction information was cross-referenced with the Australian Shark Attack File.

During the 2022/23 meshing season, there were two verified shark-human interactions at unmeshed beaches along the NSW coastline. These two interactions were outside of the SMP area of operation and occurred at: South Rosedale Beach, Batemans Bay in the South Coast region (minor injuries to foot and ankle), and Crescent Head on the Mid North Coast (serious injuries to achilles and lower leg).

One shark-human interaction did occur in the SMP region but outside the meshing season, with a surfer sustaining minor injuries after an encountering with an unidentified Whaler Shark at North Avoca in August 2022. North Avoca beach is part of the NSW Shark Meshing Program and is a meshed beach from September to April inclusive.

1.5.2 Objective 2 - minimise the impact on non-target and threatened species.

The trigger point for this objective is:

- *Trigger Point 1: Entanglements of Endangered or Critically Endangered Species, Populations or Ecological Communities in a single meshing season exceed the annual average catch plus two standard deviations of the preceding 10 years for those species;*
- *Trigger Point 2: Entanglements of Vulnerable species or ecological communities in a single meshing season exceed the annual average catch plus three standard deviations of the preceding 10 years for those species;*
- *Trigger Point 3: Entanglements of other non-target species over 2 consecutive meshing seasons exceed twice the annual average catch of the preceding 10 years for those species.*

Catch records indicate that 228 animals were reported entangled in the nets during the period from 1 September 2022 to 30 April 2023 (Table 7), and that 204 (89%) were non-target animals

(Tables 7 and 8) under the 2017 JMA whereby only White, Bull and Tiger Sharks are identified as 'target' species.

Fifty-nine of those 228 interactions were with threatened or protected species, including:

- 18 White Sharks (10 dead, 8 released alive)
- 16 Greynurse Sharks (2 dead, 14 released alive)
- 6 Leatherback Turtles (2 dead, 4 released alive)
- 6 Indo-Pacific Bottlenose Dolphins (dead)
- 5 Loggerhead Turtles (3 dead, 2 released alive)
- 3 Green Turtles (2 dead, 1 released alive)
- 2 Common Dolphins (dead)
- 2 seals (1 dead, 1 released alive)
- 1 Great Hammerhead Shark (dead)

In addition, there were 163 interactions with other non-target species, including:

- 58 Rays (15 dead, 43 released alive)
- 57 Smooth Hammerheads (56 dead, 1 released alive)
- 18 Bronze Whalers* (10 dead, 8 released alive)
- 10 Broadnose Sevengill Sharks* (dead)
- 9 Dusky Whalers* (dead)
- 4 Common Blacktips* (dead)
- 2 Shortfin Makos* (dead)
- 1 Australian Angel Shark (dead)
- 1 Spinner Shark* (dead)
- 1 Longtail Tuna (dead)
- 1 Yellowfin Tuna (dead)
- 1 unidentified whaler shark* (dead)

* prior to 2017/18 meshing season, these species were reported as 'target species'

Batoids (rays and skates) continue to comprise the greatest proportion of catches in the SMP at 25%, followed equally by Smooth Hammerheads at 25%, the collective group of 'target sharks' (Bull, White, and Tiger Sharks) accounted for approximately 10%, and Greynurse Sharks accounted for 7%.

The trigger point for the objective of '*minimising the impact on non-target species and threatened species*' was tripped in 2022/23 after the entanglement of two seals (one released alive and one found dead - Table 8). Entanglements of seals in the SMP is low with only two other entanglements recorded in the past decade (one in 2016/17 released alive, and one in 2020/21 dead). A review report for this tripped trigger point will be prepared within six months of the publication of the Annual Performance Report in collaboration with EHG in accordance with clause 8.4 of the JMA and Part 7 of the Management Plan for the SMP.

Table 7 Total SMP entanglements for the 2022/23 meshing season.

Scientific Name	Common Name	Hunter	Central Coast North	Central Coast South	Sydney North	Sydney Central	Sydney South	Illawarra	Released alive/fate unknown	Dead	Total	% of Total Catch
Target Sharks												
Galeocerdo cuvier	Tiger Shark		1	2				3	3	3	**6**	2.6%
Carcharodon carcharias	White Shark	2	6	10					8	10	**18**	7.9%
Non-Target Sharks and Rays												
Squatina australis	Australian Angel Shark				1					1	**1**	0.4%
Notorynchus cepedianus	Broadnose Sevengill Shark			2				8		10	**10**	4.4%
Carcharhinus brachyurus	Bronze Whaler		6	7	1			4	8	10	**18**	7.9%
Carcharhinus obscurus	Dusky Whaler			5	2			2		9	**9**	3.9%
Isurus oxyrinchus	Shortfin Mako			2						2	**2**	0.9%
Carcharhinus brevipinna	Spinner Shark	1								1	**1**	0.4%
Carcharhinus sp.	unidentified whaler sp.							1		1	**1**	0.4%
Carcharhinus limbatus	Common Blacktip		2	1				1		4	**4**	1.8%
Sphyrna zygaena	Smooth Hammerhead Shark		28	9	12	1	4	3	1	56	**57**	25.0%
Sphyrna mokarran	Great Hammerhead Shark			1						1	**1**	0.4%
Carcharias taurus	Greynurse Shark	3	1	9	1	1		1	14	2	**16**	7.0%
Myliobatis australis	Southern Eagle Ray	2	7	5	2	1	1	12	22	8	**30**	13.2%
Rhinoptera neglecta	Australian Cownose Ray	1	8	3	2				10	4	**14**	6.1%
Dasyatis thetidis	Black Stingray							8	7	1	**8**	3.5%
Dasyatis brevicaudata	Smooth Stingray	1	1						2		**2**	0.9%
Aetobatus ocellatus	Whitespotted Eagle Ray		1	1					2		**2**	0.9%
	unidentified ray		1			1				2	**2**	0.9%
Non-Target Marine Mammals, Reptiles and Birds												
Delphinus delphis	Common Dolphin					2				2	**2**	0.9%
Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	2		1	1		1	1		6	**6**	2.6%
Chelonia mydas	Green Turtle		2		1				1	2	**3**	1.3%
Caretta caretta	Loggerhead Turtle	2			1	2			2	3	**5**	2.2%
Dermochelys coriacea	Leatherback Turtle	1		2	1		2		4	2	**6**	2.6%
	seals			2					1	1	**2**	0.9%
Non-Target Finfish												
Thunnus tonggol	Longtail Tuna			1						1	**1**	0.4%
Thunnus albacares	Yellowfin Tuna				1					1	**1**	0.4%
	TOTAL	**15**	**64**	**63**	**26**	**8**	**8**	**44**	**85**	**143**	**228**	**100.0%**

Table 8 Non-target and threatened species entanglements[1] for 2012/13 to 2022/23 and trigger point analysis for 2022/23.

Scientific Name	Common Name	Preceding 10 years catch data										Current reporting year	Endangered 10 Year Annual Average	Vulnerable 10 Year Annual Average	Other species 2 x 10 Year Annual Avg in 2 consecutive years	Trigger tripped (True/False)
		12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	21-23	+ 2 Std Devs	+ 3 Std Devs		
Endangered																
Carcharias taurus	Greynurse Shark	9	4	4	19	17	20	9	31	9	14	16	**30.4**	-	-	FALSE
Sphyrna lewini	Scalloped Hammerhead	1	0	0	0	1	0	1	4	0	0	0	**3.2**	-	-	FALSE
Dermochelys coriacea	Leatherback Turtle	0	2	0	2	1	2	4	0	2	16	6	**12.4**	-	-	FALSE
Caretta caretta	Loggerhead Turtle	1	0	0	4	1	0	6	1	5	4	5	**6.8**	-	-	FALSE
Dugong dugon	Dugong	0	0	0	0	0	0	0	0	0	0	0	**0.0**	-	-	FALSE
Eudyptula minor	Little Penguin	0	0	0	1	0	0	0	0	0	0	0	**0.7**			FALSE
Vulnerable																
Sphyrna mokarran	Great Hammerhead	0	0	0	1	1	3	1	1	1	2	1	-	**3.8**	-	FALSE
Carcharodon carcharias	White Shark	3	6	10	31	22	26	17	42	24	28	18	-	**57.1**	-	FALSE
Chelonia mydas	Green Turtle	0	10	4	13	6	9	8	8	8	19	3	-	**23.7**	-	FALSE
Megaptera novaeangliae	Humpback Whale	2	1	0	0	0	0	0	0	2	1	0	-	**3.1**	-	FALSE
Pinnipedia	Seals	0	0	0	0	1	0	0	0	1	0	2	-	**1.5**	-	**TRUE**
Procellariidae	Shearwater	0	0	0	1	0	0	0	0	0	0	0		**1.0**		FALSE
Other Protected or Non-Target Species																
Pseudorca crassidens	False Killer Whale	0	0	0	0	0	0	0	0	0	0	0	-	-	**0.0**	FALSE
Balaenoptera acutorostrata	Minke Whale	0	0	0	0	0	0	0	0	0	0	0	-	-	**0.0**	FALSE
Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	0	1	0	9	2	3	2	0	0	0	6	-	-	**3.6**	FALSE
Delphinus delphis	Common Dolphin	0	4	3	4	2	4	3	7	5	1	2	-	-	**6.6**	FALSE
Squatina spp	Angelshark sp	3	6	1	9	5	7	7	6	4	0	1	-	-	**9.6**	FALSE
Heterodontus portusjacksoni	Port Jackson Shark	4	2	0	2	2	3	1	2	3	1	0	-	-	**4.0**	FALSE
Sphyrna zygaena	Smooth Hammerhead	22	22	42	112	71	78	87	99	60	52	57	-	-	**129.4**	FALSE
Alopias vulpinus	Thresher Shark	0	0	1	2	1	4	0	4	2	0	0	-	-	**2.8**	FALSE
Eretmochelys imbricate	Hawksbill Turtle	0	0	1	5	2	2	4	0	2	0	0	-	-	**3.2**	FALSE
Lepidochelys olivacea	Olive Ridley Turtle	0	0	0	0	0	1	0	0	1	0	0	-	-	**0.4**	FALSE
	Rays - combined	35	90	86	425	166	172	158	179	137	130	58	-	-	**315.6**	FALSE

1: 'entanglements' includes mortalities and animals released alive.

2: 'Pre 2017 JMA 'target species" include: broadnose sevengill shark, bronze whaler, dusky whaler, unknown whaler, shortfin mako, silky shark, and common blacktip

Although not a formal trigger point or performance indicator, an increase in the number of animals released alive (albeit with fate unknown) since the JMAs were implemented in 2009-10 could provide some indication of the effectiveness of reducing the time between checking the nets from 96 to 72 hours. Table 9 compares the proportion of animals released alive pre - JMA (5 years before) and post – JMA for some major faunal groups and the total numbers of releases and captures. The data suggest that since the JMAs were implemented in 2009, there was a significant increase in the total number of animals released alive, from 27% before the JMA to a 42% average over the 14-year period from 2009 - 2023. It is important to note, however, that many of these animals are caught in very small numbers, and small changes can be reflected in greater percentages.

Table 9 Percentage of major faunal groups released alive from the SMP pre-JMA and post-JMA.

Faunal Group or Species	% released alive pre-JMA (2004-2009)	Annual percentage released alive over last five years					Overall % released alive post-JMA (2009/10 - 2022/2023)
		2018/19	2019/20	2020/21	2021/22	2022/23	
Target sharks*	**5%**	33%	13%	13%	26%	50%	**15%**
White Shark	**11%**	53%	43%	29%	36%	44%	**35%**
Greynurse Shark	**25%**	56%	55%	67%	64%	88%	**58%**
All hammerheads	**0%**	1%	1%	3%	2%	2%	**1%**
Other non-target sharks**	**48%**	13%	15%	19%	13%	17%	**19%**
All rays	**62%**	77%	79%	74%	66%	74%	**76%**
All dolphins	**0%**	0%	0%	0%	0%	0%	**0%**
All turtles	**24%**	32%	40%	33%	48%	50%	**35%**
Released/Interactions	**223/826**	**157/395**	**196/480**	**144/375**	**142/376**	**85/228**	**1792/4294**
Total % released alive	**27%**	**40%**	**41%**	**38%**	**38%**	**37%**	**42%**

* 'Target sharks' normally includes White Sharks, but as a threatened species they are separated for the purpose of this analysis.
** 'Other non-target sharks' includes whaler sharks (dusky, bronze, blacktip and spinner), shortfin mako, and broadnose sevengill sharks, following the implementation of new 2017 JMA.
NC = none caught that year

1.5.3 Objective 3 - Minimise OHS risks associated with implementing the SMP.

The trigger point for this objective is: *one major or two minor OHS incidents*.

A major incident is one that results in five or more compensable days off work, and a minor incident is one that is reportable to NSW WorkCover or results in between 2 – 4 days off work.

As there were no reported OHS incidents, this trigger point was not tripped during the 2022/23 meshing season.

1.5.4 Objective 4 - Transparent monitoring and reporting.

The trigger point for this objective is: *Annual performance report submitted to the Scientific Committee, the Fisheries Scientific Committee, OEH and parties to the JMA by 31 July each year*.

This requirement was met in 2022/23 in accordance with clause 8.3 of the JMA.

1.6 Summary of Reviews and Actions

This section summarises the trigger points which have been tripped and the status of any actions since the 2017 JMA and Management Plan came into effect in the 2018/19 meshing season.

2017/18: The trigger point for the objective of *'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species'* was tripped for three species during 2017/18 following the entanglement of twenty Greynurse Sharks, three Great Hammerheads, and two Hawksbill Turtles. DPI completed the review report for those trigger points within six months of the publication of the 2017/18 Annual Performance Report.

2018/19: The trigger point for the objective of *'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species'* was tripped for three species during 2018/19 following the entanglement of six Loggerhead Turtles, four Leatherback Sea Turtles, four Hawksbill Turtles, and 87 Smooth Hammerheads. DPI completed the review report for those trigger points within six months of the publication of the 2018/19 Annual Performance Report.

2019/20: The trigger point for the objective of *'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species'* was tripped for four species during 2019/20 following the entanglement of thirty-one Greynurse Sharks, four Scalloped Hammerhead Sharks, eight Common Dolphins, and four Thresher Sharks. The trigger point for the objective of *'Minimise OHS risks associated with implementing the SMP'* was tripped with two 'minor' OHS incidents being reported. DPI completed the review report for those trigger points within six months of the publication of the 2019/20 Annual Performance Report.

2020/21: No trigger points were tripped in 2020/21.

2021/22: The trigger point for the objective of *'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species'* was tripped for two species during 2021/22 following the entanglement of nineteen Green Turtles and sixteen Leatherback Turtles. DPI will complete a review report for those trigger points within six months of the publication of the 2021/22 Annual Performance Report.

2022/23: The trigger point for the objective of *'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise the survival or conservation status of threatened species'* was tripped for 'seals' during 2022/23 following the entanglement of one Australian Fur Seal and one New Zealand Fur Seal. DPI will complete a review report this trigger point within six months of the publication of the 2022/23 Annual Performance Report.

2 Changes to the Management Plan

In accordance with clause 9 of the JMA, the Management Plan and 2017 JMA were subject for review in 2022. The review by the Parties to the Agreement did not identify a need for any specific amendments to the 2017 JMA but specific amendments to the Management Plan were identified. A working group was established to make changes to the management Plan prior to the commencement of the 2022/23 season, with specific attention being placed on trigger point analysis of threatened species entanglements. The working group liaised with internal and external biometricians and research scientist to determine a 'better' more robust trigger point system, with the underlying feedback being that the lack of knowledge of population sizes inhibits the development of an effective analysis system. A Population Viability Analysis (PVA) system is currently being considered however this type of analysis is only done on a single species and may not be practical for the varying number of species caught in the SMP. The complex nature of developing a new trigger point analysis system has delayed the release of the updated MP. Changes to the Management Plan will be made prior to the 2023/24 season.

The current JMA and Management Plan governing the 2022/23 meshing season does require that trigger point review reports for threatened species and OHS incidents need to be prepared by DPI within six months of the publication of this Annual Performance Report.

DPI Fisheries implemented the use of PSAT tagging for Greynurse Sharks at the end of the 2018/19 season and continued this throughout the 2022/23 season to determine to post-release survivorship of Greynurse Sharks caught in SMP nets. DPI Fisheries implemented the use of Passive Integrated Transponder (PIT) tags in 2023 for turtles released alive from the nets and deceased EHG species (dolphins, turtles, seals etc). The use of PIT tags will allow for positive identification of animals that have been previously caught in the shark nets.

3 Other Programs Complementing the SMP

3.1 Aerial Surveys

No helicopter aerial surveys a were conducted in the 2022/23 SMP periods as this program has been completed.

3.2 SharkSmart Public Awareness and Education Program

DPI continued ongoing work during 2022/23 on the SharkSmart public awareness and education program including releases of updated versions of the SharkSmart App for iPhone and Android. Further information can be found on the DPI website at: https://www.sharksmart.nsw.gov.au/

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Appendix 1 – Catch Summary for the 2022/23 meshing season by Region

Region	Date	Beach	Scientific Name	Common Name	Sex (M / F / unk)	Size(m)	Status (Dead / Alive & Released)	Tagged	Samples Taken (Yes / No / Whole)
Hunter	10/09/2022	Dixon Park	*Myliobatis australis*	Southern Eagle Ray	F	0.75 WS	Alive & Released	No	No
	10/09/2022	Dixon Park	*Carcharodon carcharias*	White Shark	F	2.25 FL	Alive & Released	No	No
	15/10/2022	Nobbys	*Carcharias taurus*	Greynurse Shark	F	2.30 FL	Alive & Released	No	No
	15/10/2022	Redhead	*Tursiops aduncus*	Indo-Pacific Bottlenose Dolphin	F	2.10 FL	Dead & Decomposed	No	No
	21/10/2022	Stockton	*Carcharodon carcharias*	White Shark	F	1.75 FL	Alive & Released	Yes	No
	11/11/2022	Nobbys	*Dasyatis brevicaudata*	Smooth Stingray	F	1.20 WS	Alive & Released	No	No
	19/11/2022	Stockton	*Carcharias taurus*	Greynurse Shark	F	2.32 FL	Alive & Released	Yes	No
	29/11/2022	Stockton	Myliobatis australis	Southern Eagle Ray	F	1.10 WS	Alive & Released	No	No
	3/12/2022	Merewhether	Dermochelys coriacea	Leatherback Turtle	F	1.55 TL	Alive & Released	No	No
	8/12/2022	Dixon Park	Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	F	2.46 TL	Dead	No	Yes
	2/01/2023	Redhead	Caretta caretta	Loggerhead Turtle	M	0.54 TL	Dead & Decomposed	No	No
	3/01/2023	Stockton	Carcharhinus brevipinna	Spinner Shark	M	1.07 FL	Dead	No	Yes
	25/01/2023	Stockton	Rhinoptera neglecta	Australian Cownose Ray	F	0.65 WS	Alive & Released	No	No
	15/02/2023	Newcastle	Caretta caretta	Loggerhead Turtle	unk	0.63 TL	Dead & Decomposed	No	No
	12/04/2023	Nobbys	Carcharias taurus	Greynurse Shark	F	2.31 FL	Alive & Released	No	No
Central Coast North	7/09/2022	Catherine Hill Bay	*Rhinoptera neglecta*	Australian Cownose Ray	F	0.82 WS	Dead & Decomposed	No	No
	10/09/2022	Caves	*Carcharhinus brachyurus*	Bronze Whaler	F	2.80 FL	Dead	No	Yes
	10/09/2022	Caves	*Carcharhinus brachyurus*	Bronze Whaler	F	3.00 FL	Alive & Released	No	No
	10/09/2022	Caves	*Carcharodon carcharias*	White Shark	M	2.95 FL	Dead	No	Yes
	16/09/2022	Blacksmiths	*Carcharodon carcharias*	White Shark	F	2.00 FL	Alive & Released	No	Nio
	19/09/2022	Lakes	*Aetobatus ocellatus*	Whitespotted Eagle Ray	M	1.40 WS	Alive & Released	No	No
	3/10/2022	Blacksmiths	*Myliobatis australis*	Southern Eagle Ray	F	0.83 WS	Alive & Released	No	No
	19/10/2022	Caves	*Dasyatis brevicaudata*	Smooth Stingray	M	0.96 WS	Alive & Released	No	No
	19/10/2022	Catherine Hill Bay	*Carcharodon carcharias*	White Shark	F	1.56 FL	Dead	No	Whole
	20/10/2022	Shelly	*Carcharodon carcharias*	White Shark	F	2.42 FL	Alive & Released	No	No
	25/10/2022	Lakes	*Sphyrna zygaena*	Smooth Hammerhead	M	1.22 FL	Dead	No	Yes
	8/11/2022	Blacksmiths	*Sphyrna zygaena*	Smooth Hammerhead	M	1.25 FL	Dead	No	No

	10/11/2022	Lakes	*Carcharhinus brachyurus*	Bronze Whaler	M	1.93 FL	Alive & Released	No	No
	10/11/2022	Shelly	*Carcharhinus brachyurus*	Bronze Whaler	M	2.27 FL	Alive & Released	No	No
	10/11/2022	Catherine Hill Bay	*Myliobatis australis*	Southern Eagle Ray	F	1.05 WS	Alive & Released	No	No
	13/11/2022	Shelly	*Carcharhinus brachyurus*	Bronze Whaler	unk	2.20 TL	Alive & Released	No	No
	19/11/2022	Lakes	*Myliobatis australis*	Southern Eagle Ray	M	0.77 WS	Dead	No	No
	21/11/2022	Catherine Hill Bay	*Myliobatis australis*	Southern Eagle Ray	M	0.73 WS	Dead	No	Whole
	21/11/2022	Shelly		unidentified ray	unk	0.80 WS	Dead & Decomposed	No	No
	28/11/2022	The Entrance	Carcharhinus limbatus	Common Blacktip	M	1.79 FL	Dead	No	Yes
	28/11/2022	Soldiers	Sphyrna zygaena	Smooth Hammerhead	M	1.35 FL	Dead	No	Yes
	1/12/2022	Blacksmiths	Myliobatis australis	Southern Eagle Ray	F	0.54 WS	Alive & Released	No	No
	1/12/2022	Catherine Hill Bay	Myliobatis australis	Southern Eagle Ray	F	0.96 WS	Alive & Released	No	No
	7/12/2022	Blacksmiths	Myliobatis australis	Southern Eagle Ray	M	0.92 WS	Alive & Released	No	No
	7/12/2022	Blacksmiths	Carcharodon carcharias	White Shark	M	1.96 FL	Dead	No	Yes
	29/12/2022	The Entrance	Sphyrna zygaena	Smooth Hammerhead	F	1.04 FL	Dead	No	No
	31/12/2022	Catherine Hill Bay	Carcharodon carcharias	White Shark	M	1.45 FL	Dead	No	Yes
	2/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	M	1.01 FL	Dead	No	No
	16/01/2023	Blacksmiths	Rhinoptera neglecta	Australian Cownose Ray	M	0.91 WS	Alive & Released	No	No
	16/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	M	1.15 FL	Dead	No	Yes
	16/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	1.01 FL	Dead	No	Yes
	16/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	0.95 FL	Dead	No	No
	19/01/2023	Catherine Hill Bay	Chelonia mydas	Green Turtle	F	0.68 TL	Dead	No	Yes
	21/01/2023	Lakes	Carcharhinus limbatus	Common Blacktip	F	1.12 FL	Dead	No	Yes
	24/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	1.15 FL	Dead	No	Yes
	26/01/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	1.15 FL	Dead	No	Yes
	29/01/2023	Catherine Hill Bay	Sphyrna zygaena	Smooth Hammerhead	F	0.99 FL	Dead	No	Yes
	6/02/2023	Catherine Hill Bay	Rhinoptera neglecta	Australian Cownose Ray	M	0.60 WS	Alive & Released	Yes	Yes
	8/02/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	unk	0.85 FL	Dead & Decomposed	No	No
	11/02/2023	Caves	Rhinoptera neglecta	Australian Cownose Ray	M	0.90 WS	Alive & Released	No	Yes
	12/02/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	F	1.35 FL	Dead	No	Yes
	16/02/2023	Lakes	Rhinoptera neglecta	Australian Cownose Ray	M	0.96 WS	Alive & Released	No	Yes
	18/02/2023	Catherine Hill Bay	Rhinoptera neglecta	Australian Cownose Ray	M	0.60 WS	Alive & Released	No	Yes

	21/02/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	M	0.95 FL	Dead	No	No
	24/02/2023	Catherine Hill Bay	Sphyrna zygaena	Smooth Hammerhead	M	1.07 FL	Dead	No	Yes
	24/02/2023	Lakes	Sphyrna zygaena	Smooth Hammerhead	M	1.14 FL	Dead	No	Yes
	27/02/2023	Lakes	Carcharias taurus	Greynurse Shark	F	2.44 FL	Alive & Released	Yes	No
	27/02/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	0.91 FL	Dead	No	No
	27/02/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	F	0.95 FL	Dead	No	No
	27/02/2023	Catherine Hill Bay	Sphyrna zygaena	Smooth Hammerhead	M	0.93 FL	Dead	No	No
	1/03/2023	Catherine Hill Bay	Sphyrna zygaena	Smooth Hammerhead	unk	0.80 FL	Dead & Decomposed	No	No
	1/03/2023	The Entrance	Galeocerdo cuvier	Tiger Shark	F	1.15 FL	Dead & Decomposed	No	Whole
	3/03/2023	Catherine Hill Bay	Rhinoptera neglecta	Australian Cownose Ray	M	0.95 WS	Alive & Released	Yes	Yes
	3/03/2023	Soldiers	Chelonia mydas	Green Turtle	unk	0.65 TL	Alive & Released	No	No
	17/03/2023	Blacksmiths	Sphyrna zygaena	Smooth Hammerhead	M	1.09 FL	Dead	No	Yes
	19/03/2023	Lakes	Sphyrna zygaena	Smooth Hammerhead	F	1.28 FL	Dead	No	Yes
	23/03/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	M	1.23 FL	Dead	No	Yes
	27/03/2023	The Entrance	Carcharhinus brachyurus	Bronze Whaler	F	3.30 TL	Alive & Released	Yes	No
	27/03/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	M	1.16 FL	Dead	No	Yes
	27/03/2023	Catherine Hill Bay	Sphyrna zygaena	Smooth Hammerhead	M	1.02 FL	Dead	No	Yes
	31/03/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	M	1.25 FL	Dead	No	Yes
	31/03/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	F	1.10 FL	Dead	No	Yes
	31/03/2023	The Entrance	Sphyrna zygaena	Smooth Hammerhead	M	1.08 FL	Dead	No	Yes
	23/04/2023	Lakes	Rhinoptera neglecta	Australian Cownose Ray	M	0.91 WS	Alive & Released	Yes	Yes
Central Coast South	6/09/2022	Umina	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.43 FL	Dead	No	Yes
	6/09/2022	Umina	*Carcharhinus brachyurus*	Bronze Whaler	F	2.74 FL	Dead	No	Yes
	29/09/2022	Avoca	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.64 FL	Dead	No	Yes
	29/09/2022	Avoca	*Isurus oxyrinchus*	Shortfin Mako	M	1.79 FL	Dead	No	Yes
	5/10/2022	North Avoca	*Carcharias taurus*	Greynurse Shark	F	2.30 FL	Alive & Released	No	No
	7/10/2022	Copacabana	*Carcharhinus brachyurus*	Bronze Whaler	F	2.00 FL	Alive & Released	No	No
	15/10/2022	Avoca	*Carcharias taurus*	Greynurse Shark	F	2.30 FL	Alive & Released	No	No
	15/10/2022	Copacabana	*Tursiops aduncus*	Indo-Pacific Bottlenose Dolphin	M	2.10 FL	Dead	No	Whole
	18/10/2022	Avoca	*Carcharodon carcharias*	White Shark	F	2.60 FL	Dead	No	Whole
	19/10/2022	North Avoca	*Carcharhinus brachyurus*	Bronze Whaler	F	1.80 FL	Dead	No	Yes

25/10/2022	Terrigal	*Carcharias taurus*	Greynurse Shark	F	2.13 FL	Alive & Released	Yes	No
25/10/2022	Killcare	*Sphyrna zygaena*	Smooth Hammerhead	F	1.35 FL	Dead	No	Yes
25/10/2022	Avoca	*Carcharodon carcharias*	White Shark	F	2.10 FL	Alive & Released	No	No
27/10/2022	Avoca	*Rhinoptera neglecta*	Australian Cownose Ray	M	0.78 WS	Dead	No	Whole
27/10/2022	Avoca	*Arctocephalus pussillus doriferus*	Australian Fur Seal	unk	2.00 TL	Alive & Released	No	No
27/10/2022	Avoca	*Carcharias taurus*	Greynurse Shark	F	2.28 FL	Dead	No	Whole
28/10/2022	North Avoca	*Carcharias taurus*	Greynurse Shark	F	2.44 FL	Dead	No	Yes
28/10/2022	North Avoca	*Carcharodon carcharias*	White Shark	M	1.97 FL	Dead	No	Whole
1/11/2022	Macmasters	*Carcharias taurus*	Greynurse Shark	F	2.22 FL	Alive & Released	Yes	No
11/11/2022	North Avoca	*Arctocephalus forsteri*	New Zealand Fur Seal	unk	1.60 TL	Dead	No	No
11/11/2022	Copacabana	*Myliobatis australis*	Southern Eagle Ray	M	0.60 WS	Alive & Released	No	No
11/11/2022	North Avoca	*Carcharodon carcharias*	White Shark	M	1.77 FL	Dead	No	Yes
21/11/2022	Terrigal	*Carcharhinus brachyurus*	Bronze Whaler	F	2.47 FL	Dead	No	Yes
21/11/2022	Terrigal	*Myliobatis australis*	Southern Eagle Ray	F	1.10 WS	Dead	No	Yes
21/11/2022	Copacabana	*Myliobatis australis*	Southern Eagle Ray	F	1.00 WS	Alive & Released	No	No
21/11/2022	Copacabana	*Myliobatis australis*	Southern Eagle Ray	F	0.90 WS	Alive & Released	No	No
21/11/2022	Copacabana	*Myliobatis australis*	Southern Eagle Ray	M	0.95 WS	Alive & Released	No	No
24/11/2022	Avoca	Isurus oxyrinchus	Shortfin Mako	F	1.37 FL	Dead	No	Yes
24/11/2022	Avoca	Carcharodon carcharias	White Shark	M	1.87 FL	Dead	No	Whole
24/11/2022	Copacabana	Carcharodon carcharias	White Shark	F	1.85 FL	Dead	No	Whole
25/11/2022	Avoca	Carcharodon carcharias	White Shark	M	1.71 FL	Alive & Released	No	No
25/11/2022	Terrigal	Carcharodon carcharias	White Shark	F	2.30 FL	Alive & Released	No	No
28/11/2022	Terrigal	Carcharhinus brachyurus	Bronze Whaler	F	1.98 FL	Dead	No	Yes
28/11/2022	Copacabana	Carcharias taurus	Greynurse Shark	F	2.41 FL	Alive & Released	Yes	No
30/11/2022	Killcare	Galeocerdo cuvier	Tiger Shark	F	2.75 FL	Alive & Released	Yes	No
30/11/2022	Macmasters	Carcharodon carcharias	White Shark	F	2.86 FL	Dead	No	Whole
30/11/2022	North Avoca	Carcharodon carcharias	White Shark	M	2.16 FL	Alive & Released	No	No
2/12/2022	Avoca	Carcharhinus brachyurus	Bronze Whaler	M	1.60 TL	Alive & Released	Yes	No
2/12/2022	Copacabana	Galeocerdo cuvier	Tiger Shark	F	2.43 FL	Alive & Released	Yes	No
5/12/2022	Macmasters	Carcharhinus brachyurus	Bronze Whaler	M	1.67 FL	Dead	No	Yes
5/12/2022	Copacabana	Carcharhinus obscurus	Dusky Whaler	F	1.78 FL	Dead	No	Yes

	5/12/2022	Umina	Sphyrna zygaena	Smooth Hammerhead	F	0.70 FL	Dead	No	Yes
	5/12/2022	Umina	Sphyrna zygaena	Smooth Hammerhead	F	0.63 FL	Dead	No	Yes
	7/12/2022	Umina	Sphyrna zygaena	Smooth Hammerhead	M	1.13 FL	Dead	No	Yes
	24/12/2022	Copacabana	Carcharias taurus	Greynurse Shark	F	2.22 FL	Alive & Released	Yes	No
	27/12/2022	Copacabana	Carcharhinus limbatus	Common Blacktip	M	1.87 FL	Dead	No	Yes
	27/12/2022	Copacabana	Carcharhinus obscurus	Dusky Whaler	F	1.56 FL	Dead	No	Yes
	27/12/2022	Macmasters	Carcharias taurus	Greynurse Shark	F	2.18 FL	Alive & Released	Yes	No
	27/12/2022	Avoca	Sphyrna zygaena	Smooth Hammerhead	F	1.38 FL	Dead	No	Yes
	30/01/2023	North Avoca	Dermochelys coriacea	Leatherback Turtle	M	1.80 TL	Dead	No	Yes
	30/01/2023	Avoca	Sphyrna zygaena	Smooth Hammerhead	F	1.30 FL	Dead	No	Yes
	3/02/2023	North Avoca	Carcharhinus obscurus	Dusky Whaler	M	1.37 FL	Dead	No	Yes
	15/02/2023	North Avoca	Rhinoptera neglecta	Australian Cownose Ray	F	0.77 WS	Dead & Decomposed	No	No
	16/02/2023	Killcare	Sphyrna mokarran	Great Hammerhead	M	2.86 FL	Dead	No	Whole
	27/02/2023	Avoca	Sphyrna zygaena	Smooth Hammerhead	F	1.12 FL	Dead	No	Yes
	3/03/2023	Umina	Rhinoptera neglecta	Australian Cownose Ray	M	0.92 WS	Dead & Decomposed	No	No
	3/03/2023	Umina	Carcharhinus obscurus	Dusky Whaler	F	2.81 FL	Dead	No	Yes
	3/03/2023	Killcare	Dermochelys coriacea	Leatherback Turtle	M	1.40 TL	Alive & Released	Yes	No
	3/03/2023	Killcare	Sphyrna zygaena	Smooth Hammerhead	F	0.76 FL	Dead & Decomposed	No	No
	22/03/2023	Copacabana	Carcharhinus obscurus	Dusky Whaler	F	2.85 FL	Dead	No	Yes
	22/03/2023	Copacabana	Thunnus tonggol	Longtail Tuna	unk	0.60 FL	Dead	No	No
	3/04/2023	Avoca	Sphyrna zygaena	Smooth Hammerhead	F	0.86 FL	Dead	No	Yes
	6/04/2023	Macmasters	Aetobatus ocellatus	Whitespotted Eagle Ray	F	1.00 WS	Alive & Released	No	No
Sydney North	12/09/2022	Palm	*Sphyrna zygaena*	Smooth Hammerhead	F	1.23 FL	Dead	No	No
	26/09/2022	Warriewood	*Squatina australis*	Australian Angel Shark	F	0.70 FL	Dead	No	Yes
	26/09/2022	Warriewood	*Carcharhinus brachyurus*	Bronze Whaler	F	3.00 TL	Alive & Released	No	No
	2/10/2022	Bilgola	*Sphyrna zygaena*	Smooth Hammerhead	F	1.30 FL	Dead	No	No
	3/10/2022	Palm	*Rhinoptera neglecta*	Australian Cownose Ray	M	0.86 WS	Alive & Released	No	No
	19/10/2022	Palm	*Sphyrna zygaena*	Smooth Hammerhead	F	1.09 FL	Dead	No	Yes
	19/10/2022	Palm	*Sphyrna zygaena*	Smooth Hammerhead	F	1.25 FL	Dead	No	Yes
	27/10/2022	Avalon	*Carcharias taurus*	Greynurse Shark	F	2.90 FL	Alive & Released	Yes	No
	3/11/2022	Mona Vale	*Tursiops aduncus*	Indo-Pacific Bottlenose Dolphin	F	2.37 TL	Dead	No	Whole

	30/11/2022	Whale	Myliobatis australis	Southern Eagle Ray	F	1.40 WS	Alive & Released	No	No
	2/12/2022	Warriewood	Sphyrna zygaena	Smooth Hammerhead	F	1.10 FL	Dead	No	No
	7/12/2022	Avalon	Myliobatis australis	Southern Eagle Ray	F	0.90 WS	Alive & Released	No	No
	16/01/2023	Whale	Caretta caretta	Loggerhead Turtle	unk	0.80 TL	Alive & Released	No	No
	23/01/2023	Mona Vale	Chelonia mydas	Green Turtle	F	0.90 TL	Dead	No	No
	3/02/2023	Palm	Sphyrna zygaena	Smooth Hammerhead	M	1.10 FL	Dead	No	No
	21/02/2023	Palm	Sphyrna zygaena	Smooth Hammerhead	M	1.00 FL	Dead	No	Yes
	23/02/2023	Newport	Sphyrna zygaena	Smooth Hammerhead	M	0.94 FL	Dead	No	Yes
	27/02/2023	Palm	Sphyrna zygaena	Smooth Hammerhead	F	0.85 FL	Dead	No	Yes
	1/03/2023	Bilgola	Dermochelys coriacea	Leatherback Turtle	unk	1.80 TL	Dead	No	No
	1/03/2023	Palm	Sphyrna zygaena	Smooth Hammerhead	F	1.00 FL	Alive & Released	No	No
	19/03/2023	Whale	Sphyrna zygaena	Smooth Hammerhead	F	1.00 FL	Dead	No	Yes
	19/03/2023	Palm	Sphyrna zygaena	Smooth Hammerhead	F	1.00 FL	Dead	No	Yes
	27/03/2023	Bilgola	Carcharhinus obscurus	Dusky Whaler	M	0.78 FL	Dead	No	Yes
	5/04/2023	Mona Vale	Rhinoptera neglecta	Australian Cownose Ray	M	0.85 WS	Alive & Released	No	Yes
	15/04/2023	Whale	Carcharhinus obscurus	Dusky Whaler	F	1.36 FL	Dead	No	Yes
	15/04/2023	Whale	Thunnus albacares	Yellowfin Tuna	unk	0.00	Dead	No	No
Sydney Central	19/09/2022	Narrabeen	*Caretta caretta*	Loggerhead Turtle	M	1.04 TL	Dead	No	Whole
	25/10/2022	North Steyne	*Carcharias taurus*	Greynurse Shark	F	2.40 FL	Alive & Released	Yes	Yes
	25/10/2022	Narrabeen	*Sphyrna zygaena*	Smooth Hammerhead	unk	1.52 FL	Dead & Decomposed	No	Yes
	11/11/2022	North Steyne	*Caretta caretta*	Loggerhead Turtle	unk	0.75 TL	Alive & Released	No	No
	2/12/2022	North Narrabeen	Delphinus delphis	Common Dolphin	F	1.70 TL	Dead	No	Whole
	27/02/2023	Queenscliff	Myliobatis australis	Southern Eagle Ray	F	0.57 WS	Alive & Released	No	Yes
	24/03/2023	Harbord	Delphinus delphis	Common Dolphin	unk	2.21 FL	Dead	Yes	Yes
	24/03/2023	Manly		unidentified ray	unk	0.50 WS	Dead & Decomposed	No	No
Sydney South	28/09/2022	North Cronulla	*Sphyrna zygaena*	Smooth Hammerhead	F	1.20 FL	Dead	No	Yes
	28/09/2022	North Cronulla	*Myliobatis australis*	Southern Eagle Ray	F	0.80 WS	Alive & Released	No	No
	10/11/2022	Maroubra	*Sphyrna zygaena*	Smooth Hammerhead	F	1.56 FL	Dead	No	Yes
	14/12/2022	Cronulla	Sphyrna zygaena	Smooth Hammerhead	M	1.32 FL	Dead	No	Yes
	2/02/2023	Maroubra	Dermochelys coriacea	Leatherback Turtle	unk	1.60 TL	Alive & Released	No	No
	3/02/2023	Elouera	Sphyrna zygaena	Smooth Hammerhead	unk	1.00 FL	Dead & Decomposed	No	Yes

	18/02/2023	Bronte	Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	unk	2.30 TL	Dead	No	No
	25/04/2023	Wanda	Dermochelys coriacea	Leatherback Turtle	unk	1.30 TL	Alive & Released	No	No
Illawarra	6/09/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	14/09/2022	South Wollongong	*Carcharhinus brachyurus*	Bronze Whaler	unk	2.30 FL	Dead	No	Yes
	26/09/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	26/09/2022	Garie	*Carcharhinus brachyurus*	Bronze Whaler	F	2.30 FL	Dead	No	No
	26/09/2022	North Wollongong	*Carcharias taurus*	Greynurse Shark	F	2.20 FL	Alive & Released	No	No
	3/10/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	3/10/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	3/10/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	3/10/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	3/10/2022	North Wollongong	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.40 FL	Dead	No	No
	3/10/2022	North Wollongong	*Carcharhinus brachyurus*	Bronze Whaler	F	2.40 FL	Dead	No	No
	11/10/2022	South Wollongong	*Carcharhinus brachyurus*	Bronze Whaler	F	2.40 FL	Dead	No	Yes
	11/10/2022	South Wollongong	*Sphyrna zygaena*	Smooth Hammerhead	F	1.20 FL	Dead	No	Yes
	17/10/2022	North Wollongong	*Dasyatis thetidis*	Black Stingray	F	1.20 WS	Dead	No	No
	17/10/2022	North Wollongong	*Myliobatis australis*	Southern Eagle Ray	F	1.30 WS	Dead	No	No
	19/10/2022	Thirroul	*Notorynchus cepedianus*	Broadnose Sevengill Shark	M	1.30 FL	Dead	No	No
	19/10/2022	Thirroul	*Carcharhinus spp*	Whaler shark (unknown species)	F	2.40 FL	Dead & Decomposed	No	No
	21/10/2022	North Wollongong	*Myliobatis australis*	Southern Eagle Ray	F	1.20 WS	Alive & Released	No	No
	31/10/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	F	1.40 WS	Alive & Released	No	No
	31/10/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	M	1.20 WS	Alive & Released	No	No
	31/10/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	M	1.20 WS	Alive & Released	No	No
	31/10/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	M	1.20 WS	Alive & Released	No	No
	31/10/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	F	1.20 WS	Alive & Released	No	No
	31/10/2022	Thirroul	*Myliobatis australis*	Southern Eagle Ray	F	1.20 WS	Alive & Released	No	No
	3/11/2022	Wattamolla	*Galeocerdo cuvier*	Tiger Shark	F	4.00 TL	Alive & Released	No	No
	4/11/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	F	1.20 WS	Alive & Released	No	No
	4/11/2022	Austinmer	*Dasyatis thetidis*	Black Stingray	F	1.50 WS	Alive & Released	No	No
	14/11/2022	North Wollongong	*Myliobatis australis*	Southern Eagle Ray	F	1.10 WS	Alive & Released	No	No
	28/11/2022	Wattamolla	Myliobatis australis	Southern Eagle Ray	F	1.20 WS	Dead	No	No

	2/12/2022	Wattamolla	Sphyrna zygaena	Smooth Hammerhead	F	1.20 FL	Dead	No	Yes
	2/12/2022	South Wollongong	Myliobatis australis	Southern Eagle Ray	F	1.20 WS	Alive & Released	No	No
	2/01/2023	Austinmer	Myliobatis australis	Southern Eagle Ray	F	1.40 WS	Dead	No	No
	3/01/2023	South Wollongong	Galeocerdo cuvier	Tiger Shark	unk	3.50 FL	Dead & Decomposed	No	No
	9/01/2023	Austinmer	Myliobatis australis	Southern Eagle Ray	unk	1.40 WS	Dead & Decomposed	No	No
	16/01/2023	North Wollongong	Carcharhinus obscurus	Dusky Whaler	F	3.00 FL	Dead	No	No
	17/01/2023	Thirroul	Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	F	2.60 TL	Dead	No	Yes
	24/01/2023	Garie	Carcharhinus limbatus	Common Blacktip	F	1.70 FL	Dead	No	Yes
	24/01/2023	Coledale	Sphyrna zygaena	Smooth Hammerhead	M	1.00 FL	Dead & Decomposed	No	No
	24/01/2023	Coledale	Myliobatis australis	Southern Eagle Ray	unk	1.00 WS	Dead & Decomposed	No	No
	28/03/2023	Wattamolla	Galeocerdo cuvier	Tiger Shark	F	3.20 FL	Dead	No	Yes
	12/04/2023	Thirroul	Carcharhinus obscurus	Dusky Whaler	F	1.90 FL	Dead	No	No
	12/04/2023	Austinmer	Myliobatis australis	Southern Eagle Ray	F	1.30 WS	Alive & Released	No	No
	12/04/2023	Austinmer	Myliobatis australis	Southern Eagle Ray	F	1.30 WS	Alive & Released	No	No
	21/04/2023	Thirroul	Myliobatis australis	Southern Eagle Ray	F	1.40 WS	Alive & Released	No	No