



Department of
Primary Industries

Shark Meshing (Bather Protection) Program 2020/21 Annual Performance Report

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

Published by NSW Department of Primary Industries

Title: *Shark Meshing (Bather Protection) Program 2020/21 Annual Performance Report*

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ISSN 1839-0900

Coordinating editors:

Scott Dalton, Shark Meshing Program Supervisor DPI Fisheries
Cameron Doak, Senior Shark Meshing Observer
Alex Wray-Barnes, Project Officer, Marine Estate (Spatial Planner)
Vic Peddemors, Senior Shark Scientist, DPI Fisheries

Acknowledgements

The editors wish to acknowledge the following people for their valuable contribution: Trevor Daly, Amy Smoothery, Paul Butcher, Alyssa Kanyasi, Cameron Baber, Chantelle Clain, Doug Reeves, the SMP contractors, Surf Life Saving NSW, particularly Andrew Ugarte & Chris Twine, and Phoebe Meagher (Australian Shark Attack File, Taronga Zoo), and staff from various branches of NSW Department of Primary Industries.

Appreciation is also extended to other contributors who may not be listed above.

INT21/65222

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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 375 marine animals were caught in the SMP during the 2020/21 meshing season, comprised of 40 target sharks and 335 non-target animals. One hundred and forty-four animals (38%) were released alive.

The 40 target sharks comprised 24 White Sharks; 10 Bull Sharks; and 6 Tiger Sharks.

The 335 interactions with non-target animals consisted of:

- 158 non-target sharks, including Grey Nurse Sharks; a Great Hammerhead Shark; Smooth Hammerhead Sharks; Angel Sharks (Eastern Angel Sharks and Australian Angel Sharks); Port Jackson Sharks; Thresher Sharks; a wobbegong; a Pigeye Shark; *Broadnose Sevengill Sharks; *Whaler Sharks (Bronze Whalers, Common Blacktip Sharks, Dusky Whalers, Silky Sharks; Spinner Sharks; and an unidentified whaler species), and *Shortfin Mako Sharks; (* reported as target sharks prior to 2017).
- 137 rays, including Southern Eagle Rays; Australian Cownose Rays; Black Stingrays; White Spotted Eagle Rays; Manta Rays; a Smooth Stingray; and an unidentified Devil Ray (*Mobula sp.*).
- 18 marine reptiles comprised of: 8 Green Turtles; 5 Loggerhead Turtles; 2 Leatherback Turtles; 2 Hawksbill Turtles; and an Olive Ridley Turtle.
- 9 marine mammals comprised of: 5 Common Dolphins, 2 Humpback Whales; an Australian Fur Seal; and an unidentified dolphin species.
- 13 interactions with finfish (Australian Bonito, Frigate Mackerel, Mulloway, Longtail Tuna, and Yellowtail Kingfish).

Fifty-two (14%) of the interactions were with threatened species comprised of: 24 White Sharks; 9 Grey Nurse Sharks; 8 Green Turtles; 5 Loggerhead Turtle; 2 Leatherback Turtles; 2 Humpback Whales; 1 Australian Fur Seal; and 1 Great Hammerhead Shark.

Nine (2%) of the interactions were with protected species comprised of: 5 Common Dolphins; 2 Hawksbill Turtles; 1 Olive Ridley Turtle; and 1 unidentified dolphin species.

The observer program was implemented with observers present on 39% of all net checks (hauls) 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 154 of the 231 animals found dead in the nets in 2020/21.

Those catches did not trip the trigger point for the objective of ‘*minimising the impact on non-target species and threatened species*’ in 2020/21.

During the 2020/21 meshing season there were two reported shark-human interactions at meshed beaches of the SMP. A surfer was uninjured when bumped by an unidentified Whaler Shark at Queenscliff Beach in October 2020. Another surfer was also uninjured after being dragged

backwards on his board while surfing at Cronulla Beach in March 2021. No injuries were sustained during these interactions so the trigger point for '*reducing the risk to humans from shark attacks at beaches of the SMP*' was not tripped.

During the 2020/21 meshing season, there were also seven verified shark-human interactions at unmeshed beaches and one in a coastal lake. Two of those interactions occurred in the SMP region: a spearfisher was uninjured after encountering a White Shark at Deadman's Cove, Maroubra, approximately 2km south of the nearest meshed beach at Maroubra; and a swimmer suffered serious injuries after being bitten by a Bull Shark in Lake Macquarie. There were also two unverified interactions in March 2021.

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 2020/21.

In 2020/21, DPI met all requirements of the JMA and associated Management Plan.

This Annual Performance Report has not identified a need for any specific amendments to the Management Plan or JMA, although they were both published in 2017 and will therefore be subject to review in 2022 in accordance with clause 9 of the JMA.

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 4.8 million people visited those beaches in 2020/21. 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. Including 2020/21, thirty-six (36) unprovoked shark encounters have reportedly occurred at netted beaches of the SMP, nine (9) of which involved target sharks: seven with White Sharks, and one with each of a Tiger and Bull Shark. Other encounters at meshed beaches were with unknown species of shark (13), Wobbegong Sharks (10), and unidentified Whaler Sharks (4). Although one 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 (Dudley, 1997).

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 2017 JMA will be reviewed in 2022.

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 2020/21.

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

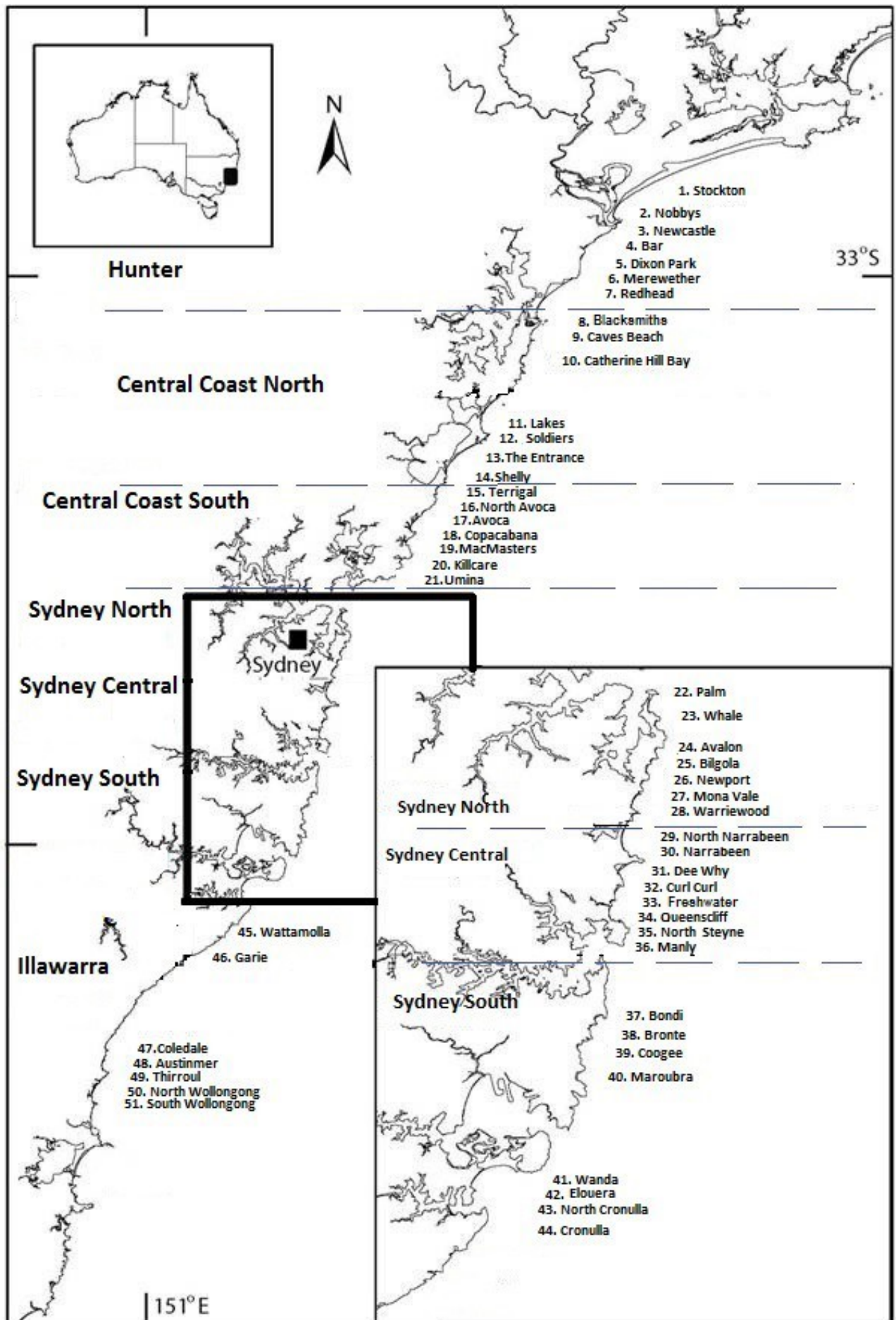


Figure 1 Location of Shark Meshing (Bather Protection) Program beaches.

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 operate a Vessel Monitoring System (VMS) whilst undertaking meshing activities. The VMS units are owned by the Department, and live monitoring of vessels is conducted by the DPI shark meshing supervisor.
- 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.
- More rigorous auditing processes through cross referencing of VMS 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 2020/21 season.

Three nets were reportedly damaged by whales* during the 2020/21 season:

- 28 September 2020, Central Coast North contractor and Shark Meshing Observer reported that the net at Catherine Hill Bay had extensive damage; believed to be from a whale. All net mesh and ropes were recovered.
- 5 October 2020, Hunter contractor reported that the Redhead net had approximately 25m of mesh torn from an interaction with a whale. All net mesh and ropes were recovered.
- 16 October 2020, the Hunter contractor reported that the net at Dixon Park had been significantly damaged after a confirmed whale entanglement. All net mesh and ropes were recovered.

* 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 only one report of vandalism during the 2020/21 season:

- 7 December 2020, Central Coast South contractor and Shark Meshing Observer reported suspected vandalism of the net at Umina with mesh and float lines having been cut.

The extreme and adverse weather conditions throughout the 2020/21 season meant that on several occasions many of the contractors removed their nets from the water to reduce the chances of losing nets. This action resulted in only one net reported as missing during the season. The net at North Wollongong was reported missing on 24 March 2021 and was subsequently found and removed from the water on 28 March 2021.

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, five people were employed as 'observers' for the eight months of the SMP: two observer positions being full-time (one permanent and one full-time temporary); and three 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 three casual observers covering the Sydney North, Sydney Central, Sydney South and Illawarra regions. The full-time observers were not restricted to specific regions and were used across all regions as required and when available, but this was kept to a minimum due to Covid-19 restrictions on cross-regional movements.

Observer coverage was significantly reduced over the last two months in the Sydney South and Illawarra regions after the two casual observers covering these regions obtained permanent positions elsewhere. 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.

There was no formal training day for observers or contractors for the 2020/21 meshing season due to Covid-19 restrictions on travel and group gatherings. The retention of the four observers (two fulltime and two casual) from the 2019/20 meshing season meant that the observer program already had experienced observers ready to commence at the start of the season. One new casual observer was added to the team to assist in covering the Sydney region and reduce travel across regions for the other observers. This new casual employee was supervised by the Senior Shark Meshing Observer until he was satisfied that they could conduct observer duties independently and was subsequently given the responsibility to primarily cover the Sydney South region.

Number of Observer Days

Observers were present for 39% of all net inspections by contractors during the 2020/21 season. A breakdown by region of observer coverage is provided in Table 2.

Table 2 Total net inspections by region during 2020/21 meshing season.

Meshing Region	No. of net inspections	No. of net inspections with observer present	Percentage of net inspections observed
Hunter	720	278	39%
Central Coast North	720	252	35%
Central Coast South	728	308	42%
Sydney North	728	350	48%
Sydney Central	832	368	44%
Sydney South	832	276	33%
Illawarra	728	235	32%
Total	5288	2067	39%

Outcomes of Observer Program

Outcomes of the Observer Program for the 2020/21 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 are uploaded and stored on the Fisheries Compliance Database. 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 154 biological samples. No whole animals were collected during 2020/21, as transport and storage would have required a large amount of travel across various regions which was not advised during Covid-19 restrictions.

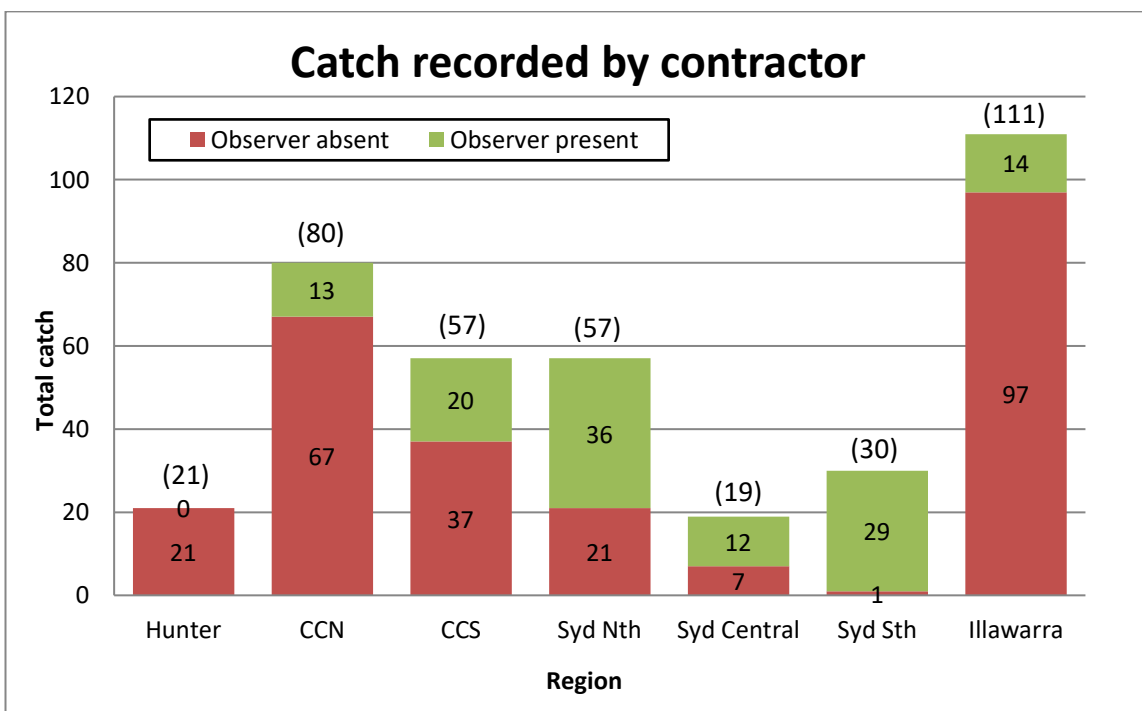


Figure 2 Catch recorded by contractor when observer present or absent during 2020/21.

1.3 Compliance Plan

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

Audit and Compliance Checks in 2020/21

Compliance inspections were undertaken prior to and during the 2020/21 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 22 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 2020/21.

Region	Pre-season		Meshing season		Inspection Count	% Comply
	comply	non-comply	comply	non-comply		
Hunter	16	-	-	-	16	100%
Central Coast North	16	-	-	-	16	100%
Central Coast South	16	-	4	-	20	100%
Sydney North	16	-	8	-	24	100%
Sydney Central	16	-	16	1	33	97%
Sydney South	16	-	1	-	17	100%
Illawarra	16	-	3	-	19	100%
Total	112	0	32	1	145	99%

Contractors are required to check their set nets every 72 hours weather permitting. This commitment was met on most occasions with 91% 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. 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 was 100%. Minor issues detected and rectified on the spot during the pre-season inspections of the contractors' nets were not recorded as non-compliance issues. The one non-compliance issue recorded by Fisheries Officer's during the meshing season (Table 3) involved the markings on a float not being visible due to the float being dirty.
- The compliance rate for dolphin pinger and whale alarms presence and their placement on nets was 100%.
- The overall compliance rate by contractors was 99% 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 99% compliance rate includes pre-season 'on land' net inspections, before the nets were set. A small number of minor issues were detected and immediately rectified during pre-season inspections and therefore not reported as non-compliance issues.
- The contractors must comply with a range of specifications under the contract outside of routine overt and covert inspections. During the 2020/21 meshing season all contractual requirements were met by all contractors, with no instances of non-compliance detected.

All non-compliance issues in 2020/21 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 2020/21.

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 <i>Activities in 2020/21:</i> none Provided in the 2010/11 Report.
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. <i>Activities in 2020/21:</i> Following Covid-19 related travel restrictions and inability to collect entire carcasses of species of research interest, enhanced effort to collect a variety of project-related samples from caught animals was implemented (e.g. eyes from Lamnid sharks), There was no change in species identification methods as onboard photography for species confirmation has proved efficient and effective. <i>Previous:</i> 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. <i>Activities in 2020/21:</i> No new relevant identification resources were identified, so no updates to the contractor and observer materials were implemented. <i>Previous:</i> 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. Weekly catch reporting to the Shark Meshing Program Supervisor continued in the 2020/21 meshing season. 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 2020/21:*

The most important training required for the 2020/21 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 and pop-up satellite archival tags (PSATs) on Grey Nurse Sharks. PSATs and acoustic tags were supplied to each contractor to ensure every opportunity of deployment on sharks released alive. The release of 38% of animals alive from the SMP nets highlights the relevance and importance of protocol reviews. Disentanglement procedures for non-target species from DPIE-EES were reviewed, discussed with observers, and 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 2020/21:*

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 Hammerhead Shark 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 2020/21:*

Travel restrictions related to Covid-19 in NSW precluded the ability to hold the annual pre-season training day. Fortunately, all but one of the observers and all seven SMP contractors were ongoing appointments. The one new observer is based at the same office as the senior shark scientist so received verbal one-on-one training in species identification from the scientist and the senior shark meshing observer.

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 2020/21:

Sixty White Sharks were tagged by DPI Fisheries between 1 Sept 2020 and 30 April 2021, **seven of which were animals released from the SMP nets** and the rest from SMART drumlines as part of the NSW Shark Program within which the SMP now sits. All of these seven SMP-released White Sharks were subsequently detected on acoustic listening stations administered through DPI Fisheries and/or the IMOS Animal Tracking Facility. One of these SMP-released White Sharks was fitted with a Pop-up Satellite Archival Tag (PSAT) which released from the shark after 1 month suggesting that the shark survived capture and release from the shark nets.

Analysis of movements from 77 satellite-tagged juvenile and sub-adult White Sharks indicated that they use the whole of the continental shelf down to depths of 350m on the continental shelf (**Lee et al. 2021**). Sharks were present over a wide range of sea surface temperatures (SSTs; 10-27°C) with the highest probability occurring at around 20°C. Sharks were more likely to exhibit area-restricted movement when SST was 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). These results imply that White Shark presence and dispersal may be linked, perhaps via prey distribution, to oceanic conditions. Identification of these conditions for nearshore distribution and abundance of White Sharks may assist as an input into decisions on the spatial and temporal allocation of shark bite mitigation measures.

Acoustic tracking of a much larger sample size of 444 immature White Sharks over three years using the 21 VR4G real-time listening stations deployed under the NSW Shark Management Strategy, however, suggested that White Sharks tolerate episodic changes in environmental conditions and that movement patterns are likely related to currently undetermined, location-specific habitat characteristics or biological components, such as local currents, prey availability or competition (**Spaet et al. 2020a**).

A third Australian study combined datasets for 103 dual-tagged immature White Sharks (i.e. carrying both satellite and acoustic tags) over 12 years and showed that these sharks travel huge distances over ~45° of latitude and ~72° of longitude ranging from Papua New Guinea to sub-Antarctic waters and to Western Australia (**Spaet et al. 2020b**). Although no clear size and sex-based differences in movement patterns and habitat preferences could be identified, eight of the ten sharks showing long-distance movements were males, despite the five largest tagged sharks being females. This corroborates studies suggesting male-biased dispersal elsewhere in the world, while females appear to bias for inshore habitats (Spaet et al. 2020b) which may have implications for the population impact of the SMP which has historically caught an almost even ratio of males and females (Reid et al. 2011).

A study off California (North Pacific Ocean) has identified a spatial shift in distribution of juvenile White Sharks linked to climate change induced variations in sea temperatures of the southern California Current. Additional to this poleward shift, thermally suitable habitat for juvenile sharks declined 223.2 km⁻¹ from 1982 to 2019 (**Tanaka et al. 2021**). The East Australian Current is the most rapidly changing boundary current in the world (Wu et al. 2012) implying that we could expect similar changes in abundance and distribution on the east coast of Australia leading to higher numbers of juvenile White Sharks in the SMP region.

Tracking the movements of White Sharks along NSW beaches with drones found that they have relatively predictable patterns of slow (~2.2km.hr⁻¹) movement parallel to the shoreline and typically behind the surfbreak (**Colefax et al. 2020**).

Previous:

DPI Fisheries works 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 show 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 be resident in the Stockton Bight region from mid-August through early January, and resident in Victoria from January through April. A post-doctoral scientist working with the DPI Fisheries shark scientists analysed White Shark movement data with CSIRO (Bruce et al., 2019). These analyses will be

Level 2: Data collection and review of existing data

incorporated in the analysis of White Sharks fitted with acoustic tags and released from SMART drumline trials as part of the NSW Shark Management Strategy (SMS), and White Sharks tagged and released from the SMP. In September 2015, DPI Fisheries initiated a new \$16 million Shark Management Strategy (SMS) which incorporates tagging and tracking of the three target shark species (White, Tiger and Bull Sharks). More than 600 White Sharks have been tagged since August 2015. 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.

2.3.2: Review existing data on other species (e.g. Tiger Shark, Bull Shark).*Activities in 2020/21:*

There have been no substantial increases in knowledge or research on Tiger Sharks occurring in NSW during 2020/21 that would affect the operations 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 northern NSW, but only one Tiger Shark and one Bull Shark were alive, tagged, and released from the shark nets during the 2020/21 season.

During the 8-month reporting period 33 Tiger Sharks were tagged with acoustic tags as part of the broader NSW Shark Program. A total of 175 Tiger Sharks have now been acoustically tagged by DPI Fisheries. Two individuals were also equipped with pop-up satellite archival tags (PSATs). To date 16 Tiger Sharks carrying PSATs will provide data about movements and potential risk to bathers in NSW waters.

Bull Shark movement research continued in 2020/21 with one individual acoustically tagged during the meshing season, eight were internally tagged by DPI Fisheries scientists in Sydney Harbour, and 15 were externally tagged following release from SMART drumlines. A total of 181 Bull Sharks are currently acoustically tagged by DPI Fisheries.

The data has been used to determine the factors driving Bull Shark movements, leading to publication of three scientific manuscripts during the past year: One publication combined acoustic telemetry and network analyses to investigate latitudinal and seasonal linkages of 73 sub-adult and adult Bull Sharks tagged in the Sydney and Townsville Reefs regions. 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.

The second publication highlights the value of telemetry studies in delineation of shark population structure. Here 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**).

The third publication used SMP and commercial catch data for Bull Sharks, and 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 overlaid on CSIRO predicted change in oceanographic conditions along the east coast of Australia subsequently indicated that 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

Level 2: Data collection and review of existing data

bite.

Previous:

There have been no substantial increases in knowledge or research on Tiger Sharks occurring in NSW that would affect the operations of the SMP; however, SMP samples did contribute to the first study of population structure and connectivity of Tiger Sharks for the east coast of Australia (Holmes *et al.*, 2017). This study indicated that there was no genetic structuring within the Indo-Pacific Ocean basin. Small annual Tiger Shark catch in the SMP is unlikely to substantially affect the viability of this large homogeneous east Australian population. These results 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). A manuscript examining environmental effects on shark catches in the SMP has been published in the scientific journal Marine Ecology Progress Series (Lee *et al.*, 2018) but Tiger Shark catches were too small to develop mathematical models of their catch in relation to seasonal, spatial, or environmental correlates.

DPI Fisheries has continued Bull Shark movement research using acoustic tags and over 700 listening stations established along the NSW coast. Results have been displayed at both the Sydney Aquarium and National Maritime Museum and have been presented at various scientific symposia and workshops and in the public media via several presentations and television documentaries. 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). The number of tagged Bull Sharks is increasing as a result of the tagging research component of the Shark Management Strategy with all tagged target sharks being reported in real-time via the 21 VR4G listening stations moored off beaches along the coast of NSW. Analyses of tagged Bull Shark movements and habitat use in relation to life history stage and environmental conditions will considerably enhance our understanding of factors affecting bather safety from potential shark interactions.

In an effort to increase cross-jurisdictional collaboration and understanding of large-scale movements of Bull Sharks, DPI Fisheries scientists have collaborated with Queensland shark scientists tagging and tracking Bull Sharks. 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).

2.3.3: Review existing data on spatial and temporal movements of non-target species.*Activities in 2020/21:*

Samples and data from the SMP contributed to substantial new information on Hammerhead Sharks for the east coast of Australia. The Great Hammerhead Shark (*Sphyrna mokarran*) is the largest hammerhead species and is also the most exploited throughout its global range leading to its protection under various international agreements. However, very little is known about its ecology. Using samples from historical SMP and SMS-caught Great Hammerhead Sharks it was determined that while there are subtle, age-related variations in diet, Great Hammerheads are apex predators, consistently preying on other sharks and benthic rays, but with a preference for the more pelagic Australian Cownose Ray during summer. Neither teleosts, cephalopods, nor crustaceans are important prey (Raoult *et al.*, (2019). Their preference for benthic and pelagic elasmobranchs, combined with their large size mean the Great Hammerhead is an important link between coastal food webs off eastern Australia. The geographic range of Great Hammerhead Sharks was subsequently investigated via stable isotope analysis using these same samples. Two methods for modelling latitudinal relationships between stable isotopes were used, and both produced similar results, suggesting the Great Hammerhead Sharks frequently observed off NSW are not resident, but rather spend most of their time off Queensland (Raoult *et al.*, 2020).

SMP catch data contributed to a draft National Stock Assessment for Scalloped Hammerhead Sharks (*Sphyrna lewini*) (Saunders *et al.*, 2021).

Level 2: Data collection and review of existing data

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**). The assessment was recently independently reviewed and is undergoing revision at the time of this report. The extremely low numbers of Scalloped Hammerhead Shark caught in the SMP are therefore insignificant in potentially impacting the Indo-Pacific stock of this species.

Previous:

The scientific literature on spatial and temporal movements of non-target species is reviewed where possible given available resources. 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). This new information will not affect the operation of the SMP.

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.

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

Region	Shark sightings								
	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Hunter	21	33	60	28	8	1	4	18	32
Central Coast	12	38	29	24	1	3	0	8	12
Sydney	46	46	46	58	8	1	9	25	45
Illawarra	3	7	4	7	0	1	0	3	11
Total	82	124	139	117	17	6	13	54	100

A decline in the number of shark sightings in the SLS NSW database between 2016/17 and 2018/19 reflects a change in the way SLS NSW records shark sightings on patrolled beaches. 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. As a result, SLS NSW started recording only sightings where a lifesaver or lifeguard was able

Level 2: Data collection and review of existing data

to confirm the presence of a shark by a second sighting.

The increased number of shark sightings for the period in this report reflects the use of drones by SLS NSW to conduct aerial surveillance over patrolled beaches in NSW as part of the three years of trials for this technology. This increase is unlikely to represent an increase in sharks along NSW beaches, but more likely to highlight the value of drone aerial surveillance in detecting sharks (Butcher *et al.*, 2019).

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 11 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 11 years averaged over 5 million people per annum. The drop in beach attendance in 2019/20 may be related to reduced outdoor activities and travel in the latter months of this period 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.

Visitations											
Region	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Hunter	152,788	286,798	360,549	741,444	690,343	728,803	764,529	729,592	714,965	656,794	619,769
Central Coast	295,034	412,764	1,095,724	1,260,034	1,241,243	1,145,309	1,173,890	736,021	1,182,741	943,798	1,312,599
Sydney	2,051,599	1,783,692	2,483,113	3,488,837	3,897,491	3,681,255	3,743,419	3,526,008	4,679,380	2,970,793	3,255,870
Illawarra	82,543	105,273	132,628	304,703	392,447	363,194	380,299	343,473	297,351	252,013	436,677
Total	2,581,964	2,588,527	4,072,014	5,795,018	6,221,524	5,918,561	6,062,137	5,335,094*	6,874,437	4,823,398	5,624,915

* 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.

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 2020/21:

Level 2: Data collection and review of existing data

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.

Previous:

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 2020/21:*

The DPI Fisheries senior shark scientist contributed to a review of non-lethal alternative systems to shark nets for mitigating unprovoked shark bite on bathers and surfers at ocean beaches (**McPhee et al., 2021**). This review highlights that deployment of 'new' technologies needs to be strategic with sufficient knowledge of their likely effectiveness under local conditions, but that there is no single approach universally applicable to ocean beaches where unprovoked shark bite occurs (McPhee et al., 2021).

The NSW Shark Management Strategy has continued trialling alternative non-lethal shark bite mitigation measures, including SMART drumlines which are designed to alert contractors as soon as a shark is captured on the gear (<https://www.dpi.nsw.gov.au/fishing/sharks/management/smart-drumlines>), thereby reducing marine wildlife mortalities whilst providing bather protection. Analysis of 24 month catch data from the six locations where SMART drumlines were trialled indicates that White Sharks were the most abundant animals captured, with catch increasing if using a 3.2m (mid-water) trace rather than when using shorter (1.6m) traces, while catch of non-target animals was consistently low (**Tate et al., 2021**). These results provide opportunity to improve current SMART drumline practices and enhance their efficacy as a bather protection mechanism.

Previous: refer to the 2019/20 Annual Performance Report

2.5.3: Use the outcomes of those reviews to trial gear-related modifications of the SMP.*Activities in 2020/21:*

No further trials of SMART drumlines were undertaken within the SMP region during the 2020/21 period.

The NSW Shark Program for 2020/21 continued to support the pilot training and use of drones at beaches patrolled by SLS NSW). Thirty-four beaches were provided aerial shark surveillance via certified SLS NSW drone operators over the 2020/21 summer holidays.

Previous: refer to the 2019/20 Annual Performance Report

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 2020/21 season.

2.6.2: Develop alternative approaches to standardised soak-times.

Level 2: Data collection and review of existing data

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
<p>3.1 Research needs identified (e.g. environmental impacts of shark meshing).</p>	<p>Status: Ongoing</p> <p>3.1.1: Distribution, abundance, biology and ecology of target species affected by the SMP.</p> <p><i>Activities in 2020/21:</i></p> <p>The University of Sydney PhD on White Shark foraging ecology continued to collect stomach and isotope samples from SMP-caught animals. Analysis of stomach contents have been completed. Fish were the predominant prey for juvenile White Sharks in NSW, with both males and females preying more on bottom-dwelling species, but there was sexual differentiation in preferred prey with males feeding more on rays (Grainger et al., 2020). Inclusion of larger prey, such as dolphins and sharks, increased as White Shark size increased; however, mammals were already included from 2.2m total length (Grainger et al., 2020). This implies that even relatively small White Sharks may consider interacting with humans if they mistake the human for potential prey.</p> <p>One of the PhDs linked to the NSW Shark Management Strategy has been investigating the role of cetaceans, especially whales, in the abundance and distribution of White Sharks. Analysis of tracks from individual White Sharks moving off NSW beaches indicated that there may be an elevated risk of shark interactions with water users in the vicinity of stranded whale carcasses (Tucker et al., 2021). White Sharks were larger, swam faster and showed more sinuous tracks in the vicinity of whale carcasses (Tucker et al., 2021).</p> <p>The Macquarie University PhD entitled ‘Sharks in the Anthropocene’ includes research into determining drivers for movements of Bull and Tiger Sharks using telemetry, plus the use of isotopes to determine ontogenetic changes in foraging strategies of Bull Sharks. Stable isotope analysis of Bull Sharks caught in the commercial shark fishery in the Clarence River (northern NSW) highlighted the importance of using fast-turnover tissues (e.g. liver) when trying to determine the diet and trophic ecology of juvenile sharks as maternal signatures were still detected in low-turnover tissues (e.g. muscle) for up to 3.5 years after birth (Niella et al., 2021a). Understanding the trophic role for wide-ranging species, such as Bull Sharks, will provide better insight into the environmental impacts of the SMP. Off Reunion Island, colleagues who invented and solely use SMART drumlines to reduce shark attacks (see Guyomard et al., 2019), have acoustically tagged the species they release. This provided the opportunity to investigate the ‘catchability’ of Bull and Tiger Sharks in this bather protection program and how the movements of these two sharks were affected by biotic and abiotic conditions including other teleost predators and the presence of MPAs. The teleosts were found more frequently inside the MPA but there was no clear pattern for sharks (Niella et al., 2021b). As per the SMP region, seasonality was observed for Bull Sharks off Reunion Island, but interannual variation in catch rates suggested that juvenile Tiger Sharks might be replacing Bull Sharks in nearshore habitats (Niella et al., 2021b). These results highlight the requirement to maintain accurate catch records from bather protection programs and to keep collecting samples from caught animals to enable determination of trophic changes that may only be evident over long time-scales, especially in relation to predicted changes in nearshore waters due to climate change.</p> <p>A Macquarie University Master of Research project was completed examining ontogenetic changes in Bull Shark tooth morphology and relating these to foraging ecology (Goodman, 2021).</p> <p>Parasite samples from sharks caught in the SMP, plus live animals caught in DPI Fisheries research activities, continue to contribute to a PhD through the University of Sydney.</p>

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)

Previous: refer to the 2019/20 Annual Performance Report

Distribution, abundance, biology and ecology of non-target species affected by the SMP.

Activities in 2020/21:

No whole carcasses of animals caught in the SMP were collected during the 2020/21 period.

No necropsies of marine mammals and sea turtles caught in the SMP were therefor conducted during the 2020/21 SMP season.

No deceased Grey Nurse Sharks were retrieved whole to contribute to the ongoing DPI Fisheries research program on this species.

Historically deceased Australian Cownose rays (*Rhinoptera neglecta*) and Southern Eagle Rays (*Myliobatis australis*) contributed to completion of a Masters in Research project through Macquarie University (Chan, 2021).

Four Grey Nurse Sharks and one White Shark released alive from the shark nets were tagged with pop-up satellite archival tags (PSATs) (see table below). Of the three sharks that are known to have survived, all three tags were recovered and will provide full track data to be incorporated into the database of historical DPI Fisheries Grey Nurse Shark projects.

Summary table of PSAT deployments on released sharks

Date Tagged	Tag #	Tag Location	Species	Date Tag Released	Location Tag Released	Result
21.09.20	84922	Stockton	Carcharodon carcharias	21.10.20	Stockton Beach	Tag not recovered - time at depth varied significantly over 30 days, individual survived . Pin intact, anchor dislodged possibly due to shallow tag application
11.11.20	84924	Stockton	Carcharias taurus	05.01.21	Broughton Island	Tag recovered - time at depth varied significantly over 55 days, individual survived . Pin intact, anchor dislodged possibly due to shallow tag application
04.12.20	84918	North Wollongong	Carcharias taurus	01.02.21	Kendall Beach	Tag recovered - time at depth varied significantly over 59 days, individual survived . Pin intact, anchor dislodged possibly due to shallow tag application
21.12.20	84917	Maroubra	Carcharias taurus	28.01.21	Monument Beach	Tag recovered (partial archive retrieved) - partial data suggests that depth varied significantly over 38 days, individual likely survived . Tag sent to manufacturer for full archive download
20.02.21	84923	Umina	Carcharias taurus	-	-	Still attached to shark therefore likely post-release survival

Previous: refer to the 2019/20 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 2020/21:

No new collaborations for genetic analysis of SMP-collected samples were established during the past year, but samples were collected to contribute to the CSIRO-led studies using next-of-kin genetics (cousins and aunts/uncles) to determine whether the east Australian population of White Sharks is stable, increasing or decreasing. Similarly, genetic samples for Broadnose Sevengill Sharks were collected for incorporation into a larger analysis of

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)	
	<p>population structure of this species in Australia. <i>Previous:</i> refer to the 2019/20 Annual Performance Report</p> <p>3.3.2: Develop SMP DNA library. A shark DNA library incorporating material from the SMP has been developed by DPI Fisheries and currently contains over 1,000 samples. Accessioning of new material from the SMP is ongoing. For further details, refer to the 2019/20 Annual Performance Report</p>
3.3 Conduct scientifically-based shark attack risk assessment.	<p>Status: Ongoing</p> <p>3.3.1: Compile data from research relating to identified high-risk elements. <i>Activities in 2020/21:</i> The NSW Shark Management Strategy (SMS) has initiated substantial research effort into better understanding factors influencing shark attacks (https://www.dpi.nsw.gov.au/fishing/sharks). 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). A review of alternative systems to shark nets has been conducted as part of the NSW SMS (Cardno, 2015) and updated for publication in a peer-reviewed scientific journal (McPhee <i>et al.</i>, 2021). A University of Sydney Master in Marine Science student has completed an analysis of NSW shark attacks which is being prepared for publication. <i>Previous:</i> 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.</p> <p>3.3.2: Apply standard risk assessment model (i.e. AS/NZ: 4360). <i>Activities in 2020/21:</i> 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 will likely start in the second half of 2021. <i>Previous:</i> refer to the 2019/20 Annual Performance Report</p>
3.4 Conduct morphometrics on sharks and other species caught in the SMP.	<p>Status: Ongoing</p> <p>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.</p>

Level 3 Establish/support collaborative research (e.g. CSIRO, other government agencies and universities)

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 – Outcomes for 2020/21.

SMP Monitoring Program – Outcomes for 2020/21													
1. Shark Meshing Contractor Catch Report	All contractors provided daily reports of catches by email and/or telephone and submit a monthly catch data summary sheet with all details of meshing operations and catch during that reporting period.												
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	<p>The tagging program continued in 2020/21, with tagging of 17 of the 34 sharks released alive from the SMP nets. Tagged sharks included; 6 White Sharks (3 tagged with acoustic tags and 1 with a mini-PSAT); 5 Bronze Whalers; 4 Grey nurse Sharks (4 with mini-PSATs); 1 Shortfin Mako Shark; and 1 Tiger Shark. Prior to 2019 DPI Fisheries protocols did not support the tagging of Grey nurse Sharks, however, with the purchase of mini-PSATs the tagging of Grey nurse Sharks commenced in February 2019. Twelve Grey nurse Sharks released from the shark nets have been tagged with mini-PSATs to date.</p> <p>No marine turtles were tagged in 2020/21. For further details refer to Appendix 1.</p>												
4. Routine DNA sampling and verification	<p>Routine DNA sampling of 170 dead animals was undertaken in 2020/21. No whole animals were taken during the 2020/21 season to reduce cross-regional travel during the Covid-19 pandemic.</p> <p>Sampling DNA from live sharks was not undertaken in 2020/21.</p> <p>Species identification was not genetically verified during 2020/21 following the Australian Museum analysis indicating 100% correct identification of hammerhead sharks (Frankham, 2017). Two Leatherback turtle samples were sent to the Australian Museum on behalf of the NSW National Parks & Wildlife Service.</p>												
5. Shark vertebral and other tissue samples. Historically no samples have been taken from Skates and Rays	<p>Biological samples were taken from 154 (all dead) of the 231 animals deceased in the 2020/21 season, and are listed below:</p> <table border="1"> <thead> <tr> <th>Common Name</th> <th>Sample Type and Number</th> <th>Total Number Sampled/Total Number Dead</th> </tr> </thead> <tbody> <tr> <td>Australian Angel Shark</td> <td>Genetics & vertebrae = 1</td> <td>1</td> </tr> <tr> <td>Australian Cownose Ray</td> <td>Genetics & vertebrae = 2</td> <td>5</td> </tr> <tr> <td>Broadnose Sevengill Shark</td> <td>Genetics & vertebrae = 4</td> <td>5</td> </tr> </tbody> </table>	Common Name	Sample Type and Number	Total Number Sampled/Total Number Dead	Australian Angel Shark	Genetics & vertebrae = 1	1	Australian Cownose Ray	Genetics & vertebrae = 2	5	Broadnose Sevengill Shark	Genetics & vertebrae = 4	5
Common Name	Sample Type and Number	Total Number Sampled/Total Number Dead											
Australian Angel Shark	Genetics & vertebrae = 1	1											
Australian Cownose Ray	Genetics & vertebrae = 2	5											
Broadnose Sevengill Shark	Genetics & vertebrae = 4	5											

	Bronze Whaler	Genetics & vertebrae = 20	31
	Bull Shark	Genetics & vertebrae = 9	9
	Common Blacktip	Genetics & vertebrae = 5	5
	Common Dolphin	Genetics & vertebrae = 5	5
	Dusky Whaler	Genetics & vertebrae = 4	4
	Eastern Angel Shark	Genetics & vertebrae = 1	1
	Great Hammerhead	Genetics & vertebrae = 1	1
	Green Turtle	Genetics & vertebrae = 2	8
	Grey nurse Shark	Genetics & vertebrae = 3	3
	Leatherback Turtle	Genetics & vertebrae = 2	2
	Olive Ridley Turtle	Genetics & vertebrae = 1	1
	Pigeye Shark	Genetics & vertebrae = 1	1
	Shortfin Mako	Genetics & vertebrae = 11	14
	Silky Shark	Genetics & vertebrae = 1	1
	Smooth Hammerhead	Genetics & vertebrae = 47	58
	Southern Eagle Ray	Genetics & vertebrae = 8	30
	Spinner Shark	Genetics & vertebrae = 3	4
	Thresher Shark	Genetics & vertebrae = 1	2
	Tiger Shark	Genetics & vertebrae = 5	5
	White Shark	Genetics & vertebrae = 16	17
	Wobbegong	Genetics & vertebrae = 1	1
	TOTALS	154 samples	214/231

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 were two fatalities and two serious injuries due to shark interactions in 2020/21 in NSW waters, and another four instances where surfers suffered minor injuries.

A total of 14 shark interactions were reported and investigated in NSW waters during 2020/21. These interactions included: five interactions with White Sharks (Wilson Headland – Woolli (fatal), Shelly Beach – Port Macquarie, Spectator Rocks – Cabarita Beach, Deadman's Cove – Maroubra, and Tuncurry Beach - Tuncurry (fatal)); two with Bull Sharks (Sharpes Beach - Ballina and Yarrowonga Park – Lake Macquarie); four with a whaler species (Terrigal Point – Terrigal, Birubi Beach – Port Stephens, Queenscliff Beach – Queenscliff, and Town Beach – Port Macquarie); one with a Wobbegong Shark (Birubi Beach – Port Stephens); one with a Grey nurse Shark (Merimbula Beach - Merimbula); and one with an unidentified shark species (Cronulla Beach - Cronulla).

Five of these interactions occurred within the SMP region of NSW coastline. Four of these interactions occurred during the eight-month netting season with two at netted beaches (Cronulla and Queenscliff) and two at non-netted locations (Deadman's Cove, Maroubra, and Yarrowonga Park, Lake

	<p>Macquarie). The other single interaction occurred outside of the meshing season at Terrigal Beach, which would normally be netted during the meshing season.</p> <p>There were also two unverified interactions that reportedly resulted in no injuries to surfers at Tura Beach and Cudgen Beach.</p>
7. Monitor technological advances in shark control measures	A review of alternative, non-lethal, shark management technologies was published in a peer-reviewed scientific journal (McPhee <i>et al.</i> , 2021).
8. Patterns of movements of non-target marine animals	DPI Fisheries continues working with relevant agencies and reviewed available information during 2020/21 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	<p>DPI Fisheries has sourced information from relevant agencies during 2020/21 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.</p> <p>As reported in the 2019/20 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 <i>et al.</i>, 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 <i>et al.</i> (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.</p>
10. Patterns of recreational water contact activities in marine waters	DPI Fisheries has reviewed the information that is available from relevant agencies for 2020/21 (refer to Table 4 section 2.4). DPI Fisheries collected some data on recreational water contact activities at SMP beaches during aerial surveys conducted during 2020/21. 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 2020/21 and DPI Fisheries is not aware of any new information that would necessitate any changes to the SMP.
12. Contractor compliance	One non-compliance issue was reported by Fisheries Officers during the 2020/21 season. This single issue involved the markings on a net float not being visible due to the float being dirty. All non-compliance issues in 2020/21 were resolved to the satisfaction of the DPI Shark Meshing Supervisor (for further details refer to section 1.3 Compliance Plan).
13. Monitor net locations by GPS	GPS location of nets was completed during the 2020/21 meshing season and all nets were in similar positions to those reported in previous years.
14. Shark Meshing Program Annual Performance Evaluation.	The 2020/21 Annual Performance Report provides an evaluation of the performance of the SMP under the Management Plan. No modifications to the SMP are recommended.

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 2020/21.

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 two shark-human interactions at meshed beaches (Queenscliff and Cronulla) during the 2020/21 meshing season. No injuries were sustained during these interactions, so the trigger point was not tripped during 2020/21.

Table 6 Shark interactions in the SMP Region 2008/09 to 2020/21

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	0	0	4	0	4

Note: Interaction information was cross-referenced with shark incident log records held by SLS NSW (Surf Life Saving Manager) and the Australian Shark Attack File.

During the 2020/21 meshing season, there were also seven verified shark-human interactions at unmeshed beaches and one in a coastal lake. Two of those interactions occurred in the SMP region: a spearfisher was uninjured after encountering a White Shark at Deadman's Cove, Maroubra, approximately 2km south of the nearest meshed beach at Maroubra; and a swimmer suffered serious injuries after being bitten by a Bull Shark in Lake Macquarie.

The other six interactions were outside of the SMP area of operation and occurred at: Cabarita Beach, and Sharpes Beach in the Far North Coast region; Town Beach, Port Macquarie in the Mid North Coast region; two interactions at Birubi Beach in the Hunter region; and Merimbula Beach in the South Coast region.

There were two unsubstantiated shark interactions reported through third party sources. These incidents could not be confirmed by DPI, SLS NSW, NSW Police or local councils.

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 375 animals were reported entangled in the nets during the period from 1 September 2020 to 30 April 2021 (Table 7), and that 335 (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.

Sixty-one of those 375 interactions were with threatened or protected species, including:

- 24 White Sharks (17 dead, 7 released alive)
- 9 Grey Nurse Sharks (3 dead, 6 released alive)
- 8 Green Turtles (8 dead)
- 5 Common Dolphins (5 dead)
- 5 Loggerhead Turtles (5 released alive)
- 2 Humpback Whales (2 released alive)
- 2 Leatherback Turtles (2 dead)
- 2 Hawksbill Turtles (1 dead, 1 released alive)
- 1 Great Hammerhead Shark (dead)
- 1 Olive Ridley Turtle (dead)
- 1 Australian Fur Seal (dead)
- 1 unidentified dolphin species (dead)

In addition, there were 298 interactions with other non-target species, including:

- 137 Rays (35 dead, 102 released alive)
- 60 Smooth Hammerheads (58 dead, 2 released alive)
- 38 Bronze Whalers* (31 dead, 7 released alive)
- 15 Shortfin Makos* (14 dead, 1 released alive)
- 8 Broadnose Sevengill Sharks* (5 dead, 3 released alive)
- 6 Common Blacktips* (5 dead, 1 released alive)
- 6 Longtail Tuna (dead)
- 4 Dusky Whalers* (dead)
- 4 Angel Sharks (2 dead; 2 released alive)
- 4 Spinner Sharks* (dead)
- 3 Port Jackson Sharks (released alive)
- 3 Frigate Mackerel (dead)
- 2 Thresher Sharks (dead)
- 2 Mulloway (dead)
- 1 Silky Shark* (dead)
- 1 Wobbegong (dead)
- 1 Pigeye Shark (dead)
- 1 unidentified whaler shark* (dead)
- 1 Yellowtail Kingfish (dead)
- 1 Australian Bonito (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 37%, followed by Smooth Hammerheads at 16%, the collective group of 'target sharks' (Bull, White, and Tiger Sharks) accounted for approximately 11%, and Grey Nurse Sharks accounted for 2.4%.

The trigger point for the objective of '*minimising the impact on non-target species and threatened species*' was not tripped in 2020/21.

Table 7 Total SMP entanglements for the 2020/21 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												
<i>Galeocerdo cuvier</i>	Tiger Shark					1		5	1	5	6	1.6%
<i>Carcharodon carcharias</i>	White Shark	3	8	1	4		1	7	7	17	24	6.4%
<i>Carcharhinus leucas</i>	Bull Shark		3	3	2			2	1	9	10	2.7%
Non-Target Sharks and Rays												
<i>Notorynchus cepedianus</i>	Broadnose Sevengill			1	1	1		5	3	5	8	2.1%
<i>Carcharhinus brachyurus</i>	Bronze Whaler	6	9	6	2		2	13	7	31	38	10.1%
<i>Carcharhinus obscurus</i>	Dusky Whaler		2	1		1				4	4	1.1%
<i>Isurus oxyrinchus</i>	Shortfin Mako		2	4	1	1	2	5	1	14	15	4.0%
<i>Carcharhinus falciformis</i>	Silky Shark			1						1	1	0.3%
<i>Carcharhinus brevipinna</i>	Spinner Shark	2	1					1		4	4	1.1%
<i>Carcharhinus sp.</i>	unidentified whaler sp.							1		1	1	0.3%
<i>Carcharhinus limbatus</i>	Common Blacktip		1	2	1	1		1	1	5	6	1.6%
<i>Squatina australis</i>	Australian Angel Shark							3	2	1	3	0.8%
<i>Squatina albipunctata</i>	Eastern Angel Shark						1			1	1	0.3%
<i>Heterodontus portusjacksoni</i>	Port Jackson Shark				1		1	1	3		3	0.8%
<i>Sphyrna zygaena</i>	Smooth Hammerhead	3	21	10	10	3	6	7	2	58	60	16.0%
<i>Sphyrna mokarran</i>	Great Hammerhead				1					1	1	0.3%
<i>Alopias vulpinus</i>	Thresher Shark		1					1		2	2	0.5%
<i>Carcharias taurus</i>	Grey nurse Shark	1		2	1			4	6	3	9	2.4%
Orectolobidae	wobbegong				1					1	1	0.3%
<i>Carcharhinus amboinensis</i>	Pigeys Shark				1					1	1	0.3%
<i>Manta birostris</i>	Manta Ray				1			1	2		2	0.5%
<i>Myliobatis australis</i>	Southern Eagle Ray		18	12	18	1	7	39	65	30	95	25.3%
<i>Rhinoptera neglecta</i>	Australian Cownose Ray	2	6	4	4	3	3	11	28	5	33	8.8%
<i>Dasyatis thetidis</i>	Black Stingray			1			1		2		2	0.5%
<i>Dasyatis brevipinna</i>	Smooth Stingray				1				1		1	0.3%
<i>Mobula spp</i>	Devil Ray			1					1		1	0.3%
<i>Aetobatus ocellatus</i>	Whitespotted Eagle Ray			1	1		1		3		3	0.8%
Non-Target Marine Mammals, Reptiles and Birds												
<i>Delphinus delphis</i>	Common Dolphin				1	2	1	1		5	5	1.3%
	unidentified dolphin					1				1	1	0.3%
<i>Arctocephalus pussillus doriferus</i>	Australian Fur Seal						1			1	1	0.3%
<i>Megaptera novaeangliae</i>	Humpback Whale	1						1	2		2	0.5%
<i>Chelonia mydas</i>	Green Turtle	1	3	2		2				8	8	2.1%
<i>Caretta</i>	Loggerhead Turtle	1			2	2			5		5	1.3%
<i>Dermodochelys coriacea</i>	Leatherback Turtle		1		1					2	2	0.5%
<i>Eretmodochelys imbricata</i>	Hawksbill Turtle	1						1	1	1	2	0.5%
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle						1			1	1	0.3%
Non-Target Finfish												
<i>Seriola lalandi</i>	Yellowtail Kingfish						1			1	1	0.3%
<i>Auxis thazard</i>	Frigate Mackerel		3							3	3	0.8%
<i>Thunnus tonggol</i>	Longtail Tuna			4	2					6	6	1.6%

<i>Argyrosomus japonicus</i>	Mulloway			1						1			2	2	0.5%
<i>Sarda australis</i>	Australian Bonito		1										1	1	0.3%
TOTAL		21	80	57	57	19	30	111	144	231	375	100.0%			

Table 8 Non-target and threatened species entanglements¹ for 2010/11 to 2020/21 and trigger point analysis for 2020/21.

Scientific Name	Common Name	Preceding 10 years catch data										Current reporting year 20-21	Endangered 10 Year Annual Average + 2 Std Devs	Vulnerable 10 Year Annual Average + 3 Std Devs	Other species 2 x 10 Year Annual Avg in 2 consecutive years	Trigger tripped (True/False)
		10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20					
Endangered																
<i>Carcharias taurus</i>	Grey Nurse Shark	3	4	9	4	4	19	17	20	9	31	9	30.7	-	-	FALSE
<i>Sphyrna lewini</i>	Scalloped Hammerhead	0	0	1	0	0	0	1	0	1	4	0	3.2	-	-	FALSE
<i>Dermochelys coriacea</i>	Leatherback Turtle	0	0	0	2	0	2	1	2	4	0	2	3.8	-	-	FALSE
<i>Caretta</i>	Loggerhead Turtle	0	0	1	0	0	4	1	0	6	1	5	5.4	-	-	FALSE
<i>Dugong dugon</i>	Dugong	0	0	0	0	0	0	0	0	0	0	0	0.0	-	-	FALSE
<i>Eudyptula minor</i>	Little Penguin	0	0	0	0	0	1	0	0	0	0	0	0.7	-	-	FALSE
Vulnerable																
<i>Sphyrna mokarran</i>	Great Hammerhead	0	0	0	0	0	1	1	3	1	1	1	-	3.5	-	FALSE
<i>Carcharodon carcharias</i>	White Shark	6	15	3	6	10	31	22	26	17	42	24	-	55.4	-	FALSE
<i>Chelonia mydas</i>	Green Turtle	5	1	0	10	4	13	6	9	8	8	8	-	18.5	-	FALSE
<i>Megaptera novaeangliae</i>	Humpback Whale	0	0	2	1	0	0	0	0	0	0	2	-	2.3	-	FALSE
Pinnipedia	Seals	0	0	0	0	0	0	1	0	0	0	1	-	1.0	-	FALSE
Procellariidae	Shearwater	0	0	0	0	0	1	0	0	0	0	0	-	1.0	-	FALSE
Other Protected or Non-Target Species																
<i>Pseudorca crassidens</i>	False Killer Whale	0	0	0	0	0	0	0	0	0	0	0	-	-	0.0	FALSE
<i>Balaenoptera acutorostrata</i>	Minke Whale	0	0	0	0	0	0	0	0	0	0	0	-	-	0.0	FALSE
<i>Tursiops aduncus</i>	Indo-Pacific Bottlenose Dolphin	2	0	0	1	0	9	2	3	2	0	0	-	-	4.0	FALSE
<i>Delphinus delphis</i>	Common Dolphin	0	0	0	4	3	4	2	4	3	7	5	-	-	5.4	FALSE
<i>Squatina spp</i>	Angelshark sp	19	14	3	6	1	9	5	7	7	6	4	-	-	15.4	FALSE
<i>Heterodontus portusjacksoni</i>	Port Jackson Shark	0	4	4	2	0	2	2	3	1	2	3	-	-	4.0	FALSE
<i>Sphyrna zygaena</i>	Smooth Hammerhead	18	36	22	22	42	112	71	78	87	99	60	-	-	117.6	FALSE
<i>Alopias vulpinus</i>	Thresher Shark	3	0	0	0	1	2	1	4	0	4	2	-	-	3.0	FALSE
<i>Eretmochelys imbricate</i>	Hawksbill Turtle	0	0	0	0	1	5	2	2	4	0	2	-	-	2.8	FALSE
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	0	0	0	0	0	0	0	1	0	0	1	-	-	0.2	FALSE
	Rays – combined	60	42	35	90	86	425	166	172	158	179	137	-	-	282.6	FALSE

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

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 (10 years after) 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 12-year period from 2009 - 2021. 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 - 2020/21)
		2016/17	2017/18	2018/19	2019/20	2020/21	
Target sharks*	5%	17%	25%	33%	13%	13%	14%
White Shark	11%	36%	46%	53%	43%	29%	34%
Grey nurse Shark	25%	65%	50%	56%	55%	67%	54%
All hammerheads	0%	0%	1%	1%	1%	3%	1%
Other non-target sharks**	48%	75%	13%	13%	15%	19%	21%
All rays	62%	72%	82%	77%	79%	74%	76%
All dolphins	0%	0%	0%	0%	0%	0%	0%
All turtles	24%	40%	29%	32%	40%	33%	29%
Released/Interactions	223/826	161/373	180/403	157/395	196/480	144/375	1568/3701
Total % released alive	27%	43%	45%	40%	41%	38%	42%

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 2020/21 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 2020/21 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 Grey nurse 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 Grey Nurse 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.

2 Changes to the Management Plan

This Annual Performance Report has not identified a need for any amendments to the Management Plan or JMA but noting 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 Grey Nurse Sharks at the end of the 2018/19 season and continued this throughout the 2020/21 season to determine to post-release survivorship of Grey Nurse Sharks caught in SMP nets.

3 Other Programs Complementing the SMP

3.1 Aerial Surveys

As in previous years, a series of aerial surveys were flown along the coast over the SMP region from Wollongong to Stockton. All surveys were flown by helicopter.

United Aero Helicopters were contracted through an open tender process to conduct one flight on Wednesday, plus each weekend day and all public holidays during NSW School holidays in September/October (hereafter termed 'spring'), December/January ('summer'), and April ('autumn'), a total of 40 potential days flying.

All aircraft were required to have a trained observer on board to collect data via the purpose-built SharkSmart PRO (SSPRO) application for onboard iPads. Using SSPRO, all sightings of marine wildlife are immediately submitted to a linked database, whilst sightings of target species (White, Bull and Tiger, unidentifiable or Whaler Sharks larger than 2m total length) were tweeted and submitted to public via alerts on the SharkSmart App for iOS and Android mobile devices directly from the helicopter in real time. The charter company was required to provide a photographer who was able to take high resolution digital photographs. The specified duties of the aerial surveillance observer were to:

- Use the supplied iPad loaded with the purpose-built SharkSmart PRO App to record all sightings.
- Record all sightings and environmental conditions on the supplied Dictaphone using local beach names to record position of the sightings/change in conditions.
- Record weather and environmental conditions for each flight, including recording the positions where these may have changed.
- If problems are experienced with the SharkSmart PRO App, log all sightings using the supplied hand-held GPS and record all sightings data, including the GPS waypoint, using the Dictaphone.

- Provide timely and adequate records of sightings to DPI, SLS NSW and the Australian Professional Ocean Lifeguards Association (APOLA).
- Report all sightings of potentially dangerous situations using the supplied radios preloaded with SLS NSW channels, or by mobile phone if no response using the radio, to the relevant surf lifesaving groups (SLS NSW and APOLA) and DPI contact person.
- Report any sightings of shark meshing contractor vessels or nets out of alignment following storms and heavy seas.

3.1.1 2020/21 Results

To maximise the observers focus on searching during flight, a world-first data recording application for iOS was built in 2016 to allow all sightings to be recorded in real time, including geolocation using the iPad GPS. Observers send sightings of marine wildlife directly into the database or, in the case of large, target shark species, submit in real time alerts to the NSW SharkSmart App (iOS and Android) and Twitter. Analysis of environmental parameters affecting shark and prey abundance and distribution along the NSW coast will be completed; however, as the SMP Annual Performance Report is focused on assessing the ability of this program to provide bather safety, all shark sightings have been assessed independently.

A total of 75 shark sightings of approximately 146 individuals were made between 26 September 2020 and 26 April 2021. No sharks were seen over the seven days flown during the spring school holidays. Eighty-three percent of shark sightings were Hammerhead Sharks, considered harmless. A total of 19 sharks greater than 2m in length were seen during these flights, of which two were Great Hammerhead Sharks, one was a Smooth Hammerhead Shark and five were Greynurse Sharks and therefore not reported 'live' on the SharkSmart App. Four of five sightings of Greynurse Sharks occurred in close proximity to the aggregation site off Marley Beach in the Royal National Park south of Sydney, while the other sighting was off Little Bay.

Twelve target sharks were recorded, including nine White Sharks, one Bull Shark, one Tiger Shark and one $\geq 2\text{m}$ unidentified shark. Three water evacuations occurred during this period.

The sightings of target sharks were spread throughout the SMP region: Four White Sharks at Stockton, one at Red Ochre/Birdie, one at Tuggerah/Lakes Entrance, one at North Avoca, one at Greenhills and one at Marley. The Tiger Shark sighting was off 'Ours' surf break (Cape Solander), whilst the Bull Shark was seen off Little Marley.

There was therefore no area of relatively higher target shark sightings.

3.1.2 Conclusions

As seen in previous years very few target sharks are seen from aircraft within the SMP region. This is attributed to the water turbidity in this region of the NSW coastline which limits the visibility of sharks in the water. This highlights one of the limitations of aerial surveillance using observers searching with the naked eye (Butcher et al., 2019). Deploying drones with hyperspectral cameras in regions with lifesavers/guards may substantially improve the efficacy of aerial surveillance to detect target shark species (Colefax et al., 2021).

Analysis of shark and prey abundance and distribution in relation to biotic and abiotic conditions at the sightings will provide a unique ability to investigate the impact of inter-annual and seasonal variation in environmental conditions on potential risk to bathers due to nearshore shark presence.

3.2 SharkSmart Public Awareness and Education Program

DPI continued ongoing work during 2020/21 on the SharkSmart public awareness and education program including releases of updated versions of the SharkSmart App for iPhone and Android. Although Covid-19 precluded face-to-face interactions with stakeholders, the DPI Fisheries Stakeholder Engagement team, managers and shark scientists held a series of online stakeholder forums with NSW coastal councils, surf lifesaving authorities, the 'Bite Club' (shark bite survivors) and scientists to provide feedback on the results from the five-year Shark Management Strategy. Further information can be found on the DPI website at: <https://www.sharksmart.nsw.gov.au/>

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Appendix 1 – Monthly catch summaries for the 2020/21 meshing season

Appendix 1 Table 1: Detailed Catch Report - 1 September 2020 to 28 September 2020

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Redhead	14/09/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.51	F
	Stockton	21/09/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	1.58	F
	Nobbys	28/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.97	F
Central Coast North	The Entrance	7/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.05	F
	Shelly	12/09/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2.1	F
	Shelly	12/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.17	M
	The Entrance	17/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.8	M
	Blacksmiths	19/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.9	M
	Blacksmiths	22/09/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	3.05	M
	The Entrance	28/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.15	F
Central Coast South	Copacabana	2/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Alive & Released	No	Yes	2.34	M
	Umina	3/09/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.59	F
	Umina	3/09/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.03	M
	Umina	3/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.2	F
	McMasters	4/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	Yes	2.2	F
	Terrigal	11/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.02	F
	Terrigal	11/09/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Alive & Released	No	No	1.9	Unk.
	Terrigal	11/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	Yes	2.2	F
	Umina	14/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	2.38	M
	North Avoca	15/09/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	2.1	F
McMasters	26/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.15	F	
Sydney North	Palm	7/09/2020	<i>Delphinus delphis</i>	Common Dolphin	Dead	Yes	No	2.1	F
	Palm	7/09/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.16	F
	Palm	11/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.12	M
	Mona Vale	15/09/2020	<i>Dasyatis brevicaudata</i>	Smooth Stingray	Alive & Released	No	No	1.4	Unk.
	Mona Vale	15/09/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2.51	M
	Warriewood	17/09/2020	<i>Caretta caretta</i>	Loggerhead Turtle	Alive	No	No	0.76	Unk.
	Warriewood	17/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.41	F
	Warriewood	17/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	Unk.
	Palm	17/09/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.2	M
Warriewood	24/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.2	F	
Sydney South	North Cronulla	2/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	Yes	2.45	F
	North Cronulla	24/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.99	F
	Coogee	24/09/2020	<i>Dasyatis thetidis</i>	Black Stingray	Alive & Released	No	No	0.8	F
	Elouera	28/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.37	F

Illawarra	Thirroul	4/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2	F
	North Wollongong	4/09/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.4	F
	North Wollongong	11/09/2020	<i>Delphinus delphis</i>	Common Dolphin	Dead	Yes	No	1.6	F
	Wattamolla	14/09/2020	<i>Megaptera novaeangliae</i>	Humpback whale	Alive & Released	No	No	5	Unk.
	Garie	14/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	No	No	1.4	F
	Austinmer	14/09/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Alive & Released	No	Yes	3.2	F
	Austinmer	14/09/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Dead	Yes	No	3.1	F
	Austinmer	14/09/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Dead	Yes	No	3.2	F
	Thirroul	14/09/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Dead	Yes	No	3.2	F
	Thirroul	14/09/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Dead	Yes	No	3.2	F
	Thirroul	14/09/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2.8	M
	North Wollongong	16/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	Unk.
	North Wollongong	16/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.7	Unk.
	North Wollongong	23/09/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Austinmer	28/09/2020	<i>Squatina australis</i>	Australian Angel Shark	Dead	Yes	No	0.95	F

Appendix 1 Table 2: Detailed Catch Report - 29 September 2020 to 26 October 2020

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Bar	7/10/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	1.6	M
	Nobbys	9/10/2020	<i>Caretta caretta</i>	Loggerhead Turtle	Alive & Released	No	No	0.95	F
	Stockton	12/10/2020	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Dead	No	No	0.61	F
	Dixon Park	13/10/2020	<i>Megaptera novaeangliae</i>	Humpback whale	Alive & Released	No	No	3.5	Unk.
	Nobbys	23/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.83	F
Central Coast North	Lakes	5/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.05	M
	Soldiers	5/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.36	M
	Blacksmiths	10/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.4	Unk.
	Blacksmiths	10/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.3	F
	Blacksmiths	10/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.52	F
	The Entrance	22/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.74	M
	Shelly	23/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.41	M
Caves Beach	24/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	No	No	2.7	Unk.	
Central Coast South	Umina	29/09/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.89	M
	Avoca	5/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	No	2.5	Unk.
	Avoca	7/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.05	F
	Copacabana	7/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	F
	Copacabana	9/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.8	F
	Umina	12/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Alive & Released	No	No	0.78	F
	Umina	12/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.3	F
	Avoca	21/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	Yes	2.5	F
Avoca	21/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.66	F	

	Umina	21/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.02	F
Sydney North	Palm	5/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.07	F
	Warriewood	8/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.24	F
	Mona Vale	20/10/2020	<i>Carcharias taurus</i>	Greynurse Shark	Alive & Released	No	No	2.5	F
	Palm	20/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.04	F
	Palm	20/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.31	F
Sydney Central	Dee Why	4/10/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Dead	Yes	No	1.2	F
Sydney South	Elouera	9/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	1.37	F
Illawarra	Thirroul	29/09/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Alive & Released	No	No	1.4	F
	Thirroul	29/09/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Alive & Released	No	No	1.4	F
	Thirroul	29/09/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	2.7	F
	Thirroul	2/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.85	F
	Thirroul	2/10/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Dead	Yes	No	1.5	M
	Thirroul	2/10/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Dead	Yes	No	1.5	M
	Wattamolla	2/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	2.3	F
	Garie	5/10/2020	<i>Alopias vulpinus</i>	Thresher Shark	Dead	Yes	No	2	F
	Garie	5/10/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.5	F
	Thirroul	13/10/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.6	Unk.
	Wattamolla	19/10/2020	<i>Carcharhinus sp.</i>	Whaler shark (unknown species)	Dead	No	No	2.5	Unk.
	Coledale	22/10/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	2.1	Unk.
	Coledale	22/10/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Dead	No	No	1.7	Unk.

Appendix 1 Table 3: Detailed Catch Report - 27 October 2020 to 23 November 2020

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Stockton	29/10/2020	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.42	M
	Stockton	11/11/2020	<i>Carcharias taurus</i>	Greynurse Shark	Alive & Released	No	Yes	2.4	F
Central Coast North	Blacksmiths	30/10/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	1.42	M
	Blacksmiths	3/11/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.75	M
	Catherine Hill Bay	4/11/2020	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.45	F
	Blacksmiths	9/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.74	M
	Blacksmiths	9/11/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	Yes	2.14	F
	Blacksmiths	14/11/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.46	F
	Blacksmiths	14/11/2020	<i>Alopias vulpinus</i>	Thresher Shark**	Dead	No	No	1.8	Unk.
Central Coast South	Copacabana	10/11/2020	<i>Carcharhinus limbatus</i>	Common Blacktip	Dead	Yes	No	1.45	M
	Kilcare	13/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray*	Alive & Released	No	No	1	Unk.
	Avoca	22/11/2020	<i>Carcharhinus falciformis</i>	Silky Shark	Dead	Yes	No	1.53	F
Sydney North	Bilgola	30/10/2020	<i>Notorynchus cepedianus</i>	Broadnose Sevengill Shark	Dead	Yes	No	1.63	M
	Palm	3/11/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.25	F
	Palm	3/11/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	3.2	M
	Palm	4/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.1	F
	Bilgola	9/11/2020	Orectolobidae	Wobbegong shark	Dead	Yes	No	1.96	M

	Palm	9/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.32	F
	Bilgola	10/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
	Bilgola	14/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	M
	Newport	20/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
Sydney Central	North Steyne	28/10/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.3	F
Sydney South	Bronte	3/11/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.7	F
	Bronte	18/11/2020	<i>Delphinus delphis</i>	Common Dolphin	Dead	Yes	No	1.61	M
	Maroubra	18/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.09	F
	Maroubra	18/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
Illawarra	Thirroul	30/10/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2	M
	Thirroul	9/11/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler**	Dead	Yes	No	2.1	Unk.
	Thirroul	9/11/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.4	M
	Thirroul	9/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.9	F
	North Wollongong	9/11/2020	<i>Heterodontus portusjacksoni</i>	Port Jackson Shark	Alive & Released	No	No	0.9	M
	Wattamolla	11/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.8	F
	Wattamolla	11/11/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	1.6	M
	North Wollongong	13/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	F
	Garie	16/11/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	No	No	18	M
	North Wollongong	16/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Austinmer	20/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.3	F
	North Wollongong	20/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
	Wattamolla	23/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
Wattamolla	23/11/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F	

Appendix 1 Table 4: Detailed Catch Report - 24 November 2020 to 21 December 2020

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Merewether	21/12/2020	<i>Carcharhinus brevipinna</i>	Spinner Shark	Dead	Yes	No	1.19	M
Central Coast North	Caves Beach	18/12/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.78	M
	Caves Beach	20/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.08	F
	Shelly	20/12/2020	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	Yes	1.55	M
	Blacksmiths	21/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Lakes	21/12/2020	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.75	F
	Lakes	21/12/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.12	M
	Lakes	21/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.76	M
	Lakes	21/12/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.69	F
Central Coast South	McMasters	4/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.5	M
	Copacabana	4/12/2020	<i>Dasyatis thetidis</i>	Black Stingray	Alive & Released	No	No	2	F
	Umina	7/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.95	F
	McMasters	16/12/2020	<i>Carcharias taurus</i>	Greynurse Shark	Dead	Yes	No	2.04	F

	McMasters	17/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.6	M
Sydney North	Palm	3/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray*	Alive & Released	No	No	1	Unk.
	Whale	7/12/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.46	M
	Avalon	8/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
	Mona Vale	9/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.3	M
	Whale	17/12/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.84	F
	Warriewood	21/12/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.29	F
Sydney Central	Manly	17/12/2020	<i>unidentified dolphin</i>	unidentified dolphin**	Dead and decomposed	No	No	1.5	Unk.
	Manly	17/12/2020	<i>Galeocerdo cuvier</i>	Tiger shark	Dead	Yes	No	2.3	F
	Manly	17/12/2020	<i>Isurus oxyrinchus</i>	Shortfin Mako**	Dead and decomposed	No	No	1.4	Unk.
	Narrabeen	18/12/2020	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.6	Unk.
Sydney South	Maroubra	21/12/2020	<i>Carcharias taurus</i>	Greynurse Shark	Alive & Released	No	Yes	2	M
Illawarra	Wattamolla	30/11/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2.2	M
	Thirroul	3/12/2020	<i>Squatina australis</i>	Australian Angel Shark	Alive & Released	No	No	0.9	M
	North Wollongong	3/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1	M
	North Wollongong	3/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.9	F
	North Wollongong	3/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	F
	North Wollongong	3/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.1	F
	Austinmer	4/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	North Wollongong	4/12/2020	<i>Carcharias taurus</i>	Greynurse Shark	Alive & Released	No	Yes	2.1	F
	North Wollongong	4/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.9	F
	Wattamolla	7/12/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.4	F
	Coledale	7/12/2020	<i>Carcharias taurus</i>	Greynurse Shark	Dead	Yes	No	2.2	F
	South Wollongong	14/12/2020	<i>Carcharias taurus</i>	Greynurse Shark	Dead	Yes	No	2.2	F
	Wattamolla	18/12/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	1.4	F
	Wattamolla	21/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1	M
	Garie	21/12/2020	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	3	F

Appendix 1 Table 5: Detailed Catch Report - 22 December 2020 to 18 January 2021

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Stockton	15/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.09	M
	Stockton	15/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.94	F
Central Coast North	Catherine Hill Bay	24/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.8	M
	The Entrance	28/12/2020	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.58	F
	Lakes	17/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.23	F
	Blacksmiths	17/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.8	M
Central Coast South	Kilcare	24/12/2020	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.14	M
	North Avoca	11/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.17	M
	McMasters	17/01/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.33	F
Sydney North	Bilgola	24/12/2020	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.12	M

	Newport	11/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Newport	11/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.5	F
	Newport	14/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.1	F
Sydney Central	North Narrabeen	27/12/2020	<i>Caretta caretta</i>	Loggerhead Turtle**	Alive & Released	No	No	1	Unk.
Sydney South	Bondi	8/01/2021	<i>Arctocephalus pusillus doriferus</i>	Australian fur-seal	Dead	No	No	1.9	M
	Bronte	11/01/2021	<i>Heterodontus portusjacksoni</i>	Port Jackson Shark	Alive & Released	No	No	0.6	M
	Bronte	13/01/2021	<i>Seriola lalandi</i>	Yellowtail kingfish	Dead	No	No	1.26	M
	Bondi	18/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Bondi	18/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.63	F
Illawarra	Coledale	24/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.6	M
	Austinmer	24/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.3	F
	North Wollongong	24/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.3	F
	North Wollongong	24/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.8	F
	Coledale	27/12/2020	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	1.6	M
	Coledale	27/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.4	M
	Coledale	27/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.6	F
	Coledale	27/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.7	F
	Coledale	27/12/2020	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.1	F
	Garie	1/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	No	No	2.3	F
	Garie	1/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.2	F
	Coledale	14/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.6	F
	Coledale	14/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.5	F
	Coledale	14/01/2021	<i>Squatina australis</i>	Australian Angel Shark	Alive & Released	No	No	1.1	F
	Wattamolla	15/01/2021	<i>Carcharias taurus</i>	Grey nurse Shark*	Alive & Released	No	No	2.1	Unk.
	Wattamolla	18/01/2021	<i>Carcharhinus brevipinna</i>	Spinner Shark	Dead	Yes	No	2	M
	Garie	18/01/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.2	M
Thirroul	18/01/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.2	M	

Appendix 1 Table 6: Detailed Catch Report - 19 January 2021 to 15 February 2021

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Newcastle	25/01/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.77	M
Central Coast North	Lakes	21/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead*	Dead	No	No	-	Unk.
	Blacksmiths	25/01/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Dead	Yes	No	0.95	M
	Blacksmiths	31/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.98	M
	Blacksmiths	31/01/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Dead	Yes	No	0.93	M
	Catherine Hill Bay	31/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.78	M
	Blacksmiths	7/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.18	F
	Blacksmiths	7/02/2021	<i>Auxis thazard</i>	Frigate Mackerel	Dead	No	No	0.54	Unk.
	Blacksmiths	7/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.97	F
Blacksmiths	10/02/2021	<i>Auxis thazard</i>	Frigate Mackerel	Dead	No	No	0.52	Unk.	

	Blacksmiths	11/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.87	M
	Caves Beach	13/02/2021	<i>Carcharhinus brevipinna</i>	Spinner Shark	Dead	Yes	No	1.44	F
	Caves Beach	13/02/2021	<i>Carcharhinus obscurus</i>	Dusky Whaler	Dead	Yes	No	0.9	F
	Caves Beach	13/02/2021	<i>Carcharhinus obscurus</i>	Dusky Whaler	Dead	Yes	No	0.91	F
Central Coast South	Terrigal	21/01/2021	<i>Chelonia mydas</i>	Green Turtle	Dead	No	No	0.67	M
	Terrigal	22/01/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.6	F
	McMasters	22/01/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.12	F
	Umina	1/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.85	F
	Umina	11/02/2021	<i>Carcharhinus obscurus</i>	Dusky Whaler	Dead	Yes	No	2.74	F
Sydney North	Palm	4/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.44	M
	Bilgola	11/02/2021	<i>Sphyrna mokarran</i>	Great Hammerhead	Dead	Yes	No	2.4	F
Sydney Central	North Narrabeen	20/01/2021	<i>Caretta caretta</i>	Loggerhead Turtle**	Alive & Released	No	No	1	Unk.
	Narrabeen	9/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead*	Dead and decomposed	No	No	-	Unk.
Sydney South	Elouera	25/01/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.9	F
	Elouera	25/01/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.23	M
	Wanda	11/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.2	M
	Elouera	11/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.15	F
Illawarra	North Wollongong	8/02/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1	F
	Wattamolla	10/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Alive & Released	No	No	1.8	F
	Garie	10/02/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.5	F

Appendix 1 Table 7: Detailed Catch Report – 16 February 2021 to 15 March 2021

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Central Coast North	Shelly	20/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1.03	M
	Blacksmiths	22/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.9	M
	Caves Beach	24/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.93	M
	Soldiers	24/02/2021	<i>Carcharhinus limbatus</i>	Common Blacktip	Dead	Yes	No	2.03	M
	Blacksmiths	27/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.09	M
	Blacksmiths	28/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.84	M
	Blacksmiths	28/02/2021	<i>Isurus oxyrinchus</i>	Shortfin Mako	Dead	Yes	No	2.86	F
	Blacksmiths	13/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.94	M
	Blacksmiths	13/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.06	F
	Lakes	13/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.03	F
	Lakes	13/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.68	M
	The Entrance	13/03/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.42	M
Central Coast South	Umina	20/02/2021	<i>Carcharias taurus</i>	Grey nurse Shark	Alive & Released	No	Yes	2	F
	Terrigal	22/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.8	F
	Terrigal	26/02/2021	<i>Mobula spp</i>	Devil Ray*	Alive & Released	No	No	2	Unk.
	Umina	26/02/2021	<i>Argyrosomus japonicus</i>	Mulloway	Dead and decomposed	No	No	-	Unk.
	Umina	28/02/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.99	M
	Umina	3/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.75	F

	Copacabana	9/03/2021	<i>Aetobatus ocellatus</i>	White Spotted Eagle Ray	Alive & Released	No	No	2	F
	Terrigal	9/03/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.88	Unk.
	Copacabana	11/03/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.88	Unk.
Sydney North	Whale	20/02/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.31	M
	Warriewood	26/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Dead	Yes	No	0.63	F
	Palm	4/03/2021	<i>Manta birostris</i>	Manta Ray*	Alive & Released	No	No	2.2	Unk.
	Palm	5/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.91	F
	Mona Vale	9/03/2021	<i>Carcharhinus limbatus</i>	Common Blacktip	Dead	Yes	No	1.44	F
Sydney Central	North Narrabeen	21/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.8	M
	Harbord	26/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.98	M
	Curl Curl	4/03/2021	<i>Delphinus delphis</i>	Common Dolphin	Dead	Yes	No	1.7	Unk.
Sydney South	North Cronulla	22/02/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.65	F
	Bronte	26/02/2021	<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	Dead	Yes	No	0.58	F
	Bronte	26/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.87	M
	Bronte	26/02/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	M
	North Cronulla	1/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.25	M
	Wanda	4/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.8	M
	North Cronulla	11/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.92	M
Illawarra	Thirroul	22/02/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Coledale	10/03/2021	<i>Manta birostris</i>	Manta Ray	Alive & Released	No	No	1.5	F
	South Wollongong	12/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.85	F

Appendix 1 Table 8: Detailed Catch Report – 16 March 2021 to 12 April 2021

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Hunter	Dixon Park	25/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Dead	No	No	0.7	M
	Dixon Park	25/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.92	F
	Dixon Park	25/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.98	F
	Dixon Park	25/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.85	F
	Dixon Park	25/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	3.1	F
	Dixon Park	25/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.14	M
	Dixon Park	25/03/2021	<i>Carcharhinus brevipinna</i>	Spinner Shark	Dead	Yes	No	2.95	F
Central Coast North	Caves Beach	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.09	F
	Soldiers	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.11	F
	Soldiers	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.4	F
	Soldiers	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.14	F
	Catherine Hill Bay	27/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.35	F
	Caves Beach	27/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.33	F
	Soldiers	27/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.38	F
	The Entrance	28/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.94	F
	Catherine Hill Bay	29/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.94	F
Lakes	1/04/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	1.56	F	

	Shelly	3/04/2021	<i>Dermochelys coriacea</i>	Leatherback Turtle	Dead	Yes	No	1.7	M
	The Entrance	4/04/2021	<i>Sarda australis</i>	Australian Bonito	Dead	No	No	0.62	Unk.
	The Entrance	4/04/2021	<i>Carcharhinus leucas</i>	Bull Shark	Alive & Released	No	No	3	M
	The Entrance	4/04/2021	<i>Auxis thazard</i>	Frigate Mackerel	Dead	No	No	0.49	Unk.
	Blacksmiths	9/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.08	M
	Blacksmiths	9/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.88	M
	Blacksmiths	9/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	0.55	M
Central Coast South	McMasters	25/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.7	F
	Terrigal	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1	F
	Terrigal	27/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.7	F
	McMasters	29/03/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.85	M
	Umina	5/04/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.95	Unk.
Sydney North	Avalon	25/03/2021	<i>Carcharhinus leucas</i>	Bull Shark	Dead	Yes	No	2.26	F
	Mona Vale	25/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray*	Alive & Released	No	No	0.5	Unk.
	Palm	25/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.5	F
	Palm	25/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.91	F
	Warriewood	25/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.88	M
	Avalon	26/03/2021	<i>Carcharhinus amboinensis</i>	Pigeye shark	Dead	Yes	No	1.55	F
	Mona Vale	26/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	1.29	F
	Mona Vale	31/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	Yes	No	0.61	F
	Warriewood	31/03/2021	<i>Caretta caretta</i>	Loggerhead Turtle	Alive & Released	No	No	1.2	Unk.
	Bilgola	5/04/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.98	Unk.
	Mona Vale	7/04/2021	<i>Dermochelys coriacea</i>	Leatherback Turtle	Dead	Yes	No	1.8	M
Mona Vale	9/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray*	Alive & Released	No	No	0.8	Unk.	
Sydney Central	Dee Why	27/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.35	F
	Queenscliff	27/03/2021	<i>Carcharhinus obscurus</i>	Dusky Whaler	Dead	Yes	No	3.6	F
	Manly	9/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.5	F
Sydney South	Cronulla	1/04/2021	<i>Squatina albipunctata</i>	Eastern Angel Shark	Dead	Yes	No	0.95	F
	Cronulla	1/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.7	F
	Coogee	5/04/2021	<i>Aetobatus ocellatus</i>	White Spotted Eagle Ray	Alive & Released	No	No	1.15	F
Illawarra	South Wollongong	16/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1.1	F
	South Wollongong	16/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1.1	F
	Austinmer	24/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	No	No	1.4	M
	Austinmer	24/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	No	No	2	M
	Garie	24/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	No	No	2.2	F
	Garie	24/03/2021	<i>Carcharodon carcharias</i>	White Shark	Alive & Released	No	No	1.5	F
	Thirroul	24/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray**	Dead and decomposed	No	No	1	Unk.
	Thirroul	24/03/2021	<i>Myliobatis australis</i>	Southern Eagle Ray**	Dead and decomposed	No	No	1.2	Unk.
	Wattamolla	24/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.2	M
	South Wollongong	29/03/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	M
	South Wollongong	29/03/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Alive & Released	No	No	2.5	M
	Wattamolla	29/03/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	0	No	1.2	F
	Wattamolla	29/03/2021	<i>Carcharodon carcharias</i>	White Shark	Dead	Yes	No	2.5	F
South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	F	

	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	F
	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	F
	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	M
	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	M
	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	1	M
	South Wollongong	1/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Dead	No	No	1	M
	Coledale	5/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.35	F
	Coledale	5/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.2	F
	Garie	5/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.4	F

Appendix 1 Table 9: Detailed Catch Report – 13 April 2021 to 30 April 2021

Region	Beach	Date	Scientific Name	Common Name	Status	Samples taken (yes/no/whole)	Tagged	Size (m) FL	Sex
Central Coast North	Blacksmiths	22/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	1.08	M
	Blacksmiths	22/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.84	M
	Catherine Hill Bay	22/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	2.06	M
	Blacksmiths	25/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead	Dead	Yes	No	0.92	F
Central Coast South	McMasters	13/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	F
	McMasters	13/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead***	Dead	No	No	0.9	Unk.
	North Avoca	13/04/2021	<i>Carcharhinus limbatus</i>	Common Blacktip	Alive & Released	No	No	1.8	M
	Copacabana	16/04/2021	<i>Chelonia mydas</i>	Green Turtle	Dead	Yes	No	0.89	M
	Terrigal	22/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.6	F
	Terrigal	22/04/2021	<i>Rhinoptera neglecta</i>	Australian Cownose Ray	Alive & Released	No	No	0.4	F
Sydney North	Warriewood	14/04/2021	<i>Aetobatus ocellatus</i>	White Spotted Eagle Ray*	Alive & Released	No	No	1.3	Unk.
	Mona Vale	16/04/2021	<i>Heterodontus portusjacksoni</i>	Port Jackson Shark	Alive & Released	No	No	0.85	M
	Avalon	27/04/2021	<i>Thunnus tonggol</i>	Longtail tuna	Dead	No	No	0.96	Unk.
	Bilgola	27/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	0.7	F
Sydney Central	Curl Curl	14/04/2021	<i>Sphyrna zygaena</i>	Smooth Hammerhead**	Dead and decomposed	No	No	0.8	Unk.
	Dee Why	14/04/2021	<i>Carcharhinus limbatus</i>	Common Blacktip	Dead	Yes	No	1.93	M
	Narrabeen	14/04/2021	<i>Chelonia mydas</i>	Green Turtle	Dead	Yes	No	0.66	Unk.
	Narrabeen	14/04/2021	<i>Delphinus delphis</i>	Common Dolphin	Dead	Yes	No	1.81	Unk.
Sydney South	Coogee	29/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.15	F
Illawarra	Austinmer	14/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Alive & Released	No	No	1.2	F
	Austinmer	14/04/2021	<i>Carcharhinus brachyurus</i>	Bronze Whaler	Dead	Yes	No	2.4	M
	Austinmer	14/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.4	F
	Austinmer	14/04/2021	<i>Myliobatis australis</i>	Southern Eagle Ray	Dead	No	No	1.4	F
	Thirroul	14/04/2021	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Alive & Released	No	No	0.7	F
	Wattamolla	14/04/2021	<i>Carcharhinus limbatus</i>	Common Blacktip	Dead	Yes	No	1.4	M
	Coledale	19/04/2021	<i>Argyrosomus japonicus</i>	Mulloway	Dead	No	No	1.2	Unk.